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Remedial Investigation and Risk Assessment Report

Site 17 – Pettibone Creek and Boat Basin

Volume I of II
Text and Appendix A

Naval Training Center Great Lakes
Great Lakes, Illinois

Southern Division
Naval Facilities Engineering Command

Contract Number N62467-94-D-0888

Contract Task Order 0154/295

September 2003

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REMEDIAL INVESTIGATION AND RISK ASSESSMENT REPORT

SITE 17 – PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER GREAT LAKES
GREAT LAKES, ILLINOIS

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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ACRONYMS

ARCS	Assessment and Remediation of Contaminated Sediment
ASTM	American Society for Testing and Materials
Atm	atmosphere
ATSDR	Agency for Toxic Substance and Disease Registry
AVS/SEM	Acid Volatile/Simultaneously extracted metals
AWQC	Ambient Water Quality Criteria
BCF	Bioconcentration Factor
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BSAFs	Biota Sediment Accumulation Factors
CDI	Chronic Daily Intake
cfs	cubic feet per second
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Act Information System
CLEAN	Comprehensive Long-Term Environmental Action Navy
cm	centimeter
COCs	Chain of Custody
COPCs	Chemicals of Potential Concern
CRAVE	Carcinogenic Risk Assessment Verification Endeavor
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
CTE	Central Tendency Exposure
CTO	Contract Task Order
CWA	Clean Water Act
DA_{event}	Absorbed dose per event
DDT	dichlorodiphenyltrichloroethane
DQO	Data Quality Objective
E&E	Ecology and Environment, INC
EE/CA	Engineering Evaluation/Cost Analysis
EEQ	Ecological Effects Quotient
Eh	Redox potential
EJ&E	Elgin, Joliet & Eastern

EMCO	EMCO Chemical Distributors, Inc.
EPC	Exposure Point Concentration
Ep	Extraction Procedure
ERA	Ecological Risk Assessment
ER-L	Effects Range-Low
ESLs	Ecological Screening Levels
EU	Exposure Unit
FI	Fraction Injected
FOL	Field Operations Lead
ft	Feet
FS	Feasibility Study
GC/MS	Gas Chromatograph/Mass Spectroscopy
GROs	Groundwater Remediation Objectives
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	Hazard Index
HPLC	High Performance Liquid Chromatography
HQ	Hazard Quotient
IAS	Initial Assessment Study
ID	Inside Diameter
IDW	Investigation Derived Waste
Illinois EPA	Illinois Environmental Protection Agency
ILCR	Incremental Lifetime Cancer Risk
IL SPCS	Illinois State Plane Coordinate System
IRIS	Integrated Risk Information System
K_d	distribution coefficient
K_{OC}	organic carbon partition coefficient
K_{OW}	octanol/water partition coefficient
LAET	Lowest Apparent Effects Threshold
LEL	Lowest Effects Levels
m^3	Cubic meter
MCL	Maximum Concentration Level
mg/kg	Milligrams per Kilogram
mg/l	Milligrams per Liter
MI	Mobility Index
MS	Matrix Spikes

mS/cm	Microsiemens per Centimeter
mV	Millivolt
NAD 88	North American Datum 1988
NAWQC	National Ambient Water Quality Criteria
NAVD 88	North American Vertical Datum 1988
NCRS	North Chicago Refiners and Smelter
NEC	No Effects Concentrations
NEL	No Effect Level
NPDES	National Pollution Discharge Elimination System
NTC	Naval Training Center
NTU	Nephelometric Turbidity Unit
OMOE	Ontario Ministry of Environment and Energy
OPPTS	Office of Prevention, Pesticides, and Toxic Substances
ORP	Oxidation Reduction Potential
OSWER	Office of Solid Waste and Emergency Response
PAET	Probable Apparent Effects Threshold
PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
RBC	Risk Based Concentration
PEL	Probable Effects Level
PID	Photoionization Detector
PRGs	Preliminary Remediation Goals
PWC	Public Work Center
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RAGS	Risk Assessment Guidance for Superfund
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RfCs	Reference Concentration
RfDs	Reference Doses
RI/RA	Remedial Investigation/Risk Assessment
RME	Reasonable Maximum Exposure
RPD	Relative Percent Difference
%R	Percent Recovery
S	(Water) Solubility
SC	Clayey sands

SDG	Sample Delivery Groups
SDWA	Safe Drinking Water Act
SEL	Severe Effect Level
SERA	Screening-Level Ecological Risk Assessment
SI	Site Inspection
SM	silty sand
SOPs	Standard Operating Procedures
SouthDiv	Southern Division
SP	Poorly sorted sand
SPLP	Synthetic Precipitate Leaching Procedure
SQB	Sediment Quality Benchmarks
SQC	Sediment Quality Criteria
SROs	Soil Remediation Objectives
SSV	Sediment Screening Values
STORET	STOrage and RETrieval
STS	STS Consultans Ltd.
SVOCs	Semivolatile Organic Compounds
TACO	Tiered Approach to Corrective Action Objectives
TAL	Target Analyte List
T_C	Time of Concentration
TCE	Trichloroethene or Trichloroethylene
TCL	Target Compounds List
TCLP	Toxicity Characteristic Leaching Procedure
TEFs	Toxic Equivalents
THMs	Trihalomethanes
TOC	Total Organic Carbon
TRVs	Toxicity Reference Values
TtNUS	Tetra Tech NUS, Inc.
UCL	Upper 95 Percent Confidence Limit
ug/kg	Micrograms per Kilogram
ug/L	Micrograms per Liter
U. S.	United States
USCS	Unified Soil Classification System
USEPA	U. S. Environmental Protection Agency
VOCs	Volatile Organic Compounds
VP	Vapor Pressure

EXECUTIVE SUMMARY

This Remedial Investigation and Risk Assessment (RI/RA) Report was prepared for the United States Navy's Naval Training Center (NTC) Great Lakes, located in Lake County, Illinois. Under Contract Task Orders (CTOs) 154 and 295, this RI/RA Report was prepared in accordance with the Comprehensive Long-Term Environmental Action Navy (CLEAN) III, Contract Number N62467-94-D-0888 and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidance for conducting RIs and feasibility studies.

SITE 17 SUMMARY

This report summarizes the environmental investigation of Site 17, Pettibone Creek and the Boat Basin. Pettibone Creek has two major branches, the North Branch that originates in an industrial area of the City of North Chicago and flows through the NTC Great Lakes property where it enters the Boat Basin and then Lake Michigan and the South Branch that originates in a residential area southwest of NTC Great Lakes and flows through a golf course and NTC Great Lakes. Pettibone Creek ranges between 15 and 30 feet in width and several inches to 2 feet in depth. Industrial properties located upstream from NTC Great Lakes include the North Chicago Refiners Smelter facility, the Vacant Lot, and Fansteel. These properties in combination with storm sewers collecting water/runoff from a large section of the City of North Chicago and 30 NTC Great Lakes storm water sewer system outfalls, drain to the creek and have contributed to elevated concentrations of contaminants.

The Boat Basin is approximately 2.6 acres in area and is the most protected portion of the NTC Great Lakes harbor system. It served as an area for boat slips when the water was deeper. The eastern portion of the Boat Basin provided access to the boat repair building, but accumulated sediment now prevents access for most vessels. Public Works Center Great Lakes has estimated that some 30,000 cubic yards of sediment would have to be dredged from the Boat Basin to reestablish a desired water depth of 8 feet. According to a feasibility study and evidence from aerial photographs, the Boat Basin would require dredging about once every 5 to 7 years to maintain that depth.

SUMMARY OF FIELD INVESTIGATION

The overall goal of the environmental investigative work at NTC Great Lakes is to characterize environmental contamination and to determine whether there is a risk to human health and the environment and therefore to (1) determine whether further action is required, (2) determine whether further investigation and characterization is needed, and/or (3) develop and design appropriate remedial actions. The overall purpose of this investigation was to address potential risks associated with Site 17 and develop the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA).

The RI field program involved collecting and analyzing surface and subsurface sediment samples and surface water samples. Pettibone Creek sediment samples were collected using disposable trowels from 38 locations from a depth range of 0 to 4 centimeters (cm) and from 14 locations at a depth of 1 foot. Boat Basin sediment samples were collected at 12 locations from four depth intervals: 0 to 4 cm, 4 cm to 3 feet, 3 to 6 feet, and 6 to 10 feet. An Eijkelkamp Piston Sampler was used to collect the sediment samples. The samples were analyzed for Target Compound List (TCL) polynuclear aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyls (PCBs), Target Analyte List (TAL) metals, and total organic carbon. Ten percent of the samples were analyzed for TCL volatile organic compounds (VOCs) plus ethyl alcohol and ethyl acetate and TCL semivolatile organic compounds (SVOCs). Selected samples were analyzed for AVS/SEM and for grain size. Surface water samples were collected from six locations and analyzed for the following parameters: TCL VOCs, SVOCs, pesticides, PCBs, and filtered and unfiltered TAL metals.

NATURE AND EXTENT OF CONTAMINATION

VOCs are not significant site-related contaminants in sediments for Site 17. PAHs are the predominant SVOCs detected in the sediment samples collected at Site 17. One or more of these chemicals were detected in the sediment samples and many of the analytical results reported exceed human health or ecological screening criteria. However, the interpretation of the PAH data must consider the fact that PAHs are common, anthropogenic contaminants frequently detected in soils and sediments as a result of the widespread use of petroleum products in our modern, industrialized society. Pettibone Creek receives surface water runoff from roadways and areas that have been paved with asphalt. The PAH concentrations reported for Pettibone Creek and the Boat Basin are within the range of concentrations reported as anthropogenic background concentrations for soils. The maximum concentrations for many PAHs detected in Pettibone Creek were reported for the sample collected at the upstream boundary of Site 17.

Pesticides were detected in the sediment samples collected at Site 17 at concentrations that reflect the widespread and historic use of the chemicals for pesticide control. DDT and its degradation by-products were the pesticides detected most frequently. With the exception of a few results reported for sediment samples collected from the Boat Basin, the pesticide concentrations reported for the Site 17 sediment samples do not exceed Tiered Approach to Corrective Action Objectives (TACO) screening levels for human health. In contrast, the pesticide results frequently exceed screening levels for ecological receptors.

PCBs were detected in less than 50 percent of the sediment samples analyzed. Average concentrations reported the PCBs for the at-depth samples in the Boat Basin exceed those reported for the surface sediment samples and the sediment samples from Pettibone Creek by a factor of two or more. Average concentrations in the sediments from the South Branch of Pettibone Creek do not exceed 50 ug/kg. The concentrations for the at-depth sediment samples from the Boat Basin exceed the TACO screening criteria for human health (1,000 µg/kg), and numerous samples in the North Branch of Pettibone Creek and the Boat Basin exceed ecological screening criteria. PCBs were detected in the off-site, upstream samples collected during previous environmental investigations. Consequently, industrial sources upstream of Site 17 have contributed to the contaminant load detected in the Pettibone Creek watershed. PCB- and lead-contaminated soil was excavated from one of the industrial facilities in 1998 and disposed in a permitted Subtitle D disposal facility. NTC Great Lakes had two transformer storage areas that may have been a potential source of contamination and that discharge to Site 17 through storm water runoff. Clean-up documentation for the transformer storage areas is not available, but the reported PCB-contaminated soil was limited. The transformer storage areas are no longer used at NTC Great Lakes.

Several metals (e.g., copper, lead, mercury, selenium, silver, and zinc) were detected in the sediments of the Boat Basin and the North Branch of Pettibone Creek at average concentrations an order of magnitude greater than background sediment and/or soil concentrations reported in TACO. In contrast, most analytical results reported for the South Branch of Pettibone Creek are similar to background sediment and/or soil concentrations reported in TACO. These metals were also detected in the off-site, upstream samples collected during previous environmental investigations. The concentrations reported for the off-site, upstream samples were often two to three times the concentrations detected in the Site 17 sediment samples. Consequently, industrial sources upstream of Site 17 have contributed to the contaminant load of Pettibone Creek watershed.

Upstream industrial sources are a primary source of the environmental contaminants detected in the surface waters of Site 17. Although overland runoff and storm water from NTC Great Lakes also discharge into Site 17 and may contribute pollutants to the watershed, the analytical results available for the Site 17 area do not suggest that a significant point source(s) is (are) impacting the surface water quality of Pettibone Creek or the Boat Basin. Acetone (a common laboratory contaminant), three trihalomethane compounds (bromodichloromethane, chlorodibromomethane, and chloroform), four chlorinated organics (tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, and vinyl chloride), and toluene were detected in the surface water samples. Maximum detected concentrations reported for bromodichloromethane, chloroform, and trichloroethene exceed TACO Groundwater Remediation Objectives (GRO) criteria. However, the trihalomethanes noted are often produced as a result of the chlorination of drinking water supply or a wastewater discharge. Maximum concentrations of the chlorinated solvents and toluene were reported for the sample collected at the upstream boundary of Site 17.

PAHs were not detected in the Site 17 surface water samples. Four pesticides were detected in the surface water samples collected from Site 17. The concentrations reported for these compounds are less than the method reporting limits and do not exceed TACO screening levels for human health. The infrequent, low-level detections suggest that the contamination is mostly likely the result of historic use of pesticides in the Pettibone Creek Watershed. Six inorganic constituents were detected in the surface water samples at concentrations exceeding one or more of the screening criteria. Analytical results reported for iron, lead, and manganese exceed the Illinois TACO Tier I GRO screening criteria and the ecological surface water screening criteria. The concentrations detected may be elevated due to sample turbidity. Previous studies of properties located upstream of the base reported several industrial metals in upstream surface waters at concentrations three times greater than background concentrations. When sample turbidity is considered, metals concentrations at the NTC Great Lakes sampling locations are similar, suggesting no obvious primary point source of contamination located on the NTC Great Lakes property. The metals concentrations detected in the NTC Great Lakes surface water samples are likely the result of natural occurrence in combination with past and present releases that originate upstream of Site 17 such as industrial point sources, urban runoff, erosional processes, flooding events, and storm water through several of the outfalls located along Pettibone Creek.

HUMAN HEALTH RISK ASSESSMENT

In the Site 17 HHRA, adult and adolescent recreational users were evaluated as potential receptors for exposure to surface water and sediment. Adult recreational users were also evaluated for exposure to fish assumed to be caught in the Boat Basin. No significant potential health hazards are associated with exposure to chemicals of potential concern (COPCs) in surface water and surface sediment (0 to 4 cm) under the recreational land use scenarios. The quantitative risk evaluation indicates that noncarcinogenic hazard indices (HIs) were less than unity (1.0) for adult and adolescent recreational users. Carcinogenic risks were less than or within the United States Environmental Protection Agency's (USEPA) risk management range, $1x10^{-6}$ to $1x10^{-4}$. The HIs and carcinogenic risks (ILCRs) estimated for recreational fisherman consuming fish contaminated with PCBs and pesticides exceeded USEPA benchmarks. However, these elevated risks were not based on actual measured fish tissue samples but rather on concentrations estimated by a model.

An evaluation of the uncertainties associated with the predicted fish tissue concentrations for the HHRA was conducted with the data used to prepare the Lake Michigan Fish Advisory. The Lake Michigan Fish Advisory is issued to restrict fish consumption depending on the species. The predicted fish concentrations at Site 17 in the HHRA were greater than the historic fish tissue concentrations from the STORET (STOrage and RETrieval) database (differed by about a factor of two). The conclusion of the HHRA is that a person could eat only very small amounts of fish from the Boat Basin per year. The findings of the risk assessment agree well with the fish advisory restrictions, thereby reducing the uncertainty in the exposure assumptions for recreational fish ingestion.

ECOLOGICAL RISK ASSESSMENT

The screening-level ERA performed for Site 17 identified several chemicals detected in the surface water and/or sediment as COPCs because their chemical concentrations exceeded conservative ecological screening levels. These COPCs were assessed in a less-conservative Step 3a evaluation to determine which chemicals have the greatest potential for causing risks to ecological receptors. The two primary ecological endpoints evaluated in this ERA were aquatic organisms (i.e., fish and invertebrates) and mammals and birds that consume invertebrates and/or fish.

No chemicals detected in the surface water were retained as ecological chemicals of concern (COCs) for risks to aquatic organisms. A few of the chemicals detected in the surface water were included in the food-chain model; however, the drinking portion of the food-chain models is an insignificant component of exposure because the chemicals concentrations in surface water are much lower than they are in sediment.

No chemicals detected in surface water/sediments in the South Branch of Pettibone Creek were retained as COCs for aquatic receptors or mammals/birds. With the exception of a few sporadic elevated detections, the chemical concentrations in this branch are relatively low and may represent a good background/reference location for comparisons to data (i.e., chemical and biological) collected in the North Branch and Boat Basin.

Several chemicals were retained as COCs in the North Branch of Pettibone Creek and the Boat Basin because they were detected at concentrations that exceeded many of the alternate benchmarks in several samples. This indicates that there may be potential risks to aquatic receptors from these chemicals. However, because these conclusions are based on literature values, there is uncertainty in the conclusions. Also, because of the large amount of soil erosion in the creek, there are physical stressors as well as chemical stressors that may be adding to the risks to aquatic organisms. These uncertainties could be reduced by conducting site-specific toxicity tests and/or biological surveys that could be used to determine site-specific risk-based screening levels.

Pesticides (DDT and DDE) were selected as COCs in the North Branch of Pettibone Creek and the Boat Basin because they may cause a risk to piscivorous birds that consume fish from the area. The risks are based on predicted fish tissue concentrations from the sediment concentrations that incorporate the assumed percent lipids of the fish and site-specific total organic carbon of the sediment. The predicted fish tissue concentrations of pesticides are much greater than the pesticide concentrations in the sediment. The literature values used to make these predictions may not represent actual site conditions. In addition, the samples were biased toward depositional areas that are expected to have greater chemical concentrations that the rest of the creek. For these reasons, there is considerable uncertainty in the conclusion of potential risks to piscivorous birds from pesticide concentrations. These uncertainties could be reduced by collecting fish tissue samples to determine actual chemical concentrations, or by conducting a biological survey to determine if there are adequate numbers of fish to comprise a significant portion of the diet for piscivorous birds.

Similar to the HHRA, an evaluation of the uncertainties associated with the predicted fish tissue concentrations for the ERA was conducted with the data used to prepare the Lake Michigan Fish Advisory. This evaluation used the same fish tissue data obtained from the Illinois EPA and USEPA through the STORET database as in the HHRA uncertainty evaluation. A qualitative assessment was conducted to evaluate the uncertainties in the ERA. The predicted fish tissue concentrations are overestimated because the fish present in Pettibone Creek are significantly smaller than those sampled in Lake Michigan, and sediment concentrations of PCBs and pesticides in samples collected for this report are significantly lower than the historical data. The risk conclusions are likely to still be over-predicted because concentrations of bioaccumulative chemicals are expected to be greatest in larger, older fish, and the risks to piscivorous wildlife consuming fish from the North Branch and Boat Basin should be based on fish that are smaller. In general, it is likely that risks would be lower to piscivorous wildlife, but the actual decrease in risks cannot be quantified at this time.

SITE 17 CONCLUSIONS

Based on the results of this RI/RA, the data indicate that upstream industrial sources (historical discharges and contamination) and storm water discharges within the Pettibone Creek Watershed are the primary sources of the environmental contaminants in the sediments of Site 17. Overland runoff and storm water discharges from NTC Great Lakes to Site 17 may contribute pollutants to the watershed, but analytical results do not suggest that a significant point source(s) is(are) impacting the sediment quality of Pettibone Creek or the Boat Basin.

The PAH concentrations in the sediment samples have increased, and this is believed to be caused by widespread and increasing use of petroleum products in our modern, industrialized society. The pesticide, PCB, and metals concentrations in the sediment samples have decreased compared to the concentrations reported for historical samples. There is a general trend that the sediment at the surface is "cleaner" than the sediment at depth.

Many of the potential sources of contamination still remain especially the storm water sewer systems and the surface water runoff from the industrial facilities into Pettibone Creek. However, a few of the industrial facilities (R. Lavin & Sons and Fansteel) that have contributed to the historical contamination in Pettibone Creek have filed petitions for bankruptcy and have ceased operations. Pettibone Creek may continue to receive a variety of wastes from the upstream industries, road runoff, storm sewers, and runoff/discharges from local residential properties. Many of the potential sources (industrial sites) have been remediated, and it is thought that additional releases to the creek should not be as significant as they were in the past. Nevertheless, there could be residual runoff into Pettibone Creek, and the upstream outfalls are permitted under the National Pollution Discharge Elimination System. The Navy should maintain documentation of the spills resulting from both Navy and non-Navy (upstream) sources.

SITE 17 RECOMMENDATIONS

The human health risks from exposure to surface water and surface sediment under the recreational land use scenarios were less than the USEPA and Illinois EPA acceptable risk management range. However, the results of the HHRA indicated that there are risks from fish ingestion. The ERA indicated that several chemicals in the surface sediment may present risks to aquatic receptors and piscivorous birds in the North Branch of Pettibone Creek and the Boat Basin. Based on the overall conclusions from this RI/RA, it is recommended that a Feasibility Study be prepared to identify possible remedial alternatives to address the risks at Site 17 from the North Branch of Pettibone Creek and the Boat Basin sediment to be compliant with CERCLA requirements. Possible remedial action alternatives that should be reviewed in the Feasibility Study include:

- the no-action remedial alternative,

- an institutional control (land use control) to restrict fishing or fish consumption from the North Branch of Pettibone Creek and the Boat Basin areas at NTC Great Lakes and land use controls to make sure the current recreational use does not change in the future, and

- an engineering control response action combined with institutional controls.

1.0 INTRODUCTION

This Remedial Investigation and Risk Assessment (RI/RA) Report was prepared for Site 17, Pettibone Creek and Boat Basin, at the United States (U.S.) Navy's Naval Training Center (NTC) Great Lakes located in Lake County, Illinois under Contract Task Orders (CTOs) 154 and 295. This RI/RA Report was prepared in accordance with the Comprehensive Long-Term Environmental Action Navy (CLEAN) III, Contract Number N62467-94-D-0888, and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) guidance for conducting remedial investigations and feasibility studies (USEPA, October 1988). The Navy identified 14 potentially contaminated areas where hazardous materials may have been released to the environment at NTC Great Lakes in the 1986 Initial Assessment Study (IAS) (Rogers, Golden, & Halpern and BCM Eastern Inc., March 1996). Many sampling events have also been conducted since the 1970s to investigate facilities (shown on Figure 1-1) located upstream of NTC Great Lakes. The Navy implemented this investigation with a team of representatives from the Illinois Environmental Protection Agency (Illinois EPA), Southern Division (SouthDiv) Naval Facilities Engineering Command and its consultant Tetra Tech NUS, Inc. (TtNUS), and the NTC Great Lakes Environmental Department. This RI/RA Report summarizes the environmental investigations of Site 17, which includes Pettibone Creek and the Boat Basin. An aerial view of the location of Site 17 is shown in Figure 1-1.

1.1 RI/RA APPROACH AND OBJECTIVES

The overall goals of the environmental investigative work at NTC Great Lakes are to characterize environmental contamination and to determine whether there is a risk to human health and the environment, and to therefore (1) determine whether further action is required, (2) determine whether further investigation and characterization is needed, and/or, (3) develop, evaluate, and if necessary, design appropriate remedial actions.

The overall purpose of this investigation was to identify potential risks associated with Site 17. The chemical data for Site 17 were used to delineate the nature and extent of contamination, to conduct a baseline human health risk assessment (HHRA) (see Section 6.0), and to complete Steps 1, 2, and 3A of an ecological risk assessment (ERA) (see Section 7.0).

NTC Great Lakes is a U.S. Navy installation located within United States Environmental Protection Agency (USEPA) Region 5 and the Illinois EPA. TtNUS has prepared this report on behalf of the U.S. Navy SouthDiv Naval Facilities Engineering Command and NTC Great Lakes to comply with USEPA Region 5 and Illinois EPA requirements. The USEPA Region 5 and Illinois EPA requirements and guidance govern the performance of RI/RA environmental investigations. In accordance with those requirements, project planning followed the USEPA Data Quality Objectives (DQO) process (USEPA, October 1999). This process requires explicit statements of the problem to be solved, the spatial and temporal boundaries related to the problem, the measurements to be made in solving the problem, and, if applicable, quantitative specifications of the tolerances for making decision errors. The process culminates in a specification of decision rules that are documented in the Quality Assurance Project Plan (QAPP) designed to solve the stated problem (TtNUS, July 2001).

1.2 REPORT SCOPE AND ORGANIZATION

This report documents the results from the current field RI program and also presents data from previous activities at Site 17. It also summarizes previous investigation findings and conclusions. Further, it incorporates these reports by reference to provide a comprehensive record of the investigative activities at Site 17.

This report contains the following sections:

1.0 Introduction
2.0 Site Background (includes previous investigations)
3.0 Site Investigation Activities
4.0 Nature and Extent of Contamination
5.0 Contaminant Fate and Transport
6.0 Human Health Risk Assessment
7.0 Ecological Risk Assessment
8.0 Conclusions and Recommendations

1.3 NTC GREAT LAKES LOCATION AND DESCRIPTION

NTC Great Lakes is located in Lake County, Illinois along the shore of Lake Michigan. It is bounded on the north by the city of North Chicago, on the south by the Veterans Administration Hospital and Shore Acres Golf Course & Country Club, on the east by Lake Michigan, and on the west by U.S. Route 41 (Skokie Highway).

NTC Great Lakes lies within both the North Branch Chicago River Drainage Basin and the Lake Michigan North Drainage Basin. The divide between the basins lies along Green Bay Road. Precipitation runoff that does not infiltrate into the ground flows into the Skokie River or Pettibone Creek. The areas east of

Green Bay Road, which includes NTC Great Lakes, drain into Lake Michigan through Pettibone Creek and areas west of Green Bay Road drain into the Skokie River.

Pettibone Creek is located on the Mainside of NTC Great Lakes between Sheridan Road and the western shoreline of Lake Michigan. Pettibone Creek originates in North Chicago and enters the northwest corner of NTC Great Lakes, meandering through Mainside and discharging into Lake Michigan. The South Branch of Pettibone Creek originates in a residential area southwest of NTC Great Lakes, meandering through the golf course and Mainside, and joins Pettibone Creek approximately 1500 feet west of Lake Michigan.

1.4 ENVIRONMENTAL SETTING

1.4.1 Geography, Demographics, and Land Use

NTC Great Lakes covers 1,632 acres of Lake County, Illinois. Lake County is located in northeastern Illinois, north of the city of Chicago, and encompasses 24 miles of Lake Michigan shoreline. Lake County extends from the Wisconsin border south to Cook County and Lake Michigan west to McHenry County. Lake County is divided into 18 townships, 52 incorporated cities and villages, and 18 unincorporated cities and villages.

There are numerous lakeside communities in Lake County. The most recent 2000 U.S. Census Bureau data estimates the county's population at 617,975. During the 1950s and 1960s, population growth occurred primarily in the lakefront communities but, by the 1980s and 1990s, population growth moved north and west. Currently, most of Lake County's population lives in the 52 incorporated cities and villages.

Current land use in Lake County consists of agriculture, industry, and residential. The farmland and lake resorts characterize the western portions of the county, while industrial, urban, and suburban areas follow the 24 miles of Lake Michigan shoreline to the east. There are also three state parks in Lake County.

NTC Great Lakes administers base operations and provides facilities and related support to training activities (including the Navy's only boot camp) as well as a variety of other military commands located on base. There are a variety of land uses that currently surround NTC Great Lakes. Along the northern boundary of the Base are the most highly urbanized and industrial areas. Much of the land beyond the northwest site boundary comprises unincorporated lands of Lake County and lies vacant, except for scattered retail and residential properties. Adjacent to the western boundary are primarily industrial properties, while along the southern boundary is a mixture of public open space and residential land. (TtNUS, July 2001).

Site 17 comprises two geographic areas. The first is Pettibone Creek, including the North Branch and South Branches. This portion of Site 17 covers approximately 8,542,500 square feet or 0.3 square mile. There is a path along the North Branch that is used by staff, military personnel and their family members, and students who hike, jog, and walk their dogs on the path. The South Branch flows at the base of steep slopes behind buildings and consequently is not frequented by people.

The Boat Basin portion of Site 17 is approximately 113,256 square feet in area. Boats are docked at the opening of the Boat Basin near the Inner Harbor. Due to sedimentation, the Boat Basin is too shallow for vessels to dock. Recreational fishing occurs in the Boat Basin.

1.4.2 Physiography and Topography

The gently rolling topography of Lake County, Illinois, is the result of glaciation. The most prominent topographic features are glacial moraines and other unconsolidated glacial deposits that cover most of the study area. The terrain of NTC Great Lakes consists of relatively flat glacial drift deposits, bordered by steep lake-facing bluffs cut with vertical sloping ravines. The unconsolidated glacial material that comprises the bluff faces and ravine walls is under continual erosion.

The topography of Lake County creates poorly defined drainage patterns, consisting of swales that enter depressions and marshes. Most of NTC Great Lakes is situated on a plateau elevated 640 to 660 feet (ft) above mean sea level. Pettibone Creek lies approximately 600 ft above sea level and the eastern portion of NTC Great Lakes, along the Lake Michigan shoreline, is 510 ft above mean sea level.

Intensive development has replaced most of the oak, hickory, maple, and other hardwood forests that originally covered the area. Native woodlands occur primarily on the vertical sloped ravine of Pettibone Creek, across the Mainside, and on the bluffs facing Lake Michigan. The banks of Pettibone Creek are forested with white and red oak, maple, European larch, and white and Scotch pine trees. There are also shrubs, including raspberry and blackberry bushes. The slopes of the site are covered with wild grape and perennial weeds. The principal mammals in the area include groundhogs, raccoons, squirrels, opossums, rabbits, chipmunks, and deer. Children and pets play in Pettibone Creek. Pettibone Creek supports aquatic life including fish, aquatic insects, frogs, and salamanders (TtNUS, July 2001).

The topography of Site 17 is moderately steep streambed gradients and banks with 30 to 60 percent slopes. The Boat Basin is a flat, depositional area for Pettibone Creek. Site 17 elevations vary from approximately 600 ft above mean sea level at the tops of Pettibone Creek's banks to approximately 510 ft above mean sea level at exposed sediments in the Boat Basin.

1.4.3 Climate

The climate of Lake County, Illinois, is considered continental. Changes in temperature, humidity, cloudiness, and wind direction occur frequently. The summer season is warm with few prolonged hot periods. Although major droughts are infrequent, there are commonly long periods of dry weather during the growing season. The area receives approximately 34 inches of rain per year, with 63 percent occurring between April and September. The average seasonal snowfall range is 37.2 to 41.1 inches. The average temperature is 58 degrees Fahrenheit; the winter months normally have temperatures below freezing.

1.4.4 Soil

The soils of Lake County, Illinois are classified into two groups: Morley-Beecher-Hennepin and Made Land soil. The Morley-Beecher-Hennepin soil consists primarily of loams and silt loams and is located on level to very steep ravines. This soil is characterized as well to poorly-drained and has slow-to-moderate permeability. The Made Land soil is an area of manmade cuts and fills covered by roads and buildings. This fill material includes a variety of soil and non-soil materials that have not been characterized.

The soil along Pettibone Creek ranges from beach sand to silt loam soils. Beach sand is found in the area immediately adjacent the creek bed in the lower section of the creek and Hennepin loam is found along the steep stream banks. The remaining soil types found on the plateau that begins at the top of the stream bank include the Morley, Aptakisic, Wauconda, Beecher, and silt loams (TtNUS, July 2001). Eroded soils are carried to the Boat Basin where they are deposited.

1.4.5 Regional Geology

The geologic units encountered at NTC Great Lakes include aeolian and lacustrine deposits, glacial till, and bedrock. The Silurian age bedrock consists of Niagran and Alexandrian dolomite that is the lowermost geologic unit encountered. The bedding is nearly horizontal to gently eastward-dipping in the vicinity of NTC Great Lakes. The interface of the bedrock surface and overlying till consists of 1 to 15 ft of broken bedrock (dolomite), gravel, sand, and coarser material. This material appears to be debris ground from the bedrock by the advancing glaciers of the Wisconsin Stage of glaciation during the Late Pleistocene Age.

Unconsolidated glacial tills blanket Lake County. Several glacial moraine systems are present within the county, including the Valparaiso, Tinley, Zion City, and Lake Border moraine systems. NTC Great Lakes falls within both the Lake Border and Zion City moraine systems. In the northern portions of the site, the Zion City moraine is exposed at the ground surface and extends from North Chicago to Waukegan, Illinois. These glacial moraine systems are composed of Wadsworth till that constitutes the largest volume of surficial deposits overlaying the bedrock. The Wadsworth till ranges from approximately 170 to 210 ft in thickness overlying the Silurian bedrock. This till is an unsorted mixture of sand, silt, and clay particles imbedded with pebbles, cobbles, and boulders. Interstices between the coarser grained sediments are typically filled with fine clay-sized particles, resulting in low permeability. Generally, the Wadsworth till is clayey, with thin and irregular lenses of sand or silty sand occurring over limited areas. The till has been further subdivided into clayey and sandy phases according to the size of the dominant particles. Because clay compromises up to 70 percent of the till at NTC Great Lakes, the clayey phase dominates in the local area.

An aeolian material, or loess, covers the Wadsworth till and ranges from 16 to 20 inches in thickness. This aeolian material is much finer-grained than the underlying Wadsworth till. These wind-blown materials of the Richland Loess classification make up the modern soil profile of NTC Great Lake. Deposits of silt, clay, and sand of the Equality Formation characterize the central and southern portions of NTC Great Lakes (TtNUS, July 2001).

The coastal geomorphology for NTC Great Lakes is characterized as a bluff coast. The bluffs consist of gray to brown glacial till interbedded with glacial-like sediments of clay, silt, sand, and sandy outwash (Chrzatowski and Trask, 1995). Silt and clay are the dominant bluff materials (Clark and Radcliff, 1990). Average grain-size distribution for the till is 10 percent sand, 42 percent silt, and 48 percent clay (Linbeck, 1974). In general, only 10 to 15 percent of eroded bluff materials are coarse enough to provide beach sediments.

Bluff heights relative to mean lake level are variable, but are generally in the range of 70 to 90 feet high and bluff slopes range from 25 degrees to nearly vertical (Chrzatowski and Trask, 1995). These bluffs are incised by a series of V-shaped ravines occupied by streams, such as Pettibone Creek, that drain uplands to the west.

Along the bluff coast, the beach and nearshore deposits occupy a narrow zone extending from the toe of the bluff to several hundred to thousands of feet offshore where the sand pinches out (Chrzatowski and Trask, 1995). Beach and nearshore thicknesses along the bluff coast indicate that maximum sand thicknesses are generally no more than 5 to 7 feet. Thicker deposits occur in some of the areas of entrapment near structures: for example, updrift of north breakwater at Great Lakes Harbor, thicknesses reach 10 to 12 feet (Chrzatowski and Trask, 1995).

1.4.6 Regional Hydrology

Pettibone Creek is a small creek that flows through NTC Great Lakes and into Lake Michigan. The Pettibone Creek watershed is one of five Lake Michigan watersheds in Lake County, Illinois. The watershed drains an area of 4.2 square miles and consists of the North and South Branches, each with a minor tributary branch. The hydrology of the watershed is well-established. It flows through well-defined ravines within NTC Great Lakes. The creek is characterized by moderately steep stream bed gradients, and banks with 30 to 60 percent slopes.

Pettibone Creek is made up of two branches. The North Branch which ranges between 15 to 30 feet wide and several inches to two feet deep is a perennial stream that originates from three storm sewers at 22nd Street and runs southeast from the North Chicago area and merges with the South Branch of Pettibone Creek. The North Branch, on NTC Great Lakes property, measures approximately 3,600 ft long before it empties into the Boat Basin. An unnamed tributary flows into North Branch approximately 910 ft downstream from the origin of North Branch.

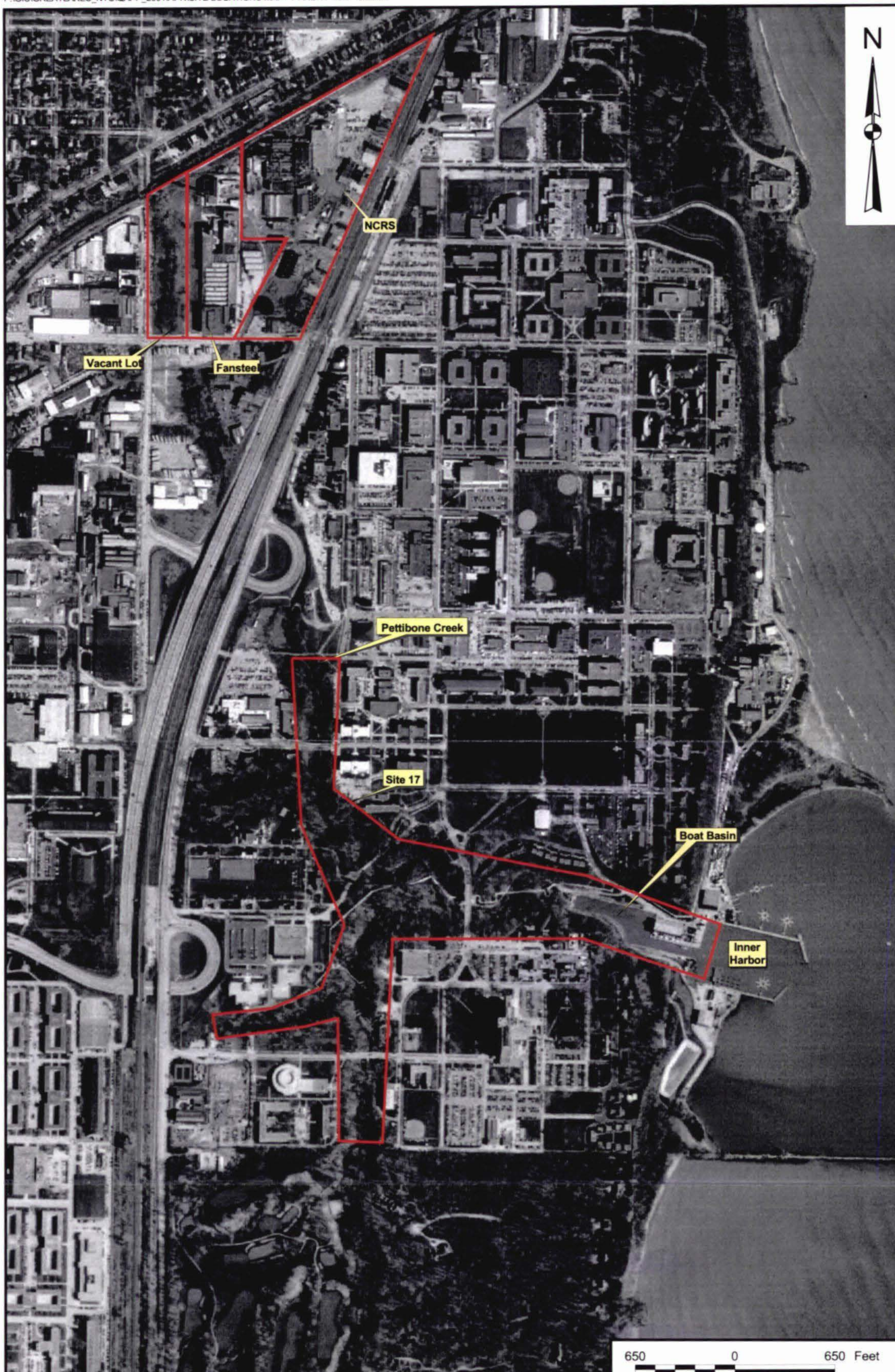
The South Branch which ranges between 10 to 20 feet wide and several inches to two feet deep begins in a residential area southwest of NTC Great Lakes. The South Branch, on NTC Great Lakes property, measures approximately 2,600 feet long before it merges with North Branch approximately 950 feet upstream of the Boat Basin. An unnamed tributary flows into South Branch approximately 1,500 feet downstream from the origin of South Branch. Runoff from overhead bridges and nearby streets in times of precipitation adds to the volume of Pettibone Creek.

There is very little floodplain area along Pettibone Creek because of the steeply sloped creek banks. The North Branch of the creek has a short time of concentration (T_C), or time it takes for a unit of water to run the watercourse. The T_C is short because the water source is primarily from an urban area that has low infiltration rates and fast run-off rates during storms. As a result, Pettibone Creek is susceptible to flash floods characterized by high channel velocities and great erosive potential (TtNUS, July 2001).

Pettibone Creek empties in the Boat Basin. The Boat Basin is nearly 850 feet long and measures approximately 100 feet wide near the discharge of Pettibone Creek, then widens to 225 feet in the center and then reduces to 60 feet as it empties into Lake Michigan. The water depth in the Boat Basin ranged from several inches to 5 feet.

Surface water in Pettibone Creek flows eastward and discharges in the Boat Basin. The Illinois State Water Survey calculated the average flow of Pettibone Creek as less than 10 cubic feet per second (cfs) or 4,488 gallons a minute (TtNUS, July 2001). This can greatly increase during periods of precipitation.

P:\GIS\GREATLAKES_NTC\QAPP_2001.APR\SITE LOCATIONS MAP - 7 AND 17 KMP 5/22/02



DRAWN BY J. BELLONE	DATE 4/5/01	SITE LOCATION MAP SITE 17 NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS	CONTRACT NUMBER N3939
CHECKED BY GP	DATE 4/18/01		APPROVED BY RFD — DATE 4/20/01
COST/SCHEDULE-AREA			APPROVED BY — DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-1 — REV 0

2.0 SITE BACKGROUND

Early investigations of Pettibone Creek and Boat Basin resulted from studies of the abandoned industrial facilities located in North Chicago in the 1970s. Several of the facilities [Fansteel, North Chicago Refiners and Smelters (NCRS), and the Vacant Lot] were turn of the century manufacturing facilities that produced tantalum mill products, non-ferrous metals, and zinc oxide. USEPA Region 5 investigated these facilities for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticide, polychlorinated biphenyl (PCB), and metals contamination. The location of these facilities is shown on Figure 1-1.

NTC Great Lakes has been used to administer base operations and provides facilities and related support to training activities (including the Navy's only boot camp) as well as a variety of other military commands located on base since 1911. Some commercial activities such as gas stations, underground storage tanks, drum storage, dry cleaners, printers, etc. are located at NTC Great Lakes, but NTC Great Lakes does not conduct industrial-type activities. The Navy identified 14 potential areas where hazardous materials may have been released to the environment at NTC Great Lakes and possibly Site 17 in the IAS (Rogers, Golden, & Halpern and BCM Eastern Inc., March 1996). These sites consisted of landfills and disposal areas, transformer storage areas, training areas, service stations, shooting ranges, and storage areas. Other potential Navy sources include surface runoff or fallout from engine exhaust from nearby roadways, historical pesticides usage applied when it was legal to do so, and VOCs storaged in tanks and drums. Of these 14 sites, seven sites were recommended for further investigation and one site was recommended for a cleanup action. The Navy, Illinois EPA, and USEPA have also conducted several investigations of Site 17, Pettibone Creek and the Boat Basin.

The following sections provide a historical overview and background for Site 17, Pettibone Creek and Boat Basin. A site plan of Pettibone Creek, the Boat Basin, and the surrounding area is provided on Figure 2-1.

2.1 SITE CHARACTERIZATION

2.1.1 Location and Description

Pettibone Creek

The majority of the NTC Great Lakes activities occur on a plateau atop a steep bluff that rises 70 feet above the beach along Lake Michigan. Pettibone Creek and its tributaries flow in a ravine that divides this plateau and discharge to the Boat Basin.

Pettibone Creek has two major branches. The North Branch originates in North Chicago near Commonwealth Avenue, flows south under Martin Luther King Jr. Drive and a parking area, resurfaces north of Sheridan Road, flows below Sheridan Road, resurfaces on the NTC Great Lakes property, and flows south and east through NTC Great Lakes until it enters the Boat Basin and then Lake Michigan. The South Branch originates in a residential area southwest of NTC Great Lakes, flows through the Shore Acres Golf Course Country Club, and flows north, entering NTC Great Lakes near the intersection of G Street and 3rd Street. Pettibone Creek ranges between 15 and 30 feet in width, and several inches to two feet in depth. Storm sewers collect storm water from a large section of the City of North Chicago (Illinois EPA, December 1995) and 30 NTC Great Lakes stormwater sewer system outfalls from roadway drainage systems drain to the creek as shown on Figure 2-2 (Halliburton NUS, Inc., June 1993).

Pettibone Creek is not used for drinking; however, children may play in the creek. Fish are present in the creek and fish have been observed migrating upstream in the spring (Illinois EPA, December 1995). No federally-listed endangered or threatened species are known to exist in the area. The highly developed nature of the general vicinity makes it unlikely that suitable habitat exists (U.S. Navy. February 2001).

An environmental assessment to control erosion in the Pettibone Creek water shed classified the stream sediments as “Special Waste” because they were contaminated with various compounds and elements (McGuire Group, Inc., December 1993).

Boat Basin

The Boat Basin, which is approximately 2.6 acres in area, is the most protected portion of the Harbor. It served as an area for boat slips when the water was deeper (Halliburton NUS, Inc., June 1993). In June 1990, the water depth of the Boat Basin ranged from less than 1 foot to 5 feet (maximum depth of 8 feet). The eastern portion of the Boat Basin provided access to the boat repair building, but accumulated sediment now prevents access for most vessels. Public Works Center (PWC) Great Lakes has estimated that some 30,000 cubic yards of material would have to be dredged from the Boat Basin to reestablish a desired water depth of 8 feet. According to the Feasibility Study (FS) and evidence from aerial photographs indicates that the Boat Basin would require dredging about once every 5 to 7 years to maintain that depth (U. S. Navy, May 1990).

2.1.2 History

Pettibone Creek

The urban nature of the creek's watershed has resulted in flash floods that caused severe erosion and sedimentation problems. Efforts to stabilize the erosion in the ravine have been made in the past. In 1982, NTC Great Lakes initiated emergency slope stabilization. In 1989, after a period of major storms in 1987 and 1988, emergency pipe replacement and slope stabilization measures were conducted in three severely eroded areas (McGuire Group Inc., December 1993).

Boat Basin

The original Boat Basin and harbor were constructed in 1906 with the outer breakwater structures added by 1923. Extensive erosion of Pettibone Creek contributes to the silting-in of the harbor. The silting-in of the harbor has hampered operations. The outer harbor anchorage again has reduced capacity, limiting the size of watercrafts that are able to be loaded/off-loaded at the recreational boat ramps. The Boat Basin was dredged in the early 1950s and again in the early 1970s (Navy Memorandum, August 1988).

2.2 PREVIOUS SAMPLING EVENTS AND UPSTREAM FACILITIES

The data from prior sampling events are shown on Tables 2-1 to 2-10. These summary tables show the minimum, maximum, average, and frequency of detection for these sampling events for surface water and sediment for offsite upstream, Pettibone Creek, South Branch of Pettibone Creek, and the Boat Basin respectively. The prior sampling events are discussed in Sections 2.2.1 to 2.2.4 and are summarized in the table below. The locations of the samples are shown in Figure 2-3. Tag maps showing the Pettibone Creek detections are provided on Figures 2-4 to 2-11 and tag maps showing the Boat Basin detections are provided as Figures 2-12 to 2-18.

Date	Sample Name (see Figure 2-3)	Conducted by	Comments
1970 - 1971		Illinois EPA	PCBs and pesticides found in samples
1975		USEPA	Inner Harbor sediment samples polluted with toxic metals
May 1980	Site #1 – Site #5	USEPA Contractor	Contaminated sediment samples
1985-1986		Rogers, Golden & Halpern for the Navy	IAS investigated 14 sites. Sites that have sources of contamination that may be discharged into Site 17 through storm water runoff include two transformer storage areas (PCBs), silk screen shop (VOCs, metals), drum storage area (VOCs) and the service station (VOCs, SVOCs, and metals).
April 1988	B-1, B-2	STS Consultants Ltd. for the Navy	USEPA did not approve open water disposal of sediments
July 1988	S48…S60	Jacobs Engineering	Copper and lead had elevated concentrations in the sediment sediments
April 1989	B-101 – B106, B-201 – B-207	STS Consultants Ltd. for the Navy	Highest concentrations at the Boat Basin bend to join a channel to the Inner Harbor
June 1990	A-1, C1-C5, D1-D2	Illinois EPA	Elevated concentrations of zinc, copper, and lead in sediments downstream of the NCRS Facility
1991		Illinois EPA	Surface water samples were contaminated with VOCs and SVOCs
Nov. 1991	X101 – X118	Illinois EPA	Metals and SVOCs were present at three times above background concentrations
Aug. 1992	SW-PC-01 – 10 SD-PC-01 – 10 SW-BB-01 – 04 SD-BB-01 – 04 SW-IN-05 – 08 SD-IN-05 – 08 SW-OH-09 –14 SD-OH-09 – 14 SW-LM-15 – 20 SD-LM-15 – 20	Halliburton NUS for the Navy	Contaminants present in Pettibone Creek and Boat Basin sediments
Sept. 1992		Illinois EPA	Elevated concentrations of inorganics, chlorinated solvents, PAHs, Pesticides, and PCBs were detected in soil and sediment samples
April 1994	X103 – X111, X201– X210	Illinois EPA	Presence of VOCs, SVOCs, pesticides, metals and organic compounds in sediment samples. Sediment samples collected along Pettibone Creek showed several metals in the sample downstream of the NCRS outfall. Elevated concentrations of arsenic, beryllium, lead, TCE, and PCBs were detected at the Vacant Lot site.
1995		Illinois EPA	Significant metal contaminates in sediment samples. Illinois EPA identified many potential sources that were part of the upstream facilities.

Date	Sample Name (see Figure 2-3)	Conducted by	Comments
1997		E&E for USEPA	Contaminants [non-hazardous lead, hazardous (based on TCLP) lead soil, and PCB/lead] found in soil samples from the Vacant Lot site and sediment samples. Offsite active industrial discharge and stormwater drainage into Pettibone creek represents potential sources of contamination.
2000		Contractor for Fansteel Inc.	Contaminants found in sediment samples
Oct. 2000		TN&A for USEPA Region 5	Downstream sampling suggested that the contaminants are migrating downstream from the NCRS/City of North Chicago discharge into Pettibone Creek

Industries upstream from NTC Great Lakes include NCRS, the Vacant Lot, and Fansteel. These industries have contributed to elevated concentrations of contaminants in Pettibone Creek sediments according to the Illinois EPA and USEPA (USEPA, April 2002c, April 2002d, and May 2002).

In 1941, R. Lavin & Sons (a division of NCRS) assumed the leases and than purchased the remaining property and engaged in the smelting and refining of non-ferrous scrap metals and the manufacture of brass and bronze ingots. The facility occupies approximately 18 acres bordered to the north by the Elgin, Joliet & Eastern (EJ&E) Railroad, to the south by Martin Luther King Jr. Drive, to the west by the Fansteel, Inc. office building, and to the east by commercial property along Sheridan Road. Much of the operational portion of the facility was paved. Prominent site features identified during the initial investigations included a slag pile, two connected surface impoundments, a process building, warehouses, and an office building. The facility ceased operations in July 2001 and has filed for bankruptcy protection.

Borings obtained from the facility in 1989 show a layer of fill material consisting of clayey, silty foundry sand, slag, gravel, and fragments of wood, rope, and brick from the surface to depths of 3.5 to 8 feet. This site was added to the Comprehensive Environmental Response Compensation and Liability System by Illinois EPA in August 1990 as a result of non-compliance of Resource Conservation and Recovery Act Regulations.

The NCRS/R. Lavin facility has four National Pollution Discharge Elimination System (NPDES) permitted discharge points into Pettibone Creek that are the following:

- 001- the reservoir tank into the southeast impoundment;
- 002- the southeast impoundment to the storm sewer tributary of Pettibone Creek;

- 003- the storm sewer system; and
- 004- another storm sewer.

Outfall 001 is overflow from a reservoir. Operations included recycling and reusing water for direct ingot cooling, smoke spray towers, flue trail dumpers, press heat exchangers, zinc die cast molds, cupola water jackets, and cupola slag granulation. Ideally, the water was recirculated through the system. However, hydraulic overload caused by precipitation or process difficulties has led the reservoir to overflow into the 002 ditch and into the storm sewer.

Outfall 002 is the overflow from the 001 receiving ditch that also receives storm water runoff via storm sewers on the property. Some of the drainage area includes Warehouses I and II, the concentrator building, the furnace building, and leachate and groundwater from filled wetlands.

Outfalls 003 and 004 receive only storm water. Outfall 003 is located in the southeast section of the property, just south of the 002 discharge, and collects runoff from the hazardous waste storage area. Outfall 004 is located in the northeast section of the property near the parking lot entrance. Schematics show this outfall receives the majority of area runoff, including the railroad receiving dock, both bag houses, and the parking lot.

According to Illinois EPA documents, the R. Lavin facility violated its NPDES permit limits at a ditch that discharges to a stormwater outfall that discharges to Pettibone Creek. The R. Lavin facility is considered a major contributor to contaminated sediments in Pettibone Creek (USEPA, April 2002d).

Vulcan-Louisville Smelting owned the property at the corner of Commonwealth and Martin Luther King Jr. Drive, known as the Vacant Lot, as late as 1929. By 1936, the property was transferred to the Chicago, North Shore and Milwaukee Railroad Co. Sometime between 1936 and 1954, the property was sold to an individual who made it into a parking lot. During this period, an unknown fill material was brought to the lot. Tailings/cinder-like material can be found in areas of the lot, but in some areas it is only at the surface. Additionally, a heap of cinder material, approximately 170 by 56 by 4 feet, was present at the site. Currently, Northern Trust Bank in Lake Forest, IL holds the title to the property as the trustee for John Stack.

Borings obtained from the property in 1989 revealed the presence of fill material consisting of black coarse sand. An Illinois EPA Emergency Response Unit incident log indicates that the "area was filled in years ago with what appears to be materials similar to fly ash, foundry sand." The Lake County Soil Survey classifies the entire site as "made land." In 1988, a fire broke out at the lot, and firefighters determined that subsurface material had become hot enough to ignite nearby brush. CERCLA investigations include a 1991 preliminary assessment and a 1993 integrated assessment that revealed the presence of VOCs, SVOCs, pesticides, PCBs, and various metals. Pettibone Creek runs through the vacant lot from north to south. Surface runoff from the lot enters the creek directly or from Martin Luther King Jr. Drive.

Around 1941, the western portion of the remaining Vulcan-Louisville Smelting property was transferred to the Tantalum Defense Corp., a subsidiary of Fansteel. The Fansteel facility dates back to 1942 when the U.S. Government authorized and financed its construction, which was actually an expansion of the already-existing Fansteel facility located south of Martin Luther King Jr. Drive. The facility produced tantalum mill products and formed non-ferrous metals until November 1990. The facility remains as the company's headquarters. CERCLA investigation was also conducted at this facility in the early 1990s. Surface runoff from the Fansteel property flows south to Martin Luther King Jr. Drive where it enters a stormwater outfall and discharges into Pettibone Creek (Illinois EPA, December 1995). Operations at this facility have ceased and the company has filed for bankruptcy protection.

2.2.1 1970s Sampling Events

PCB and pesticide residues were found in samples obtained by the Illinois EPA in 1970 and 1971. Samples collected by the USEPA in 1975 indicated that the Inner Harbor sediments were heavily polluted with toxic metals (USEPA Region 5, May 1980).

2.2.2 1980s Sampling Events

USEPA Region 5 collected sediment samples from Pettibone Creek upstream of the inner harbor on May 22, 1980. Sites 3 and 4 were heavily contaminated with oil, grease, and heavy metals and showed elevated levels of dichlorodiphenyltrichloroethane (DDT) residues. Sites 1, 2, 4, and 5 showed low to moderate levels of contaminants (USEPA Region 5, May 1980).

STS Consultants Ltd. (STS), a contractor for the Navy, conducted a sampling event to support an application for a Clean Water Act (CWA) Section 401/404 permit to dredge the Boat Basin and the Outer Harbor in April 1988. One grab sample of sediment from the Boat Basin and one from the Outer Harbor were collected and analyzed for priority pollutant metals, PCBs, and limited Extraction Procedure (EP) toxicity testing. The concentration of copper, cyanide, lead, nickel, and zinc in both samples exceeded the 1977 USEPA guidelines for classifying Great Lakes harbor sediments as "nonpolluted". The PCB concentration detected in one sample also exceeded the 1977 guidelines. Results of limited EP toxicity testing indicated that the sediment samples were not considered hazardous with respect to chromium, lead, or mercury. USEPA indicated that they would not approve open water disposal of these sediments, however the dredged materials could be disposed of in a licensed, non-hazardous landfill facility (STS, July 1988).

In July 1988, Jacobs Engineering collected surface soil and sediment samples from NCRS/R. Lavin. Copper and lead were found at elevated concentrations. Aroclors and other metals were found to be elevated in both soils and sediment, but only lead and copper exceeded comparison values (Illinois Department of Public Health, June 1995).

Seven composite sediment samples (three from the Boat Basin and four from the Outer Harbor), and one Lake Michigan surface water sample, and one background sediment sample (both from south of the south Outer Harbor breakwater) were collected in April 1989 for the Navy. The samples were analyzed for metals, polynuclear aromatic hydrocarbons (PAHs), pesticides, and PCBs. The background sediment sample was collected at a depth of 1 foot, and the other sediment samples were composites of samples collected from sediment depths of 0 to 5 feet. The concentration of detectable metals in the Boat Basin sediment samples were generally higher than in those collected in the Outer Harbor. Within the Boat Basin, the highest levels were generally found at the location where the basin bends at about 45 degrees to join a channel leading to the Inner Harbor. Metal concentrations in the sediment sample next to the mouth of the Inner Harbor were the highest among the Outer Harbor sediment samples. Several SVOCs were detected at low concentrations. PCBs were not detected in the sediment samples. Supernatant testing and analysis of metals, total suspended solids, total volatile solids, and ammonia-nitrogen were conducted for Outer Harbor samples with fine materials in excess of 20 percent.

Seven composite sediment samples (three from the Boat Basin and four from the Outer Harbor) and one Lake Michigan surface water sample (from south of the south breakwater) were collected in December 1989 and analyzed for supernatant metals, PCBs, and PAHs by the Navy. Each composite sample was comprised of grab samples from a sediment depth of 0 to 5 feet. Direct comparison of the supernatant test results with the Illinois EPA maximum allowable concentrations indicated that the Illinois EPA was not likely to permit open water disposal of the sediments (STS, May 1989).

2.2.3 <u>1990's Sampling Events</u>

The Bureau of Water Planning section of the Illinois EPA performed a water quality study of Pettibone creek in June 1990 that showed elevated concentrations of zinc, copper, and lead, particularly in the sediments downstream of the NCRS/R. Lavin (Illinois EPA, June 1990).

The Illinois EPA performed a preliminary site assessment that included soil, surface water, and sediment sampling of the NCRS/R. Lavin Site in 1991. Sediment and surface water samples were collected from three locations in the east ditch at the NCRS/R. Lavin site. Sediment detections included VOCs, SVOCs, inorganic chemicals, and PCB; however, the VOCs were suspected to be laboratory contaminants and the SVOCs were well below the quantitation limits and considered estimated. The VOCs and SVOCs detected in the surface water were attributed to contamination. Inorganic chemicals, including aluminum, arsenic, barium, copper, lead, manganese, nickel, selenium, and zinc, were also detected (Illinois EPA, December 1991).

In November 1991, Illinois EPA collected an additional 18 soil samples and analyzed them for the Target Compounds List (TCL) at the Illinois EPA laboratories. Sediment from the southeast surface impoundment at the NCRS/R. Lavin facility was also sampled. The results revealed that cadmium, calcium, chromium, copper, lead, magnesium, nickel, silver, and zinc were present at concentrations at least three times above the background concentrations. Sediment from the southwest impoundment was also sampled. The results revealed that 2-methylnaphthalene, beryllium, calcium, chromium, copper, lead, nickel, silver, and zinc were present at concentrations at least three times above background concentrations (Illinois EPA, February 1992)

A consultant for NCRS/R. Lavin sampled eight shallow and three deep monitoring wells in the winter of 1991-1992. No VOCs, SVOCs, pesticides, or PCBs were detected. Shallow aquifer contaminants that exceeded the appropriate comparison values included antimony, arsenic, boron, cadmium, fluoride, lead, manganese, nickel, and sodium. Deep aquifer contaminants included antimony, arsenic, boron, fluoride, and sodium (Illinois Department of Public Health, June 1995).

In August 1992, Halliburton NUS, a contractor for the Navy, conducted a Site Inspection (SI) at Pettibone Creek, the Boat Basin, the Inner Harbor, the Outer Harbor, and Lake Michigan. They collected 11 sediment and 11 surface water samples from Pettibone Creek; eight sediment and two surface water samples from the Boat Basin; eight sediment and two surface water samples from the Inner Harbor; 11 sediment and 2 surface water samples from the Outer Harbor; and six sediment and five surface water samples from Lake Michigan. The samples were analyzed for one or more of the following parameter groups: Target Analyte List (TAL) VOCs, SVOCs, pesticides, and PCBs; TAL metals and cyanide; Toxicity Characteristic Leaching Procedure (TCLP) VOCs, SVOCs, herbicides, pesticides, and metals; reactivity; supernatant parameters; elutriate parameters; and miscellaneous parameters (i.e. total organic carbon and particle size). Pettibone Creek sediments contained elevated concentrations of SVOCs, pesticides, and metals, and to a lesser extent VOCs and Aroclor 1254. The Boat Basin, Inner Harbor, and Outer Harbor sediments contained elevated concentrations of SVOCs, pesticides, Aroclor 1254, metals, and cyanide. The Boat Basin, Inner Harbor, and Outer Harbor surface water samples were found to be free of significant contamination. Contaminants present in the Boat Basin, Inner Harbor, and Outer Harbor sediments appear to have originated from unidentified sources located upstream from NTC Great Lakes in the city of North Chicago and from unidentified sources located on the NTC Great Lakes property (Halliburton NUS, June 1993).

The Illinois EPA performed an integrated site assessment at the Vacant Lot site in September 1992. This CERCLA investigation included groundwater, sediment, and soil sampling. Chlorinated solvents, trace concentrations of PCBs, and inorganic chemicals, including cadmium, chromium, lead, manganese, mercury, and zinc were detected in the monitoring wells. Elevated concentrations of inorganics, chlorinated solvents, PAHs, pesticides, and PCBs were detected in both the soil and sediment samples. In the soil samples, the most prevalent contaminants were arsenic, beryllium, lead, zinc, trichloroethene (TCE), benzo(a)pyrene, and PCBs. In the sediment samples, the most prevalent contaminants were beryllium, lead, benzo(a)pyrene, and PCBs. Several offsite soil samples, collected to the north and northwest of the site, also exhibited elevated levels of inorganics, PAHs, pesticides, and PCBs.

The Illinois EPA conducted an Expanded Site Inspection of the NCRS/R. Lavin site in April 1994. They collected nine surface soil samples from the residential area north-northwest of the NCRS/R. Lavin facility, two background soil samples, seven sediment samples from Pettibone Creek, two background sediment samples from tributaries to the creek, and one sediment sample from the Inner Harbor. Contaminants detected in the soil samples included VOCs, SVOCs, pesticides, PCBs, and inorganic compounds. Analyses of the sediment samples revealed the presence of VOCs, SVOCs, pesticides, PCBs, metals, and other organic compounds (Illinois EPA, August 1994).

As part of a Comprehensive Environmental Response Expanded Site for Illinois EPA, seven sediment samples were collected along the length of the creek, from its origin at the storm water discharges to the NTC Great Lakes Inner Harbor in Lake Michigan. Samples were gathered from several different depths, (0 to 6 inches and 16 to 18 inches). Sediment contamination included VOCs, SVOCs, pesticides, PCBs, and metals. Significant contaminants observed in the sediment samples include arsenic, cadmium, chromium copper, lead, manganese, mercury, nickel, zinc, and PCBs. The South Branch of Pettibone Creek showed elevated concentrations of SVOCs (Illinois EPA, December 1995).

An Engineering Evaluation/Cost Analysis (EE/CA) was performed at the Vacant Lot Site, in 1997 to evaluate alternatives for conducting a removal action under CERCLA. The EE/CA was performed by Ecology and Environment, Inc. (E&E), for the USEPA. The EE/CA included collection of several sediment samples from the on-site portion of Pettibone Creek. The sediment samples had organic and inorganic contaminants. Contamination was present at depths of 0 to 5 feet below the creek bed. The sediment sample from the EJ&E railroad ditch had only organic contamination. A human health risk assessment identified several contaminants of potential concern (COPCs) in surface soils and sediments at the site, including six PAH compounds (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and benzo(k)fluoranthene); seven metals (antimony, beryllium, cadmium, copper, iron, manganese, and zinc); and PCBs.

The following sediment contaminants were considered COPCs because they exceeded ecological sediment screening benchmarks and three times the background level: antimony, copper, lead, manganese, mercury, silver, acetone, 1,2-dichloroethene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, pyrene, alpha-chlordane, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan I, endosulfan II, heptachlor, heptachlor epoxide, methoxychlor, Aroclor-1254, and Aroclor-1260. Although they had no screening benchmark values available, barium, benzo(b)fluoranthene, benzo(g,h,l)perylene, carbazole, endrin aldehyde, and endrin ketone were also considered COPCs because their concentrations appeared elevated.

The EE/CA also identified six other studies, mostly soil and groundwater investigations, that were conducted on the Vacant Lot site. Two studies investigated sediment: a study conducted in August and September of 1994 by the City of North Chicago and a site assessment conducted in September of 1994 by E&E. Low concentrations of pesticides and PCBs, TCLP lead, zinc, and chromium, and TCE were detected in the samples collected by the City of North Chicago. Elevated levels of inorganic chemicals, including arsenic, beryllium, and lead, TCE, and PCBs were detected in the samples collected by E&E (E&E, October 1997).

2.2.4 Recent Sampling Events

Additional sediment samples were collected from Pettibone Creek in 2000 and 2001 as part of a site investigation completed by a contractor for Fansteel, Inc., at the request of the USEPA Region 5. During the site investigation, sediment samples were collected from Pettibone Creek at 3 locations at two depths, 0 to 6 inches and 6 to 12 inches. These samples were collected south of 22nd Street. One additional sediment sample was collected at the same depths (0 to 6 inches and 6 to 12 inches) from the EJ&E drainage ditch. Analytical results from the creek sediment samples indicated tetrachloroethene, vinyl chloride, benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene, arsenic, selenium, and Synthetic

Precipitate Leaching Procedure (SPLP) lead contamination in one or more of the samples at concentrations above the Illinois EPA Tiered Approach to Corrective Action Objectives (TACO) soil remediation objectives. Total lead was detected above the soil remediation objectives in each sediment sample. In addition, Arochlor-1260 was detected in four of the creek sediment samples and the ditch sediment samples, but not at concentrations above the soil remediation objectives.

Review of the organic data illustrates a pattern of SVOC contamination present in the sediment. Some of the highest concentrations of SVOC contamination are present in sample SED 1003. This sample was collected at the NCRS/R. Lavin/City of North Chicago discharge into Pettibone Creek.

Organic compounds remain elevated in samples SED 1001 and SED 1002, collected downstream from Sample SED 1003, suggesting the contaminants are migrating downstream from the outfall. Samples SED 1004, SED 1005, and SED 1006, collected upstream from sample SED 1003, contained lower concentrations of these contaminants. Sample SED 1007, the background sample, contains concentrations of SVOCs consistent with the samples collected upstream from the NCRS/R. Lavin discharge. Sample SED 1008, collected from the railroad ditch, east of the storm water pipe, north of the railroad tracks, also contained high concentrations of SVOCs.

Based on the investigation, as well as historical investigations conducted in the Pettibone Creek, the study concluded that the creek beginning at 22^{nd} Street and ending at Sheridan Road is contaminated.

The EJ&E railroad ditch has shown contamination indicating some past or current unknown discharges. Pettibone Creek remediation requires tackling this contamination issue. The NCRS/R. Lavin/City of North Chicago storm water discharge location in the Pettibone Creek had elevated concentrations of fluorene, anthracene, pyrene, phenanthrene, chrysene, benzo(a)anthracene, and fluoranthene. There are two active discharges into the Pettibone Creek. EMCO Chemical Distributors, Inc. (EMCO) discharges north of 22^{nd} Street and NCRS/R. Lavin/City of North Chicago discharges south of 22^{nd} Street. Any remediation of the creek requires taking into account the future impacts of these discharges to Pettibone Creek. USEPA conducted a removal action at the Vacant Lot site in 1998 and excavated contaminated sediments from this section of Pettibone Creek. Based on the investigation conducted by the Fansteel contractor, Pettibone Creek sediment (between 22^{nd} Street and Sheridan Road) is contaminated and poses a threat to the benthic organisms in the creek as well as to the benthic organisms in Lake Michigan due to potential sediment migration (TN&A, June 2001).

A lead- and PCB-contaminated soil removal action was conducted in 1998 at the Vacant Lot site. The removal action excavated soil from across the site that exceeded the criteria of 1,400 mg/kg total lead and 25 mg/kg PCBs. Approximately 45,000 tons of lead-contaminated soil (38,000 tons was considered hazardous waste and required stabilization/treatment prior to disposal as non-hazardous waste) and 2,000 tons of PCB-contaminated soil was excavated and disposed at permitted Subtitle D disposal facilities. The removal action also included the excavation and disposal of 4,600 tons of lead-contaminated sediments and soil from Pettibone Creek (OHM Remediation Services Corp., October 1999).

2.3 POTENTIAL NAVY SOURCES

The IAS (Rogers, Golden, & Halpern and BCM Eastern Inc., March 1986) identified 14 potential areas where hazardous materials may have been released to the environment at NTC Great Lakes. The sites that have sources of contamination that may be discharged into Site 17 through storm water runoff include two transformer storage areas (PCBs), silk screen shop (VOCs, metals), and the service station (VOCs, SVOCs, and metals). The IAS also included the investigation of demolition debris disposal area along Pettibone Creek and coal storage facilities.

Surface runoff or fallout from engine exhaust from nearby roadways at NTC Great Lakes and the roadways in North Chicago are possible contributors of the PAHs to the contaminated sediments of Pettibone Creek and the Boat Basin by way of the many storm water sewer system outfalls that discharge into the creek and basin. The PAHs are not from operational storage or use at NTC Great Lakes.

There is no evidence or records that pesticides were ever mixed or stored in the general area of Pettibone Creek and the Boat Basin. Historically, typical applications of pesticides were applied at NTC Great Lakes, when it was legal to do so, by operation and maintenance personnel or contractors who were licensed to apply these products. There is no evidence of a release of such products in excess of the reportable quantities under 40 CFR Part 373, and there are no analytical data available that indicate pesticide applications are a source of the contamination at Pettibone Creek and the Boat Basin.

NTC Great Lakes stored transformers at locations within the base until 1985. These locations stored out-of-service transformers, including some filled with PCB-containing oil. No PCB-containing transformers or capacitors greater than 3 pounds are known to remain at NTC Great Lakes nor are there any requirements to remove any smaller ballasts associated with lighting fixtures. Investigations of PCB contamination at these transformer locations was conducted in the past and indicated that some soil contamination exceeded the federal and State cleanup guidelines. Cleanup documentation of the PCB-contaminated soil is not available. The PCB-contaminated soil was reported to be limited and restricted to the transformer storage locations. There are no analytical data available that indicated the transformer *storage locations are a source of the contamination at Pettibone Creek and the Boat Basin.* The transformer storage locations are no longer used at NTC Great Lakes.

Several areas around NTC Great Lakes were used as temporary drum storage areas. NTC Great Lakes also used underground storage tanks for storage of VOCs. Tetrachloroethene was detected in groundwater samples collected from monitoring wells near Building 105, the Old Dry Cleaner Facility, at concentrations exceeding Illinois EPA screening levels. Groundwater monitoring conducted prior to the RCRA closure of this facility and documented in RCRA closure plan has not indicated contaminant migration beyond the facility boundary. An underground storage tank also leaked at the service station releasing gasoline to the environment. Contaminated groundwater was pumped out and removed by an outside contractor, and contaminated soil was excavated and disposed at a permitted disposal facility.

Along Pettibone Creek, inert demolition debris (bricks, concrete, rocks, etc.) has been placed to protect the stream banks from erosion. It was reported in the IAS that coal ash had been disposed of where fill was required for grading purposes along the banks of Pettibone Creek. Coal was used as a source of fuel for heating and power at NTC Great Lakes until the mid-1970s. The coal was stored at many locations over the facility during its period of use. None of the coal storage sites would be considered potential sources of contamination since the coal has been removed.

TABLE 2-1

OFFSITE SEDIMENT
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	Illinois EPA TACO Exposure Route-Specific Values for Soils Ingestion (mg/kg)	Illinois EPA TACO Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region 9 Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
INORGANICS										
ALUMINUM	12/12	4000	16200	9004	X117-91			76000	50	
ANTIMONY	3/12	10.4	60.4	12.7	X118-91	31		31	3	
ARSENIC	12/12	5.8	28.2	12.5	X117-91	0.4	750	0.39	10	8
BARIUM	12/12	40	387	131	X117-91	5500	690000	5400	160	145
BERYLLIUM	12/12	0.5	53.8	10.2	X117-91	0.1	1300	150	1.1	
CADMIUM	10/12	1.5	51.6	9.4	X117-91	78	1800	37	0.8	0.5
CHROMIUM	12/12	17	380	71.1	X117-91	390	270	30	0.4	16
COBALT	12/12	4	39	12.5	X117-91	4700		4700	9	
COPPER	12/12	69.8	61700	9084	X117-91	2900		2900	36	38
CYANIDE	3/12	1.5	11.4	3.1	X112-91	1600		11	0.9	
IRON	12/12	9044	60600	26379	X117-91			23000	200	18000
LEAD	12/12	46.9	13200	2723	X117-91	400		400	50	28
MAGNESIUM	12/12	5900	47200	30575	X111-91					
MANGANESE	12/12	291	2760	915	X117-91	3700	69000	1800	100	1300
MERCURY	11/12	0.14	35.9	3.9	X118-91	23	10		0.3	0.07
NICKEL	11/12	19.4	1070	181	X117-91	1600	13000	1600	30	26
POTASSIUM	11/12	549	4700	1443	X209-94					1500
SELENIUM	6/12	0.56	8.4	2.2	X117-91	390		390	0.7	
SILVER	6/12	1.9	37.4	14.6	X117-91	390		390	2	5
THALLIUM	3/12	0.24	0.49	2.2	X209-94	6.3		5.2	1	
VANADIUM	12/12	7.6	29.7	16.5	X209-94	550		550	2	
ZINC	12/12	614	100500	18055	X117-91	23000		23000	50	80
SEMIVOLATILE ORGANIC COMPOUNDS										
1,2-DICHLOROBENZENE	1/14	0.41	0.41	0.41	X118-91			370	0.03	0.34
2-METHYLNAPHTHALENE	4/14	0.093	0.32	0.22	X115-91	3100				0.368
4-METHYLPHENOL	1/14	0.82	0.82	0.82	X207-94			310		
ACENAPHTHENE	4/14	0.076	1.5	0.80	X112-91	4700		3700	20	0.585
ANTHRACENE	6/14	0.13	2	0.81	X112-91	23000		22000	0.1	0.085
BENZO(A)ANTHRACENE	5/14	0.35	2.7	1.2	X207-94	0.9		0.62	0.1	0.287
BENZO(A)PYRENE	8/14	0.27	4.4	1.8	X112-91	0.09		0.062	0.1	0.073

TABLE 2-1

OFFSITE SEDIMENT
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	Illinois EPA TACO Exposure Route-Specific Values for Soils Ingestion (mg/kg)	Illinois EPA TACO Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region 9 Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
BENZO(B)FLUORANTHENE	7/14	0.29	4.8	2.1	X112-91	0.9		0.62		0.886
BENZO(G,H,I)PERYLENE	4/14	0.46	3.4	2.0	X112-91	3100		56	0.1	0.17
BENZO(K)FLUORANTHENE	7/14	0.34	3.5	1.5	X112-91	9		6.2	0.1	8.86
BIS(2-ETHYLHEXYL)PHTHALATE	6/14	0.44	22	4.7	X207-94	46	31000	35	0.017	
BUTYL BENZYL PHTHALATE	1/14	0.21	0.21	0.21	X112-91	16000	930	12000	0.017	11
CARBAZOLE	2/9	0.11	0.83	0.47	GL63-SD-PC-10	32		24		
CHRYSENE	9/14	0.38	4.7	1.9	X112-91	88		62	0.1	0.4
DI-N-BUTYL PHTHALATE	1/14	1.1	1.1	1.1	X207-94	7800	2300	6100	200	11
DI-N-OCTYL PHTHALATE	1/14	0.32	0.32	0.32	X111-91	1600	10000	1200	0.017	
DIBENZO(A,H)ANTHRACENE	1/14	0.37	0.37	0.37	GL63-SD-PC-10	0.09		0.062		0.06
DIBENZOFURAN	3/14	0.47	0.96	0.70	X112-91			290		2
FLUORANTHENE	10/14	0.25	11	3.8	X112-91	3100		2300	0.1	2.79
FLUORENE	4/14	0.088	1.4	0.77	X112-91	3100		2600	30	0.035
INDENO(1,2,3-CD)PYRENE	6/14	0.15	3.6	1.2	X112-91	0.9		0.62	0.1	2.5
ISOPHORONE	1/14	0.086	0.086	0.086	GL63-SD-PC-11	15600	4600	510		
NAPHTHALENE	3/14	0.27	0.63	0.48	X112-91	3100		56	0.1	0.34
PHENANTHRENE	11/14	0.13	10	3.1	X112-91	3100		56	0.1	0.81
PHENOL	2/14	0.084	0.12	0.10	GL63-SD-PC-11	47000		37000	0.05	
PYRENE	10/14	0.25	6.8	2.7	X115-91			2300		0.35
VOLATILE ORGANIC COMPOUNDS										
1,1,1-TRICHLOROETHANE	2/14	0.008	0.019	0.014	X111-91		1200	630	0.07	0.17
1,1,2,2-TETRACHLOROETHANE	1/14	0.004	0.004	0.004	X207-94			0.38		0.94
1,1-DICHLOROETHANE	2/14	0.005	0.012	0.0085	X210-94	7800	1300	590	0.02	
1,1-DICHLOROETHENE	1/14	0.008	0.008	0.008	X210-94			0.054	0.1	
2-BUTANONE	2/14	0.016	0.031	0.013	X207-94			7300		
4-METHYL-2-PENTANONE	1/14	0.003	0.003	0.003	X207-94			790		
ACETONE	4/14	0.005	0.046	0.016	X207-94	7800	100000	1600		
BENZENE	1/14	0.004	0.004	0.004	GL63-SD-PC-10	22	0.8	0.65	0.01	0.006
CARBON DISULFIDE	2/14	0.004	0.005	0.005	GL63-SD-PC-10	7800	720	360		
ETHYLBENZENE	1/14	0.006	0.006	0.006	X207-94	7800	400	230	0.03	0.028
METHYLENE CHLORIDE	4/14	0.011	0.016	0.014	X115-91 X117-91	85	13	8.9		

TABLE 2-1

OFFSITE SEDIMENT
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	Illinois EPA TACO Exposure Route-Specific Values for Soils Ingestion (mg/kg)	Illinois EPA TACO Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region 9 Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
STYRENE	1/14	0.003	0.003	0.003	X207-94			1700	0.3	
TETRACHLOROETHENE	4/14	0.002	0.059	0.023	X118-91	12	11	5.7	0.002	0.53
TOLUENE	2/14	0.008	0.012	0.01	X207-94	16000	650	520	0.01	0.11
TOTAL 1,2-DICHLOROETHENE	8/14	0.004	0.7	0.12	X210-94	16000	650	520	0.01	0.11
TOTAL XYLENES	2/14	0.007	0.033	0.02	X207-94	16000	650	520	0.01	0.11
TRICHLOROETHENE	9/14	0.004	0.015	0.0091	GL63-SD-PC-11	58	5	2.8	0.1	1.6
VINYL CHLORIDE	4/14	0.03	0.67	0.21	X210-94	0.3	0.03	0.15	0.01	
PESTICIDES / PCBS										
4,4'-DDD	3/14	0.0057	0.053	0.022	X207-94	3		2.4	0.0033	0.008
4,4'-DDE	2/14	0.016	0.022	0.019	GL63-SD-PC-11-D	2		1.7	0.0033	0.005
4,4'-DDT	4/14	0.00053	0.069	0.020	X207-94	2		1.7	0.0033	0.007
ALPHA-CHLORDANE	3/14	0.0024	0.012	0.031	X207-94	0.05	20	1.6	0.00003	0.007
AROCLOR-1016	2/14	0.012	0.083	0.065	X117-91	1		3.9	0.0029	0.007
AROCLOR-1254	9/14	0.069	12	2.0	X118-91	1		0.22	0.0029	0.06
AROCLOR-1260	3/14	0.01	0.46	0.17	X207-94	1		0.22	0.0029	0.005
DIELDRIN	2/14	0.00059	0.0058	0.0088	X207-94	0.04	1	0.03	0.0005	0.052
ENDOSULFAN II	1/14	0.017	0.017	0.019	X207-94	470		370	0.00001	0.014
ENDOSULFAN SULFATE	1/14	0.009	0.009	0.015	GL63-SD-PC-11-D	470		370	0.00001	0.0054
ENDRIN	5/14	0.00044	0.26	0.064	X118-91	23		18	0.00004	0.02
ENDRIN ALDEHYDE	2/9	0.00022	0.0061	0.0032	X210-94	23		18		0.02
GAMMA-CHLORDANE	2/14	0.0017	0.0085	0.037	X207-94	0.05	20	1.6	0.00003	0.007
HEPTACHLOR EPOXIDE	1/14	0.0062	0.0062	0.0081	GL63-SD-PC-11-D	0.07	5	0.053	0.0000002	0.005

Note: Shaded values are screening values that are less than the maximum concentration.
Illinois EPA = Illinois Environmental Protection Agency
TACO = Tiered Approach to Corrective Action Objectives

TABLE 2-2

OFFSITE SURFACE WATER
FREQUENCY OF DETECTION
SITE 17
NTC GREAT LAKES, ILLINOIS

Parameter	Frequency of Detection	Minimum Detection (ug/L)	Maximum Detection (ug/L)	Average of Detections (ug/L)	Location of Maximum Detection	Groundwater Remediation Objective Class I (ug/L)	Region IX Tapwater (ug/L)	FED MCL (ug/L)	FED AWQC (ug/L)	Illinois Human Health Water Quality Standards (ug/L)	Subtitle D (ug/L)	Illinois Human Health Water Quality Criteria (ug/L)	Ecological Surface Water Screening Values (ug/L)
INORGANICS													
ALUMINUM	7/13	68	539	235	GL63-SW-PC-11		36000						87
ARSENIC	6/6	1	3.1	1.9	GL63-SW-PC-11	50	0.045	50	0.018			50	148
BARIUM	13/13	37	117	69.1	C-3	2000	2600	2000	1000			1000	5000
BORON	7/7	444	699	611	C-2-F		3300						
CALCIUM	12/13	69	126000	52775	GL63-SW-PC-11-F								
CALCIUM	12/13	69	126000	52775	GL63-SW-PC-11-F-D								
CHROMIUM	3/13	6	7	6.3	C-3	100	110	100					11
COPPER	9/13	5	100	28.2	GL63-SW-PC-11	650	1400	1300	1000				8.96
CYANIDE	1/7	12	12	12	GL63-SW-PC-10	200	6.2	200					5.2
IRON	7/13	72	10010	2786	C-3	5000	11000		300			300	1000
LEAD	2/13	36.8	37	36.9	GL63-SW-PC-11-D	7.5	15	15				50	5.08
MAGNESIUM	13/13	32	45400	17737	GL63-SW-PC-11-F								
MAGNESIUM	13/13	32	45400	17737	GL63-SW-PC-11-F-D								
MANGANESE	13/13	82	2031	409	C-3	150	880		50				1000
NICKEL	4/13	11	33	19.8	C-3	100	730		610				52.01
POTASSIUM	13/13	2.4	8530	3778	GL63-SW-PC-11-F-D								
SODIUM	13/13	33	58700	24459	GL63-SW-PC-10								
STRONTIUM	7/7	223	564	333	C-3		22000						
ZINC	9/13	101	502	206	GL63-SW-PC-11	5000	11000		5000				118
MISCELLANEOUS													
AMMONIA	4/4	0.06	1.5	0.565	C-3		210						
SEMIVOLATILE ORGANIC COMPOUNDS													
BIS(2-ETHYLHEXYL)PHTHALATE	2/3	2	3	2.5	GL63-SW-PC-11	6	4.8	6	1.8				3
ISOPHORONE	2/3	31	41	36	GL63-SW-PC-11	1400	71		36				
VOLATILE ORGANIC COMPOUNDS													
1,1-DICHLOROETHANE	2/3	8	10	9	GL63-SW-PC-11-D	700	810						47
METHYLENE CHLORIDE	2/3	56	60	58	GL63-SW-PC-11-D	5	4.3	5	4.7	2600		340	1380
TOTAL 1,2-DICHLOROETHENE	3/3	8	80	52.3	GL63-SW-PC-11-D	1000	720	1000	6800	51000	5600		110
TRICHLOROETHENE	3/3	8	72	48.7	GL63-SW-PC-11	5	1.6	5	2.7	370	29		940
VINYL CHLORIDE	2/3	6	9	7.5	GL63-SW-PC-11-D	2	0.041	2	2				

Note: Shaded values are screening values that are less than the maximum concentration.
MCL = Maximum Concentration Limit
AWQC = Ambient Water Quality Criteria

TABLE 2-3

PETTIBONE CREEK SEDIMENT
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 1 OF 2

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	Illinois EPA TACO Exposure Route-Specific Values for Soils Ingestion (mg/kg)	Illinois EPA TACO Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
INORGANICS										
ALUMINUM	6/7	2810	5300	4220	X113-91			76000	50	
ARSENIC	9/10	5.3	27.1	11.2	GL63-SD-PC-07	0.4	750	0.39	10	8
BARIUM	7/8	23.3	95	53.4	X113-91	5500	690000	5400	160	145
BERYLLIUM	6/7	0.46	1.5	0.8	GL63-SD-PC-09	0.1	1300	150	1.1	
CADMIUM	6/10	0.89	3	2.0	SITE 4	78	1800	37	0.8	0.5
CALCIUM	6/7	47800	70800	58433	GL63-SD-PC-07					
CHROMIUM	9/10	5.9	47	24.6	SITE 4	390	270	30	0.4	16
COBALT	4/7	5	7.3	6.3	X113-91	4700		4700	9	
COPPER	9/10	38.2	1030	291	GL63-SD-PC-09	2900		2900	36	38
CYANIDE	2/7	2.4	3.6	2.1	GL63-SD-PC-09	1600		11	0.9	
IRON	7/8	11600	25000	16914	C-4-SED			23000	200	18000
LEAD	9/10	40.2	392	196	GL63-SD-PC-09	400		400	50	28
MAGNESIUM	6/7	23700	40200	30633	X113-91					
MANGANESE	7/8	345	590	437	C-4-SED	3700	69000	1800	100	1300
MERCURY	7/10	0.04	1.2	0.35	GL63-SD-PC-09	23	10		0.3	0.07
NICKEL	7/8	9.2	45.1	24.7	GL63-SD-PC-09	1600	13000	1600	30	26
POTASSIUM	7/8	684	2600	1148	C-4-SED					1500
SILVER	3/8	1.8	3.8	2.8	GL63-SD-PC-09	390		390	2	5
SODIUM	5/7	238	354	284	GL63-SD-PC-07					
VANADIUM	6/7	7.6	15.6	12.9	X113-91	550		550	2	
ZINC	9/10	159	2730	890	GL63-SD-PC-09	23000		23000	50	80
SEMIVOLATILE ORGANIC COMPOUNDS										
2-METHYLNAPHTHALENE	1/7	0.085	0.085	0.085	GL63-SD-PC-09	3100				0.368
ACENAPHTHENE	2/7	0.16	0.5	0.33	GL63-SD-PC-09	4700		3700	20	0.585
ANTHRACENE	4/7	0.075	0.91	0.54	GL63-SD-PC-09	23000		22000	0.1	0.085
BENZO(A)ANTHRACENE	5/7	0.26	2.8	1.7	X206-94	0.9		0.62	0.1	0.287
BENZO(A)PYRENE	5/7	0.19	2.2	0.96	X206-94	0.09		0.062	0.1	0.073
BENZO(B)FLUORANTHENE	4/7	0.21	4.3	1.9	X206-94	0.9		0.62		0.886
BENZO(G,H,I)PERYLENE	1/7	0.58	0.58	0.58	GL63-SD-PC-09	3100		56	0.1	0.17
BENZO(K)FLUORANTHENE	5/7	0.17	2.3	1.0	X201-94	9		6.2	0.1	8.86
BIS(2-ETHYLHEXYL)PHTHALATE	6/9	0.01	300	52.4	X201-94	46	31000	35	0.017	

TABLE 2-3

PETTIBONE CREEK SEDIMENT
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 2 OF 2

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	Illinois EPA TACO Exposure Route-Specific Values for Soils Ingestion (mg/kg)	Illinois EPA TACO Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
BUTYL BENZYL PHTHALATE	2/7	0.085	0.42	0.25	X201-94	16000	930	12000	0.017	11
CHRYSENE	6/7	0.19	3.5	1.6	X206-94	88		62	0.1	0.4
DI-N-BUTYL PHTHALATE	1/7	0.74	0.74	0.74	X201-94	7800	2300	6100	200	11
DI-N-OCTYL PHTHALATE	1/7	23	23	23	X201-94	1600	10000	1200	0.017	
DIBENZOFURAN	3/7	0.12	0.51	0.31	X201-94			290		2
FLUORANTHENE	6/7	0.37	7.2	3.1	X206-94	3100		2300	0.1	2.79
FLUORENE	3/7	0.22	0.68	0.47	X201-94	3100		2600	30	0.035
INDENO(1,2,3-CD)PYRENE	2/7	0.22	0.52	0.37	GL63-SD-PC-09	0.9		0.62	0.1	2.5
NAPHTHALENE	1/7	0.17	0.17	0.17	GL63-SD-PC-09	3100		56	0.1	0.34
PHENANTHRENE	5/7	0.31	4.8	3.2	X206-94 GL63-SD-PC-09	3100		56	0.1	0.81
PYRENE	6/7	0.41	6.1	2.8	X206-94			2300		0.35
VOLATILE ORGANIC COMPOUNDS										
ACETONE	1/7	0.8	0.8	0.40	GL63-SD-PC-08	7800	100000	1600		
METHYLENE CHLORIDE	1/7	0.016	0.016	0.016	X113-91	85	13	8.9		
PESTICIDES / PCBS										
4,4'-DDD	6/10	0.026	0.46	0.20	X206-94	3		2.4	0.0033	0.008
4,4'-DDE	6/10	0.048	0.41	0.22	SITE 3	2		1.7	0.0033	0.005
4,4'-DDT	6/10	0.034	1	0.24	SITE 3	2		1.7	0.0033	0.007
ALPHA-BHC	1/8	0.006	0.006	0.006	X206-94	0.1	0.8	0.09	0.003	0.006
ALPHA-CHLORDANE	3/8	0.0011	0.016	0.0083	X206-94	0.05	20	1.6	0.00003	0.007
AROCLOR-1016	1/7	0.68	0.68	0.68	X206-94	1		3.9	0.0029	0.007
AROCLOR-1254	3/9	0.27	1.9	0.89	X206-94	1		0.22	0.0029	0.06
AROCLOR-1260	2/7	0.31	2.3	1.3	X206-94	1		0.22	0.0029	0.005
DIELDRIN	2/8	0.0048	0.052	0.028	X206-94	0.04	1	0.03	0.0005	0.052
ENDOSULFAN I	1/7	0.011	0.011	0.011	X206-94	470		370	0.00001	0.0029
ENDOSULFAN II	1/7	0.012	0.012	0.012	X201-94	470		370	0.00001	0.014
ENDRIN	2/8	0.033	0.19	0.11	X206-94	23		18	0.00004	0.02
GAMMA-BHC (LINDANE)	1/8	0.049	0.049	0.049	SITE 4	0.5		0.44	0.00005	0.003
HEPTACHLOR	3/10	0.0013	0.082	0.052	SITE 3	0.1	0.1	0.11	0.0007	0.005

Note: Shaded values are screening values that are less than the maximum concentration.
Illinois EPA = Illinois Environmental Protection Agency
TACO = Tiered Approach to Corrective Action Objectives

TABLE 2-4

PETTIBONE CREEK SURFACE WATER
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

Parameter	Frequency of Detection	Minimum Detection (ug/L)	Maximum Detection (ug/L)	Average of Detections (ug/L)	Location of Maximum Detection	Groundwater Remediation Objective Class I (ug/L)	Region IX Tapwater (ug/L)	FED MCL (ug/L)	FED AWQC (ug/L)	Illinois Human Health Water Quality Standards (ug/L)	Subtitle D (ug/L)	Illinois Human Health Water Quality Criteria (ug/L)	Ecological Surface Water Screening Values (ug/L)
INORGANICS													
ALUMINUM	6/10	61	565	191	GL63-SW-PC-08		36000						87
BARIUM	10/10	38	74	52.9	D-2	2000	2600	2000	1000			1000	5000
BORON	4/4	840	967	897	D-2		3300						
CADMIUM	1/10	6	6	6	GL63-SW-PC-09	5	18	5					2.24
CALCIUM	10/10	94	81000	45655	GL63-SW-PC-07								
CHROMIUM	4/8	7	11	9	C-4-F	100	110	100					11
COPPER	6/10	7	16	10	GL63-SW-PC-09	650	1400	1300	1000				8.96
IRON	5/10	176	699	350	GL63-SW-PC-08	5000	11000		300			300	1000
MAGNESIUM	10/10	38	31500	17569	GL63-SW-PC-07								
MANGANESE	10/10	28	106	59.9	D-2	150	880		50				1000
MERCURY	1/8	0.16	0.16	0.16	C-4	2		2	0.05			150	0.0013
NICKEL	3/10	7	9	8	D-2	100	730		610				52.01
POTASSIUM	10/10	3.6	5230	2942	GL63-SW-PC-08								
SODIUM	10/10	108	73000	39311	GL63-SW-PC-07								
STRONTIUM	4/4	372	385	378	D-2								
ZINC	5/5	19	84	49.2	GL63-SW-PC-09	5000	11000		5000				118
ARSENIC	5/5	1	2.5	1.6	GL63-SW-PC-08	50	0.045	50	0.018		190	50	148
MISCELLANEOUS													
AMMONIA	2/2	0.11	0.17	0.14	C-4		210						
CHEMICAL OXYGEN DEMAND	2/2	18	37	27.5	C-4								
HARDNESS	2/2	397	572	484.5	D-2								
NITRITE/NITRATE	2/2	1.3	2	1.7	D-2	10000	1000		10000				
PHENOLS	2/2	4	13	8.5	D-2							1	
PHOSPHORUS (ELEMENTAL)	4/4	0.02	0.14	0.085	C-4		0.73					7	
PHOSPHORUS (ELEMENTAL)	4/4	0.02	0.14	0.085	C-4-F		0.73					7	
TOTAL SUSPENDED SOLIDS	2/2	4	8	6	D-2								

Note: Shaded values are screening values that are less than the maximum concentration.
MCL = Maximum Concentration Limit
AWQC = Ambient Water Quality Criteria

TABLE 2-5

SOUTH BRANCH PETTIBONE CREEK SEDIMENT
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 1 OF 2

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	Illinois EPA TACO Exposure Route-Specific Values for Soils Ingestion (mg/kg)	Illinois EPA TACO Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
INORGANICS										
ALUMINUM	6/6	3600	10800	5910	GL63-SD-PC-05			76000	50	
ARSENIC	6/6	4.8	23.9	11.3	GL63-SD-PC-06	0.4	750	0.39	10	8
BARIUM	5/6	26.6	55.2	39.2	X202-94	5500	690000	5400	160	145
BERYLLIUM	4/6	0.3	26.8	7.1	GL63-SD-PC-04	0.1	1300	150	1.1	
CADMIUM	2/6	1.2	1.4	1.0	GL63-SD-PC-05	78	1800	37	0.8	0.5
CALCIUM	6/6	31400	80700	56550	GL63-SD-PC-06					
CHROMIUM	6/6	9.6	21	14.6	GL63-SD-PC-05	390	270	30	0.4	16
COBALT	6/6	4.8	10.5	7.8	GL63-SD-PC-05	4700		4700	9	
COPPER	6/6	14.2	23.2	19.3	GL63-SD-PC-05	2900		2900	36	38
IRON	6/6	10800	19700	15450	GL63-SD-PC-05			23000	200	18000
LEAD	6/6	19.8	48	32.2	X202-94	400		400	50	28
MAGNESIUM	6/6	16300	41100	29516.7	GL63-SD-PC-06					
MANGANESE	6/6	367	573	457.3	GL63-SD-PC-06	3700	69000	1800	100	1300
MERCURY	3/6	0.09	0.28	0.1	X114-91	23	10		0.3	0.07
NICKEL	5/6	10.4	25.3	18.5	GL63-SD-PC-05	1600	13000	1600	30	26
POTASSIUM	6/6	630	3290	1587	GL63-SD-PC-05					1500
SILVER	1/6	1.6	1.6	1.6	GL63-SD-PC-03	390		390	2	5
SODIUM	5/6	141	262	201.2	GL63-SD-PC-05					
THALLIUM	1/6	0.53	0.53	0.37	GL63-SD-PC-05	6.3		5.2	1	
VANADIUM	6/6	10.7	24.1	17.1	GL63-SD-PC-05	550		550	2	
ZINC	6/6	55.6	83.3	71.2	X202-94	23000		23000	50	80
SEMIVOLATILE ORGANIC COMPOUNDS										
2-METHYLNAPHTHALENE	1/6	0.16	0.16	0.16	X202-94	3100				0.368
ACENAPHTHYLENE	1/6	0.12	0.12	0.12	X202-94	4700		3700		0.186
ANTHRACENE	1/6	0.22	0.22	0.22	X202-94	23000		22000	0.1	0.085
BENZO(A)ANTHRACENE	3/6	0.1	0.88	0.39	X202-94	0.9		0.62	0.1	0.287
BENZO(A)PYRENE	1/6	0.14	0.14	0.14	GL63-SD-PC-04	0.09		0.062	0.1	0.073
BENZO(B)FLUORANTHENE	2/6	0.11	0.73	0.42	X202-94	0.9		0.62		0.886
BENZO(K)FLUORANTHENE	2/6	0.18	0.18	0.18	GL63-SD-PC-03 GL63-SD-PC-04	9		6.2	0.1	8.86
BIS(2-ETHYLHEXYL)PHTHALATE	3/6	0.094	0.56	0.25	X202-94	46	31000	35	0.017	

TABLE 2-5

SOUTH BRANCH PETTIBONE CREEK SEDIMENT
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 2 OF 2

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	Illinois EPA TACO Exposure Route-Specific Values for Soils Ingestion (mg/kg)	Illinois EPA TACO Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
CHRYSENE	3/6	0.13	0.87	0.41	X202-94	88		62	0.1	0.4
DI-N-BUTYL PHTHALATE	1/6	0.96	0.96	0.96	X202-94	7800	2300	6100	200	11
DIBENZOFURAN	1/6	0.13	0.13	0.13	X202-94			290		2
FLUORANTHENE	4/6	0.18	1.6	0.64	X202-94	3100		2300	0.1	2.79
FLUORENE	1/6	0.22	0.22	0.22	X202-94	3100		2600	30	0.035
NAPHTHALENE	1/6	0.17	0.17	0.17	X202-94	3100		56	0.1	0.34
PHENANTHRENE	4/6	0.085	1.1	0.43	X202-94	3100		56	0.1	0.81
PYRENE	4/6	0.16	1.4	0.56	X202-94			2300		0.35
VOLATILE ORGANIC COMPOUNDS										
2-BUTANONE	1/6	0.005	0.005	0.0055	X202-94			7300		
ACETONE	2/6	0.006	0.012	0.009	X202-94	7800	100000	1600		
BROMOMETHANE	1/6	0.011	0.011	0.011	GL63-SD-PC-03	110	10	3.9		
METHYLENE CHLORIDE	1/6	0.01	0.01	0.01	X114-91	85	13	8.9		
TOLUENE	1/6	0.049	0.049	0.049	GL63-SD-PC-05	16000	650	520	0.01	0.11
PESTICIDES / PCBS										
4,4'-DDD	3/6	0.015	0.059	0.031	X202-94	3		2.4	0.0033	0.008
4,4'-DDE	3/6	0.0088	0.041	0.020	X202-94	2		1.7	0.0033	0.005
4,4'-DDT	3/6	0.0079	0.071	0.030	X202-94	2		1.7	0.0033	0.007
ALPHA-BHC	1/6	0.0012	0.0012	0.0012	X202-94	0.1	0.8	0.09	0.003	0.006
ALPHA-CHLORDANE	1/6	0.029	0.029	0.029	X202-94	0.05	20	1.6	0.00003	0.007
AROCLOR-1260	1/6	0.16	0.16	0.16	X202-94	1		0.22	0.0029	0.005
DIELDRIN	1/6	0.0098	0.0098	0.0098	X202-94	0.04	1	0.03	0.0005	0.052
ENDRIN	1/6	0.0097	0.0097	0.0097	X202-94	23		18	0.00004	0.02
GAMMA-CHLORDANE	1/6	0.016	0.016	0.016	X202-94	0.05	20	1.6	0.00003	0.007
HEPTACHLOR EPOXIDE	1/6	0.004	0.004	0.004	X202-94	0.07	5	0.053	0.0000002	0.005

Note: Shaded values are screening values that are less than the maximum concentration.
Illinois EPA = Illinois Environmental Protection Agency
TACO = Tiered Approach to Corrective Action Objectives

TABLE 2-6

SOUTH BRANCH PETTIBONE CREEK SURFACE WATER
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

Parameter	Frequency of Detection	Minimum Detection (ug/L)	Maximum Detection (ug/L)	Average of Detections (ug/L)	Location of Maximum Detection	Groundwater Remediation Objective Class I (ug/L)	Region IX Tapwater (ug/L)	FED MCL (ug/L)	FED AWQC (ug/L)	Illinois Human Health Water Quality Standards (ug/L)	Subtitle D (ug/L)	Illinois Human Health Water Quality Criteria (ug/L)	Ecological Surface Water Screening Values (ug/L)
INORGANICS													
ALUMINUM	6/10	115	2050	769	GL63-SW-PC-04		36000						**87**
ARSENIC	7/8	1.3	3.3	2.2	GL63-SW-PC-05	50	**0.045**	**0.018**	**0.018**			50	148
BORON	1/2	53	53	53	D-1-F		3300						
BARIUM	10/10	28	70	49.4	GL63-SW-PC-05-F	2000	2600	1000	1000			1000	5000
BARIUM	10/10	28	70	49.4	GL63-SW-PC-05-F		2600	1000	1000			1000	5000
CALCIUM	10/10	94	86300	46929	GL63-SW-PC-05-F								
CHROMIUM	2/9	10	15	12.5	D-1	100	110						**11**
COPPER	5/10	3	17	9	GL63-SW-PC-04	650	1400	1000	1000				**8.96**
IRON	5/10	238	2880	1490.6	GL63-SW-PC-04	5000	11000	**300**	**300**			**300**	**1000**
LEAD	8	6.9	15.4	7.2	GL63-SW-PC-03	**7.5**	**15**					50	**5.08**
MAGNESIUM	10/10	44	38700	19139	GL63-SW-PC-05-F								
MANGANESE	10/10	18	230	80.6	GL63-SW-PC-05	**150**	880	**50**	**50**				1000
POTASSIUM	10/10	2.6	4530	3277	GL63-SW-PC-04								
SODIUM	10/10	104	91800	42421	GL63-SW-PC-05-F								
STRONTIUM	2/2	325	334	330	D-1		22000						
ZINC	6/10	8	63	25.3	GL63-SW-PC-04	5000	1400		5000				118
MISCELLANEOUS													
NITRITE/NITRATE	1/1	0.6	0.6	0.6	D-1	10000	1000		10000				
VOLATILE ORGANIC COMPOUNDS													
CARBON DISULFIDE	1/4	12	12	12	GL63-SW-PC-05	700	1000						**0.92**

Note: Shaded values are screening values that are less than the maximum concentration.
MCL = Maximum Concentration Limit
AWQC = Ambient Water Quality Criteria

TABLE 2-7

PETTIBONE CREEK BELOW CONFLUENCE SEDIMENT
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 1 OF 2

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	Illinois EPA TACO Exposure Route-Specific Values for Soils Ingestion (mg/kg)	Illinois EPA TACO Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
INORGANICS										
ALUMINUM	5/7	2570	12400	7112	X205-94			76000	50	
ANTIMONY	1/7	15.5	15.5	11.2	X204-94	31		31	3	
ARSENIC	5/7	4.4	24	12.7	X205-94	0.4	750	0.39	10	8
BARIUM	5/7	27.3	208	94.8	X204-94	5500	690000	5400	160	145
BERYLLIUM	4/7	0.51	3	1.7	X205-94	0.1	1300	150	1.1	
CADMIUM	3/7	2.8	5.6	4.4	X205-94	78	1800	37	0.8	0.5
CHROMIUM	5/7	9.5	69.2	33.4	X205-94	390	270	30	0.4	16
COBALT	3/7	6.6	18.1	13.4	X204-94	4700		4700	9	
COPPER	5/7	38	475	217.3	X205-94	2900		2900	36	38
CYANIDE	2/7	3.9	4.2	4.1	X205-94	1600		11	0.9	
IRON	5/7	11100	19000	15000	X204-94			23000	200	18000
LEAD	5/7	40.5	435	192.2	X205-94	400		400	50	28
MAGNESIUM	5/7	22400	34200	27340	GL63-SD-PC-02					
MANGANESE	5/7	343	2470	1169.2	X205-94	3700	69000	1800	100	1300
MERCURY	3/7	0.15	1.6	1.1	X205-94	23	10		0.3	0.07
NICKEL	5/7	10	445	141.4	X205-94	1600	13000	1600	30	26
POTASSIUM	5/7	652	3350	1829.8	X204-94					1500
SELENIUM	2/7	3.5	5	1.8	X205-94	390		390	0.7	
SILVER	3/7	2	50.8	31.63333	X205-94	390		390	2	5
VANADIUM	5/7	10.5	26.9	18.0	X205-94	550		550	2	
ZINC	5/7	190	1160	490.2	X204-94	23000		23000	50	80
SEMIVOLATILE ORGANIC COMPOUNDS										
ACENAPHTHENE	1/7	0.13	0.13	0.13	GL63-SD-PC-02-D	4700		3700	20	0.585
ANTHRACENE	2/7	0.12	0.41	0.27	GL63-SD-PC-02-D	23000		22000	0.1	0.085
BENZO(A)ANTHRACENE	4/7	0.15	1.7	0.69	X204-94	0.9		0.62	0.1	0.287
BENZO(A)PYRENE	3/7	0.13	0.32	0.22	GL63-SD-PC-02-D	0.09		0.062	0.1	0.073
BENZO(B)FLUORANTHENE	2/7	0.19	0.35	0.27	GL63-SD-PC-02-D	0.9		0.62		0.886
BENZO(G,H,I)PERYLENE	1/7	0.25	0.25	0.25	GL63-SD-PC-02-D	3100		56	0.1	0.17
BENZO(K)FLUORANTHENE	3/7	0.27	0.39	0.32	GL63-SD-PC-02-D	9		6.2	0.1	8.86
CARBAZOLE	1/7	0.18	0.18	0.18	GL63-SD-PC-02-D	32		24		
CHRYSENE	3/7	0.19	0.59	0.38	GL63-SD-PC-02-D	88		62	0.1	0.4

TABLE 2-7

PETTIBONE CREEK BELOW CONFLUENCE SEDIMENT
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 2 OF 2

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	Illinois EPA TACO Exposure Route-Specific Values for Soils Ingestion (mg/kg)	Illinois EPA TACO Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
DI-N-BUTYL PHTHALATE	1/7	1.1	1.1	1.1	X204-94	7800	2300	6100	200	11
DIBENZOFURAN	1/7	0.14	0.14	0.14	GL63-SD-PC-02-D			290		2
FLUORANTHENE	4/7	0.31	3	1.3	X204-94	3100		2300	0.1	2.79
FLUORENE	1/7	0.25	0.25	0.25	GL63-SD-PC-02-D	3100		2600	30	0.035
INDENO(1,2,3-CD)PYRENE	1/7	0.22	0.22	0.22	GL63-SD-PC-02-D	0.9		0.62	0.1	2.5
PHENANTHRENE	4/7	0.2	3.1	1.4	X204-94	3100		56	0.1	0.81
PYRENE	4/7	0.3	2.4	1.1	X204-94			2300		0.35
VOLATILE ORGANIC COMPOUNDS										
2-BUTANONE	2/7	0.006	0.007	0.0065	X204-94			7300		
ACETONE	2/7	0.016	0.024	0.013	X205-94	7800	100000	1600		
CARBON DISULFIDE	1/7	0.004	0.004	0.004	X205-94	7800	720	360		
PESTICIDES / PCBS										
4,4'-DDD	5/7	0.042	3.3	1.31	X204-94	3		2.4	0.0033	0.008
4,4'-DDE	5/7	0.05	0.29	0.14	X205-94	2		1.7	0.0033	0.005
4,4'-DDT	5/7	0.038	0.26	0.12	X205-94	2		1.7	0.0033	0.007
ALPHA-CHLORDANE	1/7	0.084	0.084	0.084	X204-94	0.05	20	1.6	0.00003	0.007
AROCLOR-1016	1/7	1.3	1.3	1.3	X204-94	1		3.9	0.0029	0.007
AROCLOR-1254	2/7	3.2	3.2	3.2	X204-94 X205-94	1		0.22	0.0029	0.06
AROCLOR-1260	1/7	1.4	1.4	1.4	X204-94	1		0.22	0.0029	0.005
DELTA-BHC	2/7	0.12	0.13	0.13	X205-94	0.1	0.8	0.09	0.01	0.003
DIELDRIN	2/7	0.036	0.036	0.036	X205-94 X204-94	0.04	1	0.03	0.0005	0.052
ENDOSULFAN I	1/7	0.04	0.04	0.04	X205-94	470		370	0.00001	0.0029
ENDRIN	2/7	0.16	0.21	0.19	X204-94	23		18	0.00004	0.02
ENDRIN ALDEHYDE	2/7	0.085	0.096	0.091	X204-94	23		18		0.02
GAMMA-CHLORDANE	2/7	0.036	0.046	0.041	X205-94	0.05	20	1.6	0.00003	0.007
METHOXYCHLOR	1/7	0.11	0.11	0.11	X204-94	390		310		0.019

Note: Shaded values are screening values that are less than the maximum concentration.
Illinois EPA = Illinois Environmental Protection Agency
TACO = Tiered Approach to Corrective Action Objectives

TABLE 2-8

PETTIBONE CREEK BELOW CONFLUENCE SURFACE WATER
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

Parameter	Frequency of Detection	Minimum Detection (ug/L)	Maximum Detection (ug/L)	Average of Detections (ug/L)	Location of Maximum Detection	Groundwater Remediation Objective Class I (ug/L)	Region IX Tapwater (ug/L)	FED MCL (ug/L)	FED AWQC (ug/L)	Illinois Human Health Water Quality Standards (ug/L)	Subtitle D (ug/L)	Illinois Human Health Water Quality Criteria (ug/L)	Ecological Surface Water Screening Values (ug/L)
INORGANICS													
ALUMINUM	2/6	270	402	336	GL63-SW-PC-01		36000						87
IRON	3/6	496	720	596	GL63-SW-PC-01	5000	11000	300	300			300	1000
ARSENIC	6/6	1.1	3.1	1.6	GL63-SW-PC-01	50	0.045	0.018	0.018			50	148
BARIUM	6/6	37	55	42.8	GL63-SW-PC-02-F-D	2000	2600	1000	1000			1000	5000
CALCIUM	6/6	62500	68900	64767	GL63-SW-PC-01-F								
COPPER	6/6	6	40	19.8	GL63-SW-PC-02	650	1400	1000	1000				8.96
COPPER	6/6	6	40	19.8	GL63-SW-PC-02-D	650	1400	1000	1000				8.96
LEAD	1/6	1	1	0.75	GL63-SW-PC-02-F	7.5	15					50	5.08
MAGNESIUM	6/6	24200	27600	25133	GL63-SW-PC-01-F								
MANGANESE	6/6	22	43	30.2	GL63-SW-PC-01	150	880	50	50				1000
POTASSIUM	6/6	3400	3770	3550	GL63-SW-PC-01-F								
SODIUM	6/6	51100	64600	55333	GL63-SW-PC-01-F								
ZINC	3/6	9	15	11.3	GL63-SW-PC-02-F-D	10000	1400		5000				118
VOLATILE ORGANIC COMPOUNDS													
CARBON DISULFIDE	1/3	34	34	34	GL63-SW-PC-01	700	1000						0.92

Note: Shaded values are screening values that are less than the maximum concentration.
MCL = Maximum Concentration Limit
AWQC = Ambient Water Quality Criteria

TABLE 2-9

BOAT BASIN SEDIMENT
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 1 OF 2

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	Illinois EPA TACO Exposure Route-Specific Values for Soils Ingestion (mg/kg)	Illinois EPA TACO Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
INORGANICS										
ALUMINUM	10/10	3130	9110	6100	GL63-SD-BB-04A			76000	50	
ARSENIC	14/15	1	24.4	9.7	GL63-SD-BB-04A	0.4	750	0.39	10	8
BARIUM	10/10	20.8	150	69.3	GL63-SD-BB-04A	5500	690000	5400	160	145
BERYLLIUM	13/13	0.39	9.3	1.4	GL63-SD-BB-01A	0.1	1300	150	1.1	
CADMIUM	14/15	0.8	11.9	3.5	GL63-SD-BB-04A	78	1800	37	0.8	0.5
CALCIUM	10/10	39300	71400	57210	GL63-SD-BB-02A					
CHROMIUM	15/15	0.013	86.3	27.2	GL63-SD-BB-03B	390	270	30	0.4	16
COBALT	10/10	6	12.5	8.03	GL63-SD-BB-04A	4700		4700	9	
COPPER	14/15	49	1560	358	GL63-SD-BB-04A	2900		2900	36	38
CYANIDE	7/15	0.21	14.5	6.6	GL63-SD-BB-04A	1600		11	0.9	
IRON	10/10	12000	24000	16400	GL63-SD-BB-04A			23000	200	18000
LEAD	15/15	0.09	848	272	X116-91	400		400	50	28
MAGNESIUM	10/10	19400	38800	29270	X116-91					
MANGANESE	10/10	342	755	565.5	GL63-SD-BB-04A	3700	69000	1800	100	1300
MERCURY	14/15	0.024	2.5	0.92	GL63-SD-BB-03B	23	10		0.3	0.07
NICKEL	14/15	8.5	217	69.9	GL63-SD-BB-02B	1600	13000	1600	30	26
POTASSIUM	10/10	570	2030	1271	GL63-SD-BB-02B					1500
SELENIUM	7/13	0.81	2.4	1.3	GL63-SD-BB-03B	390		390	0.7	
SILVER	10/13	1.5	85.9	24.5	GL63-SD-BB-02B	390		390	2	5
SODIUM	9/10	170	463	273	X203-94					
VANADIUM	10/10	10.8	23.2	17.1	GL63-SD-BB-04A GL63-SD-BB-02B	550		550	2	
ZINC	14/15	280	2200	901	GL63-SD-BB-04A	23000		23000	50	80
MISCELLANEOUS										
TOTAL ORGANIC CARBON	6/6	1190	15000	6470	B-104	16000	650	520	0.01	0.11
TOTAL SOLIDS	3/3	63	80.9	74.5	B-202	16000	650	520	0.01	0.11
SEMIVOLATILE ORGANIC COMPOUNDS										
2-METHYLNAPHTHALENE	7/11	0.08	0.31	0.17	X203-94	3100				0.368
ACENAPHTHENE	8/17	0.098	0.85	0.24	X203-94	4700		3700	20	0.585
ACENAPHTHYLENE	2/17	0.00016	0.00028	0.070	B-103	4700		3700		0.186
ANTHRACENE	10/17	0.0026	1.2	0.33	X203-94	23000		22000	0.1	0.085
BENZO(A)ANTHRACENE	12/17	0.0021	1.2	0.67	GL63-SD-BB-04A GL63-SD-BB-01B	0.9		0.62	0.1	0.287
BENZO(A)PYRENE	13/17	0.092	2.5	0.75	X203-94	0.09		0.062	0.1	0.073
BENZO(B)FLUORANTHENE	12/17	0.26	1.4	0.80	X116-91	0.9		0.62		0.886
BENZO(G,H,I)PERYLENE	4/17	0.16	1.3	0.53	X116-91	3100		56	0.1	0.17

TABLE 2-9

BOAT BASIN SEDIMENT
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 2 OF 2

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	Illinois EPA TACO Exposure Route-Specific Values for Soils Ingestion (mg/kg)	Illinois EPA TACO Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
BENZO(K)FLUORANTHENE	10/14	0.2	3.5	1.02	X203-94	9		6.2	0.1	8.86
BIS(2-ETHYLHEXYL)PHTHALATE	7/15	0.00097	3	1.1	GL63-SD-BB-03A	46	31000	35	0.017	
BUTYL BENZYL PHTHALATE	2/14	0.00056	0.0014	0.071	B-103	16000	930	12000	0.017	11
CARBAZOLE	6/10	0.11	1.5	0.38	X203-94	32		24		
CHRYSENE	13/14	0.35	3.8	1.1	X203-94	88		62	0.1	0.4
DI-N-BUTYL PHTHALATE	1/11	0.98	0.98	0.53	X203-94	7800	2300	6100	200	11
DI-N-OCTYL PHTHALATE	3/11	0.91	2.1	0.93	GL63-SD-BB-02A	1600	10000	1200	0.017	
DIBENZO(A,H)ANTHRACENE	3/14	0.055	0.26	0.17	B-204	0.09		0.062		0.06
DIBENZOFURAN	4/11	0.074	0.6	0.26	X203-94			290		2
FLUORANTHENE	12/14	0.17	4.3	1.9	X116-91	3100		2300	0.1	2.79
FLUORENE	11/14	0.078	0.98	0.27	X203-94	3100		2600	30	0.035
INDENO(1,2,3-CD)PYRENE	6/14	0.19	1.2	0.54	X116-91	0.9		0.62	0.1	2.5
NAPHTHALENE	2/11	0.29	0.6	0.37	X203-94	3100		56	0.1	0.34
PHENANTHRENE	13/14	0.41	5.7	1.8	X203-94	3100		56	0.1	0.81
PYRENE	13/14	0.45	4	1.4	X116-91			2300		0.35
VOLATILE ORGANIC COMPOUNDS										
1,1,1-TRICHLOROETHANE	1/10	0.013	0.013	0.013	X203-94		1200	630	0.07	0.17
2-BUTANONE	5/10	0.009	0.02	0.012	X203-94			7300		
ACETONE	1/10	0.026	0.026	0.018	X203-94	7800	100000	1600		
METHYLENE CHLORIDE	3/10	0.008	0.055	0.033	GL63-SD-BB-01A	85	13	8.9		
TOLUENE	1/10	0.004	0.004	0.0040	X203-94	16000	650	520	0.01	0.11
XYLENES, total	2/10	0.004	0.006	0.0050	X203-94	160000	410	210	0.1	0.14
PESTICIDES / PCBS										
4,4'-DDD	9/12	0.21	0.72	0.38	GL63-SD-BB-03B	3		2.4	0.0033	0.008
4,4'-DDE	9/12	0.074	0.35	0.16	X203-94	2		1.7	0.0033	0.005
4,4'-DDT	9/12	0.051	0.19	0.093	X203-94	2		1.7	0.0033	0.007
ALPHA-BHC	1/11	0.0055	0.0055	0.0055	X203-94	0.1	0.8	0.09	0.003	0.006
ALPHA-CHLORDANE	5/11	0.013	0.021	0.018	GL63-SD-BB-03B	0.05	20	1.6	0.00003	0.007
AROCLOR-1254	7/15	0.82	2.4	1.3	B-204	1		0.22	0.0029	0.06
DIELDRIN	1/11	0.012	0.012	0.012	X203-94	0.04	1	0.03	0.0005	0.052
ENDRIN	1/11	0.062	0.062	0.062	X203-94	23		18	0.00004	0.02
GAMMA-CHLORDANE	1/11	0.021	0.021	0.021	X203-94	0.05	20	1.6	0.00003	0.007
TOTAL AROCLOR	1/2	0.0121	0.0121	0.012	B-2	1		0.22	0.0029	0.06

Notes: Shaded values are screening values that are less than the maximum concentration.
Illinois EPA = Illinois Environmental Protection Agency
TACO = Tiered Approach to Corrective Action Objectives

TABLE 2-10

BOAT BASIN SURFACE WATER
FREQUENCY OF DETECTION
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

Parameter	Frequency of Detection	Minimum Detection (ug/L)	Maximum Detection (ug/L)	Average of Detections (ug/L)	Location of Maximum Detection	Groundwater Remediation Objective Class I (ug/L)	Region IX Tapwater (ug/L)	FED MCL (ug/L)	FED AWQC (ug/L)	Illinois Human Health Water Quality Standards (ug/L)	Subtitle D (ug/L)	Illinois Human Health Water Quality Criteria (ug/L)	Ecological Surface Water Screening Values (ug/L)
INORGANICS													
ALUMINUM	2/6	87	350	218.5	GL63-SW-BB-03		36000						87
COPPER	1/6	8	8	8	C-5	650	1400	1000	1000				8.96
IRON	3/6	162	554	388.3	GL63-SW-BB-03	5000	11000	300	300			300	1000
NICKEL	1/6	8	8	8	C-5	100	730	610	610				52.01
ZINC	2/6	41	44	42.5	GL63-SW-BB-01	10000	1400		5000				118
ARSENIC	1/4	1.4	1.4	1.4	GL63-SW-BB-03-F	50	0.045	0.018	0.018			50	148
BARIUM	6/6	31	52	38.8	C-5 C-5-F	2000	2600	1000	1000			1000	5000
BORON	2/2	560	573	567	C-5-F		3300						
CALCIUM	6/6	95	52500	32365	GL63-SW-BB-01								
CHROMIUM	3/5	9	11	10	C-5	100	110						11
MAGNESIUM	6/6	41	20800	12530	GL63-SW-BB-01								
MANGANESE	6/6	8	60	35.8	C-5	150	880	50	50				1000
POTASSIUM	6/6	4.1	2920	1640	GL63-SW-BB-01								
SODIUM	6/6	108	42100	22770	GL63-SW-BB-01								
STRONTIUM	2/2	370	373	372	C-5-F		22000						
MISCELLANEOUS													
AMMONIA	1/1	0.18	0.18	0.18	C-5		210						
CHEMICAL OXYGEN DEMAND	1/1	20	20	20	C-5								
HARDNESS	1/1	405	405	405	C-5								
NITRITE/NITRATE	1/1	1.1	1.1	1.1	C-5	10000	1000		10000				
PHOSPHORUS (ELEMENTAL)	2/2	0.08	0.12	0.1	C-5		0.73					7	
TOTAL SUSPENDED SOLIDS	1/1	6	6	6	C-5								
VOLATILE ORGANIC COMPOUNDS													
CIS-1,2-DICHLOROETHENE	1/1	2	2	2	C-5	70	61						590
TOLUENE	1/3	4	4	4	GL63-SW-BB-03	1000	720	6800	6800	51000	5600		110
XYLENES, TOTAL	1/3	4	4	4	GL63-SW-BB-03	10000	1400						120
TRICHLOROETHENE	1/3	1	1	1	C-5	5	1.6	2.7	2.7	370	29		940

Note: Shaded values are screening values that are less than the maximum concentration.
MCL = Maximum Concentration Limit
AWQC = Ambient Water Quality Criteria

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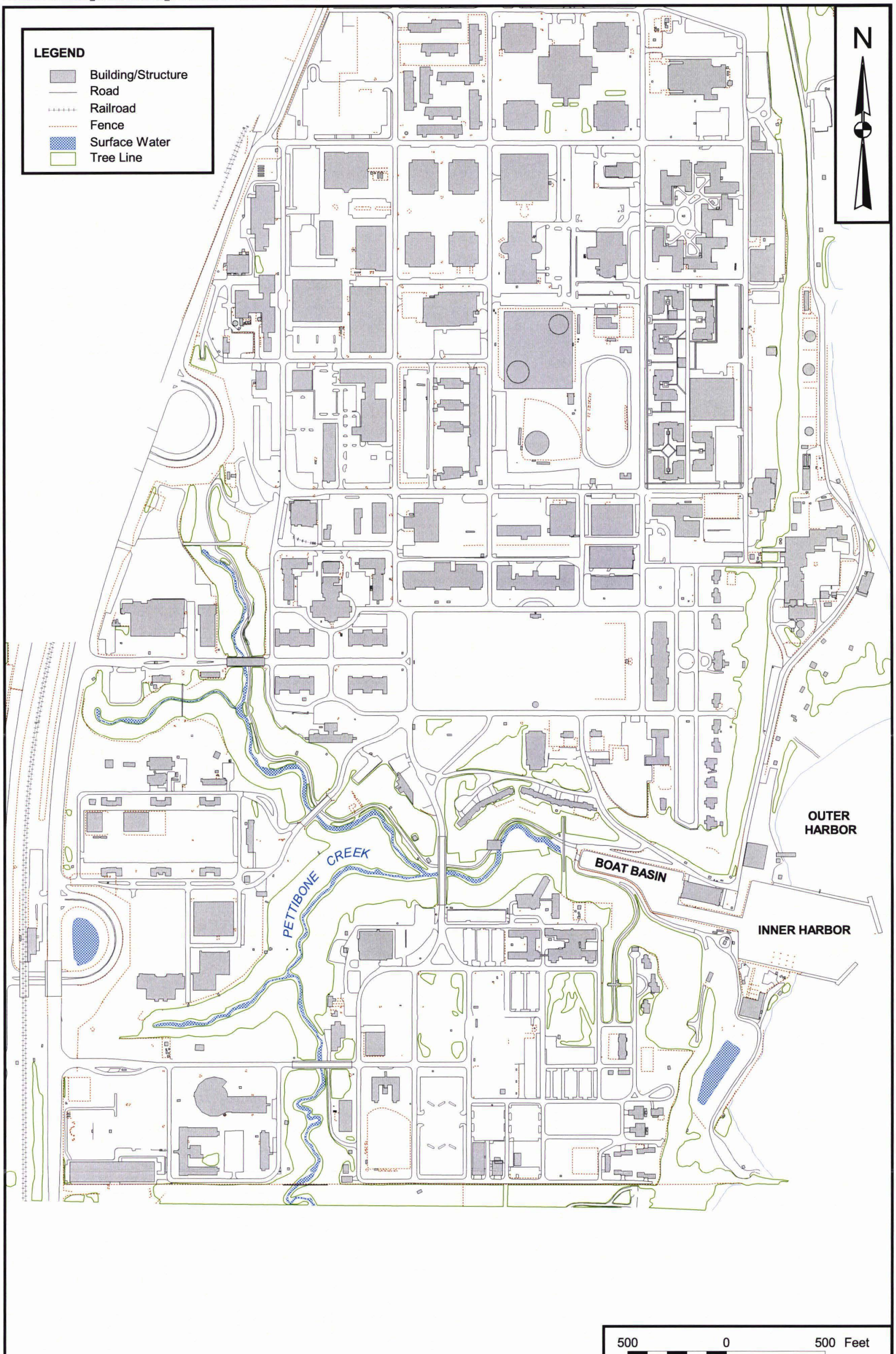
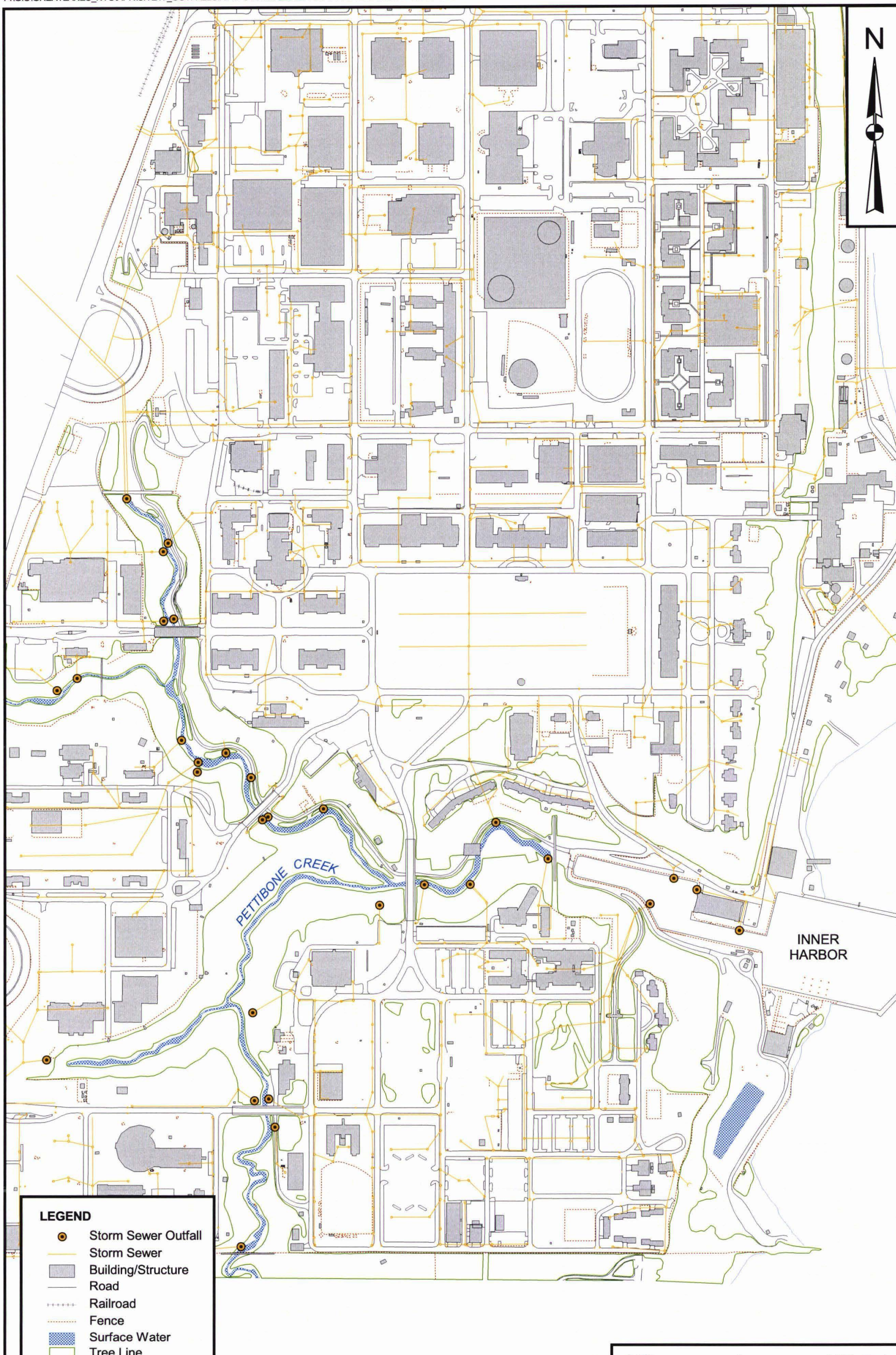


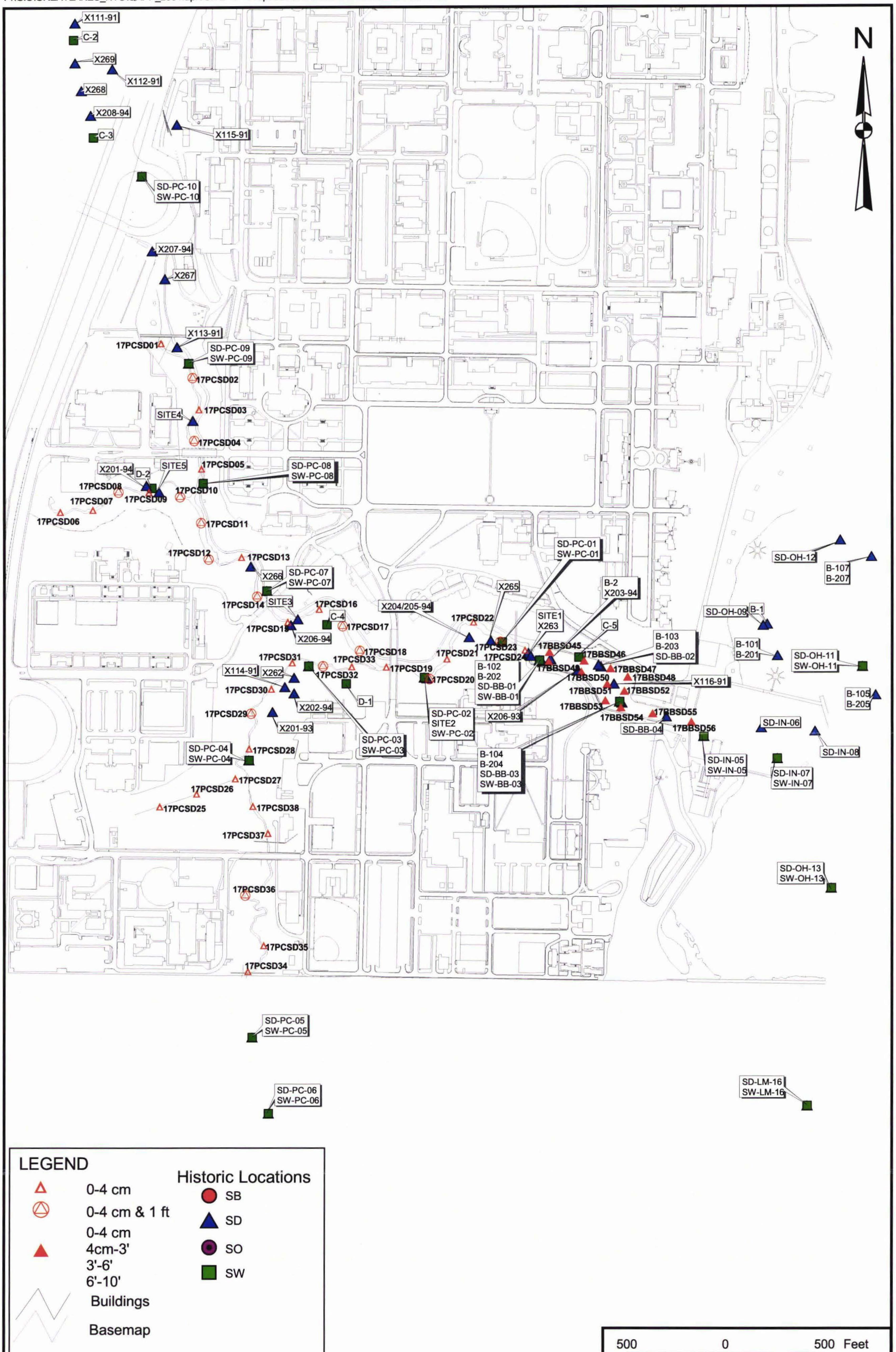
DRAWN BY J. LAMEY	DATE 8/6/03	SITE MAP SITE 17 - PETTIBONE CREEK AND BOAT BASIN NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS	CONTRACT NUMBER N3939
CHECKED BY	DATE		APPROVED BY / DATE
COST/SCHEDULE-AREA			APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 2-1 / REV 0

P:\GIS\GREATLAKES_NTC\APR\SITE17_OUTFALLS.APR STORM SEWER OUTFALL LOCATIONS 8/6/03 JAL



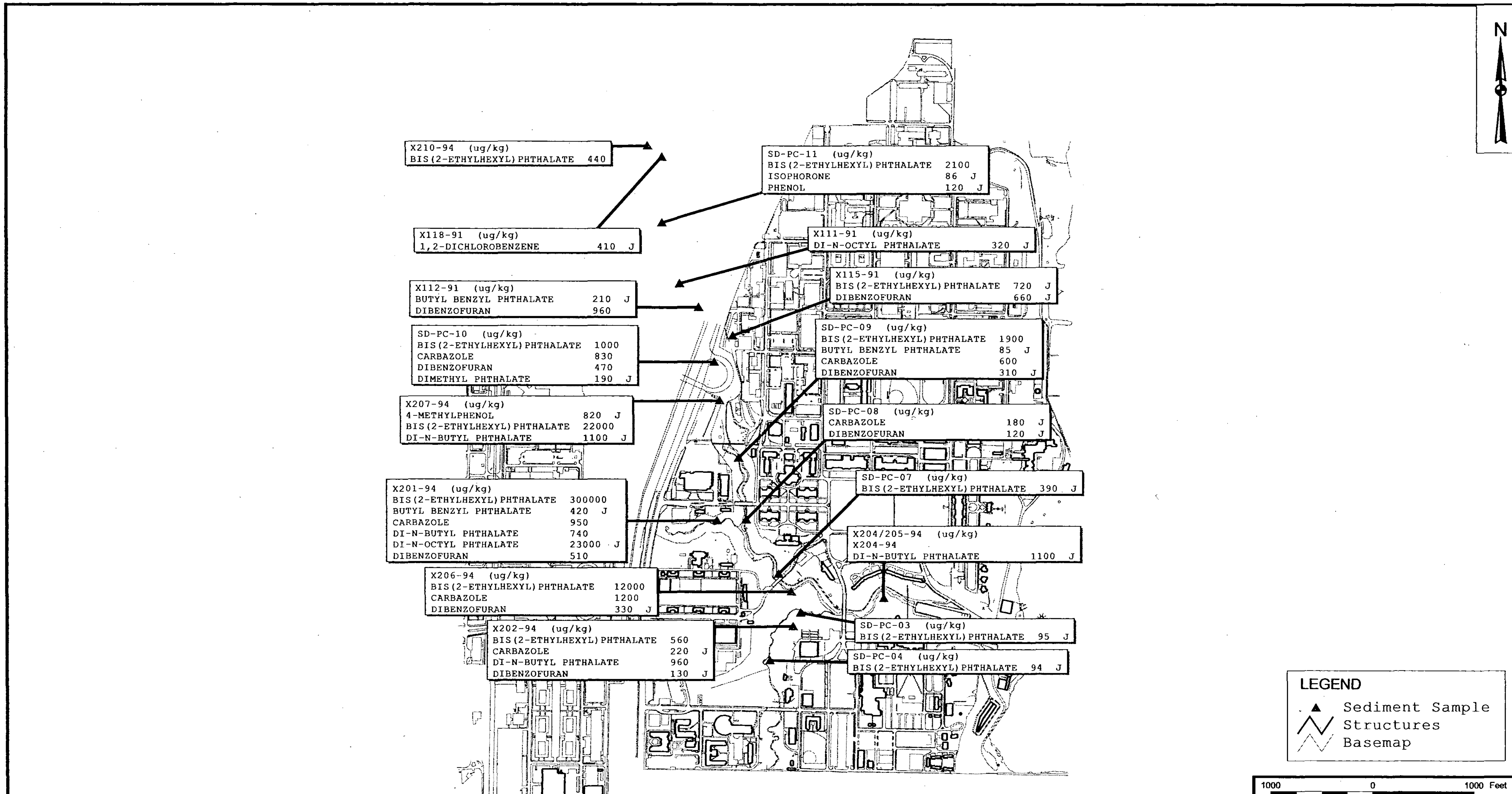
DRAWN BY J. LAMEY	DATE 8/6/03	STORM SEWER OUTFALL LOCATIONS SITE 17 - PETTIBONE CREEK AND BOAT BASIN NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS	CONTRACT NUMBER N3939
CHECKED BY	DATE		APPROVED BY — DATE —
COST/SCHEDULE-AREA			APPROVED BY — DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 2-2 — REV 0

P:\GIS\GREATLAKES_NTC\QAPP_2001.apr\ SITE 17 - Proposed and Historic locations 09/06/01 ACS



DRAWN BY A. SEAGER	DATE 4/5/01	Tetra Tech NUS, Inc.	CONTRACT NUMBER N3939	
CHECKED BY	DATE	PROPOSED AND HISTORIC SAMPLE LOCATIONS SITE 17 - PETTIBONE CREEK AND BOAT BASIN NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS	APPROVED BY	DATE
COST/SCHEDULE-AREA			APPROVED BY	DATE
SCALE AS NOTED			DRAWING NO. FIGURE 2-3	REV 1

P:\GIS\GREATLAKES_NTC\FIELD_RESEARCH_SDTAGS.APR\PETTIBONE CREEK - SEMIVOLATILE ORGANICS IN SEDIMENT JCB 5/23/01



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: J. BELLONE DATE: 5/1/01
CHECKED BY DATE
COST/SCHED-AREA
SCALE: AS NOTED

SEMIVOLATILE ORGANICS IN SEDIMENTS
SITE 17 - PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2-4 REV. 0

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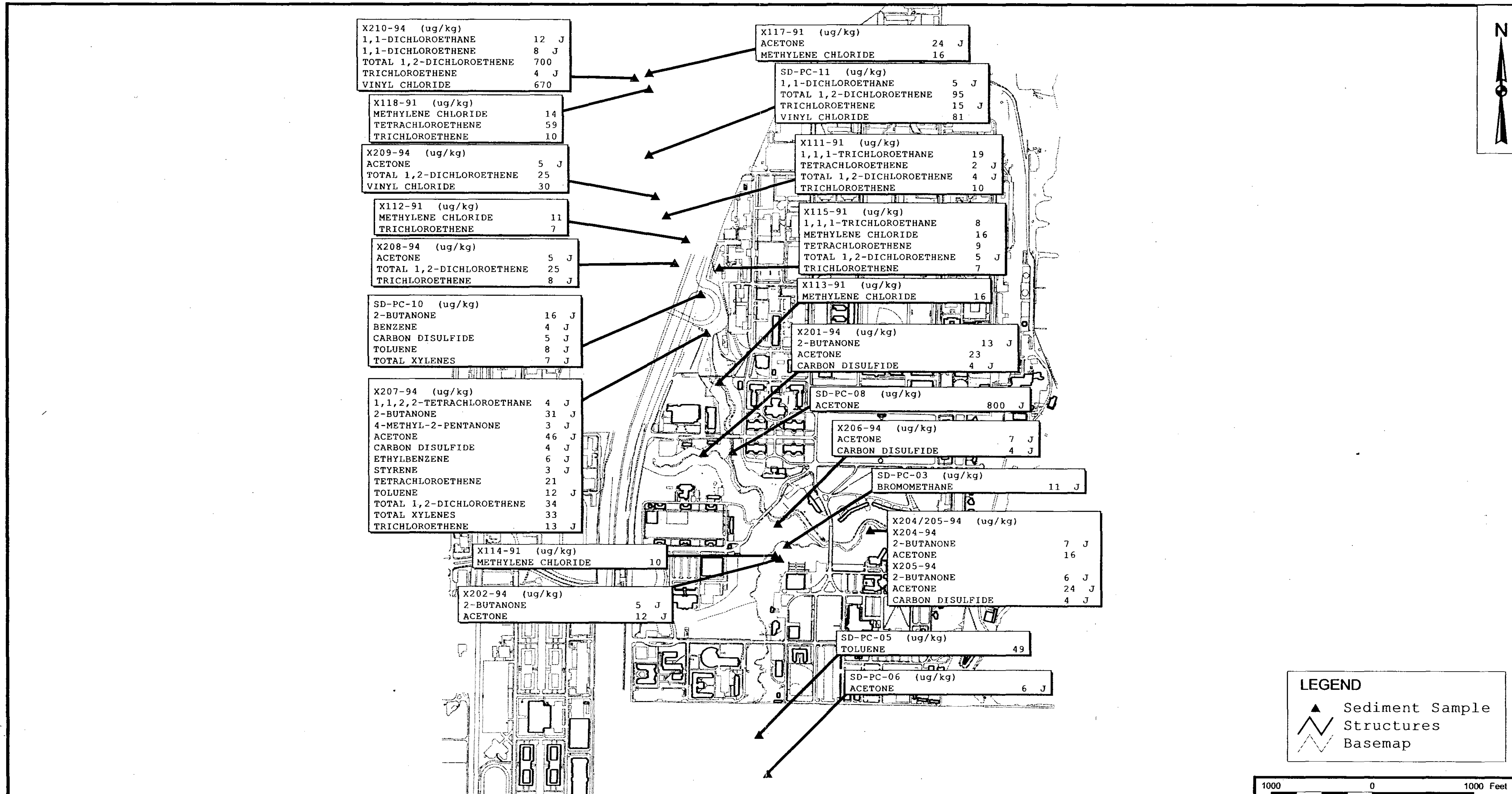

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

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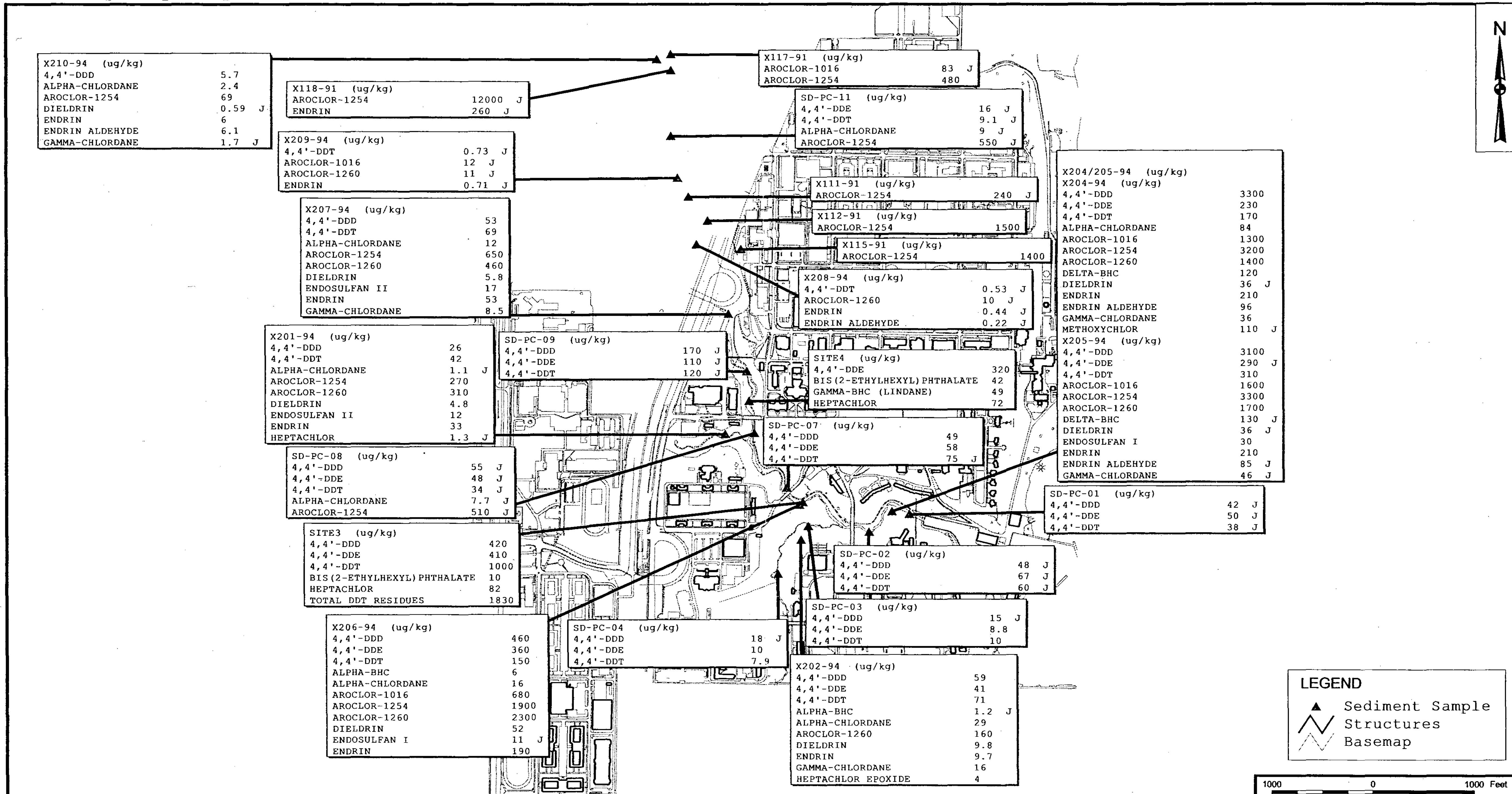
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

VOLATILE ORGANICS IN SEDIMENTS
SITE 17 - PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2-5 REV. 0

P:\GIS\GREATLAKES_NTC\FIELD_RESEARCH_SDTAGS.APR\PETTIBONE CREEK - PESTICIDES IN SEDIMENT JCB 5/23/01



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: J. BELLONE — DATE: 5/1/01
CHECKED BY — DATE
COST/SCHED-AREA
SCALE: AS NOTED

PESTICIDES/PCBs IN SEDIMENTS
SITE 17 - PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
APPROVED BY — DATE
APPROVED BY — DATE
DRAWING NO.: FIGURE 2-6 — REV.: 0

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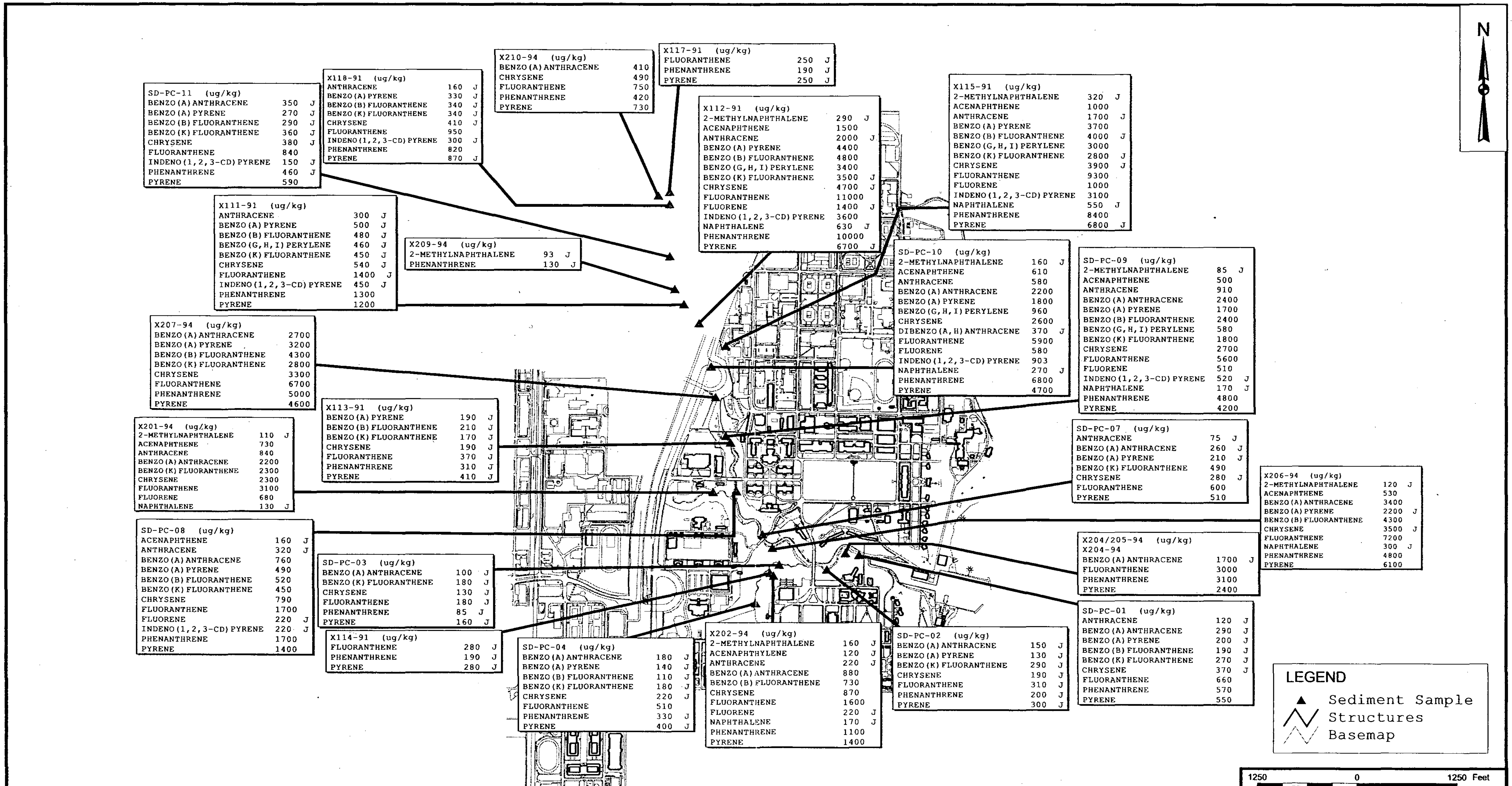

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: J. BELLONE — DATE: 5/3/01
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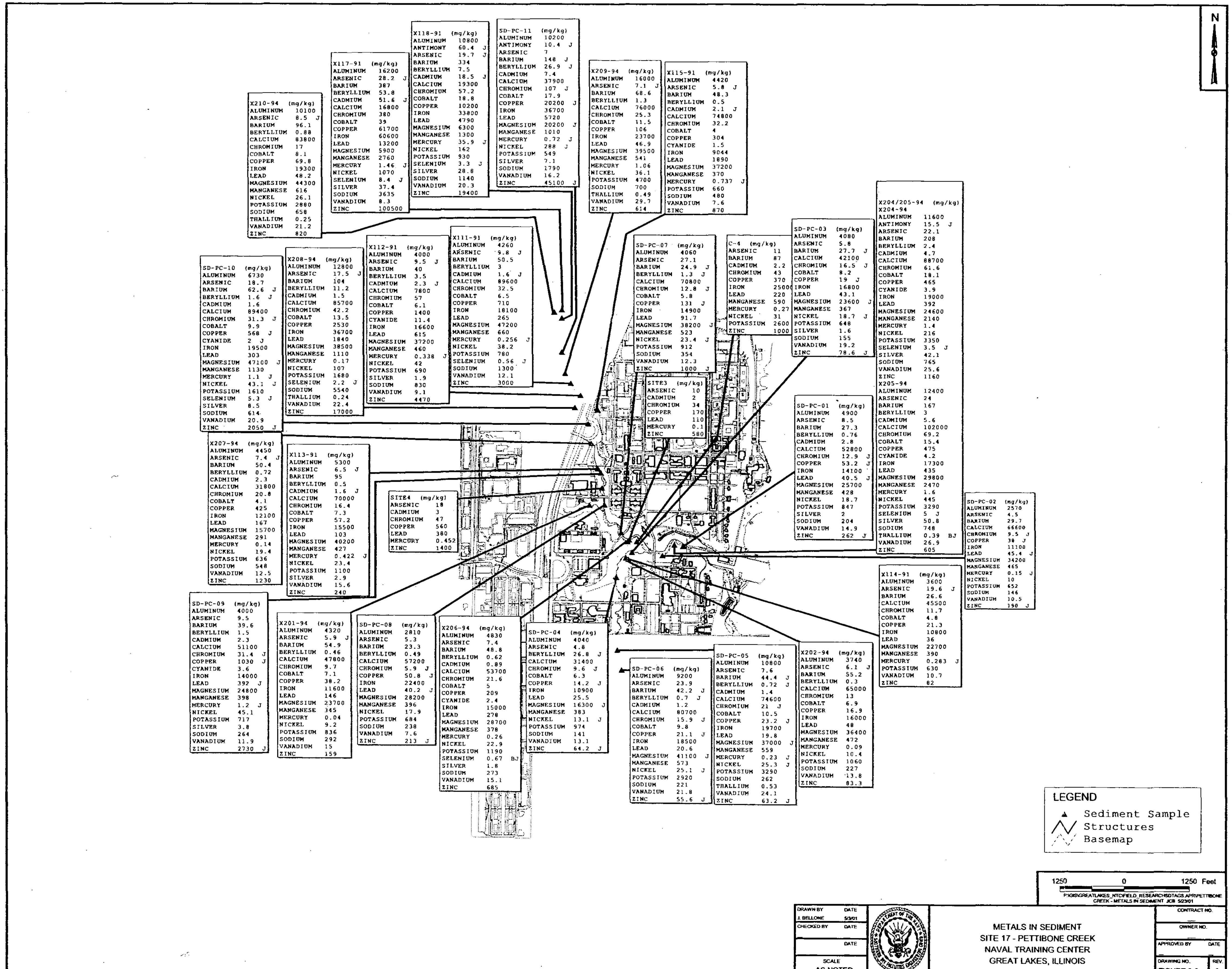
COST/SCHED-AREA
SCALE: AS NOTED

PAHs IN SEDIMENTS
SITE 17 - PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
APPROVED BY — DATE
APPROVED BY — DATE
DRAWING NO. FIGURE 2-7 — REV. 0


N
X210-94 (mg/kg)
ALUMINUM 10100
ARSENIC 8.5 J
BARIUM 96.1
BERYLLIUM 0.88
CALCIUM 83800
CHROMIUM 17
COBALT 8.1
COPPER 69.8
IRON 19300
LEAD 48.2
MAGNESIUM 44300
MANGANESE 616
NICKEL 26.1
POTASSIUM 2880
SODIUM 658
THALLIUM 0.25
VANADIUM 21.2
ZINC 820
X117-91 (mg/kg)
ALUMINUM 16200
ARSENIC 28.2 J
BARIUM 387
BERYLLIUM 53.8
CADMIUM 51.6 J
CALCIUM 16800
CHROMIUM 380
COBALT 39
COPPER 61700
IRON 60600
LEAD 13200
MAGNESIUM 5900
MANGANESE 2760
MERCURY 1.46 J
NICKEL 1070
SELENIUM 8.4 J
SILVER 37.4
SODIUM 3635
VANADIUM 8.3
ZINC 100500
X118-91 (mg/kg)
ALUMINUM 10800
ANTIMONY 60.4 J
ARSENIC 19.7 J
BARIUM 334
BERYLLIUM 7.5
CADMIUM 18.5 J
CALCIUM 19300
CHROMIUM 57.2
COBALT 18.8
COPPER 10200
IRON 33800
LEAD 4790
MAGNESIUM 6300
MANGANESE 1300
MERCURY 35.9 J
NICKEL 162
POTASSIUM 930
SELENIUM 3.3 J
SILVER 28.8
SODIUM 1140
VANADIUM 20.3
ZINC 19400
SD-PC-11 (mg/kg)
ALUMINUM 10200
ANTIMONY 10.4 J
ARSENIC 7
BARIUM 148 J
BERYLLIUM 26.9 J
CADMIUM 7.4
CALCIUM 37900
CHROMIUM 107 J
COBALT 17.9
COPPER 20200 J
IRON 36700
LEAD 5720
MAGNESIUM 20200 J
MANGANESE 1010
MERCURY 0.72 J
NICKEL 288 J
POTASSIUM 549
SILVER 7.1
SODIUM 1790
VANADIUM 16.2
ZINC 45100 J
X209-94 (mg/kg)
ALUMINUM 16000
ARSENIC 7.1 J
BARIUM 68.6
BERYLLIUM 1.3
CALCIUM 76000
CHROMIUM 25.3
COBALT 11.5
COPPER 106
IRON 23700
LEAD 46.9
MAGNESIUM 39500
MANGANESE 541
MERCURY 1.06
NICKEL 36.1
POTASSIUM 4700
SODIUM 700
THALLIUM 0.49
VANADIUM 29.7
ZINC 614
X115-91 (mg/kg)
ALUMINUM 4420
ARSENIC 5.8 J
BARIUM 48.3
BERYLLIUM 0.5
CADMIUM 2.1 J
CALCIUM 74800
CHROMIUM 32.2
COBALT 4
COPPER 304
CYANIDE 1.5
IRON 9044
LEAD 1890
MAGNESIUM 37200
MANGANESE 370
MERCURY 0.737 J
POTASSIUM 660
SODIUM 480
VANADIUM 7.6
ZINC 870
X204/205-94 (mg/kg)
X204-94
ALUMINUM 11600
ANTIMONY 15.5 J
ARSENIC 22.1
BARIUM 208
BERYLLIUM 2.4
CADMIUM 4.7
CALCIUM 88700
CHROMIUM 61.6
COBALT 18.1
COPPER 465
CYANIDE 3.9
IRON 19000
LEAD 392
MAGNESIUM 24600
MANGANESE 2140
MERCURY 1.4
NICKEL 216
POTASSIUM 3350
SELENIUM 3.5 J
SILVER 42.1
SODIUM 765
VANADIUM 25.6
ZINC 1160
X205-94
ALUMINUM 12400
ARSENIC 24
BARIUM 167
BERYLLIUM 3
CADMIUM 5.6
CALCIUM 102000
CHROMIUM 69.2
COBALT 15.4
COPPER 475
CYANIDE 4.2
IRON 17300
LEAD 435
MAGNESIUM 29800
MANGANESE 2470
MERCURY 1.6
NICKEL 445
POTASSIUM 3290
SELENIUM 5 J
SILVER 50.8
SODIUM 748
THALLIUM 0.39 BJ
VANADIUM 26.9
ZINC 605
SD-PC-10 (mg/kg)
ALUMINUM 6730
ARSENIC 18.7
BARIUM 62.6 J
BERYLLIUM 1.6 J
CADMIUM 1.6
CALCIUM 89400
CHROMIUM 31.3 J
COBALT 9.9
COPPER 568 J
CYANIDE 2 J
IRON 19500
LEAD 303
MAGNESIUM 47100 J
MANGANESE 1130
MERCURY 1.1 J
NICKEL 43.1 J
POTASSIUM 1610
SELENIUM 5.3 J
SILVER 8.5
SODIUM 614
VANADIUM 20.9
ZINC 2050 J
X208-94 (mg/kg)
ALUMINUM 12800
ARSENIC 17.5 J
BARIUM 104
BERYLLIUM 11.2
CADMIUM 1.5
CALCIUM 85700
CHROMIUM 42.2
COBALT 13.5
COPPER 2530
IRON 36700
LEAD 1840
MAGNESIUM 38500
MANGANESE 1110
MERCURY 0.17
NICKEL 107
POTASSIUM 1680
SELENIUM 2.2 J
SODIUM 5540
THALLIUM 0.24
VANADIUM 22.4
ZINC 17000
X112-91 (mg/kg)
ALUMINUM 4000
ARSENIC 9.5 J
BARIUM 40
BERYLLIUM 3.5
CADMIUM 2.3 J
CALCIUM 7800
CHROMIUM 57
COBALT 6.1
COPPER 1400
CYANIDE 11.4
IRON 16600
LEAD 615
MAGNESIUM 37200
MANGANESE 460
MERCURY 0.338 J
NICKEL 42
POTASSIUM 690
SILVER 1.9
SODIUM 830
VANADIUM 9.1
ZINC 4470
X111-91 (mg/kg)
ALUMINUM 4260
ARSENIC 9.8 J
BARIUM 50.5
BERYLLIUM 3
CADMIUM 1.6 J
CALCIUM 89600
CHROMIUM 32.5
COBALT 6.5
COPPER 710
IRON 18100
LEAD 265
MAGNESIUM 47200
MANGANESE 660
MERCURY 0.256 J
NICKEL 38.2
POTASSIUM 780
SELENIUM 0.56 J
SODIUM 1300
VANADIUM 12.1
ZINC 3000
SD-PC-07 (mg/kg)
ALUMINUM 4060
ARSENIC 27.1
BARIUM 24.9 J
BERYLLIUM 1.3 J
CALCIUM 70800
CHROMIUM 12.8 J
COBALT 5.8
COPPER 131 J
IRON 14900
LEAD 91.7
MAGNESIUM 38200 J
MANGANESE 523
NICKEL 23.4 J
POTASSIUM 912
SODIUM 354
VANADIUM 12.3
ZINC 1000 J
C-4 (mg/kg)
ARSENIC 11
BARIUM 87
CADMIUM 2.2
CHROMIUM 43
COPPER 370
IRON 2500
LEAD 220
MANGANESE 590
MERCURY 0.27
NICKEL 31
POTASSIUM 2600
ZINC 1000
SD-PC-03 (mg/kg)
ALUMINUM 4080
ARSENIC 5.8
BARIUM 27.7 J
CALCIUM 42100
CHROMIUM 16.5 J
COBALT 8.2
COPPER 19 J
IRON 16800
LEAD 43.1
MAGNESIUM 23600 J
MANGANESE 367
NICKEL 18.7 J
POTASSIUM 648
SILVER 1.6
SODIUM 155
VANADIUM 19.2
ZINC 78.6 J
SITE3 (mg/kg)
ARSENIC 10
CADMIUM 2
CHROMIUM 34
COPPER 170
LEAD 110
MERCURY 0.1
ZINC 580
SD-PC-01 (mg/kg)
ALUMINUM 4900
ARSENIC 8.5
BARIUM 27.3
BERYLLIUM 0.76
CADMIUM 2.8
CALCIUM 52800
CHROMIUM 12.9 J
COPPER 53.2 J
IRON 14100
LEAD 40.5 J
MAGNESIUM 25700
MANGANESE 428
NICKEL 18.7
POTASSIUM 847
SILVER 2
SODIUM 204
VANADIUM 14.9
ZINC 262 J
X207-94 (mg/kg)
ALUMINUM 4450
ARSENIC 7.4 J
BARIUM 50.4
BERYLLIUM 0.72
CADMIUM 2.3
CALCIUM 31800
CHROMIUM 20.8
COBALT 4.1
COPPER 425
IRON 12100
LEAD 167
MAGNESIUM 15700
MANGANESE 291
MERCURY 0.14
NICKEL 19.4
POTASSIUM 636
SODIUM 548
VANADIUM 12.5
ZINC 1230
X113-91 (mg/kg)
ALUMINUM 5300
ARSENIC 6.5 J
BARIUM 95
BERYLLIUM 0.5
CADMIUM 1.6 J
CALCIUM 70000
CHROMIUM 16.4
COBALT 7.3
COPPER 57.2
IRON 15500
LEAD 103
MAGNESIUM 40200
MANGANESE 427
MERCURY 0.422 J
NICKEL 23.4
POTASSIUM 1100
SILVER 2.9
VANADIUM 15.6
ZINC 240
SITE4 (mg/kg)
ARSENIC 18
CADMIUM 3
CHROMIUM 47
COPPER 560
LEAD 380
MERCURY 0.452
ZINC 1400
SD-PC-02 (mg/kg)
ALUMINUM 2570
ARSENIC 4.5
BARIUM 29.7
CALCIUM 66600
CHROMIUM 9.5 J
COPPER 38 J
IRON 11100
LEAD 45.4 J
MAGNESIUM 34200
MANGANESE 465
MERCURY 0.15 J
NICKEL 10
POTASSIUM 652
SODIUM 146
VANADIUM 10.5
ZINC 190 J
X114-91 (mg/kg)
ALUMINUM 3600
ARSENIC 19.6 J
BARIUM 26.6
CALCIUM 45500
CHROMIUM 11.7
COBALT 4.8
COPPER 21.3
IRON 10800
LEAD 36
MAGNESIUM 22700
MANGANESE 390
MERCURY 0.283 J
POTASSIUM 630
VANADIUM 10.7
ZINC 82
SD-PC-09 (mg/kg)
ALUMINUM 4000
ARSENIC 9.5
BARIUM 39.6
BERYLLIUM 1.5
CADMIUM 2.3
CALCIUM 51100
CHROMIUM 31.4 J
COPPER 1030 J
CYANIDE 3.6
IRON 14000
LEAD 392 J
MAGNESIUM 24800
MANGANESE 398
MERCURY 1.2 J
NICKEL 45.1
POTASSIUM 717
SILVER 3.8
SODIUM 264
VANADIUM 11.9
ZINC 2730 J
X201-94 (mg/kg)
ALUMINUM 4320
ARSENIC 5.9 J
BARIUM 54.9
BERYLLIUM 0.46
CALCIUM 47800
CHROMIUM 9.7
COBALT 7.1
COPPER 38.2
IRON 11600
LEAD 146
MAGNESIUM 23700
MANGANESE 345
MERCURY 0.04
NICKEL 9.2
POTASSIUM 836
SODIUM 292
VANADIUM 15
ZINC 159
SD-PC-08 (mg/kg)
ALUMINUM 2810
ARSENIC 5.3
BARIUM 23.3
BERYLLIUM 0.49
CALCIUM 57200
CHROMIUM 5.9 J
COPPER 50.8 J
IRON 22400
LEAD 40.2 J
MAGNESIUM 28200
MANGANESE 396
NICKEL 17.9
POTASSIUM 684
SODIUM 238
VANADIUM 7.6
ZINC 213 J
X206-94 (mg/kg)
ALUMINUM 4830
ARSENIC 7.4
BARIUM 48.8
BERYLLIUM 0.62
CADMIUM 0.89
CALCIUM 53700
CHROMIUM 21.6
COBALT 5
COPPER 209
CYANIDE 2.4
IRON 15000
LEAD 278
MAGNESIUM 28700
MANGANESE 378
MERCURY 0.26
NICKEL 22.9
POTASSIUM 1190
SELENIUM 0.67 BJ
SILVER 1.8
SODIUM 273
VANADIUM 15.1
ZINC 685
SD-PC-04 (mg/kg)
ALUMINUM 4040
ARSENIC 4.8
BERYLLIUM 26.8 J
CALCIUM 31400
CHROMIUM 9.6 J
COBALT 6.3
COPPER 14.2 J
IRON 10900
LEAD 25.5
MAGNESIUM 16300 J
MANGANESE 383
NICKEL 13.1 J
POTASSIUM 974
SODIUM 141
VANADIUM 13.1
ZINC 64.2 J
SD-PC-06 (mg/kg)
ALUMINUM 9200
ARSENIC 23.9
BARIUM 42.2 J
BERYLLIUM 0.7 J
CADMIUM 1.2
CALCIUM 80700
CHROMIUM 15.9 J
COBALT 9.8
COPPER 21.1 J
IRON 18500
LEAD 20.6
MAGNESIUM 41100 J
MANGANESE 573
NICKEL 25.1 J
POTASSIUM 2920
SODIUM 221
VANADIUM 21.8
ZINC 55.6 J
SD-PC-05 (mg/kg)
ALUMINUM 10800
ARSENIC 7.6
BARIUM 44.4 J
BERYLLIUM 0.72 J
CADMIUM 1.4
CALCIUM 74600
CHROMIUM 21 J
COBALT 10.5
COPPER 23.2 J
IRON 19700
LEAD 19.8
MAGNESIUM 37000 J
MANGANESE 559
MERCURY 0.23 J
NICKEL 25.3 J
POTASSIUM 3290
SODIUM 262
THALLIUM 0.53
VANADIUM 24.1
ZINC 63.2 J
X202-94 (mg/kg)
ALUMINUM 3740
ARSENIC 6.1 J
BARIUM 55.2
BERYLLIUM 0.3
CALCIUM 65000
CHROMIUM 13
COBALT 6.9
COPPER 16.9
IRON 16000
LEAD 48
MAGNESIUM 36400
MANGANESE 472
MERCURY 0.09
NICKEL 10.4
POTASSIUM 1060
SODIUM 227
VANADIUM 13.8
ZINC 83.3
LEGEND
Sediment Sample
Structures
Basemap
1250 0 1250 Feet
DRAWN BY J. BELLONE DATE 5/3/01
CHECKED BY DATE
DATE
SCALE AS NOTED
METALS IN SEDIMENT
SITE 17 - PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
CONTRACT NO.
OWNER NO.
APPROVED BY DATE
DRAWING NO. FIGURE 2-8
REV. 0

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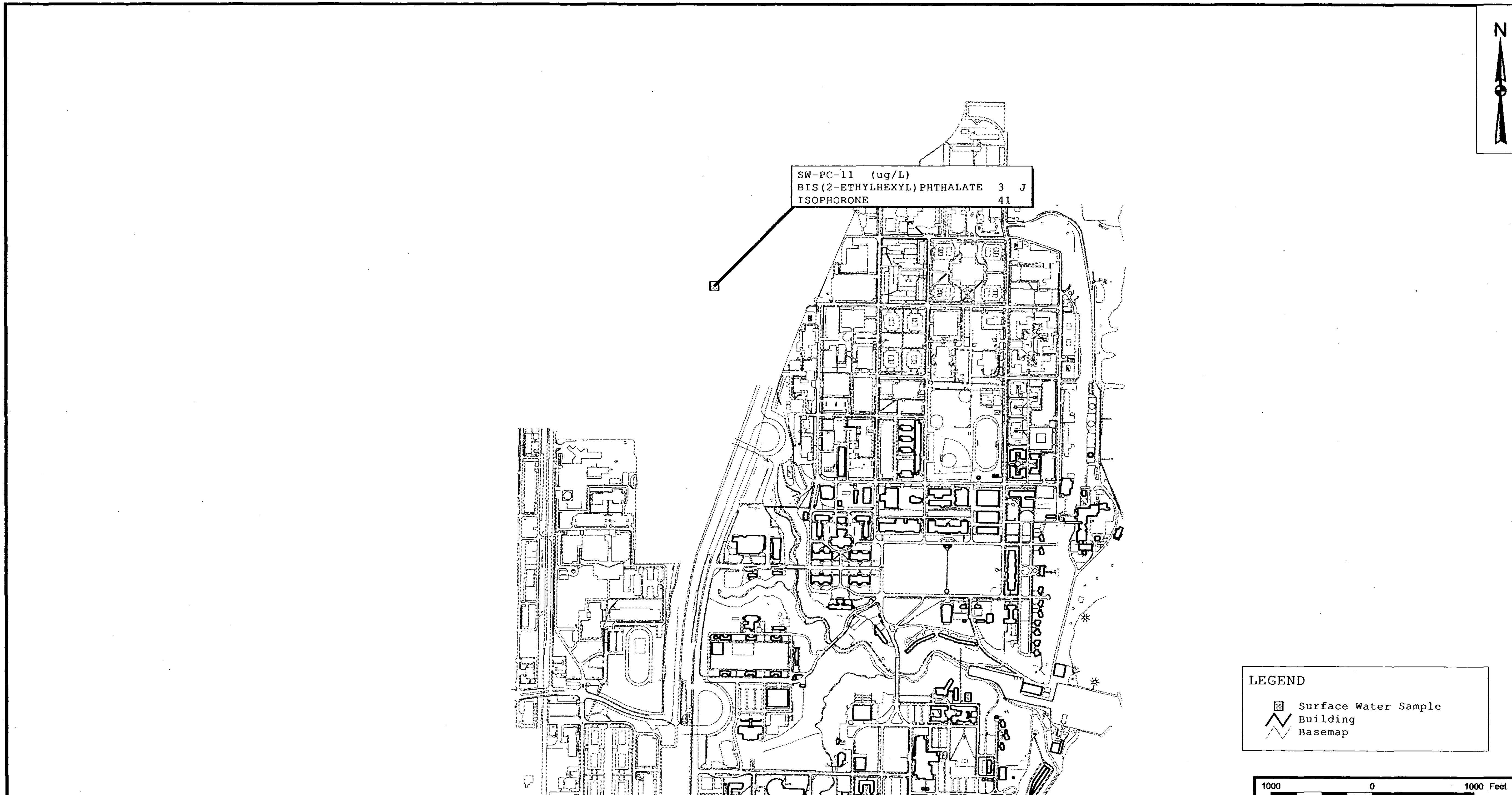

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

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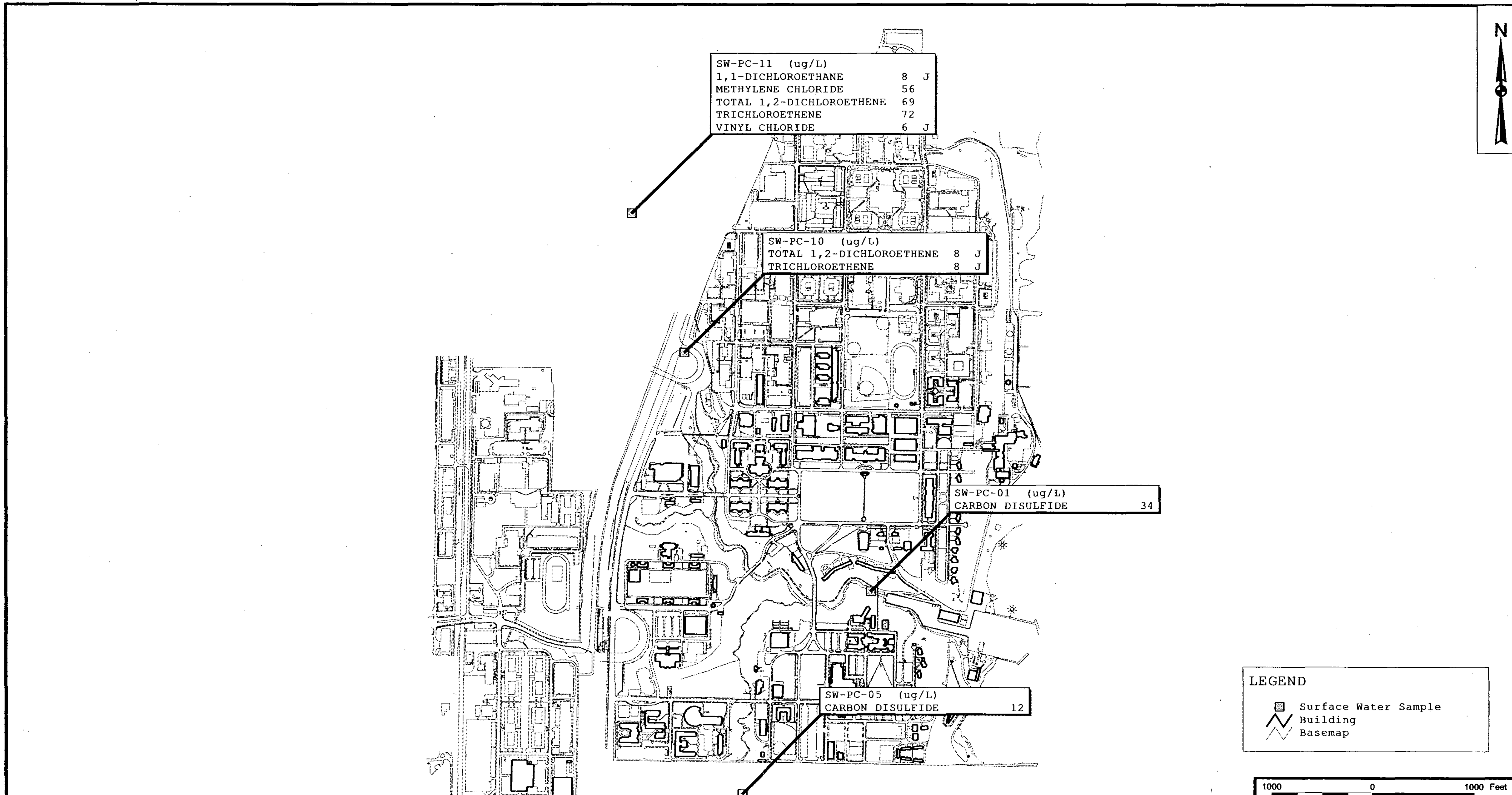
SCALE AS NOTED

SEMIVOLATILE ORGANICS IN SURFACE WATER
SITE 17 - PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2-9 REV. 0

P:\GIS\GREATLAKES_NTC\FIELD_RESEARCH_SWTAGS.APR\PETIBONE CREEK - VOLITILE ORGANICS IN SURFACE WATER JCB 5/23/01



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CHECKED BY DATE
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SCALE AS NOTED

VOLATILE ORGANICS IN SURFACE WATER
SITE 17 - PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
APPROVED BY DATE
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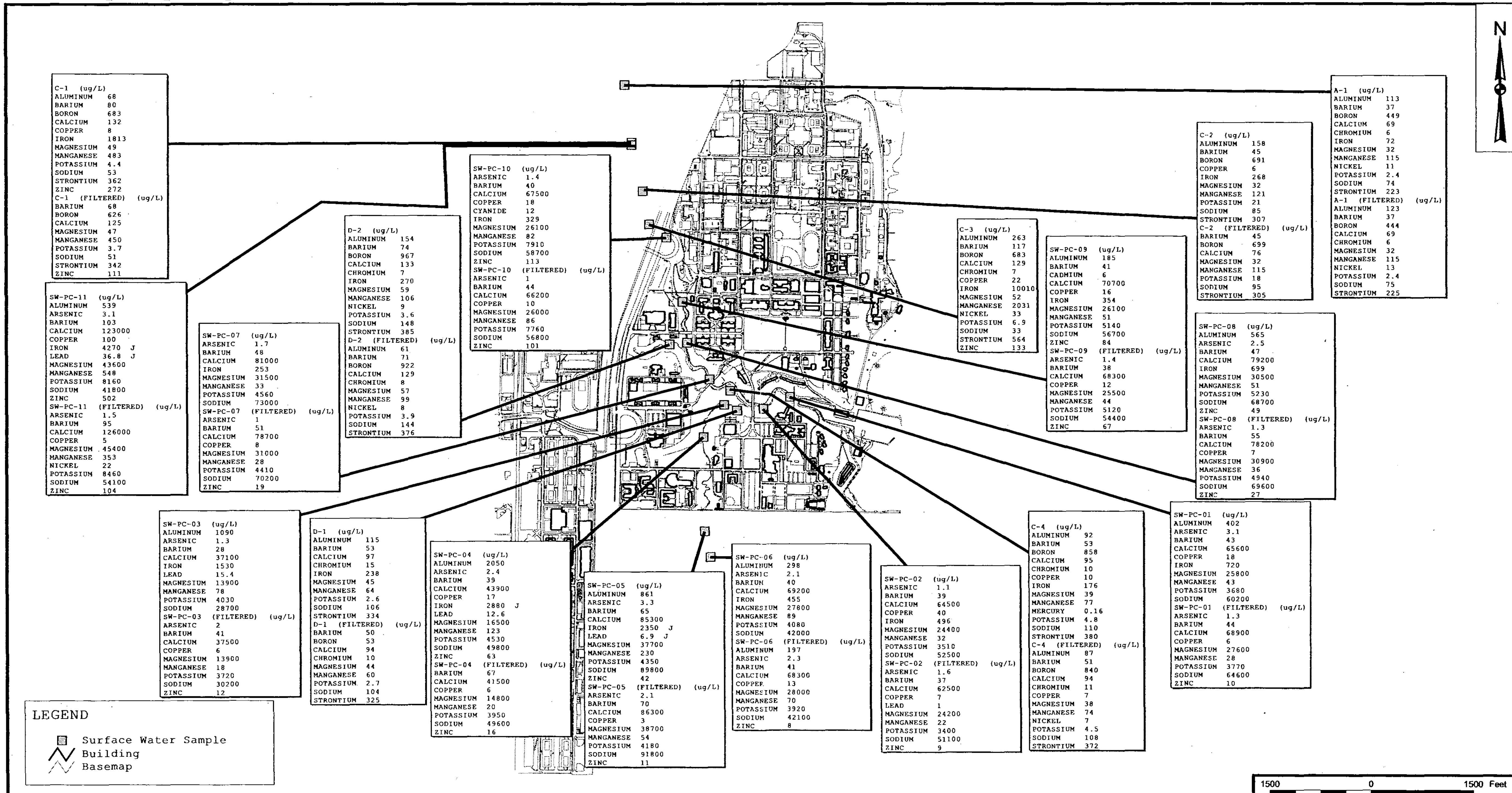
P:\GIS\GREATLAKES_NTC\FIELD_RESEARCH_SWTAGS.APR\PETIBONE CREEK - METALS IN SURFACE WATER JCB 5/23/01



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

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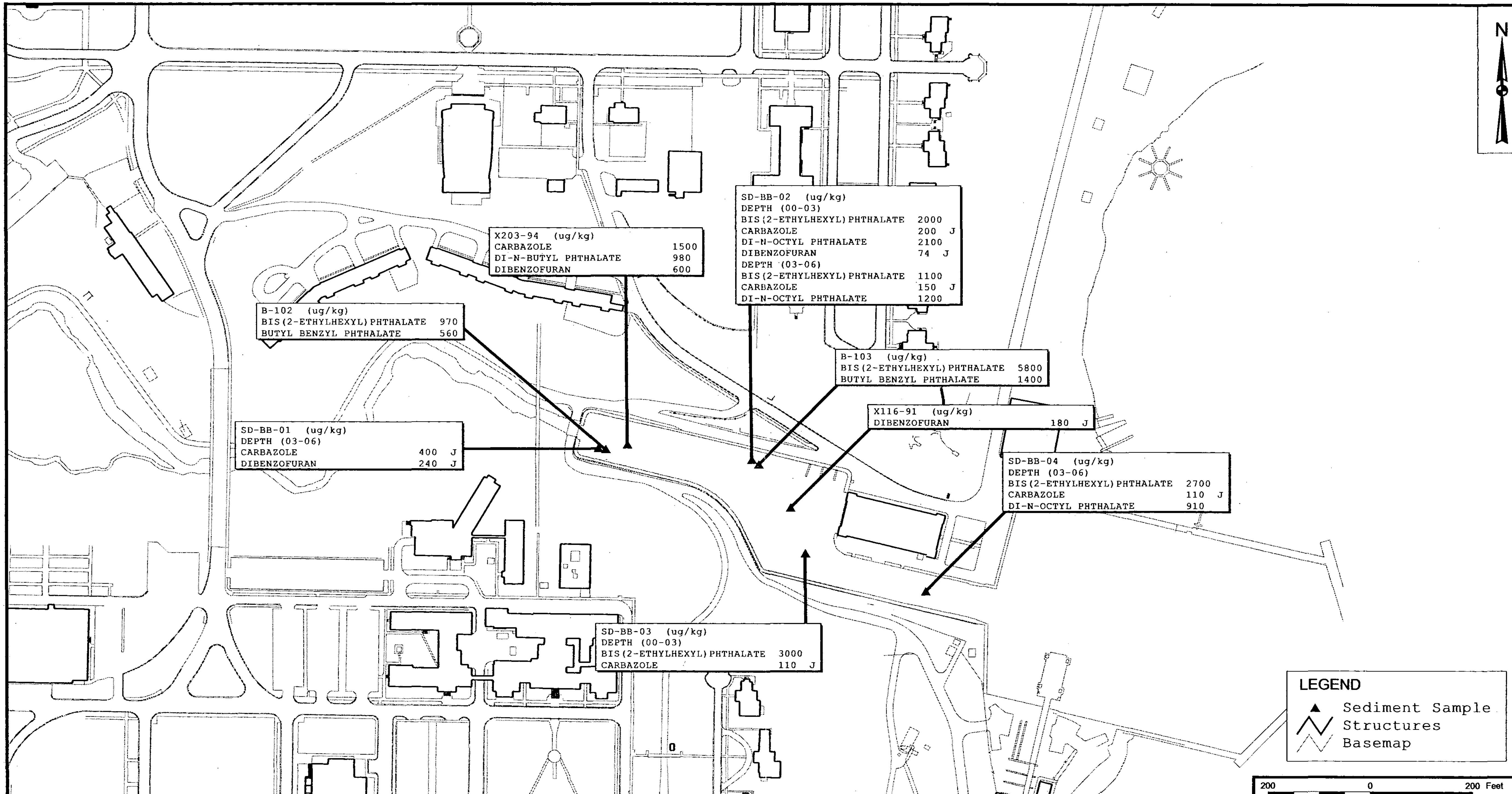
SCALE AS NOTED

METALS IN SURFACE WATER
SITE 17 - PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2-11 REV. 0

P:\GIS\GREATLAKES_NTC\FIELD_RESEARCH_SDTAGS.APR\BOAT BASIN - SEMIVOLATILE ORGANICS IN SEDIMENT JCB 5/23/01



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: J. BELLONE — DATE: 5/1/01
CHECKED BY — DATE
COST/SCHED-AREA
SCALE: AS NOTED

SEMIVOLATILE ORGANICS IN SEDIMENTS
SITE 17 - BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
APPROVED BY — DATE
APPROVED BY — DATE
DRAWING NO.: FIGURE 2-12 — REV.: 0

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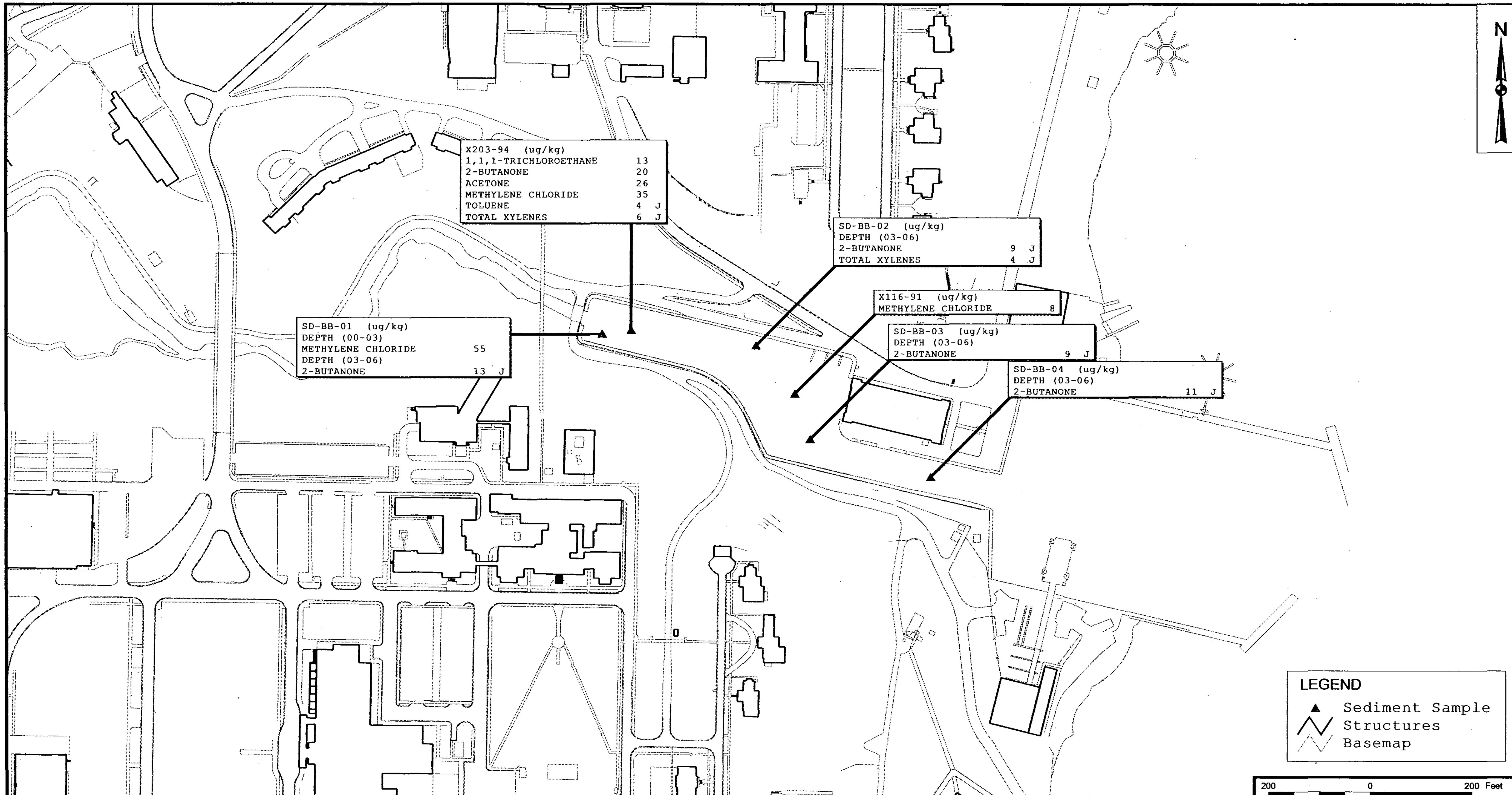

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: J. BELLONE — DATE: 5/1/01
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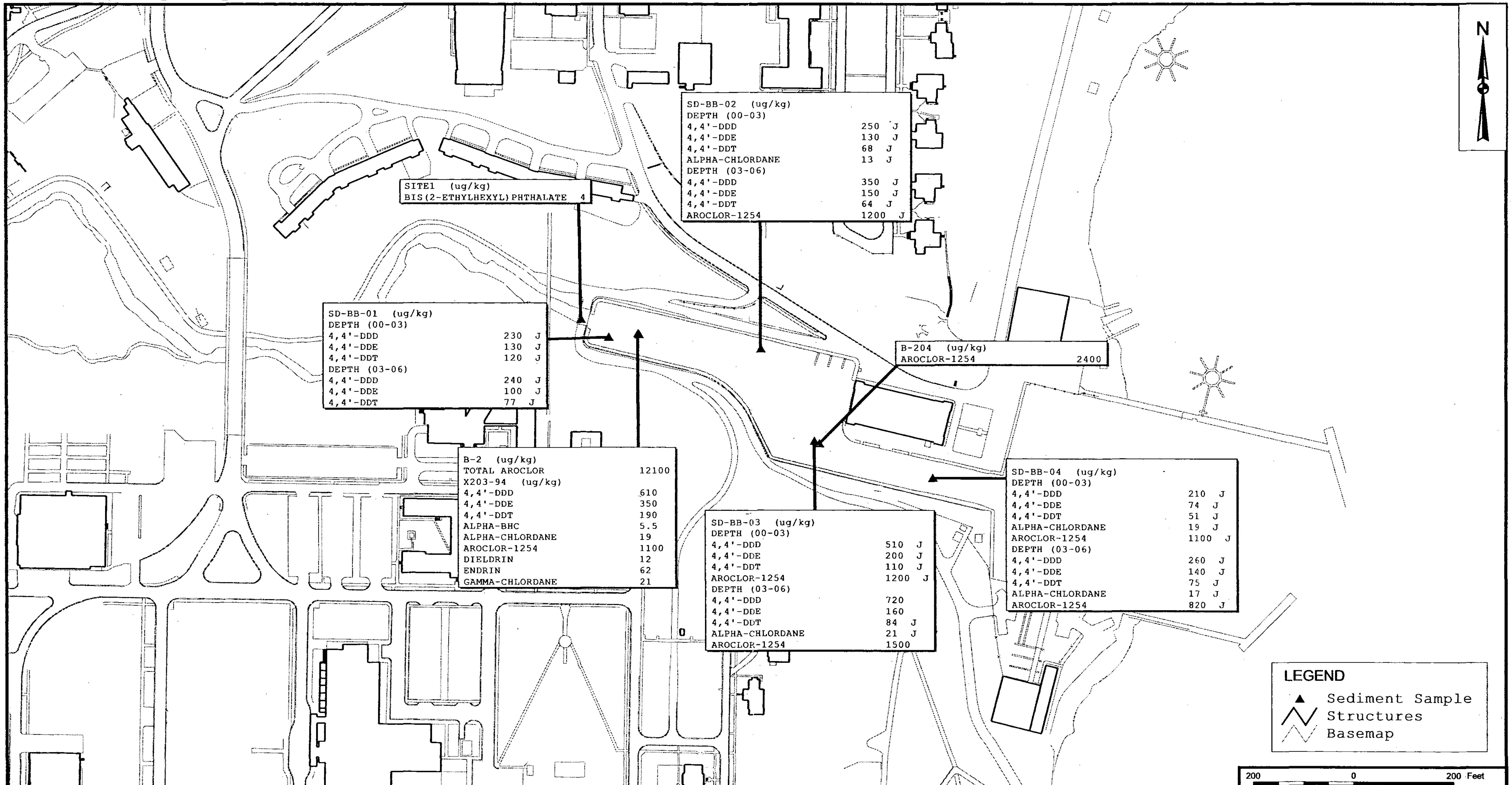
SCALE: AS NOTED

VOLATILE ORGANICS IN SEDIMENTS
SITE 17 - BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
APPROVED BY — DATE
APPROVED BY — DATE
DRAWING NO. FIGURE 2-13 — REV. 0

P:\GIS\GREATLAKES_NTC\FIELD_RESEARCH_SDTAGS.APR\BOAT BASIN - PESTICIDES IN SEDIMENT JCB 5/23/01



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY J. BELLONE DATE 5/1/01
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

PESTICIDES IN SEDIMENTS
SITE 17 - BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
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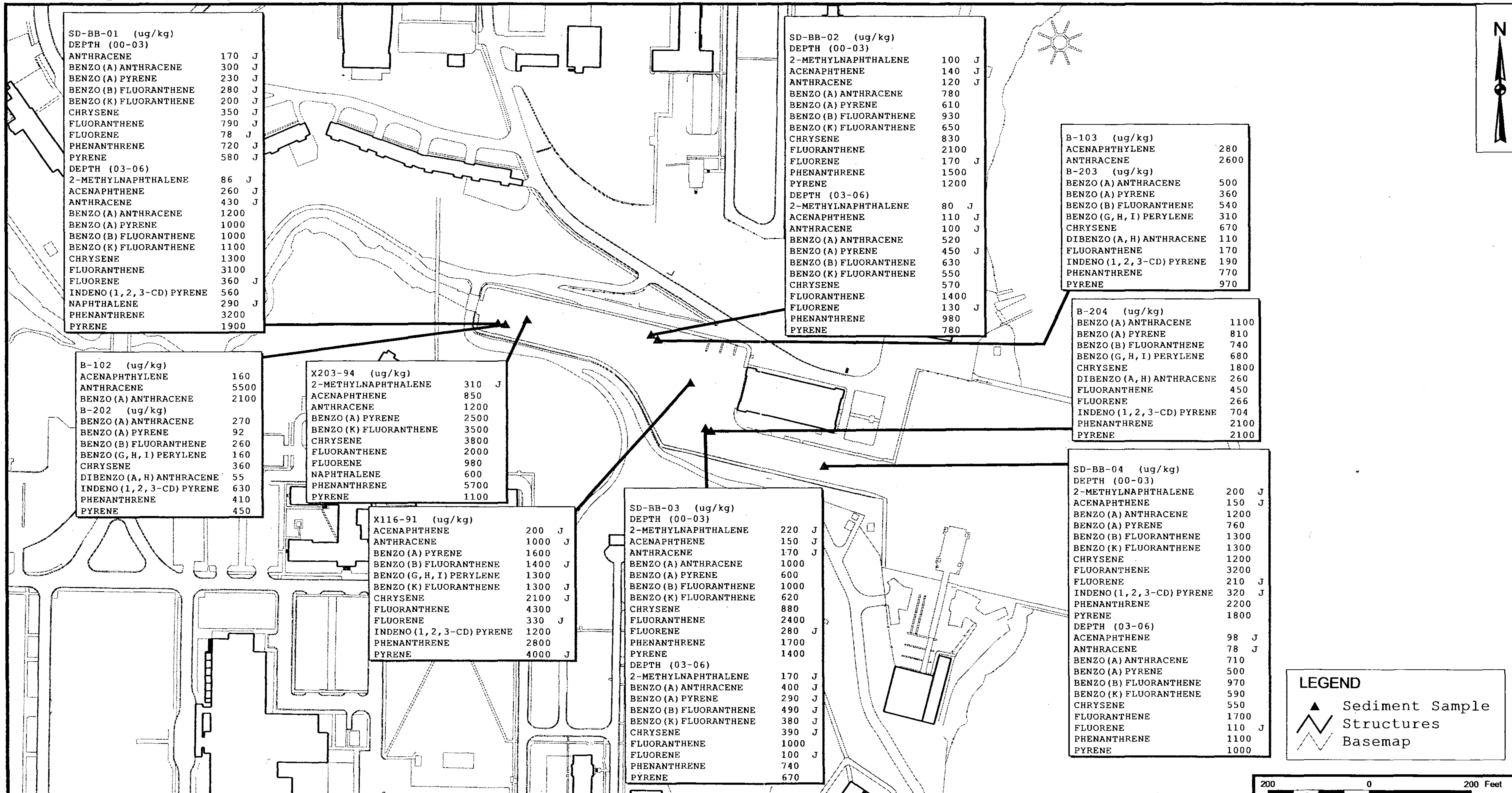
DRAWING NO. FIGURE 2-14 REV. 0

P:\GIS\GREATLAKES_NTC\FIELD_RESEARCH_SDTAGS.APR\BOAT BASIN - PAHS ORGANICS IN SEDIMENT JCB 5/1/01



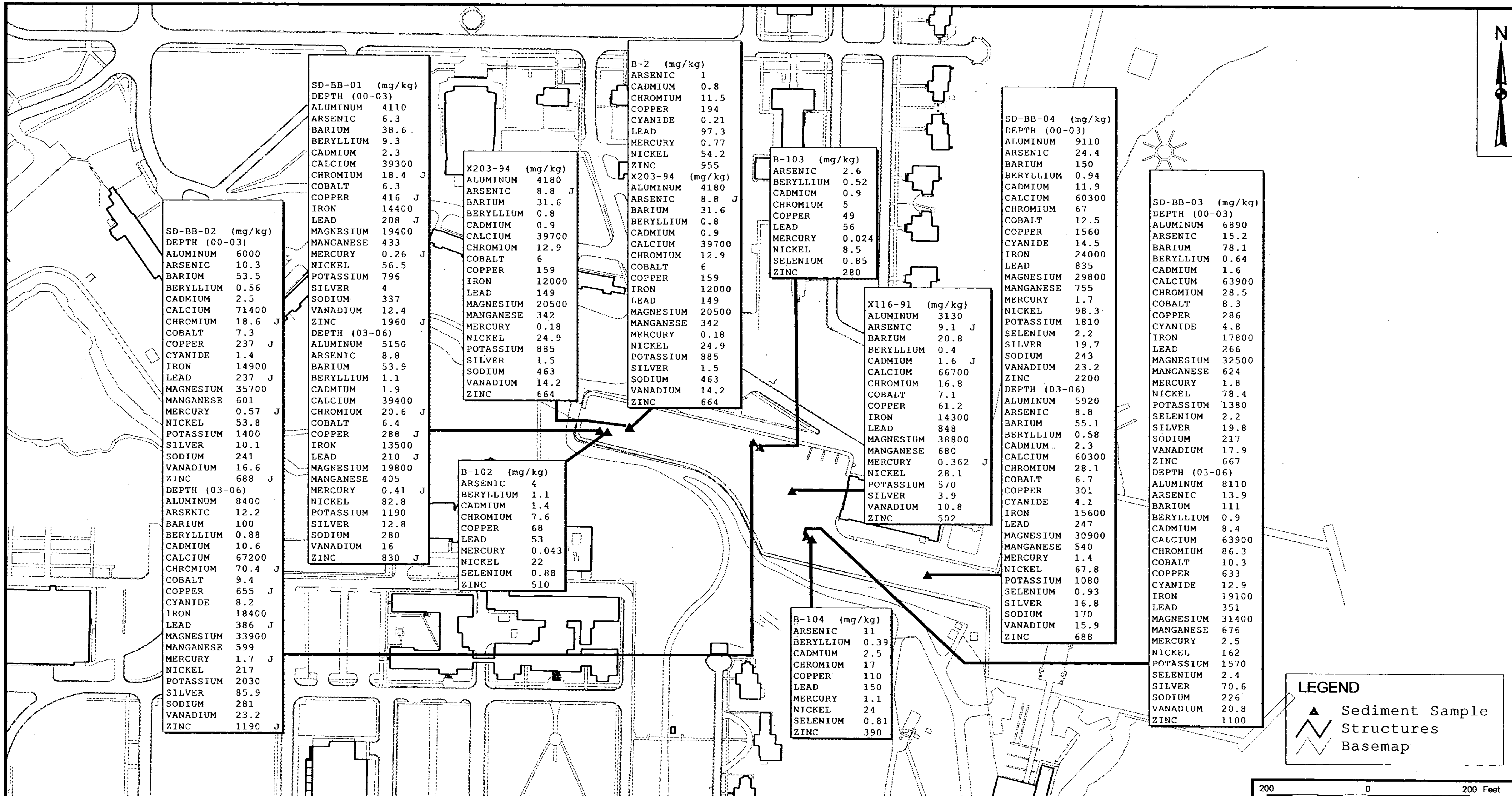
NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY J. BELLONE DATE 5/1/01
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

PAHs IN SEDIMENTS
SITE 17 - BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2-15 REV. 0

P:\GIS\GREATLAKES_NTC\FIELD_RESEARCH_SDTAGS.APR\BOAT BASIN - METALS IN SEDIMENT JCB 5/1/01



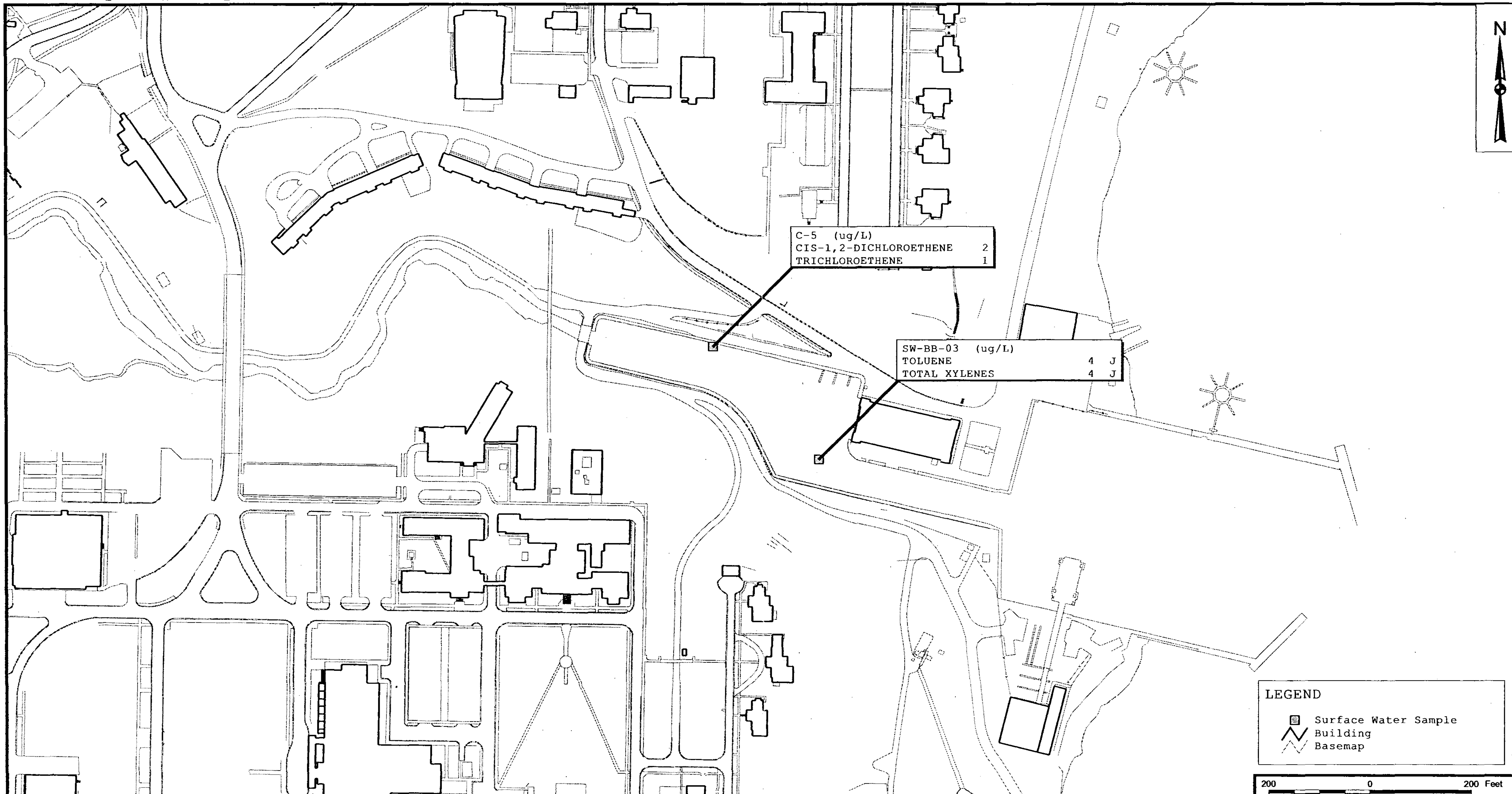
NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY J. BELLONE DATE 5/1/01
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

METALS IN SEDIMENTS
SITE 17 - BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2-16
REV. 0

P:\GIS\GREATLAKES_NTC\FIELD_RESEARCH_SWTAGS.APR\BOAT BASIN - VOLATILE ORGANICS IN SURFACE WATER JCB 5/23/01



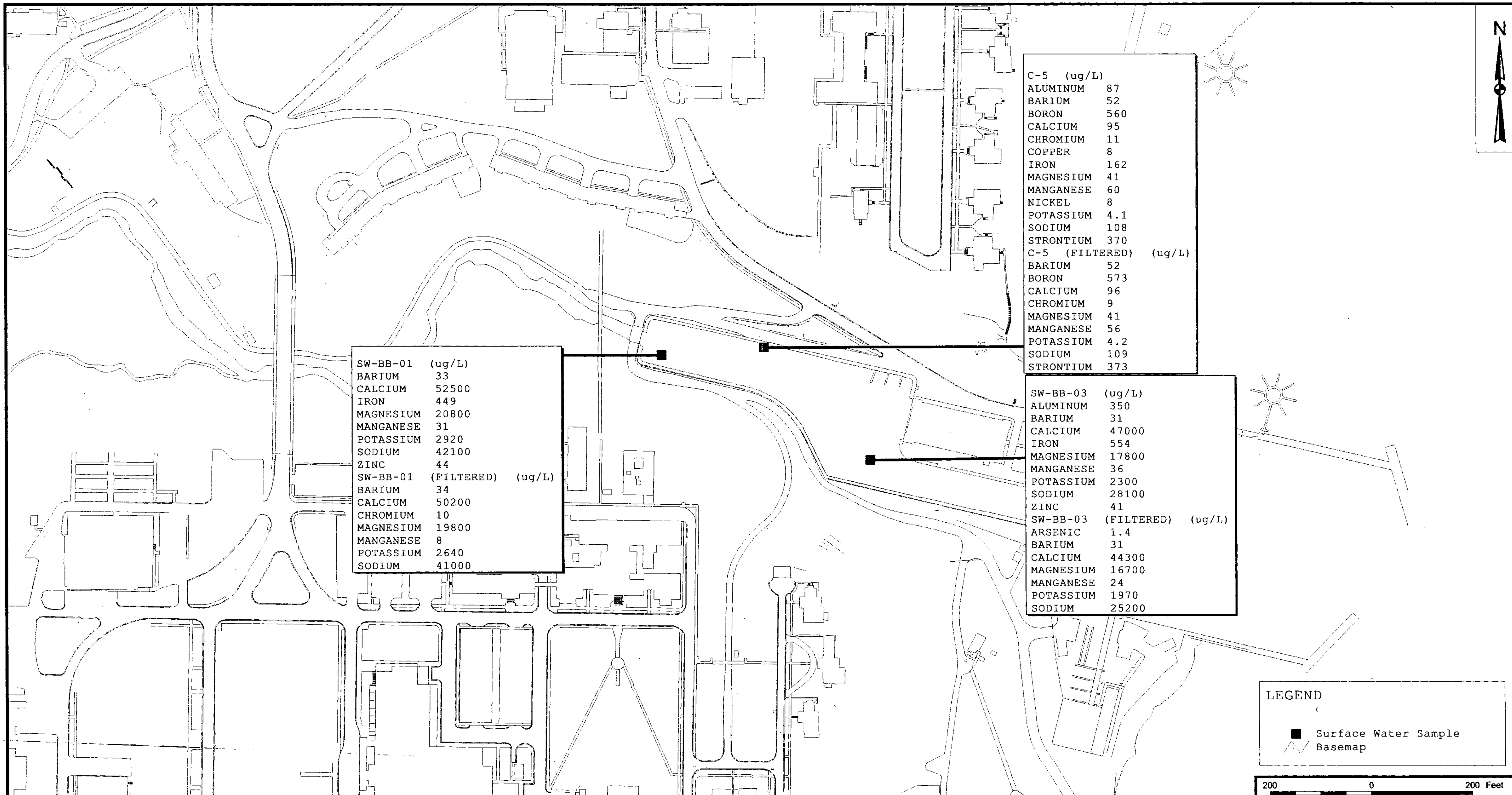
NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY J. BELLONE DATE 5/3/01
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

VOLATILE ORGANICS IN SURFACE WATER
SITE 17 - BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2-17 REV. 0

P:\GIS\GREATLAKES_NTC\FIELD_RESEARCH_SWTAGS.APR\BOAT BASIN - METALS IN SURFACE WATER JCB 5/3/01



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY J. BELLONE — DATE 5/3/01
CHECKED BY — DATE
COST/SCHED-AREA
SCALE AS NOTED

METALS IN SURFACE WATER
SITE 17 - BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO.
APPROVED BY — DATE
APPROVED BY — DATE
DRAWING NO. FIGURE 2-18 — REV. 0

3.0 SITE INVESTIGATION ACTIVITIES

The field investigation for Site 17 – Pettibone Creek and Boat Basin was performed from September 5 to 25, 2001. The activities consisted of surface water sampling and sediment sampling. These field activities included the collection of data to meet the following objectives:

- Characterize the environmental contamination and determine whether or not there is a risk to human health and environment.

- To provide adequate data with which to identify and evaluate potential remedial alternatives for the site.

A summary of the field investigation sampling rationale is presented in Table 3-1. The following sections discuss deviations from the work plan (QAPP), the field activities conducted, and the site geologic characteristics at Site 17. A summary of the 2001 Remedial Investigation surface water and sediment sampling activities is provided in Table 3-2. The sampling locations for Site 17 are shown in Figure 3-1.

3.1 DEVIATIONS FROM THE QAPP

Four deviations from the project QAPP (TtNUS, July 2001) were made during the field investigation at Site 17:

- Surface water samples were collected next to sediment locations instead of being isolated samples.
- A sample was collected at 1-foot from NTC17PCSD01 instead of NTC17PCSD02.
- Sediment samples were collected in jars instead of Encore samplers.
- The preparation/extraction method used for the sediment samples was SW-846 Method 5030 (Direct-injection with analysis within 14 days) instead of Method 5035 (Encore samplers).

Refer to Appendix A.1 for task modification forms that explain in detail the deviations listed in the first two bullets above.

The sediment sampling and analysis methodology was discussed with Illinois EPA during preparation of the QAPP (TtNUS, July 2001) for this project, and it was agreed that collection of sediments using Encore samplers would not be possible and that these samples would be collected in jars. However, this sampling methodology was not stated in the QAPP (Table B-10) and was not noticed in the review by

TtNUS, Illinois EPA, and the Navy. The sediment samples were collected based on the agreed methodology (in jars). The preparation/extraction method used for the sediment samples from the Boat Basin and Pettibone Creek used Method 5030, which involves direct injection with analysis within 14 days.

3.2 FIELD INVESTIGATION

The following sections discuss the activities during the field investigation at Site 17. The specific field activities conducted during the field investigation included surface water and sediment sampling. The activities were conducted to meet requirements of the QAPP for the Remedial Investigation and Risk Assessment at NTC Great Lakes, Illinois. A TtNUS geologist supervised the sampling activities and prepared the field documentation. A licensed TtNUS Professional Geologist reviewed the sediment logs and field documentation. The field activities followed TtNUS Standard Operating Procedures (SOPs) provided in the QAPP (TtNUS, July 2001).

3.2.1 Surface Water Sampling

Surface water sampling was performed at Site 17 from September 5 to 7 and 23 to 24, 2001. The purpose was to define nature and extent of surface water contamination. Surface water samples were collected from six sample locations and analyzed for the following parameters: TCL VOCs (USEPA Method 5030/8260B), TCL SVOCs (USEPA Method 8270), TCL Pesticides (USEPA Method 8081A), TCL PCBs (USEPA Method 8082), TAL metals (USEPA Method 6010B/7471A), and filtered TAL metals (USEPA Method 6010B/7471A). Table 3-2 provides a summary of the surface water samples collected and Figure 3-2 shows the surface water sample locations.

The surface water samples were collected using techniques in accordance with the QAPP (TtNUS, July 2001). Sampling started downstream and proceeded to the farthest upstream location. Before collecting each water sample, water quality parameters were collected using an Horiba U-22. The following parameters were recorded and documented on the surface water sample log sheets:

- pH
- Specific Conductivity (mS/cm)
- Temperature (^{o}C)
- Turbidity (NTUs)
- Dissolved Oxygen (mg/l)
- Salinity (%)
- Oxidation-Reduction Potential (mV)

Samples for VOC analysis were collected first, by filling the bottles directly from the stream. Bottles for SVOC, Pest, PCBs, and TAL (total) Metals were collected next. Finally, samples for filtered (dissolved) metals were collected by filling a transfer bottle. Then an in-line 0.45-micron, disposable particulate filter was used to filter the sample from the transfer bottle into a bottle treated with preservatives for metals analysis. The information collected during sampling was recorded on sample log sheets. Surface water sample log sheets can be found in Appendix A.2.

The surface water sample botles were placed on ice in coolers immediately after collection and shipped to STL Laboratory in Pittsburgh, Pennsylvania for chemical analysis (see Section 3.2.3 for additional information on sample handling, packaging, and shipping procedures).

3.2.2 <u>Sediment Sampling</u>

Sediment samples for Site 17 were collected from 50 locations along Pettibone Creek and within the Boat Basin (Figure 3-1). The following sections describe the sampling events for Pettibone Creek and the Boat Basin separately.

3.2.2.1 Pettibone Creek Sediment Sampling

Sediment samples were collected from 38 locations (NTC17PCSD01 through NTC17PCSD38) along the North and South Branches of Pettibone Creek from a depth range of 0 to 4 cm. At fourteen locations, a 1-foot depth sample was collected. Figures 3-3 and 3-4 show the locations of the samples collected. The samples were collected using disposable trowels and analyzed for TCL PAHs (USEPA Method 8310), TCL Pesticides (USEPA Method 8081A), TCL PCBs (USEPA Method 8082), TAL metals (USEPA Method 6010B/7471A), pH (USEPA Method 9045C), and TOC (USEPA Method Walkley Black). Ten samples were analyzed for TCL VOCs plus ethyl alcohol and ethyl acetate (USEPA Method 5030/8260B), and TCL SVOCs (USEPA Method 8270C and 8310). Nine samples were analyzed for AVS/SEM (EPA Draft Method), and six samples were analyzed for grain size (American Society for Testing and Materials [ASTM] D422).

Upon retrieval, each sediment sample was screened for the presence of volatile organics with a Photoionization detector (PID), then visually classified for lithology, soil moisture, and other pertinent observations. Copies of the soil sample log sheets are provided in Appendix A.3. A summary of the sediment samples collected is presented on Table 3-2.

Immediately after collection the sediment samples were placed in sample jars, then placed on ice in coolers and shipped to STL Laboratory in Pittsburgh, Pennsylvania for chemical analysis (see Section 3.2.3 for additional information on sample handling, packaging, and shipping procedures).

3.2.2.2 Boat Basin Sediment Sampling

Sediment samples were collected from 12 locations (NTC17BBSD45 through NTC17BBSD56) in the Boat Basin. Figure 3-5 shows the locations of the sediment sample locations. At each location four samples were collected from four depth intervals: 0 to 4 cm, 4 cm to 3 feet, 3 to 6 feet, and 6 to 10 feet. An Eijkelkamp Piston Sampler was used to collect the sediment samples in the Boat Basin. The Eijkelkamp Piston Sampler is a hand-operated device that obtains relatively undisturbed samples of soft sediment. The piston sampler used was 1.5 inch inside diameter (ID) and 3 feet long. The samples were collected in stainless steel tubes and extruded into trays or stainless steel bowls after retrieval.

Offshore work was performed from a johnboat platform. Two johnboats were strapped together and plywood was used to create a work platform. Sampling was performed through a hole in the plywood. Flush-threaded casing (3.5 inch ID) was set through the water to the top of the sediment. Samples were obtained with the piston sampler by pushing the stainless steel tube into the sediment and allowed the piston to retract as the tube filled with sediment. After sampling a specified depth interval, the casing was advanced to the top of the next sampling interval. The inside of the casing was cleaned out after each sample was collected using a hand auger in conjunction with an Eijkelkamp bailing system.

Sediment borings on land were obtained in the same manner as described above except that the johnboats were not used.

The samples collected were analyzed for TCL PAHs (USEPA Method 8310), TCL Pesticides (USEPA Method 8081A), TCL PCBs (USEPA Method 8082), TAL metals (USEPA Method 6010B/7471A), TOC (USEPA Method Walkley Black) and ph (USEPA Method 9045C). One sample was analyzed for TCL VOCs plus ethyl alcohol and ethyl acetate (USEPA Method 5030/8260B) and TCL SVOCs (USEPA Method 8270C and 8310). Two samples were analyzed for AVS/SEM (EPA Draft Method), and one sample was analyzed for grain size (ASTM D422).

Upon retrieval, the entire sediment sample was screened for the presence of volatile organics with a PID, and visually classified for lithology, soil moisture, and other pertinent observations. Copies of the sediment sample log sheets and boring logs are provided in Appendices A.3 and A.4, respectively. A summary of the sediment samples collected is presented on Table 3-2.

Immediately after collection the sediment samples were placed in sample jars, then placed on ice in coolers and shipped to STL Laboratory in Pittsburgh, Pennsylvania for chemical analysis (see Section 3.2.3 for additional information on sample handling, packaging, and shipping procedures).

3.2.3 <u>Sample Handling, Packaging, and Shipping</u>

The procedures for storing and transferring collected samples, and responsibilities of TtNUS field members are discussed below.

3.2.3.1 Sampling Handling

The following subsections describe the precautions that were taken to make certain sample integrity was maintained throughout the sample collection and shipping processes. Each sample was divided among several containers. Each container of a particular sample was specific to the analysis of one or more analyte groups (fractions). Sample collection followed a logical sequence to make sure that the more volatile components of samples were not lost during sample handling. For example, samples for VOCs were collected first and containerized immediately after collection to prevent losses from volatilization. Samples for VOC analyses were handled to minimize agitation or disturbance, again to prevent loss of VOCs. Aqueous VOC sample collection procedures were employed that made sure that the samples did not have air bubbles in them after containerization to minimize loss. In general, sample fractions were containerized in the following sequence:

- VOCs
- SVOCs
- Other organic analyses
- Non-volatile inorganic analyses

Sample nomenclature was governed by the QAPP (TtNUS, July 2001). Samples were shipped in coolers to STL Laboratory. Samples were associated into sample delivery groups (SDGs) of up to 20 samples per SDG. The samples were shipped via air courier (Federal Express). An SDG is compiled in the chronological sequence in which the samples were received at the laboratory over a period of up to 14 days. Additional details concerning various aspects of sample handling are addressed below.

3.2.3.2 Sample Preservation

Preservation requirements for sediment and surface water samples for each of the analytes of interest are provided in Table B-10 of the project QAPP (TtNUS, July 2001) except for the deviations previously mentioned in Section 3.1. The sediment samples were cooled to 4 ± 2°C and held in insulated coolers from the time of collection; no chemical preservatives were necessary. Sample bottles for aqueous samples contained the proper amounts and types of preservatives prior to being shipped to NTC Great Lakes. The preservatives placed in the sample bottles were certified free of analytes being tested in the samples. The samples were also promptly chilled with ice to 4 ± 2°C and packaged in insulated coolers. Each cooler included a temperature blank. The samples and the ice were sealed in heavy duty plastic bags to prevent water leakage. Samples were not shipped frozen.

3.2.3.3 Sample Labeling

Sample labels were printed in advance of the field effort. Before samples were packaged, the sample labels were checked to make sure that the information on the label was complete and correct. This information was also checked against the information on the sample collection log sheet and the chain-of-custody form.

3.2.3.4 Sample Packaging

Each sample container was placed in a zip-lock bag to prevent cross-contamination or leakage. The zip-lock bag was then placed in a bubble-wrap sleeve to protect it from breakage and cross-contamination. Only shipping containers that met minimum packaging requirements of 49 CFR 174 for safe shipment were used. Cubed ice was placed around and between the samples in sufficient quantity to chill the samples to 4 ± 2 °C during transport to the analytical laboratory.

The completed field Chain-of-Custody (COC) document was signed, placed in a sealed plastic envelope, and taped to the top inside cover of the shipping container. Appendix A.5 has copies of the completed COC documents. The Field Operations Leader (FOL) was responsible for completing the following forms:

- Sample Labels
- COC Forms
- Custody Seals for Coolers
- Shipping Labels for Coolers
- Express Mail Air Bills

3.2.3.5 Sample Shipping

Shipping containers (i.e., coolers) were sealed with nylon strapping tape in two places, and custody seals were signed, dated, and affixed in a manner that would allow the receiver to identify tampering that may have occurred during transport to the laboratory.

Shipments were made by Federal Express following completion of sample collection. Copies of the Express Mail air bills were retained by the FOL for tracking purposes, if needed, and for communications with the laboratory.

3.2.4 Surveying

The surface water and sediment locations at Site 17 were surveyed for horizontal and vertical control by McClure Engineering of Waukegan, Illinois (Illinois licensed), in accordance with the QAPP (TtNUS, July 2001). Surface water and sediment locations were surveyed horizontally to the nearest 0.01 foot and referenced to the Illinois State Plane Coordinate System (IL SPCS). Surface water elevations and ground surface elevations (for the sediment) were surveyed to within 0.01 foot vertical accuracy referenced to the 1988 North American Vertical Datum (NAVD88). The northing and easting coordinates are tied into the Illinois State Plane Coordinate System, North American Datum 1988 (NAD88).

Measurements were obtained from staked locations along Pettibone Creek where the samples were collected. In the instances where surface water and sediment samples were collected at the same location only the coordinates and ground surface elevation the sediment location was used to identify both samples. For samples collected in the Boat Basin, a detailed map of each location was provided to the surveyor to properly obtain the necessary survey data.

3.2.5 Investigation-Derived Waste (IDW)

During the investigation rinse water from decontamination of the Eijkelkamp Piston Sampler was generated and placed in a drum and disposed with rinse and purge water from Site 7 work. Other IDW such as trowels, paper towels, etc. were double bagged and placed in NTC Great Lakes trash receptacles (dumpsters). There was no generation of sediment IDW. Following the investigation, a composite water sample was collected and submitted for laboratory analysis to characterize the waste stream for disposal. The sample was analyzed for TCLP parameters. The sample log sheets for the IDW can be found in Appendix A.6. Completed Waste Profiles were signed and are provided in the Site 7 RI. The IDW was handled in accordance with the project QAPP (TtNUS, July 2001).

3.3 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) SAMPLES

TtNUS established a quality control (QC) program to monitor and assess the quality of field work and laboratory work performed during the environmental investigation. The program included various types of QC samples as described below. The field QC samples consisted of temperature blanks, field duplicates, trip blanks, and equipment rinsate blanks. Temperature blanks were included in each cooler submitted to the laboratory to monitor sample storage conditions prior to arrival at the laboratory. Each type of field QC sample had the same preservation, analysis, and reporting procedures as the related environmental samples with the exception of temperature blanks. These field QC samples are discussed below.

The laboratory QC samples consisted of laboratory control samples, laboratory duplicates, internal standards, laboratory method blanks, matrix spikes, matrix spike duplicates, post digestion spikes, and surrogates. Severn Trent Laboratory conducted the laboratory QC in accordance with the QAPP (TtNUS, July 2001). These internal laboratory analytical QC requirements are beyond those used for instrument calibration QC and are described below. TtNUS reviewed the laboratory QC during the data validation and noncompliances were noted in the data validation memoranda in Appendix B.

3.3.1 Field Duplicates

Field duplicates for chemical constituents were collected and analyzed as a measure of the cumulative uncertainty (i.e., precision) of sample collection, splitting, handling, storage, preparation, and analysis operations, as well as natural sample heterogeneity not eliminated through simple mixing in the field. The field duplicate was collected by mixing a volume of sample and splitting it into two separate sample containers that were labeled as individual field samples (one of which becomes the duplicate). For the surface water samples, field duplicates were generated by collecting individual water samples from the same water source in rapid succession. Field duplicates were labeled as individual environmental samples and not identified to the laboratory as duplicate samples.

3.3.2 Trip Blanks

Trip blanks were samples of deionized water were analyzed for VOCs. These blanks would identify cross-contamination of the samples by VOCs during sample shipment.

3.3.3 Equipment Rinsate Blanks

Equipment rinsate blanks or rinsate blanks were collected under representative field conditions by collecting the rinse water generated by running analyte-free water through sample collection equipment after sampling and decontamination and prior to use. These blanks would identify sample cross-contamination through improperly cleaned sampling equipment.

3.3.4 Temperature Blanks

Temperature blanks were vials of water inserted into each sample cooler prior to shipment from the field. The temperature of this blank is measured upon receipt at the laboratory to assess whether samples were properly cooled during transit.

3.3.5 Laboratory Control Samples

Laboratory control samples provided a means to monitor the overall performance of each step of the analysis, including the sample preparation. These are solid samples (sediment analyses) or blank spikes (water analyses) that are spiked with known concentrations of analytes. The laboratory control samples for metals analyses contained the analytes of interest, and the laboratory control samples for multiple-analyte organic analysis contained at least two targeted analytes from each major class of compounds subject to analysis.

3.3.6 Laboratory Duplicates

Laboratory duplicates were analyzed for metals and miscellaneous parameters to measure the cumulative uncertainty (i.e., precision) of the sample handling, subsampling, preparation, laboratory storage, and analysis operations within the laboratory, as well as sample heterogeneity not eliminated through simple mixing in the laboratory. Laboratory duplicates were generated by the laboratory analyst by mixing the sample and splitting it into 2 subsamples.

3.3.7 Internal Standards

Internal standards were applied to each sample analyzed by Gas Chromatograph/Mass Spectroscopy (GC/MS) to make sure that the analysis sensitivity and response were stable during every analytical run.

3.3.8 Laboratory Method Blanks

Laboratory method blanks or preparation blanks were analyte-free matrices prepared and analyzed in accordance with the selected analytical method to determine whether contaminants originating from laboratory sources were introduced and affected environmental sample analyses. Analyte-free water was used as a blank for water analyses. The method blank for organic sediment sample analyses consisted of an aliquot of sand subjected to the same preparation and analysis as the environmental samples. Native sediments devoid of acid-leachable metals do not exist. Therefore, the method blank for inorganic soil sample analysis consisted of an aliquot of analyte-free water that was subjected to the same preparation and analysis procedures as the environmental samples undergoing analysis. The solid method blank results were presented on a dry-weight basis assuming 100 percent solids. The aqueous results were normalized to a fictitious soil sample and presented on a dry-weight basis assuming 100 percent solids.

3.3.9 Matrix Spikes

Matrix spikes were environmental samples to which known quantities of analytes were added prior to sample preparation (digestion or extraction). These samples provided information about the heterogeneity of the samples and the effect of the sample matrix on the sample digestion and measurement methodology. The matrix spikes (MS) contained as many representative analytes as practicable. The spiking list consisted of most of the target analytes. For VOC and SVOC analyses, a shortened spiking list was used.

3.3.10 Matrix Spike Duplicates

Matrix spike duplicates were duplicates of matrix spikes and used for estimating the precision of organic target analyte analyses. They were used in lieu of simple duplicate samples because native environmental samples frequently do not exhibit detectable levels of organic target analytes, which prevents the calculation of Relative Percent Difference (RPD) values.

3.3.11 Post Digestion Spikes

Post digestion spikes are similar to matrix spikes except that the sample digestate, rather than the original soil sample, is spiked. These spikes were analyzed for metal target analytes only if the matrix spike recovery fell outside control limits. Comparing percent recovery (%R) between post digestion spikes and matrix spikes helps to identify where in the analytical process accuracy problems are occurring. The post digestion spikes contained target analytes of interest and were used to assist in determining whether unacceptable matrix spike recoveries were a result of matrix effects.

3.3.12 Surrogates

Surrogates are organic compounds (typically brominated, fluorinated, or isotopically-labeled) that are similar in nature to the compounds of concern and are not likely to be present in environmental media. The surrogates were spiked into each sample, standard, and method blank before analysis, and were used in organic chromatographic analytical procedures to check method effectiveness.

3.3.13 Additional Laboratory QC Checks

Additional internal laboratory QC checks included mass tuning for GC/MS analysis and second-column confirmation for GC and High Performance Liquid Chromatography (HPLC) analyses. Specific QC requirements for each of these QC checks were provided in the applicable SOPs included in the QAPP (TtNUS, July 2001).

3.4 SITE-SPECIFIC GEOLOGY

Geologic conditions at Site 17 were not characterized in any as part of the RI. Sediment at Site 17 was visually classified based on Boat Basin samples and Pettibone Creek samples collected during the TtNUS field investigation.

3.4.1 Pettibone Creek Sediments

Pettibone Creek sediments were characterized from 0 to 4 cm and consisted of fine to medium sands with trace amounts of silt and clay. Samples collected at a depth of one foot consisted of gravelly sands. Laboratory sieve analysis of samples from these deposits (Table 3-3) indicate that the Unified Soil Classification System (USCS) descriptions of these sediments is SP (poorly-sorted sand) to SM (silty sand) for 0 to 4 cm and SP (poorly-sorted sand) for the 1-foot depth.

3.4.2 Boat Basin Sediments

Surface and subsurface sediments in the Boat Basin were visually classified based on samples collected from the drilling of sediment borings during TtNUS field investigation. Figure 3-6 illustrates the location of a shallow geologic cross section through the Boat Basin, based on the data collected during the field investigation. Figure 3-7 shows cross-sectional transect A-A' that was developed from sediment boring data collected.

The sediments with the Boat Basin were characterized to a depth of 10 feet and consisting of layers of sands and clays. Laboratory sieve analysis of a composite sample from the top three feet of these deposits (Table 3-3) indicate that the USCS classified these sediments as SC (clayey sands).

3.5 SITE-SPECIFIC HYDROGEOLOGY

The hydrogeologic conditions at Site 17 were not characterized as part of the RI.

TABLE 3-1

**SAMPLING RATIONALE
SITE 17
PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 1 OF 6**

Sample Location	Sampling Rationale
Surface Water	
NTC17PCSW01	To assess whether site-related chemicals are present in surface water in the North Branch of Pettibone Creek.
NTC17PCSW02	To assess whether site-related chemicals are present in surface water in the North Branch of Pettibone Creek.
NTC17PCSW03	To assess whether site-related chemicals are present in surface water in the South Branch of Pettibone Creek.
NTC17PCSW04	To assess whether site-related chemicals are present in surface water in the South Branch of Pettibone Creek.
NTC17BBSW05	To assess whether site-related chemicals are present in surface water in the Boat Basin.
NTC17BBSW06	To assess whether site-related chemicals are present in surface water in the Boat Basin.
Sediment	
NTC17PCSD01	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot
NTC17PCSD02	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD03	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD04	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot
NTC17PCSD05	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD06	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD07	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm

TABLE 3-1

**SAMPLING RATIONALE
SITE 17
PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 2 OF 6**

Sample Location	Sampling Rationale
NTC17PCSD08	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot
NTC17PCSD09	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD10	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot
NTC17PCSD11	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot
NTC17PCSD12	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot
NTC17PCSD13	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD14	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot
NTC17PCSD15	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD16	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD17	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot

TABLE 3-1

SAMPLING RATIONALE
SITE 17
PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 3 OF 6

Sample Location	Sampling Rationale
NTC17PCSD18	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot
NTC17PCSD19	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD20	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm at 1 foot
NTC17PCSD21	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD22	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD23	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot
NTC17PCSD24	To assess whether site-related chemicals are present in sediments in the North Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD25	To assess whether site-related chemicals are present in sediments in the South Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD26	To assess whether site-related chemicals are present in sediments in the South Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD27	To assess whether site-related chemicals are present in sediments in the South Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD28	To assess whether site-related chemicals are present in sediments in the South Branch of Pettibone Creek. • 0 to 4 cm

TABLE 3-1

SAMPLING RATIONALE
SITE 17
PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 4 OF 6

Sample Location	Sampling Rationale
NTC17PCSD29	To assess whether site-related chemicals are present in sediments in the South Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot
NTC17PCSD30	To assess whether site-related chemicals are present in sediments in the South Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD31	To assess whether site-related chemicals are present in the South Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD32	To assess whether site-related chemicals are present in the South Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot
NTC17PCSD33	To assess whether site-related chemicals are present in the South Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD34	To assess whether site-related chemicals are present in the South Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD35	To assess whether site-related chemicals are present in the South Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot
NTC17PCSD36	To assess whether site-related chemicals are present in the South Branch of Pettibone Creek. • 0 to 4 cm • at 1 foot
NTC17PCSD37	To assess whether site-related chemicals are present in the South Branch of Pettibone Creek. • 0 to 4 cm
NTC17PCSD38	To assess whether site-related chemicals are present in the South Branch of Pettibone Creek. • 0 to 4 cm

TABLE 3-1

**SAMPLING RATIONALE
SITE 17
PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 5 OF 6**

Sample Location	Sampling Rationale
NTC17BBSD45	To assess whether site-related chemicals are present in the Boat Basin. • 0 to 4 cm • 4 cm to 3' • 3' to 6' • 6' to 10'
NTC17BBSD46	To assess whether site-related chemicals are present in the Boat Basin. • 0 to 4 cm • 4 cm to 3' • 3' to 6' • 6' to 10'
NTC17BBSD47	To assess whether site-related chemicals are present in the Boat Basin. • 0 to 4 cm • 4 cm to 3' • 3' to 6' • 6' to 10'
NTC17BBSD48	To assess whether site-related chemicals are present in the Boat Basin. • 0 to 4 cm • 4 cm to 3' • 3' to 6' • 6' to 10'
NTC17BBSD49	To assess whether site-related chemicals are present in the Boat Basin. • 0 to 4 cm • 4 cm to 3' • 3' to 6' • 6' to 10'
NTC17BBSD50	To assess whether site-related chemicals are present in the Boat Basin. • 0 to 4 cm • 4 cm to 3' • 3' to 6' • 6' to 10'
NTC17BBSD51	To assess whether site-related chemicals are present in the Boat Basin. • 0 to 4 cm • 4 cm to 3' • 3' to 6' • 6' to 10'

TABLE 3-1

**SAMPLING RATIONALE
SITE 17
PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 6 OF 6**

Sample Location	Sampling Rationale
NTC17BBSD52	To assess whether site-related chemicals are present in the Boat Basin. • 0 to 4 cm • 4 cm to 3' • 3' to 6' • 6' to 10'
NTC17BBSD53	To assess whether site-related chemicals are present in the Boat Basin. • 0 to 4 cm • 4 cm to 3' • 3' to 6' • 6' to 10'
NTC17BBSD54	To assess whether site-related chemicals are present in the Boat Basin. • 0 to 4 cm • 4 cm to 3' • 3' to 6' • 6' to 10'
NTC17BBSD55	To assess whether site-related chemicals are present in the Boat Basin. • 0 to 4 cm • 4 cm to 3' • 3' to 6' • 6' to 10'
NTC17BBSD56	To assess whether site-related chemicals are present in the Boat Basin. • 0 to 4 cm • 4 cm to 3' • 3' to 6' • 6' to 10'

Notes:
NTC – Naval Training Center
PC – Pettibone Creek
BB – Boat Basin
SW – Surface Water
SD – Sediment

TABLE 3-2

SAMPLING SUMMARY
REMEDIAL INVESTIGATION REPORT AT NTC GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 1 OF 3

SAMPLE NAME	TCL VOCs plus ETHYL ALCOHOL/ ACETATE	TCL SVOCs	TAL Metals	Filtered Metals	TOC	TCL PEST/PCBs	TCL PEST/PCBs & PAHs	pH	AVS / SEM	GRAIN SIZE	FIELD PARAMETERS(1)
SEDIMENT SAMPLES COLLECTED FROM 0-4cm BGS											
NTC17PCSD0101			X		X		X	X			
NTC17PCSD0201			X		X		X	X			
NTC17PCSD0301			X		X		X	X		X	
NTC17PCSD0401	X	X	X		X		X	X			
NTC17PCSD0501			X		X		X	X			
NTC17PCSD0601			X		X		X	X			
NTC17PCSD0701			X		X		X	X			
NTC17PCSD0801			X		X		X	X			
NTC17PCSD0901			X		X		X	X			
NTC17PCSD1001			X		X		X	X			
NTC17PCSD1101			X		X		X	X	X		
NTC17PCSD1201			X		X		X	X			
NTC17PCSD1301			X		X		X	X			
NTC17PCSD1401	X	X	X		X		X	X			
NTC17PCSD1501			X		X		X	X		X	
NTC17PCSD1601	X	X	X		X		X	X			
NTC17PCSD1701			X		X		X	X	X		
NTC17PCSD1801	X	X	X		X		X	X			
NTC17PCSD1901			X		X		X	X		X	
NTC17PCSD2001			X		X		X	X			
NTC17PCSD2101	X	X	X		X		X	X	X		
NTC17PCSD2201			X		X		X	X			
NTC17PCSD2301	X	X	X		X		X	X			
NTC17PCSD2401			X		X		X	X			
NTC17PCSD2501			X		X		X	X			
NTC17PCSD2601			X		X		X	X			
NTC17PCSD2701			X		X		X	X	X		
NTC17PCSD2801			X		X		X	X			
NTC17PCSD2901	X	X	X		X		X	X			
NTC17PCSD3001			X		X		X	X			
NTC17PCSD3101			X		X		X	X			
NTC17PCSD3201			X		X		X	X			
NTC17PCSD3301			X		X		X	X			
NTC17PCSD3401			X		X		X	X			
NTC17PCSD3501			X		X		X	X			
NTC17PCSD3601	X	X	X		X		X	X	X		
NTC17PCSD3701			X		X		X	X	X		
NTC17PCSD3801			X		X		X	X		X	
NTC17BBSD4401			X		X		X	X			
NTC17BBSD4501			X		X		X	X			
NTC17BBSD4601			X		X		X	X			

TABLE 3-2

SAMPLING SUMMARY
REMEDIAL INVESTIGATION REPORT AT NTC GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 2 OF 3

SAMPLE NAME	TCL VOCs plus ETHYL ALCOHOL/ ACETATE	TCL SVOCs	TAL Metals	Filtered Metals	TOC	TCL PEST/PCBs	TCL PEST/PCBs & PAHs	pH	AVS / SEM	GRAIN SIZE	FIELD PARAMETERS$^{(1)}$
NTC17BBSD4701	X	X	X		X		X	X			
NTC17BBSD4801			X		X		X	X			
NTC17BBSD4901			X		X		X	X			
NTC17BBSD5001			X		X		X	X			
NTC17BBSD5101			X		X		X	X			
NTC17BBSD5201			X		X		X	X			
NTC17BBSD5301			X		X		X	X	X		
NTC17BBSD5401			X		X		X	X			
NTC17BBSD5501			X		X		X	X			
NTC17BBSD5601			X		X		X	X			
SEDIMENT SAMPLES COLLECTED AT 1' DEPTH BGS											
NTC17PCSD0102			X		X		X	X		X	
NTC17PCSD0402			X		X		X	X			
NTC17PCSD0802			X		X		X	X			
NTC17PCSD1002			X		X		X	X			
NTC17PCSD1102			X		X		X	X			
NTC17PCSD1202			X		X		X	X			
NTC17PCSD1402			X		X		X	X			
NTC17PCSD1702			X		X		X	X			
NTC17PCSD1802			X		X		X	X			
NTC17PCSD2002			X		X		X	X			
NTC17PCSD2302			X		X		X	X			
NTC17PCSD2902			X		X		X	X			
NTC17PCSD3202			X		X		X	X			
NTC17PCSD3602			X		X		X	X			
SEDIMENT SAMPLES COLLECTED FROM 4cm-3' BGS											
NTC17BBSD4503			X		X		X	X			
NTC17BBSD4603			X		X		X	X			
NTC17BBSD4703			X		X		X	X			
NTC17BBSD4803			X		X		X	X			
NTC17BBSD4903			X		X		X	X			
NTC17BBSD5003			X		X		X	X			
NTC17BBSD5103			X		X		X	X			
NTC17BBSD5203			X		X		X	X			
NTC17BBSD5303	X	X	X		X		X	X		X	
NTC17BBSD5403			X		X		X	X			
NTC17BBSD5503			X		X		X	X			
NTC17BBSD5603			X		X		X	X			
SEDIMENT SAMPLES COLLECTED FROM 3'-6' BGS											
NTC17BBSD4504			X		X		X	X	X		
NTC17BBSD4604			X		X		X	X			
NTC17BBSD4704			X		X		X	X			

TABLE 3-2

SAMPLING SUMMARY
REMEDIAL INVESTIGATION REPORT AT NTC GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 3 OF 3

SAMPLE NAME	TCL VOCs plus ETHYL ALCOHOL/ ACETATE	TCL SVOCs	TAL Metals	Filtered Metals	TOC	TCL PEST/PCBs	TCL PEST/PCBs & PAHs	pH	AVS / SEM	GRAIN SIZE	FIELD PARAMETERS(1)
NTC17BBSD4804			X		X		X	X			
NTC17BBSD4904			X		X		X	X			
NTC17BBSD5004			X		X		X	X			
NTC17BBSD5104			X		X		X	X	X		
NTC17BBSD5204			X		X		X	X			
NTC17BBSD5304			X		X		X	X			
NTC17BBSD5404			X		X		X	X			
NTC17BBSD5504			X		X		X	X			
NTC17BBSD5604			X		X		X	X			
SEDIMENT SAMPLES COLLECTED FROM 6'-10' BGS											
NTC17BBSD4505			X		X		X	X			
NTC17BBSD4605			X		X		X	X			
NTC17BBSD4705			X		X		X	X			
NTC17BBSD4805			X		X		X	X			
NTC17BBSD4905			X		X		X	X			
NTC17BBSD5005			X		X		X	X			
NTC17BBSD5105			X		X		X	X			
NTC17BBSD5205			X		X		X	X			
NTC17BBSD5305			X		X		X	X			
NTC17BBSD5405			X		X		X	X			
NTC17BBSD5505			X		X		X	X			
NTC17BBSD5605			X		X		X	X			
SURFACE WATER (surface)											
NTC17PCSW0101	X	X	X	X		X					X
NTC17PCSW0201	X	X	X	X		X					X
NTC17PCSW0301	X	X	X	X		X					X
NTC17PCSW0401	X	X	X	X		X					X
NTC17BBSW0501	X	X	X	X		X					X
NTC17BBSW0601	X	X	X	X		X					X

1. Field Parameters include temperature, pH, specific conductance, turbidity, ORP, dissolved oxygen and salinity.

Notes:
BGS - below ground surface
TCL - Target Compound List
VOC - Volatile Organic Compound
SVOC- Semi-Volatile Organic Compounds
TAL - Target Analyte List
TOC - Total Organic Carbon
PEST- Pesticides
PCBs- Polychlorinated Biphenyl
PAHs- Polynuclear Aromatic Hydrocarbons
AVS - Acid Volatile Sulfides
SEM - Simultaneously Extractred Metals
NTC - Naval Training Center
SD - Sediment
PC - Pettibone Creek
BB - Boat Basin
SW - Surface Water
ORP - Oxidation Reduction Potential

TABLE 3-3

SUMMARY OF SEIVE ANALYSIS
SITE 17
PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

SITE	**SITE 17**	**SITE 17**	**SITE 17**	**SITE 17**	**SITE 17**	**SITE 17**
LOCATION	**NTC17PCSD01**	**NTC17PCSD03**	**NTC17PCSD15**	**NTC17PCSD19**	**NTC17PCSD38**	**NTC17BBSD53**
DEPTH RANGE[(1)]	**AT 1'**	**0 - 4 cm**	**0 - 4 cm**	**0 - 4 cm**	**0 - 4 cm**	**4 cm - 3'**
SAMPLE ID	**NTC17PCSD0102**	**NTC17PCSD0301**	**NTC17PCSD1501**	**NTC17PCSD1901**	**NTC17PCSD3801**	**NTC17BBSD5303**
SAMPLE DATE	**9/24/2001**	**9/24/2001**	**9/23/2001**	**9/22/2001**	**9/24/2001**	**9/6/2001**
MATRIX	**SD**	**SD**	**SD**	**SD**	**SD**	**SD**
Miscellaneous Parameters (%)						
SIEVE 1"	100	100	100	100	100	100
SIEVE 3/4"	98.42	100	100	100	100	100
SIEVE 1/2"	97.88	100	100	100	100	98.07
SIEVE 3/8"	94.71	100	100	99.56	100	97.88
NO. 4 SIEVE	86.51	99.73	97.8	98.9	99.7	96.55
NO. 10 SIEVE	56.58	99.58	90.6	95.82	98.88	93.89
NO. 20 SIEVE	22.82	98.61	71.22	86.93	97.16	90.53
NO. 40 SIEVE	10.65	86.64	34.5	69.83	91.79	84.63
NO. 60 SIEVE	4.42	47.6	5.31	40.84	49.74	71.56
NO. 140 SIEVE	0.79	14.37	0.76	16.53	14.85	54.32
NO. 200 SIEVE	0.65	11.4	0.69	13.66	12	49.45
USCS SYMBOL	SP	SM	SP	SM	SM	SC
USCS CLASSIFICATION	SAND	SILTY SAND	SAND	SILTY SAND	SILTY SAND	CLAYEY SAND

NTC - Naval Training Center
PC - Pettibone Creek
BB - Boat Basin
SD - Sediment
USCS - Unified Soil Classification System

1 Depth measured below ground surface

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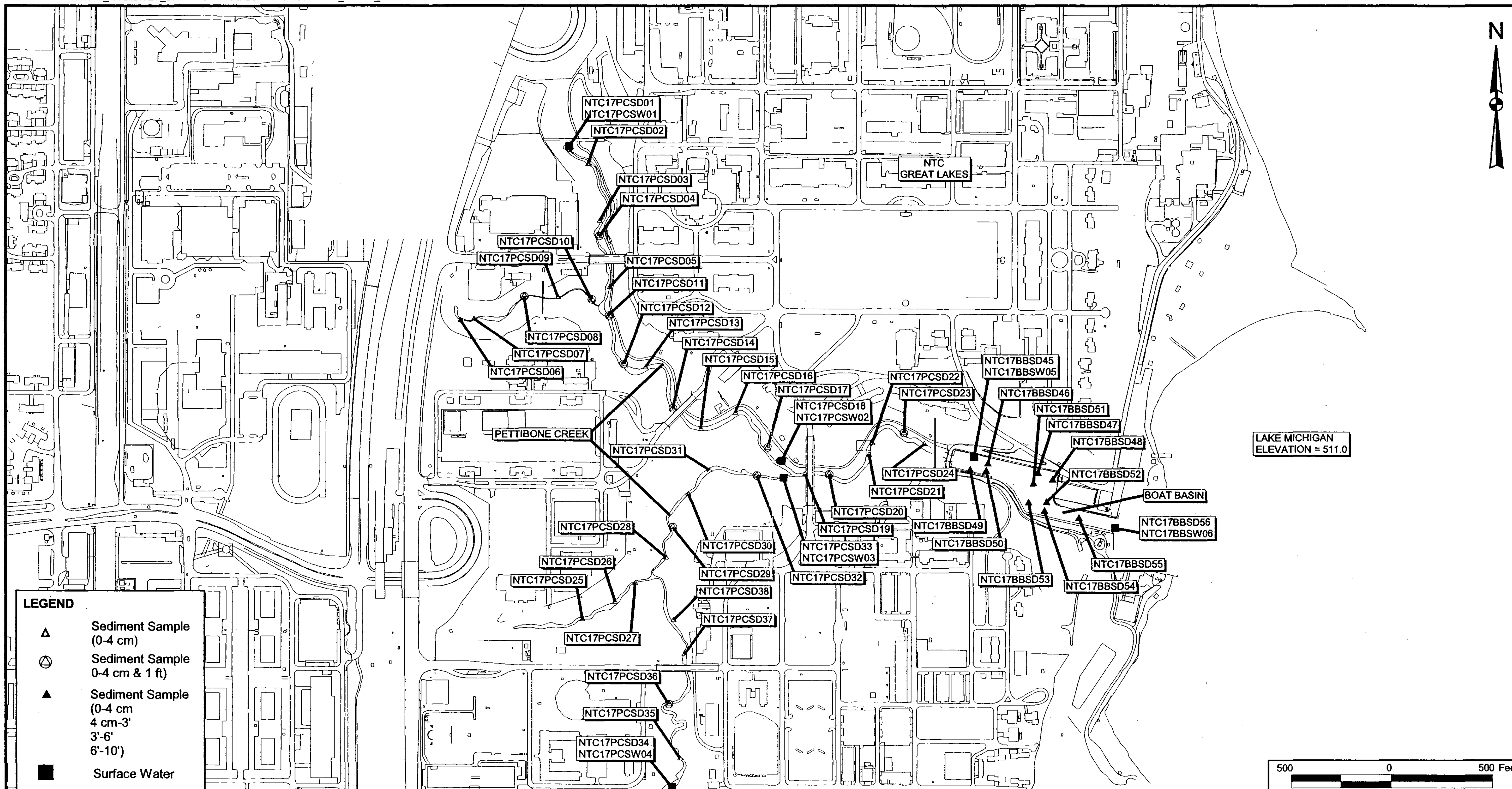

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: K. PEILA — DATE: 5/1/02
CHECKED BY: B. BALKOVEC — DATE: 5/1/02
COST/SCHEDULE-AREA
SCALE: AS NOTED

Tetra Tech NUS, Inc.

SURFACE WATER AND SEDIMENT
SAMPLE LOCATIONS
SITE 17 PETTIBONE CREEK & BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NUMBER: N3939
OWNER NUMBER: —
APPROVED BY: RFD — DATE: 5/1/02
APPROVED BY: — DATE: —
DRAWING NO.: FIGURE 3-1
REV: 0

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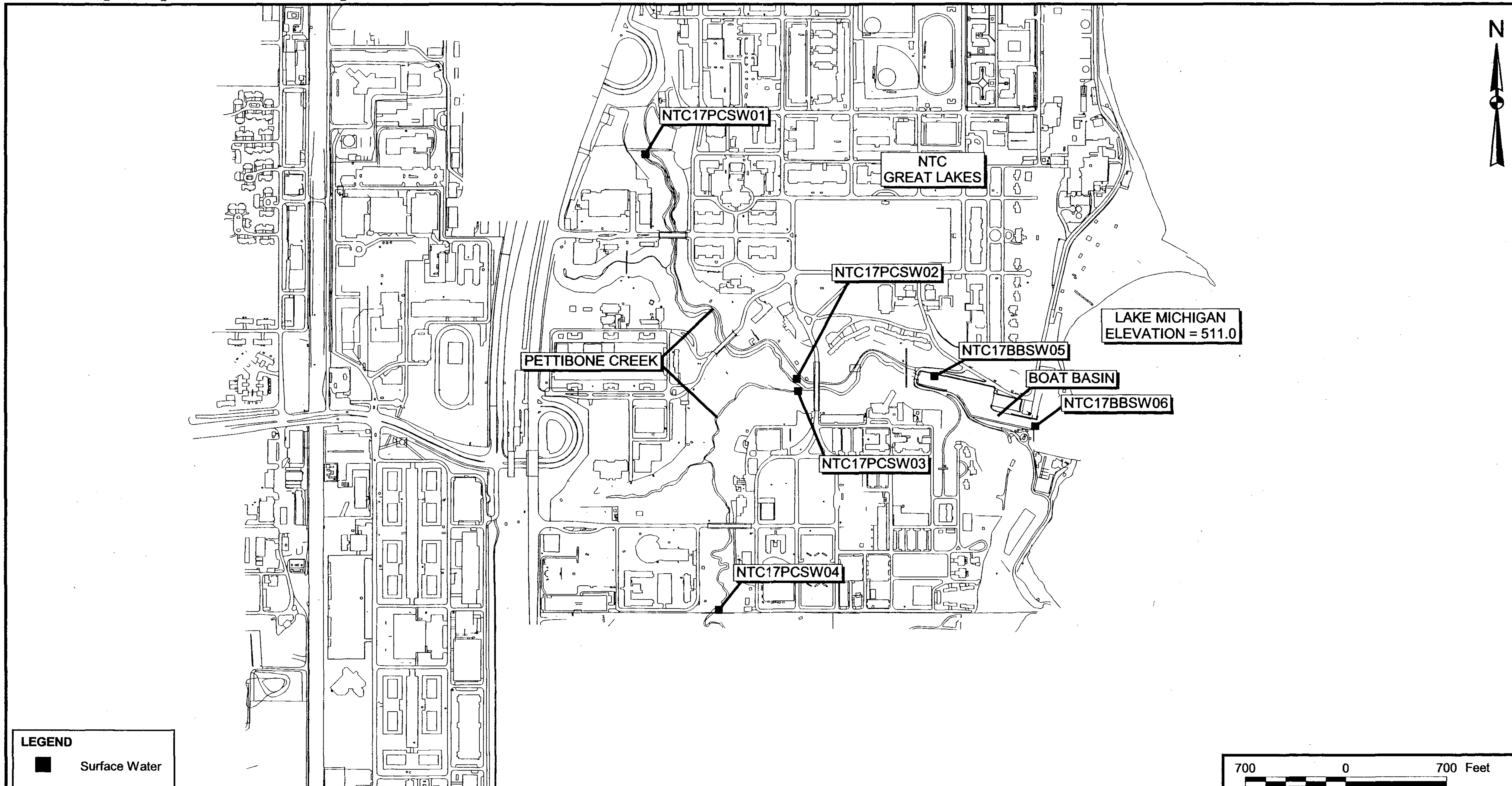

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: K. PEILA — DATE: 5/1/02
CHECKED BY: B. BALKOVEC — DATE: 5/1/02
COST/SCHEDULE-AREA
SCALE: AS NOTED

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOCATIONS
SITE 17 PETTIBONE CREEK & BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NUMBER: N3939
OWNER NUMBER: —
APPROVED BY: RFD — DATE: 5/1/02
APPROVED BY: — DATE: —
DRAWING NO.: FIGURE 3-2
REV: 0

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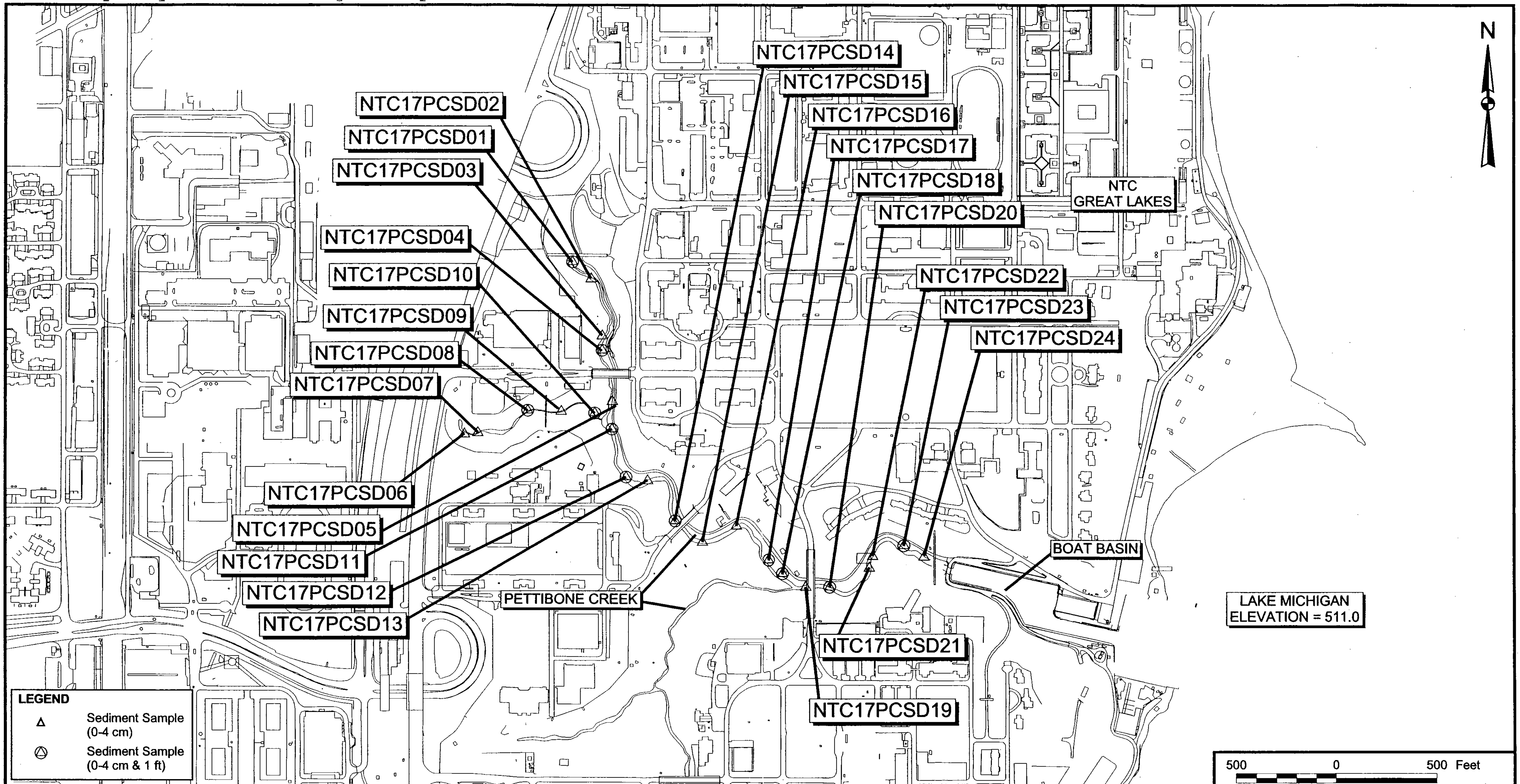

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: K. PEILA — DATE: 5/1/02
CHECKED BY: B. BALKOVEC — DATE: 5/1/02
COST/SCHEDULE-AREA
SCALE: AS NOTED

Tetra Tech NUS, Inc.

SEDIMENT SAMPLES
SITE 17 NORTH BRANCH OF PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NUMBER: N3939
OWNER NUMBER: —
APPROVED BY: RFD — DATE: 5/1/02
APPROVED BY: — — DATE: —
DRAWING NO.: FIGURE 3-3
REV: 0

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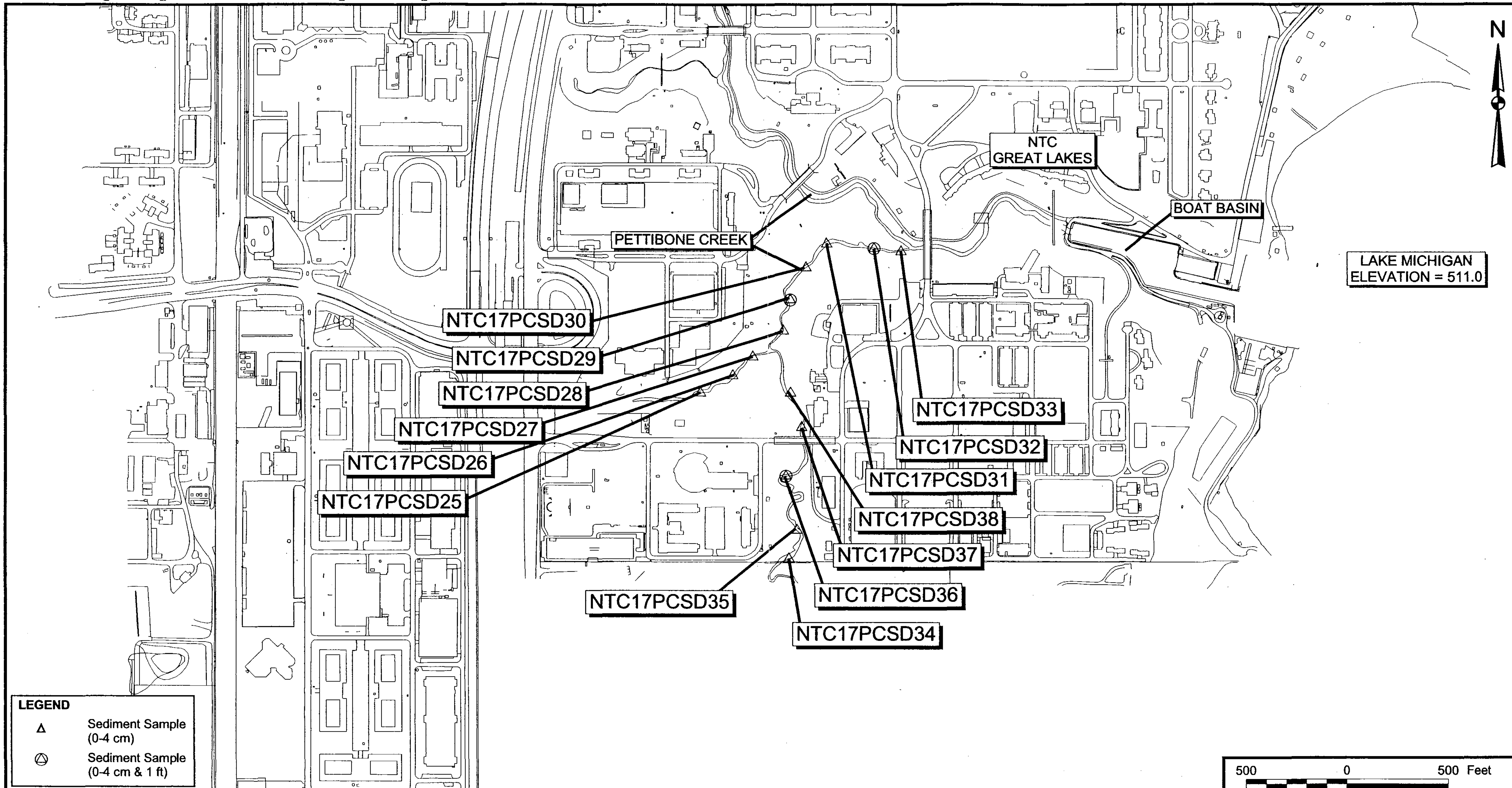

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: K. PEILA	DATE: 5/1/02
CHECKED BY: B. BALKOVEC	DATE: 5/1/02
COST/SCHEDULE-AREA	
SCALE: AS NOTED	

Tetra Tech NUS, Inc.

SEDIMENT SAMPLES
SITE 17 SOUTH BRANCH OF PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NUMBER: N3939	OWNER NUMBER: —
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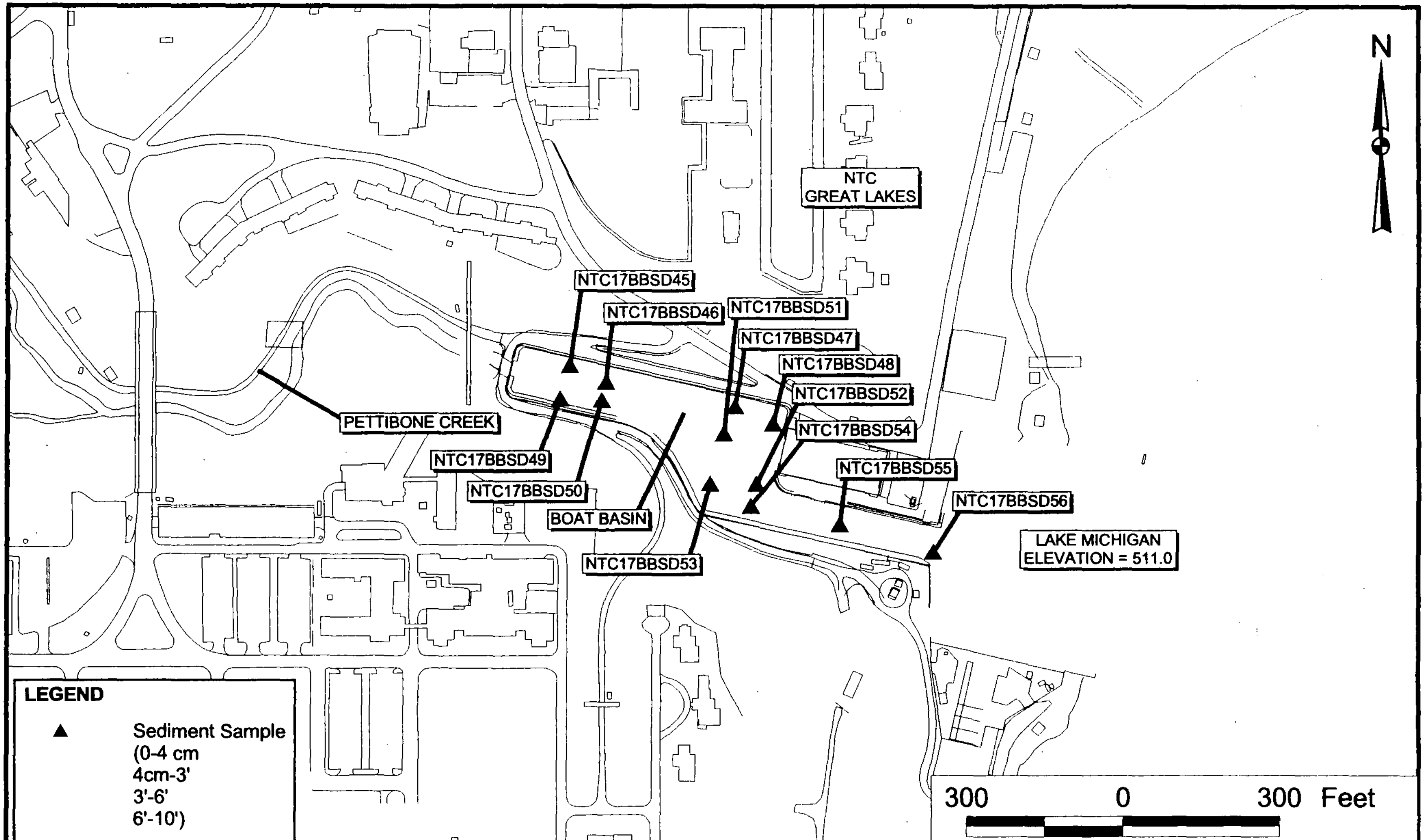
APPROVED BY: —	DATE: —
DRAWING NO.: FIGURE 3-4	REV: 0



DRAWN BY	DATE		CONTRACT NUMBER	OWNER NUMBER
K. PEILA	5/1/02	Tetra Tech NUS, Inc.	N3939	—
CHECKED BY	DATE	SEDIMENT SAMPLE LOCATIONS SITE 17 BOAT BASIN NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS	APPROVED BY RFD	DATE 5/1/02
B. BALKOVEC	5/1/02		APPROVED BY —	DATE —
COST/SCHEDULE-AREA				
SCALE AS NOTED			DRAWING NO. FIGURE 3-5	REV 0

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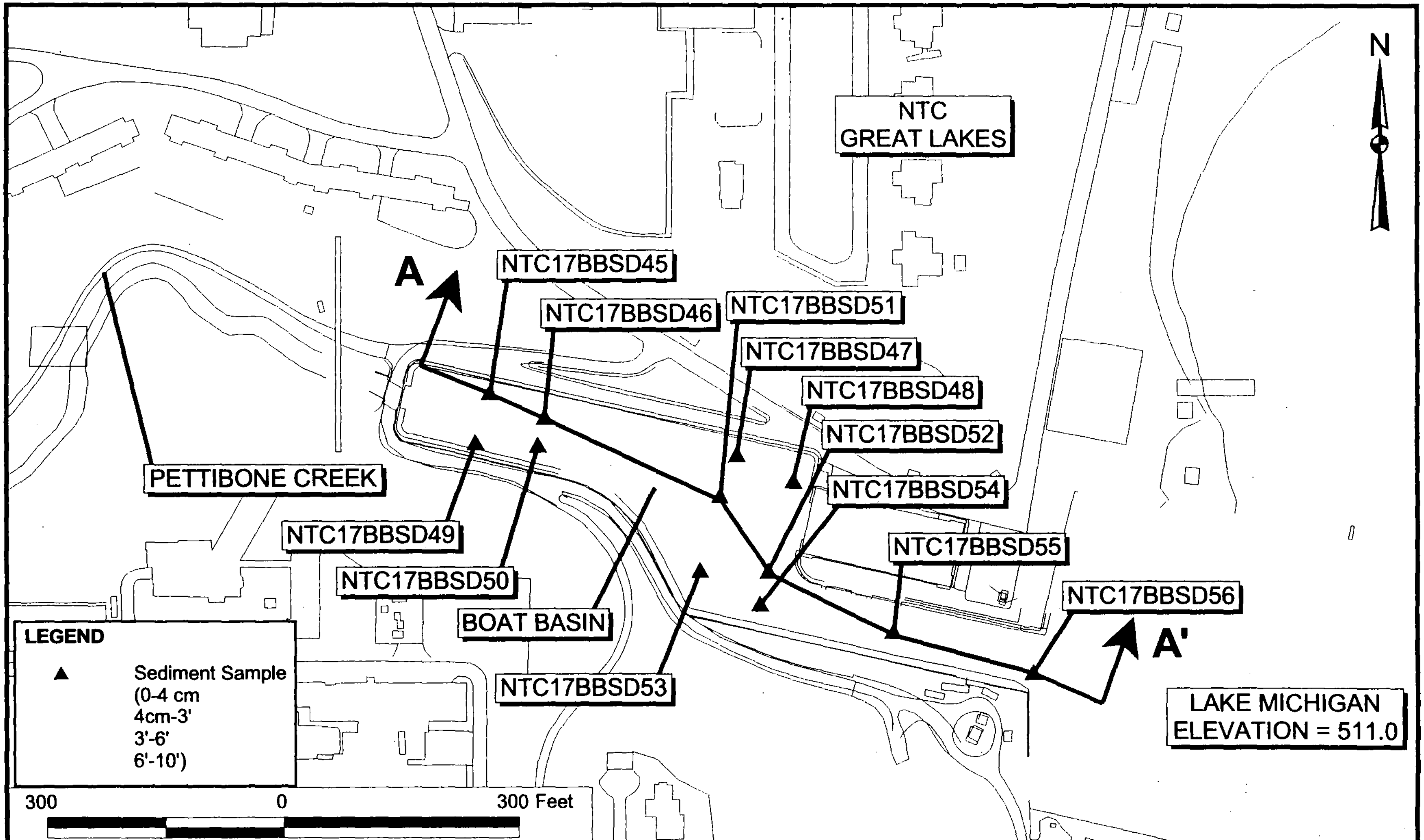

DRAWN BY K. PEILA	DATE 5/1/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER N3939	OWNER NUMBER —
CHECKED BY B. BALKOVEC	DATE 5/1/02	GEOLOGIC CROSS-SECTION LOCATION MAP SECTION A-A' SITE 17 BOAT BASIN NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS	APPROVED BY RFD	DATE 5/1/02
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 3-6	REV 0

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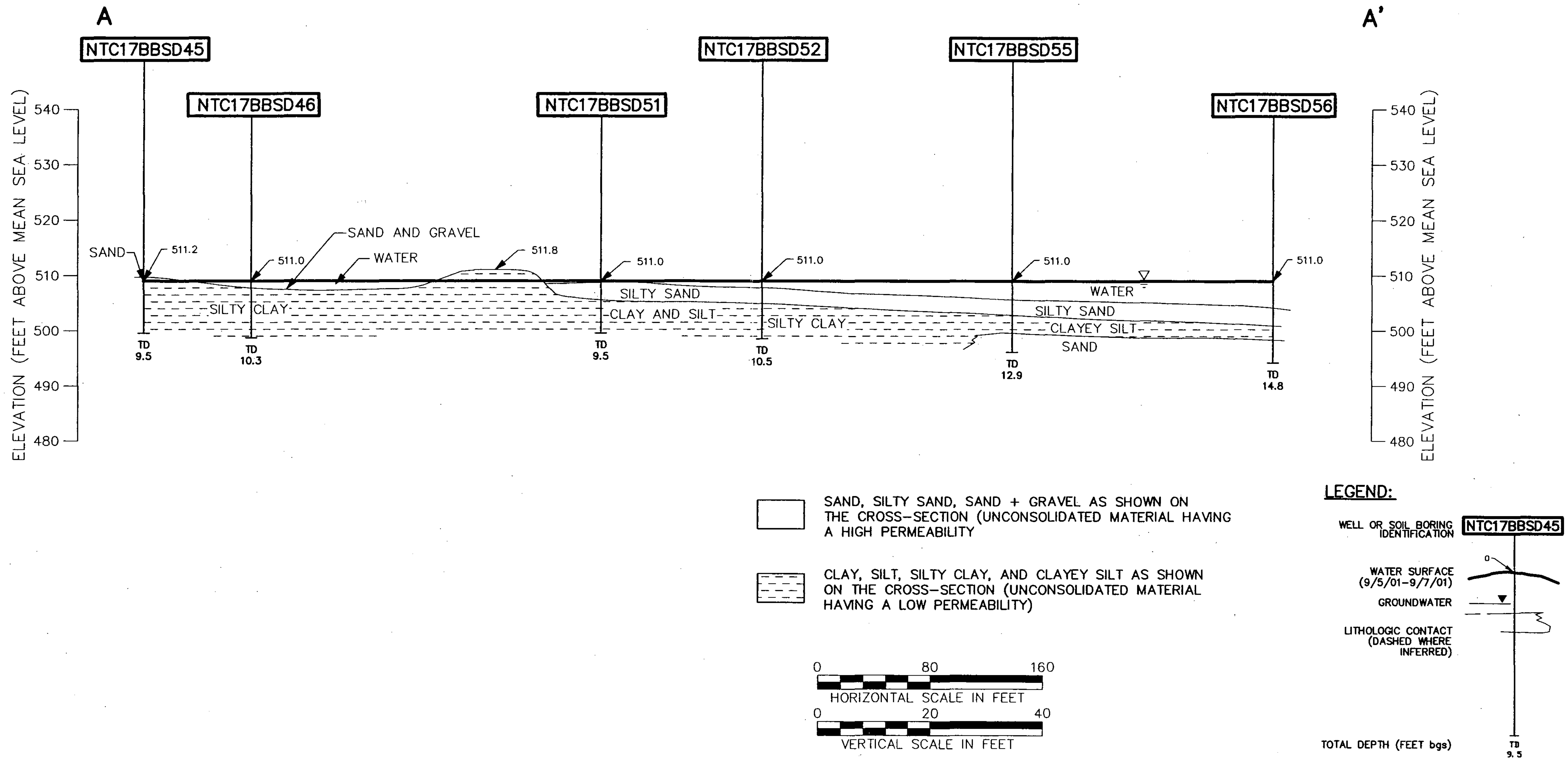

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: HJB	DATE: 2/8/02
CHECKED BY: B.B.	DATE: 3/20/02
COST/SCHED-AREA	
SCALE: AS NOTED	

GENERALIZED GEOLOGIC CROSS SECTION A-A'
SITE 17 BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO. 3939	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 3-7	REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

4.0 NATURE AND EXTENT OF CONTAMINATION

This section summarizes and evaluates the results of the Site 17 RI/RA sampling and analysis activities as described in Sections 2.0 and 3.0. Specifically, this section summarizes the nature and extent of contamination in surface water, surface sediment (0 to 4 cm), and sediment at depth samples collected at the Site 17 locations displayed in Figure 3-1. The nature and extent of contamination for the surface sediment summaries for Site 17 will be divided into three areas of interest (North and South Branches of Pettibone Creek and the Boat Basin) because of known differences in contaminant transport and deposition among these areas. The nature and extent for the surface water and sediment at depth will be summarized for Site 17 as a whole. The analytical database and Form Is (analytical summary sheets from the subcontract laboratory) are presented in Appendices B and C. Ten percent of the data packages received from the analytical laboratory were validated; the results of the data validation are summarized in the data validation memoranda presented in Appendix B.

The quality of the chemical analytical data collected during the Site 17 investigation has been documented in the data validation memoranda. The analytical data validation process was completed for selected laboratory data packages in accordance with the USEPA Region 5 Guidelines for Organic Data Validation (USEPA, August 1993), and the USEPA Region 5 Guidelines for Inorganic Data Validation (USEPA, September 1993) as well as the USEPA National Functional Guidelines for Organic Data Validation (USEPA, October 1999), and the USEPA National Functional Guidelines for Inorganic Data Validation (USEPA, February 1994). The data set compiled using these guidelines is considered acceptable for use in this RI/RA. A more detailed explanation of the data usability, including a detection limit evaluation, can be found in Appendix B.

Contaminant sources related to Site 17 are discussed in Section 4.1. "Metropolitan Background Values" for soil presented in the Illinois EPA TACO (Illinois EPA, March 2002) and Illinois EPA Unsieved Stream Sediment Background Concentrations (Illinois EPA, August 1997) are found in Section 4.2. In Section 4.3, the nature and extent of contamination in the environmental media is discussed and evaluated against TACO and unsieved sediment data reported in the Evaluation of Illinois Sieved Stream Sediment Data (Illinois EPA, August 1997), where available. Historical data are compared with the data collected during this RI/RA investigation in Section 4.4. The summary and conclusions of the nature and distribution of contamination at Site 17 are presented in Section 4.5.

The discussion of the nature and extent of contamination at Site 17 is structured according to the RI/FS guidance (USEPA, October 1988). The RI/RA surface water and sediment sampling results are then discussed, with the surface sediment results subdivided by stream segment. Within each of these media, analytical fractions are discussed in the following order: VOCs, SVOCs, pesticides, PCBs, and inorganics.

4.1 SOURCES OF CONTAMINATION

A brief summary of historical investigations of potential contamination at Site 17 and the reported historic releases to the environment is provided below. Additional details regarding the source areas and releases are provided in Section 2.2.

Date	Conducted by	Comments
1970 - 1971	Illinois EPA	PCBs and pesticides found in samples
1975	USEPA	Inner Harbor sediment samples polluted with toxic metals
May 1980	USEPA Contractor	Contaminated sediment samples
April 1988	STS Consultants Ltd. for the Navy	USEPA didn't approve open water disposal of sediments
July 1988	Jacobs Engineering	Copper and lead had elevated concentrations in the sediment sediments
April 1989	STS Consultants Ltd. for the Navy	Highest concentrations at the Boat Basin bend to join a channel to the Inner Harbor
June 1990	Illinois EPA	Elevated concentrations of zinc, copper, and lead in sediments downstream of the NCRS Facility
1991	Illinois EPA	Surface water samples were contaminated with VOCs and SVOCs
Nov. 1991	Illinois EPA	Metals and SVOCs were present at three times above background concentrations
Aug. 1992	Halliburton NUS for the Navy	Contaminants present in Pettibone Creek and Boat Basin sediments
Sept. 1992	Illinois EPA	Elevated concentrations of inorganics, chlorinated solvents, PAHs, Pesticides, and PCBs were detected in soil and sediment samples
April 1994	Illinois EPA	Presence of VOCs, SVOCs, pesticides, metals and organic compounds in sediment samples
1995	Illinois EPA	Significant metal contaminates in sediment samples. Illinois EPA identified many potential sources that were part of the upstream facilities.
1997	E&E for USEPA	Contaminants found in soil samples from the Vacant Lot site and sediment samples. Offsite active industrial discharge and stormwater drainage into Pettibone creek represents potential sources of contamination.
2000	Contractor for Fansteel Inc.	Contaminants found in sediment samples
Oct. 2000	TN&A for USEPA Region 5	Downstream sampling suggested that the contaminants are migrating downstream from the NCRS/City of North Chicago discharge into Pettibone Creek

Industries located upstream of NTC Great Lakes include the NCRS/R. Lavin facility, the Vacant Lot, and Fansteel. These industries in combination with several storm sewers collecting water/runoff from a large section of the City of North Chicago (Illinois EPA, December 1995) have contributed to elevated concentrations of contaminants in Pettibone Creek sediments according to the Illinois EPA and USEPA (USEPA, April 2002c, April 2002d, and May 2002) based on the historical information provided in Section 2. In addition, the Navy identified potential areas where hazardous materials may have been released to the environment at NTC Great Lakes in the 1986 IAS (Rogers, Golden, & Halpern and BCM Eastern Inc., March 1996). The IAS identified 14 potentially contaminated sites along with potential sources such as surface runoff or fallout from engine exhaust from nearby roadways, historical pesticides usage applied when it was legal to do so, and volatile organic chemicals detected in the groundwater samples collected from monitoring wells.

4.2 BACKGROUND SCREENING CONCENTRATIONS

At the present time, facility background concentrations for naturally occurring or anthropogenic chemicals have not been determined for NTC Great Lakes. Therefore, the chemical concentrations detected in the Site 17 surface sediment (0 to 4 cm) and sediment at depth were compared to the "Metropolitan Background Values" for inorganic chemicals in soils provided by Illinois EPA in Appendix A, Table G of TACO (Illinois EPA, March 2002) and Illinois EPA Unsieved Stream Sediment Background Data (Illinois EPA, August 1997).

4.3 CONTAMINATION ASSESSMENT

This section discusses the RI data collected for Site 17 and is organized by media type with surface sediment further divided into the three areas of interest.

4.3.1 Surface water

The agreed upon QAPP (TtNUS, July 2001) specified the collection and analysis of surface water samples from six locations on the NTC Great Lakes property:

Pettibone Creek:	Sample	Turbidity (NTU)	Sample	Turbidity (NTU)
North Branch	17SW01	300	17SW02	21.2
South Branch	17SW03	926	17SW04	600
Boat Basin	17SW05	85.2	17SW06	21.1

The samples were analyzed for TCL VOCs, SVOCs, pesticides, PCBs, and TAL metals (filtered and unfiltered samples). Samples 17SW01, 17SW03, and 17SW04 were collected after a rain event on September 23, 2001. The samples were collected from Pettibone Creek when the velocity of the creek was faster, the depth of the water (and therefore the flow) was greater, and the turbidity of the water was higher compared to samples 17SW02, 17SW05, and 17SW06. The results associated with samples 17SW01, 17SW03, and 17SW04 are most likely biased high because of the increases in surface runoff, outfall discharges and particulates into the creek when they were collected. On the other hand, contaminant concentrations associated with groundwater discharge to the creek are most likely biased low.

The analytical results are grouped by fraction and TtNUS interpretations are included below. The analytical results were used to delineate the nature and extent of contamination and to support human health and ecological risk assessments. Table 4-1 presents the analytical results for the six surface water samples with sample locations shown on Figure 3-2. Descriptive statistics (e.g., frequency of detection, range detected, location of maximum positive detection, etc.) are presented in Table 4-1. Additionally, the analytical results are compared to the following standards and criteria, and the results of that comparison are shown in Table 4-1 and displayed on Figures 4-1 and 4-2:

- **Illinois EPA, Class I TACO Tier 1 Groundwater Remediation Objective – Ingestion [TACO Tier 1 Groundwater Remediation Objectives (GROs)] -** Some of the Class I TACO Tier 1 GROs are risk-based concentrations derived to evaluate chemical concentrations in groundwater or surface water that may used as a domestic water supply. Others are Groundwater Quality Standards listed in Title 35 of State of Illinois Administrative Code Section 620.410 and are not strictly risk-based (Illinois EPA, March 2002). The TACO Tier 1 GROs were selected since the criteria are similar to the Region IX Preliminary Remediation Goal Standards, but the TACO Tier 1 GROs are more relevant to the region where the base property is located. The TACO Tier 1 GROs are conservative benchmarks for the evaluation of Site 17 surface water samples because surface water within the study area is not used as a drinking source.

- **Ecological Screening Levels for Surface Water** – The ecological screening levels (ESLs) for surface water presented in Table 4-1 are default benchmarks suggested for use in the ecological risk assessments (ERA) presented in Section 7.0. These criteria are presented as points of reference only.

VOCs

The following ten VOCs were detected in the surface water samples collected from Site 17:

- 2-Butanone – 5.6 µg/L (1 positive detection in 6 samples)
- Acetone – 2.6 µg/L to 11 µg/L (5 positive detections in 6 samples)
- Bromodichloromethane – 0.34 µg/L to 0.74 µg/L (2 positive detections in 6 samples)
- Chlorodibromomethane – 0.59 µg/L (1 positive detection in 6 samples)
- Chloroform – 0.42 µg/L to 1.2 µg/L (2 positive detections in 6 samples)
- cis-1,2-dichloroethene – 1.1 µg/L to 9.2 µg/L (2 positive detections in 6 samples)
- Tetrachloroethane – 0.41 µg/L to 1.4 µg/L (2 positive detections in 6 samples)
- Toluene – 0.7 µg/L (1 positive detection in 6 samples)
- Trichloroethene – 0.46 µg/L to 5.5 µg/L (2 positive detections in 6 samples)
- Vinyl chloride – 0.77 µg/L (1 positive detection in 6 samples)

Concentrations reported for three VOCs detected in the Site 17 surface water samples (bromodichloromethane, chloroform, and trichloroethene) exceed the Illinois TACO Tier I GRO screening criteria, but the constituents are orders of magnitude less than the ecological surface water screening criteria presented in Table 4-1. The highest concentrations of bromodichloromethane and chloroform were detected in sample NTC17PCSW0201; however, the maximum concentrations of bromodichloromethane and chloroform are less than the current Safe Drinking Water Act (SDWA) Maximum Concentration Level (MCL) for THMs (trihalomethanes) 80 µg/L. The detected THMs are probably present as a result of sewer discharge since wastewater treatment plant discharges are usually treated with chlorine. For example, chloroform is formed as a by-product of water treatment processes (i.e., chlorination). The amount of chloroform normally expected to be in treated drinking water is ranges from 2 to 44 ppb (µg/L) (ATSDR, June 2001).

Trichloroethene was detected in sample NTC17PCSW0101 at a concentration of 5.5 µg/L. Trichloroethene does not occur naturally in the environment. However, it has been found in underground water sources and many surface waters as a result of the manufacture, use, and disposal of the chemical.

Acetone was detected in five samples at a maximum concentration (11 µg/L) less than the criteria presented in Table 4.1. The analytical results reported for acetone are similar to those frequently noted in field and laboratory quality assurance blanks. However, only 10 % of the analytical data for Site 17 were validated. Consequently, the positive result reported for acetone may not be site related.

The North Branch of Pettibone Creek receives effluents from industrial point sources, urban runoff, and storm water discharges from several different locations that originate up-stream from the base property as well as surface water run-off/storm water discharge from NTC Great Lakes. Five volatile organic chemicals (including tetrachloroethene, trichloroethene, and vinyl chloride) were detected at location NTC17PCSW0101, at the upstream boundary of the Site 17 study area. Three volatile organic compounds were detected in sample NTC17PCSW02, located further downstream on the North Branch. However, no volatile organic compounds were detected in the samples NTC17PCSW03 and NTC17PCSW04, located on the South Branch.

SVOCs

One phthalate compound (di-N-butyl phthalate, a typical plastizer) was detected in one Site 17 surface water sample (NTC17PCSW0101). The concentration detected was less than the method reporting limit and, consequently, the analytical result was qualified as estimated. The result reported (di-N-butyl phthalate, 2.7 µg/L) is less than the criteria presented in Table 4.1. The analytical result reported for di-N-butyl phthalate is also similar to those frequently noted in laboratory quality assurance blanks. However, only 10 % of the analytical data for Site 17 were validated. Phthalates are common laboratory contaminants and therefore, the detection of di-N-butyl phthalate may not be site related.

PESTICIDES/PCBs

The following four pesticides were detected in the surface water samples collected from Site 17.

- 4,4'-DDD – 0.0054 µg/L (1 positive detection in 6 samples)
- 4,4'-DDT – 0.0064 µg/L to 0.024 µg/L (3 positive detections in 6 samples)
- 4,4'-DDE – 0.029 µg/L (1 positive detection in 6 samples)
- Endosulfan I – 0.01 µg/L (1 positive detection in 6 samples)

The concentrations reported for these compounds are less than the method reporting limits and, consequently, the analytical results were qualified as estimates. The maximum concentrations of 4,4'-DDD, 4,4'-DDT, and 4,4'-DDE were detected in sample NTC17PCSW0201, located just up-stream of the confluence of the North and South Branches. The concentrations of 4,4'-DDD, 4,4'-DDT, and 4,4'-DDE detected in the Site 17 surface water samples are orders of magnitude less than the Illinois TACO Tier I GRO screening criteria, but exceed the ecological surface water screening criteria (0.001 µg/L) presented in Table 4-1. DDT and its breakdown products may enter surface water indirectly when rain-washed soil (i.e. erosion of stream banks and flooding) containing DDT enters surface waters (ATSDR, 1994). The infrequent low-level detections suggest that the contamination is mostly likely the result of historic use of pesticides in the Pettibone Creek Watershed.

The maximum concentration for Endosulfan is less than the criteria presented in Table 4-1.

PCBs were not detected in Site 17 surface water samples.

INORGANICS

The following six inorganic constituents were detected in the surface water samples at concentrations exceeding one or more of the screening criteria presented in Table 4-1:

Parameter	Range Detected (µg/L)	Ecological Screening (µg/L)	TACO Tier 1 GW Ingestion (µg/L)
Aluminum	44.8-9460	87 (5)	NA
Copper	6.9-22.2	17.6 (2)	650 (0)
Iron	84.4-10900	1000 (2)	5,000 (1)
Lead	3-18	16.5 (1)	7.5 (2)
Manganese	14.6-245	1000 (0)	150 (1)
Mercury	0.05-0.1	0.0013 (4)	2 (0)

NA – Not available.
The number of exceedances is presented in parentheses.

Analytical results reported for iron, lead, and manganese in surface water sample NTC17PCSW0301 exceed the Illinois TACO Tier I GRO screening criteria and the ecological surface water screening criteria. (The maximum concentrations were reported for location NTC17PCSW03 in the South Branch near the confluence of the North and South Branches of Pettibone Creek.) The concentrations detected at location NTC17PCSW03 maybe elevated due to sample turbidity (926 NTU).

One or more analytical results reported for six metals (aluminum, copper, iron, lead, manganese, and mercury) exceed the ecological surface water screening criteria. However, metals concentrations at locations NTC17PCSW01, NTC17PCSW03, and NTC17PCSW04 may be elevated due to sample turbidity because of the rain event. Also, results reported for aluminum (C_{max} = 317 µg/L) and mercury (C_{max} = 0.08 µg/L) exceed the ecological surface water screening criteria in filtered samples NTC17BBSW0601 and NTC17PCSW0401, respectively. Sample NTC17BBSW0601 is located in the

Boat Basin. Aluminum was detected in 5 of the 6 filtered samples and mercury was detected in 1 of the 6 filtered samples.

When sample turbidity is considered, metal concentrations at NTC Great Lakes sampling locations are similar, suggesting no obvious primary point source of contamination located on the NTC Great Lakes property. The metals concentrations detected in the NTC Great Lakes surface water samples are likely the result of natural occurrence in combination with past and present releases from sources that originate within the Pettibone Creek Watershed via industrial point sources, urban runoff, erosional processes, flooding events, and storm water through several of the outfalls located along Pettibone Creek.

4.3.2 Surface Sediment – North Branch Pettibone Creek

Twenty-four surface sediment (0 to 4 cm) samples (NTC17PCSD0101 through NTC17PCSD2401), analyzed for TCL PAHs, pesticides, PCBs, and TAL metals, were collected from Site 17 North Branch of Pettibone Creek in accordance with the QAPP (TtNUS, July 2001). Six samples were analyzed for TCL VOCs and SVOCs. The analytical results were used to delineate the nature and extent of contamination and to support human health and ecological risk assessments. Table 4-2 presents the analytical results for the twenty-four surface sediment samples with sample locations shown on Figure 3-3. Descriptive statistics (e.g., frequency of detection, range detected, location of maximum positive detection, etc.) are presented in Table 4-2. Additionally, the analytical results are compared to the following standard and criteria, and the results of that comparison are shown in Table 4-2 and displayed on Figures 4-3 and 4-4.

- **Illinois EPA, TACO Tier 1 Soil Remediation Objective – Ingestion (TACO Tier 1 Soil Remediation Objectives (SROs) -** The TACO Tier 1 SROs are risk-based concentrations for evaluating chemical concentrations in soil. The TACO Tier 1 SROs were calculated for a human receptor hypothetically exposed to chemicals in soil assuming a residential land use scenario and assuming that the receptor was exposed as a result of the daily ingestion of small amount of soil. TACO Tier 1 SROs are also available for the inhalation route of exposure; however, as discussed in Section 6, the inhalation of air-borne soil particulates or vapors is not a significant concern at Site 17. The following narrative focuses on the TACO Tier 1 SROs because these criteria are similar to the Region IX Preliminary Remediation Goal Standards, but the TACO Tier 1 SROs are more relevant the region where the base property is located. The TACO Tier 1 SROs are conservative benchmarks for evaluating the Site 17 sediments because human exposure to sediments is likely to be less intensive than human exposure to surface soil (assuming residential land use scenario).

- **Illinois EPA, TACO Metropolitan Background Concentrations –** Statewide background soil concentrations are provided for a limited list of inorganics in Appendix A, Table G of TACO. According to TACO, these values may "be used as the upper limit of the area background concentration for a site". Background soil concentrations for "Counties Within Metropolitan Statistical Areas" of Illinois are referenced in this report because neither site-specific nor base-specific background concentrations are currently available.

- **Ecological Screening Levels for Sediment –** The ESLs for surface sediment listed in Tables 4-2 through 4-4 are default benchmarks suggested for use in ERA presented in Section 7.0. These criteria are presented as points of reference only.

- **Illinois EPA Unsieved Stream Sediment Background** – The background concentrations for stream sediment presented are a statistical classification of Illinois stream sediment concentrations based on unsieved data collected from 94 background sites. Since there are no standards at the time for Illinois stream sediment concentrations, Kelly and Hite (1984) developed the statistical classification. The information has been used by the Illinois EPA for purposes of classifying stream sediments. Background sediment concentrations for unsieved stream sediment are referenced in this report because neither site-specific nor base-specific background concentrations are currently available.

VOCs

Methylene chloride was detected in sample NTC17PCSD0401 at a concentration of 11 µg/kg in one surface sediment sample collected from Site 17 – North Branch of Pettibone Creek. The analytical result reported for methylene chloride is similar to those frequently noted in field and laboratory quality assurance blanks. However, only 10 % of the analytical data for Site 17 were validated. Consequently, the positive result reported for methylene chloride may not be site related.

SVOCs and PAHs

Two phthalate compounds [bis(2-Ethylhexyl) phthalate and butyl benzyl phthalate] and nineteen PAHs and were detected in the North Branch surface sediment samples. The phthalate compounds (typical plasticizers) were detected at maximum concentrations of 680 µg/kg and 37 µg/kg, respectively. These concentrations reported are orders of magnitude less than the TACO and the ecological screening criteria presented in Table 4-2. Phthalates are common laboratory contaminants and therefore, the detection of bis(2-Ethylhexyl) phthalate and butyl benzyl phthalate may not be site related.

The analytical results for the PAHs are summarized below and compared to concentrations reported in the scientific literature for background soil samples.

Parameter	Range Detected (µg/kg)	Background Concentration Reported in Rural/Urban Background Soils [1] (µg/kg)
2-Methylnaphthalene	55-93	17-640 [2]
Acenaphthylene	13-92	18-1,100 [2]
Anthracene	37-4,000	29-5,700 [2]
Benzo(a)anthracene	150-11,000	5-20/169-59,000
Benzo(a)pyrene	130-11,000	2-1,300/165-220
Benzo(b)fluoranthene	150-12,000	20-30/15,000-62,000
Benzo(g,h,i)perylene	70-7,500	10-70/900-47,000
Benzo(k)fluoranthene	78-6,300	10-110/300-26,000
Carbazole	75-720	NA
Chrysene	150-12,000	38.3/251-640
Dibenzofuran	37-250	NA
Fluoranthene	380-33,000	0.3-40/200-166,000
Fluorene	21-2,400	22-3,300 [2]
Indeno(1,2,3-CD)pyrene	70-5,800	10-15/8,000-61,000
Phenanthrene	210-24,000	30/NA and 71-36,000 [2]
Pyrene	310-27,000	1-19.7/145-147,000

1 Unless noted otherwise, data presented in the Toxicological Profile for Polycyclic Aromatic Hydrocarbons, Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Public Health Service (ATSDR, October 1989).

2 Data presented for soil samples collected from several cities, Table 3 in Background Levels of Polycyclic Aromatic Hydrocarbons and Selected Metals in New England Urban Soils (Bradley et al, 1994).

The maximum concentrations listed above were reported for sample NTC17PCSD0101, located at the upstream boundary of the Site 17 study area. The interpretation of the PAH data must consider that Pettibone Creek receives urban runoff and storm water from areas that are paved with petroleum asphalt that contain a mixture of paraffinic and aromatic hydrocarbons and heterocyclic compounds [including PAHs (Hawley et al, 1993)]. The asphalt is a likely, predominant source of the PAHs. PAHs are also produced during fossil fuel combustion and are natural components of crude and refined petroleum and of coal (Anthropogenic Sources, qlink.queens.ca/~4mql/pg1.5.html). In addition, the PAH concentrations noted in the North Branch surface sediments are less than or similar to the range of concentrations reported in the scientific literature for background soil samples.

PESTICIDES/PCBs

Twelve pesticides and two PCBs were detected in the surface sediment samples collected from the North Branch. 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD were detected in the 24 samples with maximum concentrations of 1800 µg/kg (NTC17PCSD0501), 210 µg/kg (NTC17PCSD1901), and 170 µg/kg (NTC17PCSD1901), respectively. Sample NTC17PCSD0501 is located downstream from two outfalls that discharge urban runoff from the roadway and bridge. Sample NTC17PCSD1901 is located downstream from an outfall that discharges urban runoff into the North Branch. Aroclor-1254 was detected in 14 of 24 samples with a maximum concentration of 440 µg/kg in sample NTC17PCSD1901. Aroclor-1260 was detected in 12 of 24 samples with a maximum concentration of 150 µg/kg in sample NTC17PCSD0301. The maximum concentrations for the pesticides and PCBs are orders of magnitudes less than the TACO screening criteria presented in Table 4-2.

The eight pesticides and two PCBs listed below were detected at concentrations exceeding the ecological screening criteria presented in Table 4-2.

Parameter	Range Detected (µg/kg)	Ecological Screening (µg/kg)
4,4'-DDD	2.3-170	2 (24)
4,4'-DDE	4.3-210	2 (24)
4,4'-DDT	4.9-1800	1 (24)
Aldrin	6.4	0.51 (1)
Alpha-Chlordane	0.16-6.9	0.5 (12)
Aroclor-1254	56-440	60 (13)
Aroclor-1260	41-150	5 (12)
Endosulfan I	1.1	0.15 (1)
Endosulfan II	0.52-12	0.15 (9)
Gamma-Chlordane	0.91-2.9	0.5 (7)

The number of exceedances is presented in parentheses.

Pesticide contamination is probably a result of historic use of these compounds throughout the watershed, particularly in developed areas. Previous PCB data suggest significant possible upstream sources may have contributed to the sediment contamination. In addition, PCB contamination of sediments may have occurred due to storage by NTC Great Lakes of out-of-service transformers (some filled with PCB-containing oil) at various locations within the base. Past investigations at these storage locations indicated that some limited soil contamination exceeded federal and State clean-up guidelines. However, there is no clean-up documentation available on the PCB-contaminated soil. Contamination was reported to be limited and restricted to the transformer storage locations. There are no analytical data available indicating that the transformer storage locations are a source of contamination at Pettibone Creek and the Boat Basin. The historical data show a maximum concentration of 12 mg/kg for Aroclor-1254.

INORGANICS

With the exception of arsenic, inorganic constituents were detected in one or more of the 24 North Branch surface sediment samples at concentrations less than TACO screening criteria present in Table 4-2. However, the arsenic results were less than the TACO metropolitan background concentration screening criteria presented in Table 4-2.

The nine inorganic constituents listed below exceeded the ecological screening criteria and seven constituents exceeded the Illinois unsieved background screening criteria presented in Table 4-2.

Parameter	Range Detected (mg/kg)	Ecological Screening (mg/kg)	TACO Tier 1 SRO Ingestion (mg/kg)	Illinois Unsieved Stream Sediment Background (mg/kg)
Arsenic	3.7-10.4	6 (7)	13*	8 (3)
Cadmium	0.11-4.2	0.6 (6)	78	0.5 (9)
Chromium	8.4-55.8	26 (3)	390	16 (9)
Copper	35.1-477	16 (24)	2,900	38 (23)
Lead	30.8-322	31 (23)	400	28 (24)
Manganese	243-662	460 (3)	3,700	1300
Mercury	0.04-4.7	0.2 (8)	23	0.07 (19)
Silver	0.55-3.2	1 (5)	390	NA
Zinc	126-2,120	120 (24)	23,000	80 (24)

NA – Not available.
The number of exceedances is presented in parentheses.
* TACO Metropolitan Background Value.

The maximum concentrations for the detected inorganic constituents were reported for several different sample locations through out the North Branch. Copper, lead, mercury, selenium, silver, and zinc are an order of magnitude greater than the Illinois Unsieved Stream Sediment Background. The metals concentrations detected in the NTC Great Lakes surface sediment samples are likely the result of natural occurrence in combination with past and present releases from sources that originate within the Pettibone Creek Watershed including industrial point sources, urban runoff, erosional processes, flooding events, and storm water discharge through several of the outfalls located along Pettibone Creek. The industrial metals, cadmium, chromium, copper, lead, mercury, and zinc were consistently detected in the samples throughout the North Branch samples at concentrations that exceed ecological screening criteria.

4.3.3 Surface Sediment – South Branch - Pettibone Creek

Fourteen surface sediment samples, analyzed for TCL PAHs, pesticides, PCBs, and TAL metals, and two samples, analyzed for TCL VOCs and SVOCs, were collected from Site 17 – South Branch of Pettibone Creek in accordance with the QAPP (TtNUS, July 2001). The analytical results were used to delineate the nature and extent of contamination and to support human health and ecological risk assessments. Table 4-3 presents the analytical results for the fourteen surface sediment samples with sample locations shown on Figure 3-4. Descriptive statistics (e.g., frequency of detection, range detected, location of maximum positive detection, etc.) are presented in Table 4-3.

VOCs

Methylene chloride was detected in only sample NTC17PCSD2901, collected from Site 17 – South Branch of Pettibone Creek. The analytical result reported for methylene chloride is similar to those frequently noted in field and laboratory quality assurance blanks. However, only 10% of the analytical data for Site 17 were validated. Consequently, the positive results reported for methylene chloride may not be site related.

SVOCs and PAHs

One phthalate compound [bis(2-ethylhexyl) phthalate] and thirteen PAHs and were detected in the South Branch surface sediment samples. The phthalate compound (a typical plasticizer) was detected in two samples with the maximum concentration of 130 µg/kg in sample NTC17PCSD2901. The results are orders of magnitude less than the Illinois TACO screening criteria presented in Table 4-3. Phthalates are common laboratory contaminants and therefore, the detection of bis(2-Ethylhexyl) phthalate may not be site related.

The analytical results for the PAHs are summarized below and compared to concentrations reported in the scientific literature for background soil samples:

Parameter	Range Detected (µg/kg)	Background Concentration Reported in Rural/Urban Background Soils [(1)] (µg/kg)
Acenaphthylene	25-51	18-1,100 [(2)]
Anthracene	19-1,100	29-5,700 [(2)]
Benzo(a)anthracene	69-2,800	5-20/169-59,000
Benzo(a)pyrene	66-2,100	2-1,300/165-220
Benzo(b)fluoranthene	61-2,200	20-30/15,000-62,000
Benzo(g,h,i)perylene	34-990	10-70/900-47,000
Benzo(k)fluoranthene	34-1,300	10-110/300-26,000
Chrysene	65-2,900	38.3/251-640
Fluoranthene	160-9,000	0.3-40/200-166,000
Fluorene	13-410	22-3,300 [(2)]
Indeno(1,2,3-CD)pyrene	37-880	10-15/8,000-61,000
Phenanthrene	85-6,300	30/NA and 71-36,000 [(2)]
Pyrene	130-6,400	1-19.7/145-147,000

1 Unless noted otherwise, data presented in the Toxicological Profile for Polycyclic Aromatic Hydrocarbons, Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Public Health Service (ATSDR, October 1989).

2 Data presented for soil samples collected from several cities, Table 3 in Background Levels of Polycyclic Aromatic Hydrocarbons and Selected Metals in New England Urban Soils (Bradley et al, 1994).

The maximum concentrations listed above were reported for sample NTC17PCSD2701, except acenaphthylene, fluorene, and phenanthrene which had maximum concentrations reported for sample NTC17PCSD3501. Sample NTC17PCSD2701 is located downstream of a storm water outfall. The interpretation of the PAH data must consider that Pettibone Creek receives urban runoff and storm water from areas that are paved with petroleum asphalt that contain a mixture of paraffinic and aromatic hydrocarbons and heterocyclic compounds [including PAHs (Hawley et al, 1993)]. The asphalt is a likely, predominant source of the PAHs. PAHs are also produced during fossil fuel combustion and are natural components of crude and refined petroleum and of coal (Anthropogenic Sources, qlink.queens.ca/~4mql/pg1.5.html). In addition, the PAH concentrations noted in the South Branch surface sediments are similar to the range of concentrations reported in the scientific literature for background soil samples. Finally, the average PAH concentrations reported for the South Branch sediment are two to ten times less than the North Branch average PAH concentrations.

PESTICIDES/PCBs

Ten pesticides and three PCBs were detected in the surface sediment samples collected from the South Branch. 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD were detected in the 14 samples at maximum concentrations of 290 µg/kg (NTC17PCSD3101), 31 µg/kg (NTC17PCSD2701), and 32 µg/kg (NTC17PCSD3501), respectively. Aroclor-1248 was detected in 1 of 14 samples at a concentration of 50 µg/kg sample (NTC17PCSD3101). Aroclor-1254 was detected in 3 of 14 samples at a maximum concentration of 140 µg/kg in sample NTCPCSD2901. Aroclor-1260 was detected in 1 of 11 samples at a maximum concentration of 55 µg/kg in sample NTC17PCSD3301. The maximum concentrations for the pesticides and PCBs are orders of magnitude less than the TACO screening criteria presented in Table 4-3.

The six pesticides and three PCBs listed below were detected at concentrations exceeding the ecological screening criteria presented in Table 4-3.

Parameter	Range Detected (µg/kg)	Ecological Screening (µg/kg)
4,4'-DDD	7.6-32	2 (14)
4,4'-DDE	10-31	2 (14)
4,4'-DDT	8.5-290	1 (14)
Alpha-Chlordane	0.35 -2.4	0.5 (11)
Aroclor-1248	50	30 (1)
Aroclor-1254	84-140	60 (3)
Aroclor-1260	55	5 (1)
Endosulfan II	0.3-1.9	0.15 (7)
Gamma-Chlordane	0.31-1.6	0.5 (11)

The number of exceedances is presented in parentheses.

Pesticide contamination is probably a result of historic use of these compounds throughout the watershed, particularly in developed areas.

INORGANICS

With the exception of arsenic, inorganic constituents were detected in one or more of the 14 South Branch surface sediment samples at concentrations less than TACO screening criteria present in Table 4-3. However, the arsenic results were less than the TACO metropolitan background concentration screening criteria presented in Table 4-3.

The five inorganic constituents listed below were detected at concentrations exceeding the ecological screening criteria and/or the Illinois unsieved background screening criteria presented in Table 4-3.

Parameter	Range Detected (mg/kg)	Ecological Screening (mg/kg)	TACO Tier 1 SRO Ingestion (mg/kg)	Illinois Unsieved Stream Sediment Background (mg/kg)
Copper	3.4-46.2	16 (7)	2,900	38 (1)
Lead	8.3-57.9	31 (7)	400	28 (9)
Manganese	177-504	460 (1)	3,700	1300
Mercury	0.02-0.23	0.2 (1)	23	0.07 (9)
Zinc	31-253	120 (4)	23,000	80 (7)

The number of exceedances is presented in parentheses.

The maximum concentrations of copper, lead, and zinc were detected in sample NTC17PCSD2601 and the maximum concentration of mercury was detected in sample NTC17PCSD3401. The average concentrations of copper, lead, and zinc in the South Branch Sediment are an order of magnitude less than the average concentrations in the North Branch concentrations in the North Branch sediments. The maximum detected surface sediment concentrations of copper, lead, zinc, and mercury are greater than the Illinois EPA Unsieved Stream Sediment Background Concentrations. Each of these metals is a naturally occurring metal and an industrial metal. The probable sources are natural occurrence in combination with the storm water discharges and road runoff within the Pettibone Creek Watershed.

4.3.4 Surface Sediment - Boat Basin

Twelve surface sediment samples, analyzed for TCL PAHs, pesticides, PCBs, and TAL metals, were collected from Site 17 – Boat Basin in accordance with the QAPP (TtNUS, July 2001). One surface sediment sample was analyzed for TCL VOCs and SVOCs. The analytical results were used to delineate the nature and extent of contamination and to support human health and ecological risk assessments. Table 4-4 presents the analytical results for the twelve surface sediment samples with sample locations shown on Figure 3-5. Descriptive statistics (e.g., frequency of detection, range detected, location of maximum positive detection, etc.) are presented in Table 4-4. Additionally, the analytical results are compared to the standards and criteria (previously discussed), and the results of that comparison are shown in Table 4-4 and displayed on Figures 4-7 and 4-8.

VOCs

Methylene chloride was detected in sample NTC17BBSD4701 at a maximum concentration of 6.6 µg/kg in the surface sediment samples collected from Site 17 – Boat Basin. The analytical result reported for methylene chloride is similar to those frequently noted in field and laboratory quality assurance blanks. However, only 10 % of the analytical data for Site 17 were validated. Consequently, the positive result reported for methylene chloride may not be site related.

SVOCs and PAHs

One phthalate compound [bis(2-ethylhexyl) phthalate] and fourteen PAHs and were detected in the Boat Basin surface sediment samples. The result reported [bis(2-ethylhexyl) phthalate, 610 µg/kg] is orders of magnitude less than the Illinois TACO screening criteria presented in Table 4-4. Phthalates are common laboratory contaminants and therefore, the detection of bis(2-Ethylhexyl) phthalate may not be site related.

The analytical results for the PAHs are summarized below and compared to concentrations reported in the scientific literature for background soil samples:

Parameter	Range Detected (µg/kg)	Background Concentration Reported in Rural/Urban Background Soils [(1)] (µg/kg)
Acenaphthylene	24-200	18-1,100 [(2)]
Anthracene	49-1,900	29-5,700 [(2)]
Benzo(a)anthracene	250-4,900	5-20/169-59,000
Benzo(a)pyrene	260-4,500	2-1,300/165-220
Benzo(b)fluoranthene	280-4,500	20-30/15,000-62,000
Benzo(g,h,i)perylene	200-2,800	10-70/900-47,000
Benzo(k)fluoranthene	150-2,500	10-110/300-26,000
Chrysene	270-4,900	38.3/251-640
Fluoranthene	730-14,000	0.3-40/200-166,000
Fluorene	40-1,300	22-3,300 [(2)]
Indeno(1,2,3-CD)pyrene	150-2,000	10-15/8,000-61,000
Naphthalene	1,200	NA
Phenanthrene	380-10,000	30/NA and 71-36,000 [(2)]
Pyrene	560-11,000	1-19.7/145-147,000

1 Unless noted otherwise, data presented in the Toxicological Profile for Polycyclic Aromatic Hydrocarbons, Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Public Health Service (ATSDR, October 1989).
2 Data presented for soil samples collected from several cities, Table 3 in Background Levels of Polycyclic Aromatic Hydrocarbons and Selected Metals in New England Urban Soils (Bradley et al, 1994).

PAHs were detected in the 12 surface sediment samples collected. As summarized in Table 4-4, twelve of the analytical results reported PAHs exceed the TACO screening criteria for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene. Most of the PAHs listed above were detected at a maximum concentration at location NTC17PCSD45, located downstream from an outfall. However, the PAHs concentrations may be inflated due to the total organic carbon concentration (7250 mg/kg) of that sample. Analytical results reported for 12 PAHs exceeded the ecological screening criteria and the maximum concentrations were located at NTC17BBSD4501. The interpretation of the PAH data must consider that Pettibone Creek receives urban runoff and storm water from areas that are paved with petroleum asphalt that contain a mixture of paraffinic and aromatic hydrocarbons and heterocyclic compounds [including PAHs (Hawley et al, 1993)]. The asphalt is a likely, predominant source of the PAHs. PAHs are also produced during fossil fuel combustion and are natural components of crude and refined petroleum and of coal (Anthropogenic Sources, qlink.queens.ca/~4mql/pg1.5.html). In addition, most of the PAH concentrations (except for benzo(a)pyrene and chrysene) noted in the Site 17 surface sediments are similar to the range of concentrations reported in the scientific literature for background soil samples.

PESTICIDES/PCBs

Seventeen pesticides and two PCBs were detected in the surface sediment samples collected from the Boat Basin. 4,4'-DDD, 4,4'-DDE, and alpha-chlordane were detected in the 12 samples at maximum concentrations of 310 µg/kg (NTC17BBSD4801), 230 µg/kg (NTC17BBSD4801), and 11 µg/kg (NTC17BBSD4801) respectively. Aroclor-1254 was detected in 4 of 12 samples at a maximum concentration of 660 µg/kg in sample NTC17BBSD4801. Aroclor-1260 was detected in 3 of 12 samples at a maximum concentration of 270 µg/kg in sample NTC17BBSD4801. The maximum concentrations for the pesticides and PCBs are an order of magnitude less than the TACO screening criteria presented in Table 4-4. The thirteen pesticides and two PCBs listed below exceed the ecological screening criteria presented in Table 4-4.

Parameter	Range Detected (µg/kg)	Ecological Screening (µg/kg)
4,4'-DDD	71-310	2 (12)
4,4'-DDE	55-230	2 (12)
4,4'-DDT	34-120	1 (11)
Aldrin	4.1	0.51 (1)
Alpha-BHC	6.5	0.023 (1)
Alpha-Chlordane	1.2-11	0.5 (12)
Aroclor-1254	79-660	60 (4)
Aroclor-1260	49-270	5 (3)
Beta-BHC	5.6-7.6	0.37(3)
Endosulfan I	0.68-8.7	0.15 (10)
Endosulfan II	0.94-12	0.15 (9)
Endosulfan sulfate	7.3	5.4 (1)
Gamma-BHC (Lindane)	4.6	0.39 (1)
Gamma-Chlordane	1.2-8	0.5 (10)
Methoxychlor	32	8.8 (1)

The number of exceedances is presented in parentheses.

Pesticide contamination is probably a result of historic use of these compounds throughout the watershed, particularly in developed areas. Previous PCB data suggest significant possible upstream sources may have contributed to the sediment contamination. In addition, PCB contamination of sediments may have occurred due to storage by NTC Great Lakes of out-of-service transformers (some filled with PCB-containing oil) at various locations within the base. Past investigations at these storage locations indicated that some limited soil contamination exceeded federal and State clean-up guidelines. However, there is no clean-up documentation available on the PCB-contaminated soil. Contamination was reported to be limited and restricted to the transformer storage locations. There are no analytical data available indicating that the transformer storage locations are a source of contamination at Pettibone Creek and the Boat Basin. The historical data show a maximum concentration of 12 mg/kg for Aroclor-1254.

INORGANICS

With the exception of arsenic, inorganic constituents were detected in the 12 surface sediment samples from the Boat Basin were less than the TACO screening criteria. However, the arsenic results were less than the TACO metropolitan background concentration screening criteria presented in Table 4-4.

The eleven inorganic constituents listed below were detected at concentrations exceeding the ecological screening criteria and/or the Illinois unsieved background screening criteria presented in Table 4-4.

Parameter	Range Detected (mg/kg)	Ecological Screening (mg/kg)	TACO Tier 1 SRO Ingestion (mg/kg)	Illinois Unsieved Stream Sediment Background (mg/kg)
Arsenic	3.4-9.9	6 (1)	13*	8 (1)
Cadmium	0.23-2.2	0.6 (4)	78	0.5 (6)
Chromium	7.9-28.9	26 (1)	390	16 (1)
Copper	55.5-283	16 (12)	2,900	38 (12)
Iron	7,410-19,200	20,000	NA	18,000 (1)
Lead	47.6-289	31 (12)	400	28 (12)
Manganese	226-731	460 (2)	3,700	1,300
Mercury	0.068-0.95	0.2 (3)	23	0.07 (11)
Nickel	8.9-31.5	30 (1)	1,600	NA
Silver	0.29-4.2	1 (2)	390	NA
Zinc	247-2,070	120 (12)	23,000	80 (12)

NA – Not available.
The number of exceedances is presented in parentheses.
* = TACO Metropolitan Background Value.

The maximum concentrations for most of the above constituents were detected in sample NTC17PCSD4801, located in the northeast corner of the Boat Basin near two separate outfalls. The inorganic concentrations in sample NTC17PCSD4801 may be inflated due to the total organic carbon concentration (21800 mg/kg). The maximum concentration of manganese and zinc were detected in sample NTC17PCSD4901; and the maximum concentration of nickel was detected in sample NTC17PCSD5401. Copper, lead, and zinc are an order of magnitude greater than the Illinois unsieved stream sediment background concentrations. However, the reported results for samples NTC17PCSD4801 and NTC17PCSD4901 may be inflated due to the total organic carbon concentrations of 21800 mg/kg and 7760 mg/kg, respectively. The inorganic constituents are a result of industrial point sources, urban runoff, erosional processes, flooding events, and storm water discharge through outfalls along Pettibone Creek as well as natural occurrence. These metal concentrations in the Boat Basin are similar to those noted in the North Branch.

4.3.5 Sediment at Depth North Branch and South Branch Pettibone Creek, and Boat Basin

A total of fifty sediment at depth samples were collected from Site 17, Pettibone Creek – North Branch (11 samples), Pettibone Creek – South Branch (3 samples), and the Boat Basin (36 samples) and analyzed for TCL PAHs, Pesticides, PCBs, and TAL metals in accordance with the QAPP (TtNUS, 2001). Ten samples from the North and South Branches and two samples in the Boat Basin were also analyzed for TCL VOCs and SVOCs. The samples in the North and South Branches were collected at a 1-foot depth, and the Boat Basin samples were collected from three depth intervals: 4 cm to 3 feet, 3 to 6 feet, and 6 to 10 feet (more detailed information is provided in Sections 3.2.2.1 and 3.2.2.2). The analytical results were used to delineate the nature and extent of contamination. Tables 4-5, 4-6, and 4-7 present analytical results reported for the sediment at depth samples with sample locations shown on Figures 3-3, 3-4, and 3-5. Descriptive statistics (e.g., frequency of detection, range detected, location of maximum positive detection, etc.) are presented in Tables 4-5, 4-6, and 4-7. Additionally, the analytical results are compared to previously defined standards and criteria, and the results of that comparison are shown in Tables 4-5, 4-6, and 4-7 and displayed on Figures 4-9 through 4-15.

VOCs

No volatile organic compounds were detected in the sediment at depth samples from the North and South Branches of Pettibone Creek. Methylene chloride was detected in the sediment at depth samples collected from the Boat Basin. Methylene chloride was detected in sample NTC17BBSD5303 at a maximum concentration of 11 µg/kg and did not exceed the criteria presented in Table 4-7. The analytical result reported for methylene chloride is similar to those frequently noted in field and laboratory quality assurance blanks. However, only 10 % of the analytical data for Site 17 were validated. Consequently, the positive result reported for methylene chloride may not be site related.

SVOCs

Thirteen PAHs were detected in both the North Branch and the South Branch sediment at depth samples and fifteen PAHs and one phthalate compound [bis(2-ethylhexyl) phthalate] were detected in the Boat Basin sediment at depth samples. The maximum detected analytical results for the PAHs are summarized below and compared to concentrations reported in the scientific literature for background soil samples:

Parameter	Range Detected (µg/kg)	Background Concentration Reported in Rural/Urban Background Soils (1) (µg/kg)
Acenaphthylene*	130-230	18-1,100 (2)
Anthracene*	54-1,600	29-5,700 (2)
Benzo(a)anthracene*	230-4,100	5-20/169-59,000

Parameter	Range Detected (µg/kg)	Background Concentration Reported in Rural/Urban Background Soils (1) (µg/kg)
Benzo(a)pyrene*	230-4,000	2-1,300/165-220
Benzo(b)fluoranthene*	240-4,100	20-30/15,000-62,000
Benzo(g,h,i)perylene*	170-2,600	10-70/900-47,000
Benzo(k)fluoranthene*	130-2,300	10-110/300-26,000
Chrysene*	240-4,200	38.3/251-640
Fluoranthene*	580-13,000	0.3-40/200-166,000
Fluorene**	33-910	22-3,300 (2)
Indeno(1,2,3-CD)pyrene*	120-1,600	10-15/8,000-61,000
Phenanthrene*	270-8,500	30/NA and 71-36,000 (2)
Pyrene*	480-9,700	1-19.7/145-147,000

1 Unless noted otherwise, data presented in the Toxicological Profile for Polycyclic Aromatic Hydrocarbons, Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Public Health Service (ATSDR, October 1989).
2 Data presented for soil samples collected from several cities, Table 3 in Background Levels of Polycyclic Aromatic Hydrocarbons and Selected Metals in New England Urban Soils (Bradley et al, 1994).
* Denotes maximum concentration detected in the North Branch.
** Denotes maximum concentration detected in the Boat Basin.

Three PAHs [benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene] were detected at concentrations exceeding the TACO screening criteria. With the exception of benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene all of the PAHs listed above exceed the ecological screening criteria. The maximum concentrations were reported for samples from the North Branch and ranged from two to twenty times greater than the concentrations in the South Branch samples. The concentrations reported from the Boat Basin were less the North Branch but greater than those reported for the South Branch. The maximum concentrations of PAHs were detected in sample NTC17PCSD0102, except the maximum concentration of acenaphthylene was detected in sample NTC17PCSD0402. Sample NTC17PCSD0102 is located at the upstream boundary of the Site 17 study area. Sample NTC17PCSD0402 is the next sample location downstream from sample NTC17PCSD0102 on the North Branch. In addition, the Pettibone Creek Watershed receives urban runoff and storm water from areas that are paved with petroleum asphalt which that contains a mixture of paraffinic and aromatic hydrocarbons and heterocyclic compounds [including PAHs (Hawley et al, 1993)]. The asphalt is a likely, predominant source of the PAHs. PAHs are also produced during fossil fuel combustion and are natural components of crude and refined petroleum and of coal (Anthropogenic Sources, qlink.queens.ca/~4mql/pg1.5.html). Even though several PAHs exceed ecological screening criteria, the PAH concentrations detected in the Site 17 sediment at depth samples are similar to the range of concentrations reported in the scientific literature for background soil samples.

Bis (2-ethylhexyl)phthalate was detected in sample NTC17BBSD5303 at a maximum concentration of 6300 µg/kg, an order of magnitude less than the Illinois TACO screening criteria presented in Table 4-5. Phthalates are common laboratory contaminants and therefore, the detection of bis(2-Ethylhexyl) phthalate may not be site related.

PESTICIDES/PCBs

Twelve pesticides and three PCBs were detected in the at depth samples from the North Branch, ten pesticides were detected in samples from the South Branch, and eighteen pesticides and three PCBs were detected in the sediment at depth samples collected from the Boat Basin. The maximum concentrations were detected in the samples from the Boat Basin except the maximum concentration of 4,4'-DDT was detected in sample NTC17PCSD0402 located on the North Branch. The concentrations reported for samples from the North Branch were greater than those collected from the South Branch. In the North Branch, 4,4-DDT was detected at a maximum concentration of 580 µg/kg in sample NTC17PCSD0402. In the Boat Basin, 4,4'-DDE, and 4,4'-DDD were detected in the 36 samples at maximum concentrations of 540 µg/kg (NTC17BBSD4505) and 4100 µg/kg (NTC17BBSD4604), respectively. Aroclor-1248 was detected in 11 of 36 samples at a maximum concentration of 1500 µg/kg in samples NTC17BBSD4804 and NTC17BBSD5004. Aroclor-1254 was detected in 34 of 36 samples at a maximum concentration of 6100 µg/kg in sample NTC17BBSD4505. Aroclor-1260 was detected in 27 of 36 samples at a maximum concentration of 1100 µg/kg in sample NTC17BBSD4803.

The seventeen pesticides and three PCBs listed below exceed the ecological screening criteria presented in Table 4-5. In addition, two pesticides and three PCBs listed below exceed the TACO screening criteria.

Parameter	Range Detected (µg/kg)	TACO Tier 1 SRO Ingestion (µg/kg)
4,4'-DDD	30-4,100	3,000 (3)
4,4'-DDE	13-540	2,000
4,4'-DDT	6.5-400	2,000
Aldrin	1.8	40
Alpha-BHC	4.1	100
Alpha-Chlordane	2-95	50 (3)
Aroclor-1248	130-1,500	1,000 (2)

Parameter	Range Detected (µg/kg)	TACO Tier 1 SRO Ingestion (µg/kg)
Aroclor-1254	130-6,100	1,000 (16)
Aroclor-1260	47-1,100	1,000 (1)
Beta-BHC	2.9-6.4	NA
Dieldrin	1.6-77	40 (2)
Endosulfan I	0.92-31	470,000
Endosulfan II	1.2-41	470,000
Endrin	2.6-41	23,000
Gamma-BHC (Lindane)	2.8	500
Gamma-Chlordane	1.1-36	50
Methoxychlor	11-16	390,000

NA – Not available.
The number of exceedances is presented in parentheses.

Pesticides and PCBs strongly adhere to soil particles and are fairy immobile. The greater concentrations detected in the Boat Basin samples suggests that the pesticides and PCBs were adhered to soil particles that entered the Pettibone Creek via urban runoff, erosional processes, flooding events, and storm water discharges. The increase in concentrations in the Boat Basin is a result of sedimentation following the aforementioned processes. The average PCB concentrations presented on Table 4-11 suggest slight increases in concentrations of PCBs in historical deeper samples, particularly in Boat Basin samples. The pesticide concentrations also vary with depth in the Boat Basin. Many at depth concentrations are orders of magnitude increased in the Boat Basin compared to the other data sets. The aforementioned is evidence that PCB/pesticide contamination was more of a problem in the past.

INORGANICS

Twenty-three inorganic constituents were detected in the 11 at-depth samples of the North Branch, and twenty-two inorganic constituents were detected in at-depth samples from the South Branch and Boat Basin. Arsenic exceeded the TACO metropolitan background concentration screening criteria in two of the eleven samples of the North Branch and nine of the thirty-six samples of the Boat Basin, respectively. The maximum concentration (34.2 mg/kg) was detected in sample NTC17PCSD0402, located downstream from the beginning of the Site 17 study area on the North Branch. However, the average concentrations of arsenic are similar in the North Branch and Boat Basin.

A maximum concentration for lead (435 mg/kg) was detected in sample NTC17PCSD0402 located on the North Branch. This value is similar to the 400 mg/kg screening criteria. The average concentration calculated for Boat Basin samples (253.7 mg/kg) is greater than the average calculated for the North Branch samples (159.5 mg/kg).

The following twelve constituents were detected at concentrations exceeding the Illinois unsieved background screening criteria presented in Table 4-7:

Parameter	Range Detected (mg/kg)	TACO Tier 1 Ingestion (mg/kg)	Illinois Unsieved Stream Sediment Background (mg/kg)
Antimony	0.45-2.7	31	NA
Arsenic	4.7-34.2	13* (2)	8 (3)
Cadmium	0.24-5.7	78	0.5 (5)
Chromium	9.8-31	390	16 (5)
Copper	39.4-577	2,900	38 (11)
Iron	10,400-30,300	NA	18,000 (2)
Lead	71.9-435	400 (1)	28 (11)
Manganese	291-1,600	3,700	1,300 (1)
Mercury	0.07-0.87	23	0.07 (10)
Nickel	11.2-44	1,600	NA
Silver	0.65-5.5	390	NA
Zinc	171-2,620	23,000	80 (11)

NA – Not available.
The number of exceedances is presented in parentheses.
* = TACO Background Value.

The maximum concentrations for antimony (C_{max} = 2.7), arsenic (C_{max} = 34.2 mg/kg), cadmium (C_{max} = 5.7 mg/kg), chromium (C_{max} = 31 mg/kg), lead (C_{max} = 435 mg/kg), mercury (C_{max} = 0.87 mg/kg), and nickel (C_{max} = 44 mg/kg) were detected in sample NTC17PCSD0402, the second sample location in the Site 17 study area on the North Branch. The maximum concentration for iron (C_{max} = 30300 mg/kg) was detected in sample NTC17PCSD1402, located on the North Brach near a bridge. The maximum concentration for zinc (C_{max} = 2620 mg/kg) was detected in sample NTC17PCSD0102, the first sample location in the Site 17 study area on the North Branch. The analytical data suggest that the primary source of contamination is historical discharge and storm water discharge within the Pettibone Creek Watershed. The analytical results from the Boat Basin suggest that the at-depth samples are more contaminated than the surface sediment samples, again, indicating that metals contamination of the Pettibone Creek Watershed was more of a problem historically.

4.4 HISTORICAL DATA COMPARISON

A historical data review was completed for Site 17 by comparing seven TtNUS samples to the historical data from previous reports. The samples selected were determined by overlaying the previous sample locations with the most recent TtNUS sample locations. The sample locations that were closest together were chosen for comparison as shown on Figure 4-16.

Table 4-8 shows the semivolatile data for co-located samples (historical and recent). The semivolatile compounds (phthalates) that were previously detected were not detected (or detected infrequently) in the most recent samples. However, the PAH concentrations increased since 1994 for the co-located samples with the exception of NTC17PCSD09/X201-94 and NTC17PCSD30/X202-94 in which case the concentrations decreased since the 1994 investigation. Sample NTC17PCSD09/X201-94 was collected from a tributary to the North Branch of Pettibone Creek. Sample NTC17PCSD30/X202-94 was collected from in the South Branch of Pettibone Creek; PAH concentrations at the location decreased since the 1994 investigation. There could be several reasons for the increased PAH concentrations but the most notable one is the fact that more roads are being constructed and hence, increased vehicle traffic. This increase could also be due to the severe erosion and flash floods that have been known to occur in the Creek.

Table 4-9 shows the pesticide data for co-located samples (historical and recent). The analytical data indicate that pesticide concentrations in the North Branch (NTC17PCSD02/SD-PC-09) and the South Branch (NTC17PCSD30/X202-94) have decreased over time. Samples NTC17PCSD09/X201-94 (in the tributary to North Branch) also had pesticide concentrations that decreased. Sample pairs NTC17PCSD05/SD-PC-08, NTC17PCSD14/SD-PC-07, and NTC17PCSD24/SD-PC-01 had concentrations that increased, some of them by one or more orders of magnitude. The sample B-204 was not analyzed for pesticides and therefore not compared to the TtNUS sample from the Boat Basin.

Table 4-9 shows the PCB data for co-located samples (historical and recent). PCBs were not detected in the historic samples NTC17PCSD02/SD-PC-09 and NTC17PCSD14/SD-PC-07; positive detections were reported for TtNUS 2001 Investigation. However, PCB concentrations reported for other sampling locations decreased since the previous sampling events (i.e., were either now non-detected or had lower concentrations than in the past).

Table 4-10 shows the metal data for co-located samples (historical and recent). Most of the analytical results reported for the TtNUS samples are less than those reported for historical samples. There are a few exceptions. Copper and/or zinc concentrations in recent samples NTC17PCSD05, NTC17PCSD09, NTC17PCSD24, and NTC17BBSD52 were greater than concentrations for SD-PC-08, X201-94, SD-PC-01, and B-204, respectively. The sediment at depth samples have much higher concentrations than the surface sediment samples. Because the industrial operations north of Pettibone Creek have decreased, the surface sediment in Pettibone Creek is not as contaminated as in the past.

4.5 SUMMARY AND CONCLUSIONS

The following items briefly summarize the nature and extent of contamination detected at Site 17:

- **Environmental contaminants detected in the surface waters and sediments of Site 17.** Predominant inorganic contaminants in the Site 17 sediments (e.g., copper, lead, and zinc) were identified as significant environmental contaminants in sediment samples collected upstream and off-site of Site 17 during past environmental investigations. Although overland run-off and stormwater discharges from Site 17 may contribute pollutants to the watershed, the analytical results available for the Site 17 area do not suggest that a significant point source(s) from NTC Great Lakes is (are) impacting the surface water/sediment quality of Pettibone Creek or the Boat Basin.

- **Chemical concentrations detected in the sediments of the South Branch of Pettibone Creek are less than those reported for samples collected from the North Branch of Pettibone Creek and the Boat Basin by a factor of 2 or more.** For example, the average lead concentrations in the North Branch, South Branch, and Boat Basin are 118 mg/kg, 32 mg/kg, and 101 mg/kg, respectively. The differences are attributable to the fact that significant industrial sources of contamination exist(ed) upstream of the North Branch of Pettibone Creek (which drains to the Boat Basin); similar industrial sources do not exist on the South Branch of Pettibone Creek.

- **Average concentrations of pesticides, PCBs, and metals in the deeper (at-depth) samples of the Boat Basin often exceed the average concentrations reported in the surface sediment samples of the Boat Basin by a factor of 2 or more.** For example, the average concentrations of copper and Aroclor-1254 in the at-depth samples are 364 mg/kg and 1400 µg/kg, respectively, versus 116 mg/kg and 310 µg/kg, respectively, for the surface sediment samples. The differences with depth may reflect decreases in contaminant loading over time - sediments have built up undisturbed in the Boat Basin since the last dredging event in the early 1970s. **Average concentrations of most metals, pesticides, and PCBs in the at-depth samples of the Boat Basin also exceed those reported for surface or at-depth sediments collected along Pettibone Creek.**

- **VOCs are not significant site related contaminants for Site 17.** Methylene chloride (a common laboratory/field blank contaminant) was the only VOC detected in the sediments. The maximum concentration detected (11 µg/kg) is less than the risk-based benchmarks/criteria referenced in the nature and extent evaluation. Acetone (also a common laboratory contaminant), three trihalomethane compounds (bromodichloromethane, chlorodibromomethane, and chloroform), four chlorinated organics (tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, and vinyl chloride), and toluene were detected in the surface water samples at maximum concentrations not exceeding 11 µg/L. Maximum detected concentrations reported for bromodichloromethane, chloroform, and trichloroethene exceed TACO GRO criteria. However, the trihalomethanes noted are often produced as a result of the chlorination process (e.g., chlorination of drinking water supply or a wastewater discharge). Maximum concentrations of the chlorinated solvents and toluene were reported for the sample collected at the upstream boundary of Site 17.

- **PAHs are the predominant SVOCs detected in the sediment samples collected at Site 17.** One or more of these chemicals were detected in the sediment samples collected. Average concentrations reported for the North Branch of Pettibone Creek and the Boat Basin (typically less than 5,000 µg/kg) tend to exceed those reported for the South Branch of Pettibone Creek (typically less than 1,000 µg/kg). Many of the analytical results reported exceed the referenced human health or ecological screening criteria. However, any interpretation of the PAH data must consider the fact that PAHs are common, anthropogenic contaminants frequently detected in soils and sediments as a result of the wide-spread use of petroleum products in our modern, industrialized society. For example, Pettibone Creek receives surface water run-off from roadways and areas that have been paved with asphalt. The PAH concentrations reported for Pettibone Creek and the Boat Basin are within the range of concentrations reported as anthropogenic background for soils. The maximum concentrations for many PAHs detected in Pettibone Creek were reported for the sample collected at the upstream boundary of Site 17. **PAHs were not detected in the Site 17 surface water samples.**

- **Pesticides were detected in the sediment samples collected at Site 17 at concentrations that reflect the widespread and historic use of the chemicals for pesticide control.** DDT and its degradation by-products were the pesticides detected most frequently. Average concentrations for pesticides in the at-depth samples collected from the Boat Basin (typically 50 µg/kg to less than 720 µg/kg) exceed those calculated for samples from the surface sediments and the sediment samples from Pettibone Creek (typically 10 µg/kg to less than 180 µg/kg). Average concentrations for pesticides detected in the South Branch of Pettibone Creek do not exceed 50 µg/kg. With the exception of a few results reported for sediment samples collected from the Boat Basin, the pesticide concentrations reported for the Site 17 sediment samples do not exceed TACO screening levels for human health. In contrast, the pesticide results frequently exceed referenced screening levels for ecological receptors. Analytical results for the Boat Basin, in particular, suggest a decrease in chemical loading over time.

- **PCBs were detected in less than 50 percent of the sediment samples analyzed.** Average concentrations reported the Aroclor-1248, 1254, and 1260 for the at-depth samples in the Boat Basin (240 µg/kg, 1400 µg/kg, and 300 µg/kg, respectively) exceed those reported for the surface sediment samples and the sediment samples from Pettibone Creek by a factor of 2 or more. Average concentrations in the sediments from the South Branch of Pettibone Creek do not exceed 50 µg/kg. Only concentrations for the at-depth sediment samples from the Boat Basin exceed the TACO screening criteria for human health (1,000 µg/kg). Numerous samples in the North Branch of Pettibone and the Boat Basin exceed the referenced ecological screening criteria. PCBs were detected in the off-site, upstream samples collected during previous environmental investigations. Previous PCB data suggest significant possible upstream sources may have contributed to the sediment contamination. In addition, PCB contamination of sediments may have occurred due to storage by NTC Great Lakes of out-of-service transformers (some filled with PCB-containing oil) at various locations within the base. Past investigations at these storage locations indicated that some limited soil contamination exceeded federal and State clean-up guidelines. However, there is no clean-up documentation available on the PCB-contaminated soil. Contamination was reported to be limited and restricted to the transformer storage locations. There are no analytical data available indicating that the transformer storage locations are a source of contamination at Pettibone Creek and the Boat Basin.

- **Several metals (e.g., copper, lead, mercury, selenium, silver, zinc) were detected in the sediments of the Boat Basin and the North Branch of Pettibone Creek at average concentrations an order of magnitude greater than background sediment and/or soil concentrations reported in TACO.** In contrast, most analytical results reported for the South Branch of Pettibone Creek are similar to background sediment and/or soil concentrations reported in TACO. These metals were also detected in the off-site, upstream samples collected during previous environmental investigations. The concentrations that were reported for the off-site, upstream samples were often 2 to 3 times the concentrations noted in the Site 17 sediment samples. The analytical data suggest that the primary source of contamination is historical discharge and storm water discharge within the Pettibone Creek Watershed.

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TABLE 4-1

FREQUENCY OF DETECTION IN SURFACE WATER
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTS	RANGE OF NON DETECTS	SAMPLE WITH MAXIMUM CONCENTRATION	AVERAGE POSITIVE DETECT	REGION 9 PRG TAP WATER (1)	REGION 9 TAP WATER EXCEEDANCES (2)	ILLINOIS TACO: GW INGESTION CLASS 1 (3)	ILLINOIS GW CLASS 1 EXCEEDANCES (2)	FEDERAL MAXIMUM CONTAMINANT LEVEL (4)	FEDERAL MCL EXCEEDANCES (2)	FEDERAL AMBIENT WATER QUALITY HH/CONSUMPTION WATER & ORGANISMS (5)	FEDERAL WATER QUALITY EXCEEDANCES (2)	ECOLOGICAL SURFACE WATER CRITERIA (6)	ECOLOGICAL SURFACE WATER EXCEEDANCES (2)
VOLATILE ORGANICS (UG/L)															
2-BUTANONE	1/6	5.6	5	NTC17PCSW0101	5.6	1900	0	NC	0	NC	0	NC	0	NC	NA
ACETONE	5/6	2.6 - 11	10	NTC17PCSW0101	6.3	610	0	700	0	NC	0	NC	0	122000	0
BROMODICHLOROMETHANE	2/6	0.34 - 0.74	1	NTC17PCSW0201	0.5	0.18	2	0.02	2	80	0	0.56	1	11000	0
CHLORODIBROMOMETHANE	1/6	0.59	1	NTC17PCSW0201	0.6	0.13	1	140	0	80	0	0.41	1	11000	0
CHLOROFORM	2/6	0.42 - 1.2	1	NTC17PCSW0201	0.8	0.16	2	0.02	2	80	0	5.7	0	150	0
CIS-1,2-DICHLOROETHENE	2/6	1.1 - 9.2	1	NTC17PCSW0101	5.2	61	0	70	0	70	0	NC	0	11600	0
TETRACHLOROETHENE	2/6	0.41 - 1.4	1	NTC17PCSW0101	0.9	1.1	1	5	0	5	0	0.8	1	152	0
TOLUENE	1/6	0.7	1	NTC17PCSW0101	0.7	720	0	1000	0	1000	0	6800	0	230	0
TRICHLOROETHENE	2/6	0.46 - 5.5	1	NTC17PCSW0101	3.0	1.6	1	5	1	5	1	2.7	1	940	0
VINYL CHLORIDE	1/6	0.77	2	NTC17PCSW0101	0.8	0.041	1	2	0	2	0	2	0	11600	0
SEMIVOLATILE ORGANICS (UG/L)															
DI-N-BUTYL PHTHALATE	1/6	2.7	10	NTC17PCSW0101	2.7	3600	0	700	0	NC	0	2700	0	35	0
PESTICIDES/PCBS (UG/L)															
4,4'-DDD	1/6	0.0054	0.05	NTC17PCSW0201	0.0	0.28	0	0.11	0	NC	0	0.00083	1	0.001	1
4,4'-DDE	3/5	0.0064 - 0.024	0.05	NTC17PCSW0201	0.0	0.2	0	0.04	0	NC	0	0.00059	3	0.001	3
4,4'-DDT	1/6	0.029	0.05	NTC17PCSW0201	0.0	0.2	0	0.12	0	NC	0	0.00059	1	0.001	1
ENDOSULFAN I	1/6	0.01	0.05	NTC17BBSW0501	0.0	220	0	NC	0	NC	0	110	0	0.056	0
INORGANICS (UG/L)															
ALUMINUM	6/6	44.8 - 9460	0	NTC17PCSW0301	2384.3	36000	0	NC	0	NC	0	NC	0	87	5
ARSENIC	3/6	3.7 - 3.8	3.2	NTC17BBSW0501	3.7	0.045	3	50	0	5	0	0.018	3	148	0
BARIUM	6/6	16.8 - 61.8	0	NTC17PCSW0301	43.4	2600	0	2000	0	2000	0	1000	0	5000	0
BERYLLIUM	1/6	0.26	0.17	NTC17PCSW0301	0.3	73	0	4	0	4	0	NC	0	0.66	0
CALCIUM	6/6	23200 - 91600	0	NTC17PCSW0101	55483.3	NC	0	NC	0	NC	0	NC	0	NC	NA
CHROMIUM	1/6	14.4	1.8 - 5.6	NTC17PCSW0301	14.4	NC	0	100	0	100	0	NC	0	NC	NA
COBALT	1/6	4.6	2.9	NTC17PCSW0301	4.6	2200	0	1000	0	NC	0	NC	0	23	0
COPPER	5/6	6.9 - 22.2	2.4	NTC17PCSW0101	14.5	1400	0	650	0	1300	0	1000	0	17.6	2
IRON	6/6	84.4 - 10900	0	NTC17PCSW0301	2810.4	11000	0	5000	1	NC	0	300	5	1000	2
LEAD	5/6	3 - 18	1.8	NTC17PCSW0301	7.8	NC	0	7.5	2	15	1	NC	0	16.5	1
MAGNESIUM	6/6	7720 - 37400	0	NTC17PCSW0101	22970.0	NC	0	NC	0	NC	0	NC	0	NC	NA
MANGANESE	6/6	14.6 - 245	0	NTC17PCSW0301	83.1	880	0	150	1	NC	0	50	3	1000	0
MERCURY	4/6	0.05 - 0.1	0.047	NTC17PCSW0401	0.1	11	0	2	0	2	0	0.05	3	0.0013	4
NICKEL	1/6	12.5	10.4	NTC17PCSW0301	12.5	730	0	100	0	NC	0	610	0	97.7	0
POTASSIUM	6/6	1270 - 6280	0	NTC17PCSW0301	3991.7	NC	0	NC	0	NC	0	NC	0	NC	NA
SODIUM	6/6	13100 - 122000	0	NTC17PCSW0101	59916.7	NC	0	NC	0	NC	0	NC	0	NC	NA
VANADIUM	3/6	2.9 - 15.6	2.5	NTC17PCSW0301	8.4	260	0	49	0	NC	0	NC	0	20	0
ZINC	4/6	28 - 150	13.5 - 32.7	NTC17PCSW0101	78.5	11000	0	5000	0	NC	0	5000	0	225	0
FILTERED INORGANICS (UG/L)															
ALUMINUM	5/6	25.5 - 317	21.1	NTC17BBSW0601-F	108.6	36000	0	NC	0	NC	0	NC	0	87	2
ARSENIC	2/6	3.6 - 4.3	3.2	NTC17BBSW0501-F	4.0	0.045	2	50	0	5	0	0.018	2	148	0
BARIUM	6/6	16.8 - 53.3	0	NTC17PCSW0101-F	31.1	2600	0	2000	0	2000	0	1000	0	5000	0
CADMIUM	1/6	0.58	0.39 - 0.51	NTC17PCSW0101-F	0.6	18	0	5	0	5	0	NC	0	4.41	0
CALCIUM	6/6	23500 - 87500	0	NTC17PCSW0101-F	50716.7	NC	0	NC	0	NC	0	NC	0	NC	NA
COPPER	5/6	2.9 - 10.7	2.4	NTC17PCSW0101-F	7.8	1400	0	650	0	1300	0	1000	0	17.6	0
IRON	5/6	78 - 429	30.3	NTC17BBSW0601-F	215.0	11000	0	5000	0	NC	0	300	2	1000	0
LEAD	1/6	3.3	1.8 - 2.5	NTC17BBSW0601-F	3.3	NC	0	7.5	0	15	0	NC	0	16.5	0
MAGNESIUM	6/6	7840 - 35700	0	NTC17PCSW0101-F	20306.7	NC	0	NC	0	NC	0	NC	0	NC	NA
MANGANESE	6/6	14.6 - 46.3	0	NTC17PCSW0101-F	25.3	880	0	150	0	NC	0	50	0	1000	0
MERCURY	1/6	0.08	0.047 - 0.05	NTC17PCSW0401-F	0.1	11	0	2	0	2	0	0.05	1	0.0013	1
POTASSIUM	6/6	1360 - 5150	0	NTC17PCSW0101-F	3095.0	NC	0	NC	0	NC	0	NC	0	NC	NA
SELENIUM	1/6	4.4	3.3 - 4.5	NTC17PCSW0101-F	4.4	180	0	50	0	50	0	170	0	5	0
SODIUM	6/6	13400 - 115000	0	NTC17PCSW0101-F	57700.0	NC	0	NC	0	NC	0	NC	0	NC	NA
VANADIUM	1/6	2.8	2.5	NTC17PCSW0201-F	2.8	260	0	49	0	NC	0	NC	0	20	0
ZINC	4/6	5.6 - 111	11.9 - 29	NTC17PCSW0101-F	39.6	11000	0	5000	0	NC	0	5000	0	225	0

Footnotes:
1 - USEPA (November 2000).
2 - Number of samples that exceed critieria.
3 - Illinois EPA (March 2002).
4 - USEPA (June 2000).
5 - USEPA (April 1999).
6 - See Table 7-1.
NC - No Criteria

TABLE 4-2

FREQUENCY OF DETECTION IN SURFACE SEDIMENT (0-4 CM)
SITE 17 - NORTH BRANCH PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTS	RANGE OF NON DETECTS	SAMPLE WITH MAXIMUM CONCENTRATION	AVERAGE CONCENTRATION (1)	TACO BACKGROUND SOIL WITHIN METROPOLITAN (2)	TACO BACKGROUND EXCEEDANCES (3)	ILLINOIS EPA UNSIEVED STREAM SEDIMENT BACKGROUND (4)	ILLINOIS EPA BACKGROUND EXCEEDANCES (3)	ILLINOIS TACO ROUTE SPECIFIC VALUES FOR SOIL INGESTION(2)	TACO EXCEEDANCES (3)	REGION 9 PRG RESIDENTIAL SOIL(5)	REGION 9 RESIDENTIAL EXCEEDANCES (3)	REGION 9 PRG INDUSTRIAL SOIL(6)	REGION 9 INDUSTRIAL EXCEEDANCES (3)	ECOLOGICAL SEDIMENT CRITERIA(7)	ECOLOGICAL SEDIMENT EXCEEDANCES (3)
VOLATILE ORGANICS (UG/KG)																	
METHYLENE CHLORIDE	1/6	11	5.3 - 6.4	NTC17PCSD0401	4.3	NC	NA	NC	NA	85000	0	8900	0	21000	0	18	0
SEMIVOLATILE ORGANICS (UG/KG)																	
2-METHYLNAPHTHALENE	3/6	55 - 93	360 - 410	NTC17PCSD2301	130.3	NC	NA	NC	NA	3100000	0	56000	0	190000	0	368	0
ACENAPHTHYLENE	8/24	13 - 92	400 - 16000	NTC17PCSD1001	727.9	NC	NA	NC	NA	4700000	0	3700000	0	38000000	0	186	0
ANTHRACENE	24/24	37 - 4000	0	NTC17PCSD0101	443.2	NC	NA	NC	NA	23000000	0	22000000	0	100000000	0	85	18
BENZALDEHYDE	1/6	1500	350 - 420	NTC17PCSD0401	409.2	NC	NA	NC	NA	NC	NA	6100000	0	88000000	0	1.1	1
BENZO(A)ANTHRACENE	24/24	150 - 11000	0	NTC17PCSD0101	1304.2	NC	NA	NC	NA	900	9	620	11	2900	1	287	21
BENZO(A)PYRENE	24/24	130 - 11000	0	NTC17PCSD0101	1294.2	NC	NA	NC	NA	90	24	62	24	290	22	73	24
BENZO(B)FLUORANTHENE	24/24	150 - 12000	0	NTC17PCSD0101	1362.1	NC	NA	NC	NA	900	8	620	11	2900	1	886	8
BENZO(G,H,I)PERYLENE	23/24	70 - 7500	85	NTC17PCSD0101	885.5	NC	NA	NC	NA	3100000	0	56000	0	54000000	0	170	21
BENZO(K)FLUORANTHENE	24/24	78 - 6300	0	NTC17PCSD0101	739.9	NC	NA	NC	NA	9000	0	6200	1	29000	0	8860	0
BIS(2-ETHYLHEXYL)PHTHALATE	6/6	280 - 680	0	NTC17PCSD2301	561.7	NC	NA	NC	NA	46000	0	35000	0	180000	0	130000	0
BUTYL BENZYL PHTHALATE	1/6	37	360 - 420	NTC17PCSD1801	167.0	NC	NA	NC	NA	16000000	0	12000000	0	100000000	0	6000	0
CAPROLACTAM	1/6	57	360 - 420	NTC17PCSD1801	170.3	NC	NA	NC	NA	NC	NA	31000000	0	100000000	0	NC	NA
CARBAZOLE	6/6	75 - 720	0	NTC17PCSD1401	284.2	NC	NA	NC	NA	32000	0	24000	0	120000	0	110	5
CHRYSENE	24/24	150 - 12000	0	NTC17PCSD0101	1350.8	NC	NA	NC	NA	88000	0	62000	0	290000	0	400	20
DIBENZOFURAN	6/6	37 - 250	0	NTC17PCSD1401	118.3	NC	NA	NC	NA	NC	NA	290000	0	5100000	0	910	0
FLUORANTHENE	24/24	380 - 33000	0	NTC17PCSD0101	3771.7	NC	NA	NC	NA	3100000	0	2300000	0	30000000	0	2790	9
FLUORENE	24/24	21 - 2400	0	NTC17PCSD0101	269.5	NC	NA	NC	NA	3100000	0	2600000	0	33000000	0	35	23
INDENO(1,2,3-CD)PYRENE	24/24	70 - 5800	0	NTC17PCSD0101	657.9	NC	NA	NC	NA	900	5	620	6	2900	1	2500	1
PHENANTHRENE	24/24	210 - 24000	0	NTC17PCSD0101	2497.9	NC	NA	NC	NA	3100000	0	56000	0	54000000	0	810	12
PHENOL	1/6	94	350 - 420	NTC17PCSD0401	174.8	NC	NA	NC	NA	47000000	0	37000000	0	100000000	0	140000	0
PYRENE	24/24	310 - 27000	0	NTC17PCSD0101	2973.8	NC	NA	NC	NA	2300000	0	2300000	0	54000000	0	350	23
PESTICIDES/PCBS (UG/KG)																	
4,4'-DDD	24/24	2.3 - 170	0	NTC17PCSD1901	64.0	NC	NA	NC	NA	3000	0	2400	0	17000	0	2	24
4,4'-DDE	24/24	4.3 - 210	0	NTC17PCSD1901	82.9	NC	NA	NC	NA	2000	0	1700	0	12000	0	2	24
4,4'-DDT	24/24	4.9 - 1800	0	NTC17PCSD0501	173.8	NC	NA	NC	NA	2000	0	1700	1	12000	0	1	24
ALDRIN	1/24	6.4	1.9 - 210	NTC17PCSD0101	13.1	NC	NA	NC	NA	40	0	29	0	150	0	0.51	1
ALPHA-CHLORDANE	14/22	0.16 - 6.9	1.9 - 210	NTC17PCSD1901	10.3	NC	NA	NC	NA	50	0	1600	0	11000	0	0.5	12
AROCLOR-1254	14/24	56 - 440	35 - 43	NTC17PCSD1901	120.2	NC	NA	NC	NA	1000	0	220	4	1000	0	60	13
AROCLOR-1260	12/23	41 - 150	35 - 43	NTC17PCSD0301	47.9	NC	NA	NC	NA	1000	0	220	0	1000	0	5	12
DIELDRIN	6/22	0.23 - 1.7	18 - 210	NTC17PCSD2101	13.5	NC	NA	NC	NA	40	0	30	0	150	0	50	0
ENDOSULFAN I	1/24	1.1	1.9 - 210	NTC17PCSD1201	12.5	NC	NA	NC	NA	470000	0	370000	0	5300000	0	0.15	1
ENDOSULFAN II	9/24	0.52 - 12	4.1 - 210	NTC17PCSD0101	12.6	NC	NA	NC	NA	470000	0	370000	0	5300000	0	0.15	9
ENDRIN	1/24	2.6	1.9 - 210	NTC17PCSD0401	12.6	NC	NA	NC	NA	23000	0	18000	0	260000	0	19	0
ENDRIN ALDEHYDE	1/24	3.3	1.9 - 210	NTC17PCSD1001	13.0	NC	NA	NC	NA	23000	0	18000	0	260000	0	20	0
GAMMA-CHLORDANE	7/24	0.91 - 2.9	1.9 - 210	NTC17PCSD0401	11.1	NC	NA	NC	NA	50	0	0.0016	7	NC	NA	0.5	7
HEPTACHLOR EPOXIDE	3/24	0.13 - 0.2	1.9 - 210	NTC17PCSD1001	12.8	NC	NA	NC	NA	70	0	53	0	270	0	5	0
INORGANICS (MG/KG)																	
ALUMINUM	24/24	1960 - 4810	0	NTC17PCSD1001	2741.7	9500	0	NC	NA	NC	NA	76000	0	100000	0	58030	0
ANTIMONY	11/24	0.27 - 1.5	0.29 - 0.87	NTC17PCSD0101	0.4	4	0	NC	NA	31	0	31	0	820	0	2	0
ARSENIC	24/24	3.7 - 10.4	0	NTC17PCSD0101	5.8	13	0	8	3	0.4	24	0.39	24	2.7	24	6	7
BARIUM	24/24	17.2 - 122	0	NTC17PCSD0601	35.4	110	1	NC	NA	5500	0	5400	0	100000	0	NC	NA
BERYLLIUM	18/24	0.39 - 1.4	0.24 - 0.36	NTC17PCSD1501	0.6	0.59	12	NC	NA	160	0	150	0	2200	0	NC	NA
CADMIUM	21/24	0.11 - 4.2	0.06	NTC17PCSD1501	0.7	0.6	6	0.5	9	78	0	37	0	810	0	0.6	6
CALCIUM	24/24	34300 - 110000	0	NTC17PCSD0601	58020.8	9300	24	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
CHROMIUM	24/24	8.4 - 55.8	0	NTC17PCSD0101	16.5	16.2	9	16	9	390	0	30	1	450	0	26	3
COBALT	24/24	4 - 11.3	0	NTC17PCSD2101	6.0	8.9	2	NC	NA	4700	0	4700	0	100000	0	50	0
COPPER	24/24	35.1 - 477	0	NTC17PCSD0201	155.6	19.6	24	38	23	2900	0	2900	0	76000	0	16	24
IRON	24/24	8570 - 14900	0	NTC17PCSD0101	11758.3	15900	0	18000	0	NC	NA	23000	0	100000	0	20000	0
LEAD	24/24	30.8 - 322	0	NTC17PCSD0101	117.8	36	23	28	24	400	0	400	0	750	0	31	23
MAGNESIUM	24/24	17900 - 51400	0	NTC17PCSD1201	30187.5	4820	24	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
MANGANESE	24/24	243 - 662	0	NTC17PCSD0601	368.0	636	1	1300	0	3700	0	1800	0	32000	0	460	3
MERCURY	24/24	0.04 - 4.7	0	NTC17PCSD1401	0.4	0.06	20	0.07	19	23	0	23	0	610	0	0.2	8
NICKEL	24/24	8.1 - 23	0	NTC17PCSD1301, NTC17PCSD1501	14.8	18	6	NC	NA	1600	0	1600	0	41000	0	30	0
POTASSIUM	24/24	292 - 798	0	NTC17PCSD1001	427.3	1268	0	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
SELENIUM	4/24	0.46 - 6.6	0.35 - 0.43	NTC17PCSD1601	0.5	0.48	3	NC	NA	390	0	390	0	10000	0	NC	NA
SILVER	8/24	0.55 - 3.2	0.09 - 0.57	NTC17PCSD0401	0.6	0.55	7	NC	NA	390	0	390	0	10000	0	1	5
SODIUM	24/24	128 - 658	0	NTC17PCSD1501	242.5	130	23	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
THALLIUM	13/24	0.74 - 2.1	0.61 - 0.73	NTC17PCSD1001	0.8	0.32	13	NC	NA	6.3	0	5.2	0	130	0	NC	NA
VANADIUM	24/24	7.1 - 17.9	0	NTC17PCSD0901	10.7	25.2	0	NC	NA	550	0	550	0	14000	0	NC	NA
ZINC	24/24	126 - 2120	0	NTC17PCSD1501		95	24	80	24	23000	0	23000	0	100000	0	120	24
MISCELLANEOUS PARAMETERS (MG/KG)																	
PH S.U.	24/24	7.9 - 8.4	0	NTC17PCSD0601	8.2	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
TOTAL ORGANIC CARBON	24/24	1000 - 9240	0	NTC17PCSD0101	3896.3	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA

Footnotes:

1 - The average concentrations were calculated by using one-half the detection limit for non-detects.
2 - Illinois EPA (March 2002).
3 - Number of samples that exceed criteria.
4 - Illinois EPA (August 1997).
5 - USEPA (November 2000).
6 - USEPA (November 2000).
7 - See Table 7-2.
NC - No Criteria

TABLE 4-3

FREQUENCY OF DETECTION IN SURFACE SEDIMENT (0-4 cm)
SITE 17 - SOUTH BRANCH PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTS	RANGE OF NON DETECTS	SAMPLE WITH MAXIMUM CONCENTRATION	AVERAGE CONCENTRATION (1)	TACO BACKGROUND SOIL WITHIN METROPOLITAN (2)	TACO BACKGROUND EXCEEDANCES (3)	ILLINOIS EPA UNSIEVED STREAM SEDIMENT BACKGROUND (4)	ILLINOIS EPA BACKGROUND EXCEEDANCES (3)	ILLINOIS TACO ROUTE SPECIFIC VALUES FOR SOIL INGESTION (2)	TACO EXCEEDANCES (3)	REGION 9 PRG RESIDENTIAL SOIL (5)	REGION 9 RESIDENTIAL PRG EXCEEDANCES (3)	REGION 9 PRG INDUSTRIAL SOIL (6)	REGION 9 INDUSTRIAL PRG EXCEEDANCES (3)	ECOLOGICAL SEDIMENT CRITERIA (7)	ECOLOGICAL SEDIMENT EXCEEDANCES (3)
VOLATILE ORGANICS (UG/KG)																	
METHYLENE CHLORIDE	1/2	8.9	6.3	NTC17PCSD2901	6.0	NC	NA	NC	NA	85000	0	8900	0	21000	0	18	0
SEMIVOLATILE ORGANICS (UG/KG)																	
ACENAPHTHYLENE	2/14	25 - 51	79 - 4100	NTC17PCSD3501	235.5	NC	NA	NC	NA	4700000	0	3700000	0	38000000	0	186	0
ANTHRACENE	14/14	19 - 1100	0	NTC17PCSD2701	128.4	NC	NA	NC	NA	23000000	0	22000000	0	100000000	0	85	3
BENZO(A)ANTHRACENE	14/14	69 - 2800	0	NTC17PCSD2701	360.2	NC	NA	NC	NA	900	1	620	1	2900	0	287	2
BENZO(A)PYRENE	14/14	66 - 2100	0	NTC17PCSD2701	326.8	NC	NA	NC	NA	90	12	62	14	290	3	73	12
BENZO(B)FLUORANTHENE	14/14	61 - 2200	0	NTC17PCSD2701	323.5	NC	NA	NC	NA	900	1	620	1	2900	0	886	1
BENZO(G,H,I)PERYLENE	14/14	34 - 990	0	NTC17PCSD2701	172.9	NC	NA	NC	NA	3100000	0	56000	0	54000000	0	170	2
BENZO(K)FLUORANTHENE	14/14	34 - 1300	0	NTC17PCSD2701	182.2	NC	NA	NC	NA	9000	0	6200	0	29000	0	8860	0
BIS(2-ETHYLHEXYL)PHTHALATE	2/2	80 - 130	0	NTC17PCSD2901	105.0	NC	NA	NC	NA	46000	0	35000	0	180000	0	130000	0
CHRYSENE	14/14	65 - 2900	0	NTC17PCSD2701	370.6	NC	NA	NC	NA	88000	0	62000	0	290000	0	400	2
FLUORANTHENE	14/14	160 - 9000	0	NTC17PCSD2701	1060.7	NC	NA	NC	NA	3100000	0	2300000	0	30000000	0	2790	1
FLUORENE	14/14	13 - 410	0	NTC17PCSD2701	56.2	NC	NA	NC	NA	3100000	0	2600000	0	33000000	0	35	3
INDENO(1,2,3-CD)PYRENE	14/14	37 - 880	0	NTC17PCSD2701	160.1	NC	NA	NC	NA	900	0	620	1	2900	0	2500	0
PHENANTHRENE	14/14	85 - 6300	0	NTC17PCSD2701	675.2	NC	NA	NC	NA	3100000	0	56000	0	54000000	0	810	2
PYRENE	14/14	130 - 6400	0	NTC17PCSD2701	783.6	NC	NA	NC	NA	2300000	0	2300000	0	54000000	0	350	5
PESITICDES/PCBS (UG/KG)																	
4,4'-DDD	14/14	7.6 - 32	0	NTC17PCSD3501	17.4	NC	NA	NC	NA	3000	0	2400	0	17000	0	2	14
4,4'-DDE	14/14	10 - 31	0	NTC17PCSD2701	19.9	NC	NA	NC	NA	2000	0	1700	0	12000	0	2	14
4,4'-DDT	14/14	8.5 - 290	0	NTC17PCSD3101	41.8	NC	NA	NC	NA	2000	0	1700	0	12000	0	1	14
ALPHA-CHLORDANE	13/14	0.35 - 2.4	20	NTC17PCSD2901	1.7	NC	NA	NC	NA	50	0	1600	0	11000	0	0.5	11
AROCLOR-1248	1/14	50	40 - 46	NTC17PCSD3101	23.1	NC	NA	NC	NA	1000	0	220	0	1000	0	30	1
AROCLOR-1254	3/14	84 - 140	40 - 46	NTC17PCSD2901	40.5	NC	NA	NC	NA	1000	0	220	0	1000	0	60	3
AROCLOR-1260	1/14	55	39 - 45	NTC17PCSD3301	23.3	NC	NA	NC	NA	1000	0	220	0	1000	0	5	1
DIELDRIN	12/13	0.16 - 2.9	20	NTC17PCSD2801	1.6	NC	NA	NC	NA	40	0	30	0	150	0	50	0
ENDOSULFAN II	7/14	0.3 - 1.9	2 - 20	NTC17PCSD3301	2.4	NC	NA	NC	NA	470000	0	370000	0	5300000	0	0.15	7
ENDRIN	4/14	0.42 - 1.3	2 - 20	NTC17PCSD2801	2.5	NC	NA	NC	NA	23000	0	18000	0	260000	0	19	0
ENDRIN ALDEHYDE	1/14	4	2 - 20	NTC17PCSD3401	2.8	NC	NA	NC	NA	23000	0	18000	0	260000	0	20	0
GAMMA-CHLORDANE	12/14	0.31 - 1.6	2 - 20	NTC17PCSD2701	1.7	NC	NA	NC	NA	50	0	0.0016	12	NC	NA	0.5	11
HEPTACHLOR EPOXIDE	4/14	0.15 - 0.46	2 - 20	NTC17PCSD2801	2.3	NC	NA	NC	NA	70	0	53	0	270	0	5	0
INORGANICS (MG/KG)																	
ALUMINUM	14/14	1480 - 3760	0	NTC17PCSD3401	2445.0	9500	0	NC	NA	NC	NA	76000	0	100000	0	58030	0
ANTIMONY	4/14	0.33 - 0.49	0.28 - 0.33	NTC17PCSD3801	0.2	4	0	NC	NA	31	0	31	0	820	0	2	0
ARSENIC	14/14	1.5 - 5.4	0	NTC17PCSD3401	4.0	13	0	8	0	0.4	14	0.39	14	2.7	11	6	0
BARIUM	14/14	6.9 - 40.4	0	NTC17PCSD2601	22.3	110	0	NC	NA	5500	0	5400	0	100000	0	NC	NA
BERYLLIUM	11/14	0.13 - 0.44	0.1 - 0.3	NTC17PCSD2601	0.2	0.59	0	NC	NA	160	0	150	0	2200	0	NC	NA
CADMIUM	9/14	0.07 - 0.19	0.06 - 0.07	NTC17PCSD3401	0.1	0.6	0	0.5	0	78	0	37	0	810	0	0.6	0
CALCIUM	14/14	25700 - 99100	0	NTC17PCSD2501	45171.4	9300	14	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
CHROMIUM	14/14	5.5 - 14.7	0	NTC17PCSD2601	9.3	16.2	0	16	0	390	0	30	0	450	0	26	0
COBALT	14/14	2.4 - 7.6	0	NTC17PCSD3101	4.7	8.9	0	NC	NA	4700	0	4700	0	100000	0	50	0
COPPER	14/14	3.4 - 46.2	0	NTC17PCSD2601	17.8	19.6	5	38	1	2900	0	2900	0	76000	0	16	7
IRON	14/14	4900 - 13100	0	NTC17PCSD2701	9287.1	15900	0	18000	0	NC	NA	23000	0	100000	0	20000	0
LEAD	14/14	8.3 - 57.9	0	NTC17PCSD2601	32.4	36	4	28	9	400	0	400	0	750	0	31	7
MAGNESIUM	14/14	14100 - 54500	0	NTC17PCSD2501	24450.0	4820	14	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
MANGANESE	14/14	177 - 504	0	NTC17PCSD2501	316.9	636	0	1300	0	3700	0	1800	0	32000	0	460	1
MERCURY	14/14	0.02 - 0.23	0	NTC17PCSD3401	0.1	0.06	9	0.07	9	23	0	23	0	610	0	0.2	1
NICKEL	14/14	3.6 - 15.4	0	NTC17PCSD3101	8.9	18	0	NC	NA	1600	0	1600	0	41000	0	30	0
POTASSIUM	14/14	306 - 602	0	NTC17PCSD3401	408.4	1268	0	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
SODIUM	14/14	78.3 - 205	0	NTC17PCSD2601	124.6	130	6	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
THALLIUM	7/14	0.73 - 1.5	0.69 - 0.79	NTC17PCSD3401	0.7	0.32	7	NC	NA	6.3	0	5.2	0	130	0	NC	NA
VANADIUM	14/14	6.8 - 13.2	0	NTC17PCSD3401	9.2	25.2	0	NC	NA	550	0	550	0	14000	0	NC	NA
ZINC	14/14	31 - 253	0	NTC17PCSD2601	113.8	95	6	80	7	23000	0	23000	0	100000	0	120	4
MISCELLANEOUS PARAMETERS (MG/KG)																	
PH S.U.	14/14	7.9 - 8.5	0	NTC17PCSD2501	8.1	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
TOTAL ORGANIC CARBON	14/14	1400 - 16400	0	NTC17PCSD3301	5285.7	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA

Footnotes
1 - The average concentrations were calculated by using one-half the detection limit for non-detects.
2 - Illinois EPA (March 2002).
3 - Number of samples that exceed criteria.
4 - Illinois EPA (August 1997).
5 - USEPA (November 2000).
6 - USEPA (November 2000).
7 - See Table 7-2.
NC - No Criteria.
NA - Not Applicable.

TABLE 4-4

FREQUENCY OF DETECTION IN SURFACE SEDIMENT (0-4 cm)
SITE 17 - BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTS	RANGE OF NON DETECTS	SAMPLE WITH MAXIMUM CONCENTRATION	AVERAGE CONCENTRATION (1)	TACO BACKGROUND SOIL WITHIN METROPOLITAN (2)	TACO BACKGROUND EXCEEDANCES (3)	ILLINOIS EPA UNSIEVED STREAM SEDIMENT BACKGROUND (4)	ILLINOIS EPA BACKGROUND EXCEEDANCES (3)	ILLINOIS TACO ROUTE SPECIFIC VALUES FOR SOIL INGESTION (2)	TACO EXCEEDANCES (3)	REGION 9 PRG RESIDENTIAL SOIL (5)	REGION 9 RESIDENTIAL PRG EXCEEDANCES (3)	REGION 9 PRG INDUSTRIAL SOIL (6)	REGION 9 INDUSTRIAL PRG EXCEEDANCES (3)	ECOLOGICAL SEDIMENT CRITERIA (7)	ECOLOGICAL SEDIMENT EXCEEDANCES (3)
VOLATILE ORGANICS (UG/KG)																	
METHYLENE CHLORIDE	1/1	6.6	0	NTC17BBSD4701	6.6	NC	NA	NC	NA	85000	0	8900	0	21000	0	18	0
SEMIVOLATILE ORGANICS (UG/KG)																	
ACENAPHTHYLENE	6/12	24 - 200	420 - 3900	NTC17BBSD5601	378.0	NC	NA	NC	NA	4700000	0	3700000	0	38000000	0	186	1
ANTHRACENE	12/12	49 - 1900	0	NTC17BBSD4601	500.7	NC	NA	NC	NA	23000000	0	22000000	0	100000000	0	85	11
BENZO(A)ANTHRACENE	12/12	250 - 4900	0	NTC17BBSD4501	1247.5	NC	NA	NC	NA	900	4	620	7	2900	2	287	11
BENZO(A)PYRENE	12/12	260 - 4500	0	NTC17BBSD4501	1128.3	NC	NA	NC	NA	90	12	62	12	290	11	73	12
BENZO(B)FLUORANTHENE	12/12	280 - 4500	0	NTC17BBSD4501	1141.7	NC	NA	NC	NA	900	4	620	6	2900	1	886	4
BENZO(G,H,I)PERYLENE	10/12	200 - 2800	160 - 450	NTC17BBSD4501	633.8	NC	NA	NC	NA	3100000	0	56000	0	54000000	0	170	10
BENZO(K)FLUORANTHENE	12/12	150 - 2500	0	NTC17BBSD4501	645.0	NC	NA	NC	NA	9000	0	6200	0	29000	0	8860	0
BIS(2-ETHYLHEXYL)PHTHALATE	1/1	610	0	NTC17BBSD4701	610.0	NC	NA	NC	NA	46000	0	35000	0	180000	0	130000	0
CHRYSENE	12/12	270 - 4900	0	NTC17BBSD4501	1235.8	NC	NA	NC	NA	88000	0	62000	0	290000	0	400	7
FLUORANTHENE	12/12	730 - 14000	0	NTC17BBSD4501	3590.8	NC	NA	NC	NA	3100000	0	2300000	0	30000000	0	2790	4
FLUORENE	12/12	40 - 1300	0	NTC17BBSD4501, NTC17BBSD4601	332.0	NC	NA	NC	NA	3100000	0	2600000	0	33000000	0	35	12
INDENO(1,2,3-CD)PYRENE	12/12	150 - 2000	0	NTC17BBSD4501	481.7	NC	NA	NC	NA	900	2	620	2	2900	0	2500	0
NAPHTHALENE	1/12	1200	360 - 4200	NTC17BBSD4601	704.6	NC	NA	NC	NA	3100000	0	56000	0	190000	0	340	1
PHENANTHRENE	12/12	380 - 10000	0	NTC17BBSD4501	2653.3	NC	NA	NC	NA	3100000	0	56000	0	54000000	0	810	7
PYRENE	12/12	560 - 11000	0	NTC17BBSD4501	2725.8	NC	NA	NC	NA	2300000	0	2300000	0	54000000	0	350	12
PESTICIDES/PCBS (UG/KG)																	
4,4'-DDD	12/12	71 - 310	0	NTC17BBSD4801	116.9	NC		NC	NA	3000	0	2400	0	17000	0	2	12
4,4'-DDE	12/12	55 - 230	0	NTC17BBSD4801	86.5	NC	NA	NC	NA	2000	0	1700	0	12000	0	2	12
4,4'-DDT	11/12	34 - 120	46	NTC17BBSD4701	63.8	NC	NA	NC	NA	2000	0	1700	0	12000	0	1	11
ALDRIN	1/12	4.1	8.2 - 51	NTC17BBSD4701	9.0	NC	NA	NC	NA	40	0	29	0	150	0	0.51	1
ALPHA-BHC	1/12	6.5	8.2 - 51	NTC17BBSD5601	9.6	NC	NA	NC	NA	100	0	90	0	590	0	0.023	1
ALPHA-CHLORDANE	12/12	1.2 - 11	0	NTC17BBSD4801	3.6	NC	NA	NC	NA	50	0	1600	0	11000	0	0.5	12
AROCLOR-1254	4/12	79 - 660	36 - 44	NTC17BBSD4801	115.8	NC	NA	NC	NA	1000	0	220	2	1000	0	60	4
AROCLOR-1260	3/12	49 - 270	36 - 47	NTC17BBSD4801	56.2	NC	NA	NC	NA	1000	0	220	1	1000	0	5	3
BETA-BHC	3/12	5.6 - 7.6	8.2 - 51	NTC17BBSD5201	7.9	NC	NA	NC	NA	NC	0	320	0	2100	0	0.37	3
DELTA-BHC	4/12	2 - 8.5	8.2 - 21	NTC17BBSD5601	6.1	NC	NA	NC	NA	100	0	90	0	590	0	NC	NA
DIELDRIN	10/12	1.5 - 13	11 - 21	NTC17BBSD4801	4.7	NC	NA	NC	NA	40	0	30	0	150	0	50	0
ENDOSULFAN I	10/11	0.68 - 8.7	9.7	NTC17BBSD4801	3.4	NC	NA	NC	NA	470000	0	370000	0	5300000	0	0.15	10
ENDOSULFAN II	9/11	0.94 - 12	15 - 21	NTC17BBSD5201	5.4	NC	NA	NC	NA	470000	0	370000	0	5300000	0	0.15	9
ENDOSULFAN SULFATE	1/12	7.3	8.2 - 51	NTC17BBSD5201	8.2	NC	NA	NC	NA	470000	0	370000	0	5300000	0	5.4	1
ENDRIN	1/12	1.3	8.2 - 51	NTC17BBSD4601	9.2	NC	NA	NC	NA	23000	0	18000	0	260000	0	19	0
ENDRIN KETONE	1/12	4.7	8.2 - 51	NTC17BBSD4501	9.4	NC	NA	NC	NA	23000	0	18000	0	260000	0	20	0
GAMMA-BHC (LINDANE)	1/12	4.6	8.2 - 51	NTC17BBSD5601	9.5	NC	NA	NC	NA	500	0	440	0	2900	0	0.39	1
GAMMA-CHLORDANE	10/12	1.2 - 8	21 - 46	NTC17BBSD4801	4.8	NC	NA	NC	NA	50	0	0.0016	10	NC	NA	0.5	10
METHOXYCHLOR	1/12	32	82 - 510	NTC17BBSD5201	78.5	NC	NA	NC	NA	390000	0	310000	0	4400000	0	8.8	1
INORGANICS (MG/KG)																	
ALUMINUM	12/12	1300 - 6860	0	NTC17BBSD4801	2719.2	9500	0	NC	NA	NC	NA	76000	0	100000	0	58030	0
ANTIMONY	2/12	0.45 - 0.47	0.36 - 0.8	NTC17BBSD5301	0.3	4	0	NC	NA	31	0	31	0	820	0	2	0
ARSENIC	12/12	3.4 - 9.9	0	NTC17BBSD4801	5.4	13	0	8	1	0.4	12	0.39	12	2.7	12	6	1
BARIUM	12/12	12 - 57.8	0	NTC17BBSD4801	25.9	110	0	NC	NA	5500	0	5400	0	100000	0	NC	NA
BERYLLIUM	10/12	0.26 - 6.7	0.32 - 0.47	NTC17BBSD4901	1.1	0.59	5	NC	NA	160	0	150	0	2200	0	NC	NA
CADMIUM	12/12	0.23 - 2.2	0	NTC17BBSD4801	0.7	0.6	4	0.5	6	78	0	37	0	810	0	0.6	4
CALCIUM	12/12	33500 - 86300	0	NTC17BBSD4901	55791.7	9300	12	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
CHROMIUM	12/12	7.9 - 28.9	0	NTC17BBSD4801	12.6	16.2	1	16	1	390	0	30	0	450	0	26	1
COBALT	12/12	3.7 - 10.1	0	NTC17BBSD4801	5.6	8.9	1	NC	NA	4700	0	4700	0	100000	0	50	0
COPPER	12/12	55.5 - 283	0	NTC17BBSD4801	115.8	19.6	12	38	12	2900	0	2900	0	76000	0	16	12
IRON	12/12	7410 - 19200	0	NTC17BBSD4801	11733.3	15900	1	18000	1	NC	NA	23000	0	100000	0	20000	0
LEAD	12/12	47.6 - 289	0	NTC17BBSD4801	100.7	36	12	28	12	400	0	400	0	750	0	31	12
MAGNESIUM	12/12	17200 - 46900	0	NTC17BBSD4901	28233.3	4820	12	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
MANGANESE	12/12	226 - 731	0	NTC17BBSD4901	385.6	636	1	1300	0	3700	0	1800	0	32000	0	460	2
MERCURY	12/12	0.068 - 0.95	0	NTC17BBSD4801	0.2	0.06	12	0.07	11	23	0	23	0	610	0	0.2	3
NICKEL	12/12	8.9 - 31.5	0	NTC17BBSD5401	16.9	18	3	NC	NA	1600	0	1600	0	41000	0	30	1
POTASSIUM	12/12	180 - 1150	0	NTC17BBSD4801	386.0	1268	0	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
SELENIUM	3/12	0.66 - 1.2	0.5 - 0.65	NTC17BBSD4801	0.4	0.48	3	NC	NA	390	0	390	0	10000	0	NC	NA
SILVER	12/12	0.29 - 4.2	0	NTC17BBSD4801	1.0	0.55	6	NC	NA	390	0	390	0	10000	0	1	2
SODIUM	12/12	136 - 487	0	NTC17BBSD4901	236.0	130	12	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
VANADIUM	12/12	6 - 18.9	0	NTC17BBSD4801	10.2	25.2	0	NC	NA	550	0	550	0	14000	0	NC	NA
ZINC	12/12	247 - 2070	0	NTC17BBSD4901	662.0	95	12	80	12	23000	0	23000	0	100000	0	120	12
MISCELLANEOUS PARAMETERS (MG/KG)																	
PH S.U.	12/12	7.2 - 8	0	NTC17BBSD5001	7.6	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
TOTAL ORGANIC CARBON	11/12	1460 - 21800	60.6	NTC17BBSD4801	6415.0	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA

Footnotes:

1 - The average concentrations were calculated by using one-half the detection limit for non-detects.
2 - Illinois EPA (March 2002).
3 - Number of samples that exceed criteria.
4 - Illinois EPA (August 1997).
5 - USEPA (November 2000).
6 - USEPA (November 2000).
7 - See Table 7-2.
NC - No Criteria.

TABLE 4-5

FREQUENCY OF DETECTION IN SEDIMENT AT DEPTH
SITE 17 - NORTH BRANCH PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTS	RANGE OF NON DETECTS	SAMPLE WITH MAXIMUM CONCENTRATION	AVERAGE CONCENTRATION (1)	TACO BACKGROUND SOIL WITHIN METROPOLITAN (2)	TACO BACKGROUND EXCEEDANCES (3)	ILLINOIS EPA UNSIEVED STREAM SEDIMENT BACKGROUND (4)	ILLINOIS EPA BACKGROUND EXCEEDANCES (3)	ILLINOIS TACO ROUTE SPECIFIC VALUES FOR SOIL INGESTION (2)	TACO EXCEEDANCES (3)	REGION 9 PRG RESIDENTIAL SOIL (5)	REGION 9 RESIDENTIAL PRG EXCEEDANCES (3)	REGION 9 PRG INDUSTRIAL SOIL (6)	REGION 9 INDUSTRIAL PRG EXCEEDANCES (3)	ECOLOGICAL SEDIMENT (7)	ECOLOGICAL SEDIMENT EXCEEDANCES (3)
SEMIVOLATILE ORGANICS (UG/KG)																	
ACENAPHTHYLENE	3/11	130 - 230	180 - 1500	NTC17PCSD0402	304.1	NC	NA	NC	NA	4700000	0	3700000	0	38000000	0	186	2
ANTHRACENE	11/11	54 - 1600	0	NTC17PCSD0102	461.6	NC	NA	NC	NA	23000000	0	22000000	0	100000000	0	85	9
BENZO(A)ANTHRACENE	11/11	230 - 4100	0	NTC17PCSD0102	1272.7	NC	NA	NC	NA	900	5	620	6	2900	1	287	9
BENZO(A)PYRENE	11/11	230 - 4000	0	NTC17PCSD0102	1265.5	NC	NA	NC	NA	90	11	62	11	290	9	73	11
BENZO(B)FLUORANTHENE	11/11	240 - 4100	0	NTC17PCSD0102	1295.5	NC	NA	NC	NA	900	5	620	7	2900	2	886	5
BENZO(G,H,I)PERYLENE	11/11	170 - 2600	0	NTC17PCSD0102	950.0	NC	NA	NC	NA	3100000	0	56000	0	54000000	0	170	9
BENZO(K)FLUORANTHENE	11/11	130 - 2300	0	NTC17PCSD0102	720.9	NC	NA	NC	NA	9000	0	6200	0	29000	0	8860	0
CHRYSENE	11/11	240 - 4200	0	NTC17PCSD0102	1290.0	NC	NA	NC	NA	88000	0	62000	0	290000	0	400	8
FLUORANTHENE	11/11	580 - 13000	0	NTC17PCSD0102	3743.6	NC	NA	NC	NA	3100000	0	2300000	0	30000000	0	2790	4
FLUORENE	11/11	22 - 840	0	NTC17PCSD0102	244.7	NC	NA	NC	NA	3100000	0	2600000	0	33000000	0	35	10
INDENO(1,2,3-CD)PYRENE	11/11	120 - 1600	0	NTC17PCSD0102, NTC17PCSD0802	612.7	NC	NA	NC	NA	900	3	620	3	2900	0	2500	0
PHENANTHRENE	11/11	270 - 8500	0	NTC17PCSD0102	2412.7	NC	NA	NC	NA	3100000	0	56000	0	54000000	0	810	8
PYRENE	11/11	480 - 9700	0	NTC17PCSD0102	2836.4	NC	NA	NC	NA	2300000	0	2300000	0	54000000	0	350	11
PESTICIDES/PCBS (UG/KG)																	
4,4'-DDD	11/11	3.8 - 190	0	NTC17PCSD1802	81.1	NC	NA	NC	NA	3000	0	2400	0	17000	0	2	11
4,4'-DDE	11/11	8.5 - 250	0	NTC17PCSD1802	109.5	NC	NA	NC	NA	2000	0	1700	0	12000	0	2	11
4,4'-DDT	11/11	9.5 - 580	0	NTC17PCSD0402	144.9	NC	NA	NC	NA	2000	0	1700	0	12000	0	1	11
ALDRIN	2/10	0.97 - 1.1	7.3 - 87	NTC17PCSD0802	16.1	NC	NA	NC	NA	40	0	29	0	150	0	0.51	2
ALPHA-CHLORDANE	8/10	0.78 - 16	38 - 41	NTC17PCSD1802	9.1	NC	NA	NC	NA	50	0	1600	0	11000	0	0.5	8
AROCLOR-1248	1/11	380	36 - 45	NTC17PCSD1202	52.5	NC	NA	NC	NA	1000	0	220	1	1000	0	30	1
AROCLOR-1254	6/11	78 - 930	37 - 45	NTC17PCSD1802	229.3	NC	NA	NC	NA	1000	0	220	3	1000	0	60	6
AROCLOR-1260	4/11	47 - 320	36 - 45	NTC17PCSD0402	56.8	NC	NA	NC	NA	1000	0	220	1	1000	0	5	4
DELTA-BHC	1/11	0.11	0.9 - 87	NTC17PCSD0802	14.6	NC	NA	NC	NA	100	0	90	0	590	0	NC	NA
DIELDRIN	2/10	0.57 - 13	1.8 - 87	NTC17PCSD1802	13.6	NC	NA	NC	NA	40	0	30	0	150	0	50	0
ENDOSULFAN II	4/11	0.9 - 2.8	10 - 87	NTC17PCSD0102	14.9	NC	NA	NC	NA	470000	0	370000	0	5300000	0	0.15	4
ENDRIN	1/11	1.3	1.8 - 87	NTC17PCSD1002	14.8	NC	NA	NC	NA	23000	0	18000	0	260000	0	19	0
ENDRIN ALDEHYDE	1/10	2.7	1.8 - 87	NTC17PCSD0802	16.3	NC	NA	NC	NA	23000	0	18000	0	260000	0	20	0
GAMMA-CHLORDANE	4/11	0.63 - 3.5	1.8 - 87	NTC17PCSD1102	13.0	NC	NA	NC	NA	50	0	0.0016	4	NC	NA	0.5	4
HEPTACHLOR EPOXIDE	2/11	0.29 - 0.41	1.8 - 87	NTC17PCSD1002	14.6	NC	NA	NC	NA	70	0	53	0	270	0	5	0
INORGANICS (MG/KG)																	
ALUMINUM	11/11	2340 - 6300	0	NTC17PCSD1402	3713.6	9500	0	NC	NA	NC	NA	76000	0	100000	0	58030	0
ANTIMONY	5/11	0.45 - 2.7	0.27 - 0.78	NTC17PCSD0402	0.6	4	0	NC	NA	31	0	31	0	820	0	2	1
ARSENIC	11/11	4.7 - 34.2	0	NTC17PCSD0402	10.3	13	2	8	3	0.4	11	0.39	11	2.7	11	6	8
BARIUM	11/11	15.7 - 61.9	0	NTC17PCSD0802	38.0	110	0	NC	NA	5500	0	5400	0	100000	0	NC	NA
BERYLLIUM	10/11	0.41 - 1.9	0.33	NTC17PCSD1402	0.9	0.59	8	NC	NA	160	0	150	0	2200	0	NC	NA
CADMIUM	11/11	0.24 - 5.7	0	NTC17PCSD0402	0.9	0.6	3	0.5	5	78	0	37	0	810	0	0.6	3
CALCIUM	11/11	37300 - 111000	0	NTC17PCSD1202	71481.8	9300	11	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
CHROMIUM	11/11	9.8 - 31	0	NTC17PCSD0402	16.9	16.2	3	16	5	390	0	30	2	450	0	26	2
COBALT	11/11	4.3 - 10.7	0	NTC17PCSD0402	6.7	8.9	2	NC	NA	4700	0	4700	0	100000	0	50	0
COPPER	11/11	39.4 - 577	0	NTC17PCSD0402	205.1	19.6	11	38	11	2900	0	2900	0	76000	0	16	11
IRON	11/11	10400 - 30300	0	NTC17PCSD1402	16190.9	15900	4	18000	2	NC	NA	23000	1	100000	0	20000	2
LEAD	11/11	71.9 - 435	0	NTC17PCSD0402	159.5	36	11	28	11	400	1	400	1	750	0	31	11
MAGNESIUM	11/11	19700 - 57500	0	NTC17PCSD1702	37463.6	4820	11	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
MANGANESE	11/11	291 - 1600	0	NTC17PCSD0102	495.9	636	1	1300	1	3700	0	1800	0	32000	0	460	4
MERCURY	11/11	0.07 - 0.87	0	NTC17PCSD0402	0.2	0.06	11	0.07	10	23	0	23	0	610	0	0.2	3
NICKEL	11/11	11.2 - 44	0	NTC17PCSD0402	19.1	18	3	NC	NA	1600	0	1600	0	41000	0	30	1
POTASSIUM	11/11	324 - 1270	0	NTC17PCSD1402	611.8	1268	1	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
SELENIUM	5/11	0.46 - 62.5	0.36 - 0.72	NTC17PCSD1102	6.2	0.48	4	NC	NA	390	0	390	0	10000	0	NC	NA
SILVER	2/11	0.65 - 5.5	0.15 - 0.65	NTC17PCSD0402	0.7	0.55	2	NC	NA	390	0	390	0	10000	0	1	1
SODIUM	11/11	157 - 2330	0	NTC17PCSD1402	482.5	130	11	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
THALLIUM	9/11	0.8 - 2.5	0.68 - 1.2	NTC17PCSD1402	1.3	0.32	9	NC	NA	6.3	0	5.2	0	130	0	NC	NA
VANADIUM	11/11	8.7 - 16.3	0	NTC17PCSD0402	12.8	25.2	0	NC	NA	550	0	550	0	14000	0	NC	NA
ZINC	11/11	171 - 2620	0	NTC17PCSD0102	1250.8	95	11	80	11	23000	0	23000	0	100000	0	120	11
MISCELLANEOUS PARAMETERS (MG/KG)																	
PH S.U.	11/11	7.3 - 8.6	0	NTC17PCSD1202	8.2	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
TOTAL ORGANIC CARBON	11/11	1640 - 18600	0	NTC17PCSD0402	6490.0	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA

Footnotes
1 - The average concentrations were calculated by using one-half the detection limit for non-detects.
2 - Illinois EPA (March 2002).
3 - Number of samples that exceed criteria.
4 - Illinois EPA (August 1997).
5 - USEPA (November 2000).
6 - USEPA (November 2000).
7 - See Table 7-2.
NC - No Criteria
NA - Not Applicable

TABLE 4-6

FREQUENCY OF DETECTION IN SEDIMENT AT DEPTH
SITE 17 - SOUTH BRANCH PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTS	RANGE OF NON DETECTS	SAMPLE WITH MAXIMUM CONCENTRATION	AVERAGE CONCENTRATION	TACO BACKGROUND WITHIN METROPOLITAN (2)	TACO BACKGROUND EXCEEDANCES (3)	ILLINOIS EPA UNSIEVED STREAM SEDIMENT BACKGROUND (4)	ILLINOIS EPA EXCEEDANCES (3)	ILLINOIS TACO ROUTE SPECIFIC VALUES FOR SOIL INGESTION (2)	TACO EXCEEDANCES (3)	REGION 9 PRG RESIDENTIAL SOIL (5)	REGION 9 RESIDENTIAL PRG EXCEEDANCES (3)	REGION 9 PRG INDUSTRIAL SOIL (6)	REGION 9 INDUSTRIAL PRG EXCEEDANCES (3)	ECOLOGICAL SEDIMENT CRITERIA (7)	ECOLOGICAL SEDIMENT EXCEEDANCES (3)
SEMIVOLATILE ORGANICS (UG/KG)																	
ACENAPHTHYLENE	1/3	81	78 - 440	NTC17PCSD3602	113.3	NC	NA	NC	NA	4700000	0	3700000	0	38000000	0	186	0
ANTHRACENE	3/3	20 - 93	0	NTC17PCSD2902	68.3	NC	NA	NC	NA	23000000	0	22000000	0	100000000	0	85	2
BENZO(A)ANTHRACENE	3/3	110 - 310	0	NTC17PCSD2902	216.7	NC	NA	NC	NA	900	0	620	0	2900	0	287	1
BENZO(A)PYRENE	3/3	120 - 340	0	NTC17PCSD2902	226.7	NC	NA	NC	NA	90	3	62	3	290	1	73	3
BENZO(B)FLUORANTHENE	3/3	120 - 310	0	NTC17PCSD2902	213.3	NC	NA	NC	NA	900	0	620	0	2900	0	886	0
BENZO(G,H,I)PERYLENE	3/3	98 - 190	0	NTC17PCSD2902	132.7	NC	NA	NC	NA	3100000	0	56000	0	54000000	0	170	1
BENZO(K)FLUORANTHENE	3/3	62 - 170	0	NTC17PCSD2902	114.0	NC	NA	NC	NA	9000	0	6200	0	29000	0	8860	0
CHRYSENE	3/3	110 - 290	0	NTC17PCSD2902	206.7	NC	NA	NC	NA	88000	0	62000	0	290000	0	400	0
FLUORANTHENE	3/3	240 - 700	0	NTC17PCSD2902	506.7	NC	NA	NC	NA	3100000	0	2300000	0	30000000	0	2790	0
FLUORENE	3/3	17 - 59	0	NTC17PCSD3602	41.7	NC	NA	NC	NA	3100000	0	2600000	0	33000000	0	35	2
INDENO(1,2,3-CD)PYRENE	3/3	66 - 180	0	NTC17PCSD2902	125.3	NC	NA	NC	NA	900	0	620	0	2900	0	2500	0
PHENANTHRENE	3/3	110 - 440	0	NTC17PCSD3602	303.3	NC	NA	NC	NA	3100000	0	56000	0	54000000	0	810	0
PYRENE	3/3	200 - 570	0	NTC17PCSD2902	403.3	NC	NA	NC	NA	2300000	0	2300000	0	54000000	0	350	2
PESTICIDES/PCBS (UG/KG)																	
4,4'-DDD	3/3	15 - 21	0	NTC17PCSD3602	18.7	NC	NA	NC	NA	3000	0	2400	0	17000	0	2	3
4,4'-DDE	3/3	14 - 26	0	NTC17PCSD3602	20.7	NC	NA	NC	NA	2000	0	1700	0	12000	0	2	3
4,4'-DDT	3/3	9 - 36	0	NTC17PCSD2902	20.3	NC	NA	NC	NA	2000	0	1700	0	12000	0	1	3
ALPHA-CHLORDANE	3/3	1 - 1.5	0	NTC17PCSD3602	1.3	NC	NA	NC	NA	50	0	1600	0	11000	0	0.5	3
DELTA-BHC	1/3	0.095	2 - 9	NTC17PCSD3602	1.9	NC	NA	NC	NA	100	0	90	0	590	0	NC	NA
DIELDRIN	3/3	0.49 - 1.2	0	NTC17PCSD3602	0.9	NC	NA	NC	NA	40	0	30	0	150	0	50	0
ENDOSULFAN II	3/3	0.44 - 0.92	0	NTC17PCSD2902	0.7	NC	NA	NC	NA	470000	0	370000	0	5300000	0	0.15	3
ENDRIN	1/3	0.46	2.2 - 9	NTC17PCSD3202	2.0	NC	NA	NC	NA	23000	0	18000	0	260000	0	19	0
ENDRIN ALDEHYDE	1/3	0.67	2 - 9	NTC17PCSD3602	2.1	NC	NA	NC	NA	23000	0	18000	0	260000	0	20	0
GAMMA-CHLORDANE	3/3	0.76 - 1.2	0	NTC17PCSD3602	1.0	NC	NA	NC	NA	50	0	0.0016	3	NC	NA	0.5	3
INORGANICS (MG/KG)																	
ALUMINUM	3/3	2030 - 3570	0	NTC17PCSD2902	2763.3	9500	0	NC	NA	NC	NA	76000	0	100000	0	58030	0
ANTIMONY	1/3	0.51	0.28 - 0.32	NTC17PCSD3602	0.3	4	0	NC	NA	31	0	31	0	820	0	2	0
ARSENIC	3/3	2.8 - 4.9	0	NTC17PCSD2902	3.9	13	0	8	0	0.4	3	0.39	3	2.7	3	6	0
BARIUM	3/3	15.2 - 30.2	0	NTC17PCSD2902	20.8	110	0	NC	NA	5500	0	5400	0	100000	0	NC	NA
BERYLLIUM	3/3	0.13 - 0.46	0	NTC17PCSD3602	0.3	0.59	0	NC	NA	160	0	150	0	2200	0	NC	NA
CADMIUM	1/3	0.27	0.06 - 0.07	NTC17PCSD2902	0.1	0.6	0	0.5	0	78	0	37	0	810	0	0.6	0
CALCIUM	3/3	38200 - 43800	0	NTC17PCSD3202	41133.3	9300	3	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
CHROMIUM	3/3	7.5 - 13.4	0	NTC17PCSD2902	9.5	16.2	0	16	0	390	0	30	0	450	0	26	0
COBALT	3/3	4 - 6.4	0	NTC17PCSD2902	5.1	8.9	0	NC	NA	4700	0	4700	0	100000	0	50	0
COPPER	3/3	9.2 - 91.1	0	NTC17PCSD3602	41.6	19.6	2	38	1	2900	0	2900	0	76000	0	16	2
IRON	3/3	7900 - 11600	0	NTC17PCSD2902	9816.7	15900	0	18000	0	NC	NA	23000	0	100000	0	20000	0
LEAD	3/3	18.5 - 47.2	0	NTC17PCSD3602	37.3	36	2	28	2	400	0	400	0	750	0	31	2
MAGNESIUM	3/3	19500 - 24000	0	NTC17PCSD3202	21966.7	4820	3	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
MANGANESE	3/3	314 - 433	0	NTC17PCSD2902	356.7	636	0	1300	0	3700	0	1800	0	32000	0	460	0
MERCURY	3/3	0.07 - 0.31	0	NTC17PCSD2902	0.2	0.06	3	0.07	2	23	0	23	0	610	0	0.2	1
NICKEL	3/3	8.5 - 13.5	0	NTC17PCSD2902	10.9	18	0	NC	NA	1600	0	1600	0	41000	0	30	0
POTASSIUM	3/3	290 - 511	0	NTC17PCSD2902	387.3	1268	0	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
SELENIUM	1/3	0.5	0.39 - 0.42	NTC17PCSD2902	0.3	0.48	1	NC	NA	390	0	390	0	10000	0	NC	NA
SODIUM	3/3	79.1 - 255	0	NTC17PCSD3602	143.5	130	1	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
THALLIUM	2/3	0.97 - 1	0.67	NTC17PCSD3602	0.8	0.32	2	NC	NA	6.3	0	5.2	0	130	0	NC	NA
VANADIUM	3/3	6.6 - 12.3	0	NTC17PCSD2902	10.0	25.2	0	NC	NA	550	0	550	0	14000	0	NC	NA
ZINC	3/3	117 - 665	0	NTC17PCSD3602	354.0	95	3	80	3	23000	0	23000	0	100000	0	120	2
MISCELLANEOUS PARAMETERS (MG/KG)																	
PH S.U.	3/3	7.8 - 8.1	0	NTC17PCSD2902	8.0	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
TOTAL ORGANIC CARBON	3/3	3080 - 7180	0	NTC17PCSD2902	5146.7	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA

Footnotes:

1 - The average concentrations were calculated by using one-half the detection limit for non-detects.
2 - Illinois EPA (March 2002).
3 - Number of samples that exceed criteria.
4 - Illinois EPA (August 1997).
5 - USEPA (November 2000).
6 - USEPA (November 2000).
7 - See Table 7-2.
NC - No criteria.
NA - Not applicable.

TABLE 4-7

FREQUENCY OF DETECTION IN SEDIMENT AT DEPTH
SITE 17 - BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTS	RANGE OF NON DETECTS	SAMPLE WITH MAXIMUM CONCENTRATION	AVERAGE CONCENTRATION (1)	TACO BACKGROUND SOIL WITHIN METROPOLITAN (2)	TACO BACKGROUND EXCEEDANCES (3)	ILLINOIS EPA UNSIEVED STREAM SEDIMENT BACKGROUND (4)	ILLINOIS EPA BACKGROUND EXCEEDANCES (3)	ILLINOIS TACO ROUTE SPECIFIC VALUES FOR SOIL INGESTION (2)	TACO EXCEEDANCES (3)	REGION 9 PRG RESIDENTIAL SOIL (5)	REGION 9 RESIDENTIAL EXCEEDANCES (3)	REGION 9 PRG INDUSTRIAL SOIL (6)	REGION 9 INDUSTRIAL EXCEEDANCES (3)	ECOLOGICAL SEDIMENT CRITERIA (7)	ECOLOGICAL SEDIMENT EXCEEDANCES (3)
VOLATILE ORGANICS (UG/KG)																	
METHYLENE CHLORIDE	1/1	11	0	NTC17BBSD5303	11.0	NC	NA	NC	NA	85000	0	8900	0	21000	0	18	0
SEMIVOLATILE ORGANICS (UG/KG)																	
ACENAPHTHYLENE	18/36	14 - 220	430 - 4100	NTC17BBSD5104	281.2	NC	NA	NC	NA	4700000	0	3700000	0	38000000	0	186	1
ANTHRACENE	35/36	40 - 990	50	NTC17BBSD4904	208.3	NC	NA	NC	NA	23000000	0	22000000	0	100000000	0	85	30
BENZO(A)ANTHRACENE	35/36	180 - 2500	94	NTC17BBSD4904	603.5	NC	NA	NC	NA	900	4	620	14	2900	0	287	29
BENZO(A)PYRENE	36/36	170 - 2300	0	NTC17BBSD4904	578.1	NC	NA	NC	NA	90	36	62	36	290	28	73	36
BENZO(B)FLUORANTHENE	36/36	140 - 2300	0	NTC17BBSD4904	597.5	NC	NA	NC	NA	900	4	620	12	2900	0	886	4
BENZO(G,H,I)PERYLENE	31/36	120 - 1200	94 - 210	NTC17BBSD4904	296.6	NC	NA	NC	NA	3100000	0	56000	0	54000000	0	170	24
BENZO(K)FLUORANTHENE	35/36	80 - 1300	94	NTC17BBSD4904	317.4	NC	NA	NC	NA	9000	0	6200	0	29000	0	8860	0
BIS(2-ETHYLHEXYL)PHTHALATE	1/1	6300	0	NTC17BBSD5303	6300.0	NC	NA	NC	NA	46000	0	35000	0	180000	0	130000	0
CHRYSENE	36/36	160 - 2600	0	NTC17BBSD4904	635.8	NC	NA	NC	NA	88000	0	62000	0	290000	0	400	25
DIBENZO(A,H)ANTHRACENE	2/36	42 - 57	42 - 830	NTC17BBSD5504	85.8	NC	NA	NC	NA	90	0	62	0	290	0	60	0
FLUORANTHENE	36/36	300 - 7700	0	NTC17BBSD4904	1780.3	NC	NA	NC	NA	3100000	0	2300000	0	30000000	0	2790	4
FLUORENE	36/36	33 - 910	0	NTC17BBSD4904	175.0	NC	NA	NC	NA	3100000	0	2600000	0	33000000	0	35	35
INDENO(1,2,3-CD)PYRENE	35/36	67 - 1200	210	NTC17BBSD4904	281.2	NC	NA	NC	NA	900	1	620	2	2900	0	2500	0
NAPHTHALENE	2/36	200 - 290	210 - 4100	NTC17BBSD4905	417.5	NC	NA	NC	NA	3100000	0	56000	0	190000	0	340	0
PHENANTHRENE	36/36	140 - 6800	0	NTC17BBSD4904	1309.2	NC	NA	NC	NA	3100000	0	56000	0	54000000	0	810	23
PYRENE	36/36	210 - 5900	0	NTC17BBSD4904	1352.2	NC	NA	NC	NA	2300000	0	2300000	0	54000000	0	350	35
PESTICIDES/PCBS (UG/KG)																	
4,4'-DDD	36/36	30 - 4100	0	NTC17BBSD4604	713.6	NC	NA	NC	NA	3000	3	2400	3	17000	0	2	36
4,4'-DDE	36/36	13 - 540	0	NTC17BBSD4505	180.3	NC	NA	NC	NA	2000	0	1700	0	12000	0	2	36
4,4'-DDT	35/36	6.5 - 400	660	NTC17BBSD4604	96.7	NC	NA	NC	NA	2000	0	1700	0	12000	0	1	35
ALDRIN	1/35	1.8	2.1 - 710	NTC17BBSD4805	51.3	NC	NA	NC	NA	40	0	29	0	150	0	0.51	1
ALPHA-BHC	1/36	4.1	2.1 - 710	NTC17BBSD5603	50.2	NC	NA	NC	NA	100	0	90	0	590	0	0.023	1
ALPHA-CHLORDANE	34/36	2 - 95	660 - 710	NTC17BBSD4504	38.8	NC	NA	NC	NA	50	3	1600	0	11000	0	0.5	34
AROCLOR-1248	11/36	130 - 1500	41 - 260	NTC17BBSD4804, NTC17BBSD5004	235.4	NC	NA	NC	NA	1000	2	220	10	1000	2	30	11
AROCLOR-1254	34/36	130 - 6100	41 - 46	NTC17BBSD4505	1355.1	NC	NA	NC	NA	1000	16	220	32	1000	16	60	34
AROCLOR-1260	27/36	47 - 1100	42 - 260	NTC17BBSD4803	300.2	NC	NA	NC	NA	1000	1	220	16	1000	1	5	27
BETA-BHC	3/35	2.9 - 6.4	2.1 - 710	NTC17BBSD5604	50.3	NC	NA	NC	NA	NC	0	320	0	2100	0	0.37	3
DELTA-BHC	3/35	2.9 - 6.1	2.1 - 710	NTC17BBSD5604	50.3	NC	NA	NC	NA	100	0	90	0	590	0	NC	NA
DIELDRIN	35/36	1.6 - 77	710	NTC17BBSD4505	27.4	NC	NA	NC	NA	40	2	30	6	150	0	50	2
ENDOSULFAN I	31/36	0.92 - 31	46 - 710	NTC17BBSD5105	38.3	NC	NA	NC	NA	470000	0	370000	0	5300000	0	0.15	31
ENDOSULFAN II	28/36	1.2 - 41	46 - 710	NTC17BBSD4804	41.5	NC	NA	NC	NA	470000	0	370000	0	5300000	0	0.15	28
ENDOSULFAN SULFATE	1/36	0.26	17 - 710	NTC17BBSD5605	50.4	NC	NA	NC	NA	470000	0	370000	0	5300000	0	5.4	0
ENDRIN	16/36	2.6 - 41	2.1 - 710	NTC17BBSD5005	45.1	NC	NA	NC	NA	23000	0	18000	0	260000	0	19	2
ENDRIN ALDEHYDE	1/36	12	2.1 - 710	NTC17BBSD5305	50.1	NC	NA	NC	NA	23000	0	18000	0	260000	0	20	0
ENDRIN KETONE	3/36	6.7 - 16	2.1 - 710	NTC17BBSD5304	49.5	NC	NA	NC	NA	23000	0	18000	0	260000	0	20	0
GAMMA-BHC (LINDANE)	1/36	2.8	2.1 - 710	NTC17BBSD5603	50.2	NC	NA	NC	NA	500	0	440	0	2900	0	0.39	1
GAMMA-CHLORDANE	30/34	1.1 - 36	46 - 710	NTC17BBSD4804	39.5	NC	NA	NC	NA	50	0	0.0016	30	NC	NA	0.5	30
METHOXYCHLOR	3/36	11 - 16	21 - 7100	NTC17BBSD4904	490.3	NC	NA	NC	NA	390000	0	310000	0	4400000	0	8.8	3
INORGANICS (MG/KG)																	
ALUMINUM	36/36	1340 - 11000	0	NTC17BBSD5203	5442.2	9500	2	NC	NA	NC	NA	76000	0	100000	0	58030	0
ANTIMONY	17/36	0.55 - 8	0.64 - 1.6	NTC17BBSD5305	1.5	4	4	NC	NA	31	0	31	0	820	0	2	7
ARSENIC	36/36	3.9 - 28.7	0	NTC17BBSD5305	11.5	13	9	8	25	0.4	36	0.39	36	2.7	36	6	32
BARIUM	36/36	15.4 - 230	0	NTC17BBSD5305	71.5	110	6	NC	NA	5500	0	5400	0	100000	0	NC	NA
BERYLLIUM	34/36	0.18 - 4	0.44 - 0.56	NTC17BBSD4903	0.8	0.59	23	NC	NA	160	0	150	0	2200	0	NC	NA
CADMIUM	36/36	0.77 - 26	0	NTC17BBSD4705	5.0	0.6	36	0.5	36	78	0	37	0	810	0	0.6	36
CALCIUM	36/36	35700 - 94400	0	NTC17BBSD5505	59941.7	9300	36	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
CHROMIUM	36/36	7.8 - 147	0	NTC17BBSD4705	37.7	16.2	31	16	32	390	0	30	19	450	0	26	20
COBALT	36/36	3.4 - 43.2	0	NTC17BBSD5203	10.7	8.9	20	NC	NA	4700	0	4700	0	100000	0	50	0
COPPER	36/36	86.4 - 948	0	NTC17BBSD4705	363.6	19.6	36	38	36	2900	0	2900	0	76000	0	16	36
IRON	36/36	7750 - 24600	0	NTC17BBSD5305	16095.8	15900	19	18000	15	NC	NA	23000	2	100000	0	20000	5
LEAD	36/36	72.9 - 503	0	NTC17BBSD4504	253.7	36	36	28	36	400	2	400	2	750	0	31	36
MAGNESIUM	36/36	17300 - 45500	0	NTC17BBSD5505	29388.9	4820	36	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
MANGANESE	36/36	234 - 1290	0	NTC17BBSD5305	574.6	636	8	1300	0	3700	0	1800	0	32000	0	460	25
MERCURY	36/36	0.088 - 4.2	0	NTC17BBSD4704	1.3	0.06	36	0.07	36	23	0	23	0	610	0	0.2	32
NICKEL	36/36	11.5 - 309	0	NTC17BBSD4504	80.9	18	32	NC	NA	1600	0	1600	0	41000	0	30	29
POTASSIUM	36/36	180 - 2040	0	NTC17BBSD4505	858.2	1268	6	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
SELENIUM	31/36	0.62 - 13.4	0.57 - 0.64	NTC17BBSD5305	2.5	0.48	31	NC	NA	390	0	390	0	10000	0	NC	NA
SILVER	36/36	1.1 - 70.8	0	NTC17BBSD4504	23.5	0.55	36	NC	NA	390	0	390	0	10000	0	1	36
SODIUM	36/36	103 - 376	0	NTC17BBSD5305	236.1	130	35	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
VANADIUM	36/36	7.2 - 27	0	NTC17BBSD5305	15.9	25.2	2	NC	NA	550	0	550	0	14000	0	NC	NA
ZINC	36/36	257 - 1580	0	NTC17BBSD4805	821.3	95	36	80	36	23000	0	23000	0	100000	0	120	36
MISCELLANEOUS PARAMETERS (MG/KG)																	
PH S.U.	36/36	7.1 - 7.9	0	NTC17BBSD5605	7.4	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA
TOTAL ORGANIC CARBON	36/36	2110 - 30200	0	NTC17BBSD4604	16958.6	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA	NC	NA

Footnotes:
1 - The average concentrations were calculated by using one-half the detection limit for non-detects.
2 - Illinois EPA (March 2002).
3 - Number of samples that exceed criteria.
4 - Illinois EPA (August 1997).
5 - USEPA (November 2000).
6 - USEPA (November 2000).
7 - See Table 7-2.
NC - No Criteria.

TABLE 4-8

SEMIVOLATILE COMPARISON OF PREVIOUSLY COLLECTED DATA TO TTNUS 2001 INVESTIGATION
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

Location	NTC17PCSD02	SD-PC-09	NTC17PCSD05	SD-PC-08	X113-91	NTC17PCSD09	X201-94	NTC17PCSD14	NTC17PCSD14	SD-PC-07	NTC17PCSD24	SD-PC-01	NTC17PCSD30	X114-91	X202-94	NTC17BBSD52	B-204
Sample	NTC17PCSD0201	GL63-SD-PC-09	NTC17PCSD0501	GL63-SD-PC-08	X113-91	NTC17PCSD0901	X201-94	NTC17PCSD1401	NTC17PCSD1402	GL63-SD-PC-07	NTC17PCSD2401	GL63-SD-PC-01	NTC17PCSD3001	X114-91	X202-94	NTC17BBSD5201	B-204
Depth of Range (ft)	(0-0.13)	(0-0)	(0-0.131)	(0-0)	(0-0)	(0-0.131)	(0-0)	(0-0.13)	(1-1)	(0-0)	(0-0.131)	(0-0)	(0-0.131)	(0-0)	(0-0)	(0-0.131)	(0-0)
Sample Date	9/24/2001	8/25/1992	9/24/2001	8/24/1992	11/15/1991	9/24/2001	4/27/1994	9/23/2001	9/23/2001	8/24/1992	9/22/2001	8/24/1992	9/23/2001	11/14/1991	4/27/1994	9/5/2001	12/6/1989
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Units	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG
Semivolatile Organic Compounds																	
1,1-BIPHENYL	NA		NA			NA		370 U	NA		NA		NA			NA	
2,2'-OXYBIS(1-CHLOROPROPANE)	NA		NA			NA		370 U	NA		NA		NA			NA	
2,4,5-TRICHLOROPHENOL	NA		NA			NA		370 U	NA		NA		NA			NA	
2,4,6-TRICHLOROPHENOL	NA		NA			NA		370 U	NA		NA		NA			NA	
2,4-DICHLOROPHENOL	NA		NA			NA		370 U	NA		NA		NA			NA	
2,4-DIMETHYLPHENOL	NA		NA			NA		370 U	NA		NA		NA			NA	
2,4-DINITROPHENOL	NA		NA			NA		1,800 U	NA		NA		NA			NA	
2,4-DINITROTOLUENE	NA		NA			NA		370 U	NA		NA		NA			NA	
2,6-DINITROTOLUENE	NA		NA			NA		370 U	NA		NA		NA			NA	
2-CHLORONAPHTHALENE	NA		NA			NA		370 U	NA		NA		NA			NA	
2-CHLOROPHENOL	NA		NA			NA		370 U	NA		NA		NA			NA	
2-METHYLNAPHTHALENE	NA	85 J	NA			NA	110 J	64 J	NA		NA		NA		160 J	NA	
2-METHYLPHENOL	NA		NA			NA		370 U	NA		NA		NA			NA	
2-NITROANILINE	NA		NA			NA		1,800 U	NA		NA		NA			NA	
2-NITROPHENOL	NA		NA			NA		370 U	NA		NA		NA			NA	
3,3'-DICHLOROBENZIDINE	NA		NA			NA		1,800 U	NA		NA		NA			NA	
3-NITROANILINE	NA		NA			NA		1,800 U	NA		NA		NA			NA	
4,6-DINITRO-2-METHYLPHENOL	NA		NA			NA		1,800 U	NA		NA		NA			NA	
4-BROMOPHENYL PHENYL ETHER	NA		NA			NA		370 U	NA		NA		NA			NA	
4-CHLORO-3-METHYLPHENOL	NA		NA			NA		370 U	NA		NA		NA			NA	
4-CHLOROANILINE	NA		NA			NA		370 U	NA		NA		NA			NA	
4-CHLOROPHENYL PHENYL ETHER	NA		NA			NA		370 U	NA		NA		NA			NA	
4-METHYLPHENOL	NA		NA			NA		370 U	NA		NA		NA			NA	
4-NITROANILINE	NA		NA			NA		1,800 U	NA		NA		NA			NA	
4-NITROPHENOL	NA		NA			NA		1,800 U	NA		NA		NA			NA	
ACENAPHTHENE	3,500 U	500	2,000 U	160 J		400 U	730	740 U	800 U		1600 U		450 U			2200 U	
ACENAPHTHYLENE	3,500 U		2,000 U			400 U		36 J	800 U		1600 U		450 U		120 J	160 J	
ACETOPHENONE	NA		NA			NA		370 U	NA		NA		NA			NA	
ANTHRACENE	930	910	320 J	320 J		61 J	840	110 J	290	75 J	400	120 J	220		220 J	620	
ATRAZINE	NA		NA			NA		370 U	NA		NA		NA			NA	
BENZALDEHYDE	NA		NA			NA		370 U	NA		NA		NA			NA	
BENZO(A)ANTHRACENE	2,400	2,400	1,000	760		390	2200	440	500	260 J	930	290 J	500		880	1900	1100
BENZO(A)PYRENE	2,300	1,700	1,100	490	190 J	470		410	410	210 J	840	200 J	530			1700	810
BENZO(B)FLUORANTHENE	2,400	2,400	1,200	520	210 J	460		440	380		870	190 J	480		730	1600	740
BENZO(G,H,I)PERYLENE	1,600	580	930			360		260	230		610 J		290			450 U	680
BENZO(K)FLUORANTHENE	1,300	1,800	620	450	170 J	260	2300	240	230	490	500	270 J	260			1000	
BIS(2-CHLOROETHOXY)METHANE	NA		NA			NA		370 U	NA		NA		NA			NA	
BIS(2-CHLOROETHYL)ETHER	NA		NA			NA		370 U	NA		NA		NA			NA	
BIS(2-CHLOROISOPROPYL)ETHER	NA		NA			NA			NA		NA		NA			NA	
BIS(2-ETHYLHEXYL)PHTHALATE	NA	1,900	NA			NA	300000	620	NA	390 J	NA		NA		560	NA	
BUTYL BENZYL PHTHALATE	NA	85 J	NA			NA	420 J	370 U	NA		NA		NA			NA	
CAPROLACTAM	NA		NA			NA		370 U	NA		NA		NA			NA	
CARBAZOLE	NA	600	NA	180 J		NA	950	720	NA		NA		NA		220 J	NA	
CHRYSENE	2,400	2,700	1,000	790	190 J	410	2300	430	430	280 J	890	370 J	460		870	1800	1800
DIBENZO(A,H)ANTHRACENE	710 U		410 U			81 U		150 U	160 U		330 U		91 U			450 U	260
DIBENZOFURAN	NA	310 J	NA	120 J		NA	510	250 J	NA		NA		NA		130 J	NA	
DIETHYL PHTHALATE	NA		NA			NA		370 U	NA		NA		NA			NA	
DIMETHYL PHTHALATE	NA		NA			NA		370 U	NA		NA		NA			NA	
DI-N-BUTYL PHTHALATE	NA		NA			NA	740	370 U	NA		NA		NA		960	NA	
DI-N-OCTYL PHTHALATE	NA		NA			NA	23000 J	370 U	NA		NA		NA			NA	
FLUORANTHENE	7,400	5,600	3,000	1,700	370 J	950	3100	1,200	1,300	600	2800	660	1,300	280 J	1,600	4,500	450
FLUORENE	570 J	510	190 J	220 J		46 J	680	80 J	150 J		170 J		110		220 J	270 J	266
HEXACHLOROBENZENE	NA		NA			NA		370 U	NA		NA		NA			NA	
HEXACHLOROBUTADIENE	NA		NA			NA		370 U	NA		NA		NA			NA	
HEXACHLOROCYCLOPENTADIENE	NA		NA			NA		1,800 U	NA		NA		NA			NA	
HEXACHLOROETHANE	NA		NA			NA		370 U	NA		NA		NA			NA	
INDENO(1,2,3-CD)PYRENE	940	520 J	590	220 J		270		170	140 J		390 J		240			610	704
ISOPHORONE	NA		NA			NA		370 U	NA		NA		NA			NA	
NAPHTHALENE	3,500 U	170 J	2,000 U			400 U	130 J	740 U	800 U		1600 U		450 U		170 J	2200 U	
NITROBENZENE	NA		NA			NA		370 U	NA		NA		NA			NA	
N-NITROSO-DI-N-PROPYLAMINE	NA		NA			NA		370 U	NA		NA		NA			NA	
N-NITROSODIPHENYLAMINE	NA		NA			NA		370 U	NA		NA		NA			NA	
PENTACHLOROPHENOL	NA		NA			NA		1,800 U	NA		NA		NA			NA	
PHENANTHRENE	4,800	4,800	1,700	1,700	310 J	490		720	1,000		1800	570	840	190 J	1,100	2,600	2,100
PHENOL	NA		NA			810		370 U	NA		NA		NA			NA	
PYRENE	5,500	4,200	2,300	1,400	410 J	NA		930	1,000	510	2000	550	1,000	280 J	1,400	3,600	2,100

Notes:
Only the positive detections are presented for the historical data.
NA = Not analyzed.

TABLE 4-9

PESTICIDE/PCB COMPARISON OF PREVIOUSLY COLLECTED DATA TO TTNUS 2001 INVESTIGATION
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

Location	NTC17PCSD02	SD-PC-09	NTC17PCSD05	SD-PC-08	NTC17PCSD09	X201-94	NTC17PCSD14	NTC17PCSD14	SD-PC-07	NTC17PCSD24	SD-PC-01	NTC17PCSD30	X202-94	NTC17BBSD52	B-204
Sample	NTC17PCSD0201	GL63-SD-PC-09	NTC17PCSD0501	GL63-SD-PC-08	NTC17PCSD0901	X201-94	NTC17PCSD1401	NTC17PCSD1402	GL63-SD-PC-07	NTC17PCSD2401	GL63-SD-PC-01	NTC17PCSD3001	X202-94	NTC17BBSD5201	B-204
Depth of Range (ft)	(0-0.13)	(0-0)	(0-0.131)	(0-0)	(0-0.131)	(0-0)	(0-0.13)	(1-1)	(0-0)	(0-0.131)	(0-0)	(0-0.131)	(0-0)	(0-0.131)	(0-0)
Sample Date	9/24/2001	8/25/1992	9/24/2001	8/24/1992	9/24/2001	4/27/1994	9/23/2001	9/23/2001	8/24/1992	9/22/2001	8/24/1992	9/23/2001	4/27/1994	9/5/2001	12/6/1989
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Units	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG
Pesticides/PCBs															
4,4'-DDD	7.2 J	170 J	150 J	55 J	4.4	26	100	180	49	78	42 J	20	59	190	
4,4'-DDE	66	110 J	200 J	48 J	20		150	200	58	89	50 J	20	41	140	
4,4'-DDT	51	120 J	1,800	34 J	17	42	190	190	75 J	93	38 J	28	71	46 U	
ALDRIN	18 U		210 U		4.1 U		38 U	41 U		21 U		2.3 U		46 U	
ALPHA-BHC	18 U		210 U		4.1 U		38 U	41 U		21 U		2.3 U	1.2 J	46 U	
ALPHA-CHLORDANE	2.5 J		210 U	7.7 J	0.44 J	1.1 J	38 U	41 U		1.4 J		1 J	29	6.7 J	
AROCLOR-1016	35 U		40 U		40 U		37 U	40 U		41 U		45 U		44 U	
AROCLOR-1221	35 U		40 U		40 U		37 U	40 U		41 U		45 U		44 U	
AROCLOR-1232	35 U		40 U		40 U		37 U	40 U		41 U		45 U		44 U	
AROCLOR-1242	35 U		40 U		40 U		37 U	40 U		41 U		45 U		44 U	
AROCLOR-1248	35 U		40 U		40 U		37 U	40 U		41 U		45 U		44 U	
AROCLOR-1254	110		160	510 J	40 U	270	200	40 U		41 U		45 U		44 U	2,400
AROCLOR-1260	49		110		40 U	310	43	40 U		41 U		45 U	160	44 U	
BETA-BHC	18 U		210 U		4.1 U		38 U	41 U		21 U		2.3 U		7.6 J	
DELTA-BHC	18 U		210 U		4.1 U		38 U	41 U		21 U		2.3 U		2 J	
DIELDRIN	18 U		210 U		0.23 J	4.8	38 U	41 U		21 U		0.66 J	9.8	6.3 J	
ENDOSULFAN I	18 U		210 U		4.1 U		38 U	41 U		21 U		2.3 U		7.7 J	
ENDOSULFAN II	18 U		210 U		4.1 U	12	38 U	41 U		21 U		0.75 J		12 J	
ENDOSULFAN SULFATE	18 U		210 U		4.1 U		38 U	41 U		21 U		2.3 U		7.3 J	
ENDRIN	18 U		210 U		4.1 U	33	38 U	41 U		21 U		0.57 J	9.7	46 U	
ENDRIN ALDEHYDE	18 U		210 U		4.1 U		38 U	41 U		21 U		2.3 U		46 U	
ENDRIN KETONE	18 U		210 U		4.1 U		38 U	41 U		21 U		2.3 U		46 U	
GAMMA-BHC (LINDANE)	18 U		210 U		4.1 U		38 U	41 U		21 U		2.3 U		46 U	
GAMMA-CHLORDANE	18 U		210 U		4.1 U		38 U	41 U		21 U		1.1 J	16	46 U	
HEPTACHLOR	18 U		210 U		4.1 U	1.3 J	38 U	41 U		21 U		2.3 U		46 U	
HEPTACHLOR EPOXIDE	18 U		210 U		4.1 U		38 U	41 U		21 U		0.15 J	4	46 U	
METHOXYCHLOR	180 U		2,100 U		41 U		380 U	410 U		210 U		23 U		32 J	
TOXAPHENE	710 U		8,200 U		160 U		1,500 U	1,600 U		830 U		91 U		1,800 U	

Notes:
Only the positive detections are presented for the historical data.

TABLE 4-10

METALS COMPARISON OF PREVIOUSLY COLLECTED DATA TO TTNUS 2001 INVESTIGATION
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

Location	NTC17PCSD02	SD-PC-09	NTC17PCSD05	SD-PC-08	X113-91	NTC17PCSD09	X201-94	NTC17PCSD14	NTC17PCSD14
Sample	NTC17PCSD0201	GL63-SD-PC-09	NTC17PCSD0501	GL63-SD-PC-08	X113-91	NTC17PCSD0901	X201-94	NTC17PCSD1401	NTC17PCSD1402
Depth of Range (ft)	(0-0.13)	(0-1)	(0-0.131)	(0-1)	(0-0)	(0-0.131)	(0.33-0.67)	(0-0.13)	(1-1)
Sample Date	9/24/2001	8/25/1992	9/24/2001	8/24/1992	11/15/1991	9/24/2001	4/27/1994	9/23/2001	9/23/2001
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Inorganic Compounds									
ALUMINUM	2,820	4,000	2,260	2,810	5,300	3,300	4,320	2,790	6,300
ANTIMONY	0.45		0.29 U			0.62		0.6 U	0.78 U
ARSENIC	5.2	9.5	5.4	5.3	6.5 J	4.8	5.9 J	5.9	19.1
BARIUM	29.3	39.6	21.2	23.3	95	27.9	54.9	24.3	38.8
BERYLLIUM	0.84	1.5	0.88	0.49	0.5	0.26 U	0.46	0.81	1.9
CADMIUM	0.58	2.3	0.61		1.6 J	0.11		0.64	0.79
CALCIUM	56,500	51,100	67,000	57,200	70,000	49,200	47,800	65,600	67,500
CHROMIUM	13.7	31.4 J	10.8	5.9 J	16.4	12.1	9.7	13.4	14.2
COBALT	6.9		4.2		7.3	5.6	7.1	5.2	9.7
COPPER	477	1,030 J	225	50.8 J	57.2	42.6	38.2	123	268
CYANIDE	NA	3.6	NA			NA		NA	NA
IRON	12,600	14,000	10,600	22,400	15,500	12,400	11,600	11,700	30,300
LEAD	144	392 J	117	40.2 J	103	30.8	146	108	177
MAGNESIUM	29,400	24,800	36,200	28,200	40,200	26,500	23,700	32,600	35,600
MANGANESE	339	398	271	396	427	358	345	404	492
MERCURY	0.17	1.2 J	0.17		0.422 J	0.31	0.04	4.7	0.1
NICKEL	18.3	45.1	12	17.9	23.4	14.2	9.2	17.7	28.5
POTASSIUM	383	717	292	684	1,100	692	836	417	1,270
SELENIUM	0.35 U		0.46			0.4 U		0.37 U	1.3
SILVER	0.56 U	3.8	0.48 U		2.9	0.11 U		1.4	0.21 U
SODIUM	281	264	319	238		138	292	313	2,330
THALLIUM	1.4		0.7 U			1.4		0.64 U	2.5
VANADIUM	10.2	11.9	7.7	7.6	15.6	17.9	15	9	14.9
ZINC	1,390	2,730 J	1,030	213 J	240	126	159	810	2,180

Location	SD-PC-07	NTC17PCSD24	SD-PC-01	NTC17PCSD30	X114-91	X202-94	NTC17BBSD52	B-104
Sample	GL63-SD-PC-07	NTC17PCSD2401	GL63-SD-PC-01	NTC17PCSD3001	X114-91	X202-94	NTC17BBSD5201	B-104
Depth of Range (ft)	(0-1)	(0-0.131)	(0-1)	(0-0.131)	(0-0)	(0.33-0.5)	(0-0.131)	(0-5)
Sample Date	8/24/1992	9/22/2001	8/24/1992	9/23/2001	11/14/1991	4/27/1994	9/5/2001	4/19/1989
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
Inorganic Compounds								
ALUMINUM	4,060	2,130	4,900	1,970	3,600	3,740	2,470	
ANTIMONY	1.5 R	0.3 U		0.33 U			0.4 U	
ARSENIC	27.1	3.7	8.5	3.7	19.6 J	6.1 J	4.3	11
BARIUM	24.9 J	26.4 J	27.3	17.9	26.6	55.2	19.3	
BERYLLIUM	1.3 J	0.42 J	0.76	0.17		0.3	0.57	0.39
CADMIUM		0.31 J	2.8	0.11			0.23	2.5
CALCIUM	70,800	36,600 J	52,800	34,800	45,500	65,000	50,800	
CHROMIUM	12.8 J	8.9 J	12.9 J	9.1	11.7	13	9.4	17
COBALT	5.8	4 J		4.7	4.8	6.9	4.5	
COPPER	131 J	151	53.2 J	13.4	21.3	16.9	78.8	110
CYANIDE		NA		NA			NA	
IRON	14,900	8,570 J	14,100	7,470	10,800	16,000	10,500	
LEAD	91.7	60.3	40.5 J	28.6	36	48	56.4	150
MAGNESIUM	38,200 J	18,900	25,700	18,200	22,700	36,400	25,300	
MANGANESE	523	264	428	267	390	472	308	
MERCURY		0.09		0.11	0.283 J	0.09	0.34	1.1
NICKEL	23.4 J	8.1	18.7	8.9		10.4	12.4	24
POTASSIUM	912	379	847	373	630	1,060	408	
SELENIUM		0.41 U		0.45 U			0.61 U	0.81
SILVER		0.25 U	2	0.11 U			0.36	
SODIUM	354	157 J	204	92.5		227	255	
THALLIUM		0.71 U		0.78 U			2.5 U	
VANADIUM	12.3	8.9	14.9	6.8	10.7	13.8	9.8	
ZINC	1,000 J	376 J	262 J	74.9	82	83.3	531	390

Notes:
Only the positive detections are presented for the historical data.
NA = Not analyzed.

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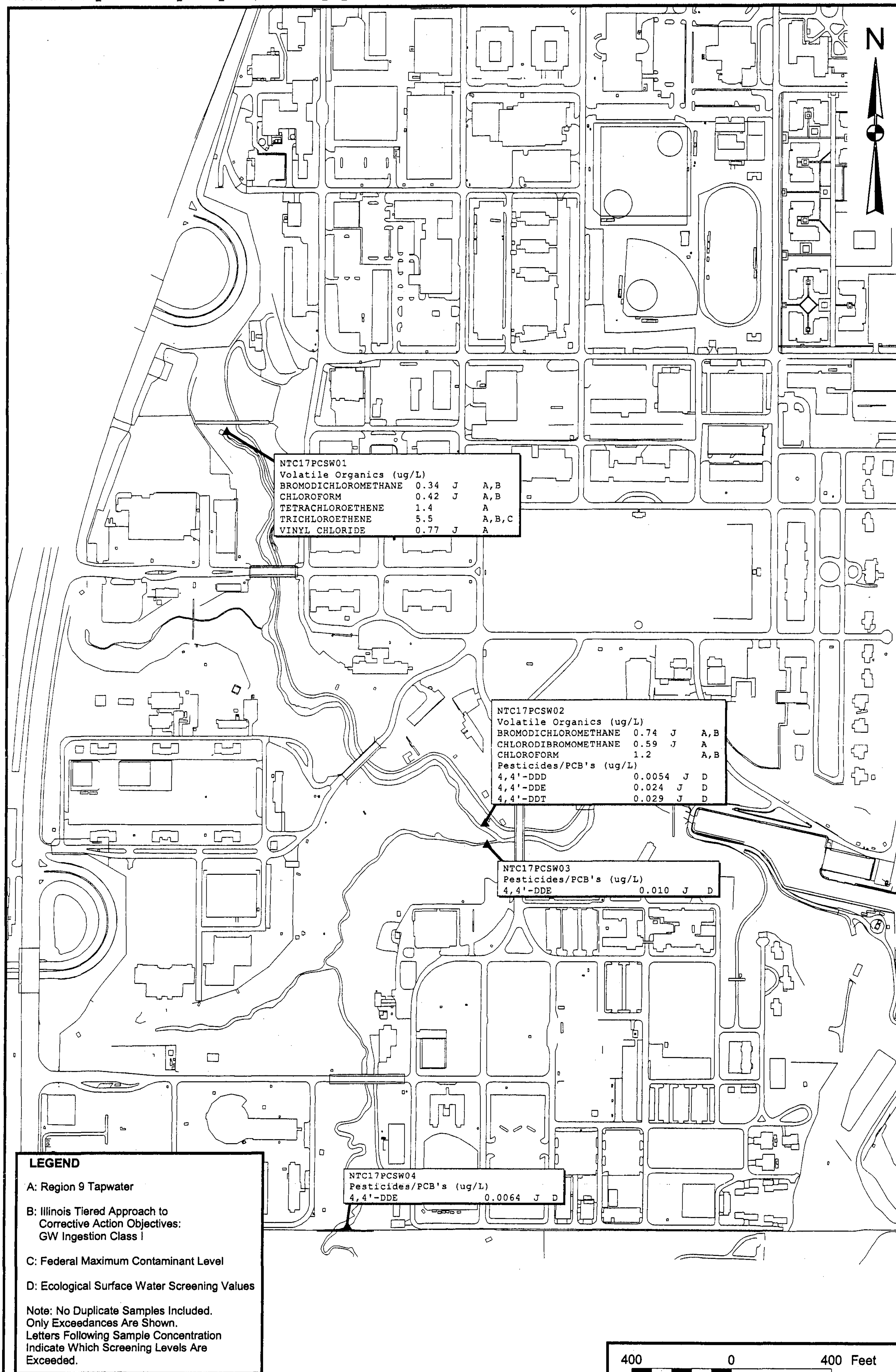

DRAWN BY K. PEILA	DATE 4/10/02	ORGANIC SURFACE WATER EXCEEDANCES SITE 17 - PETTIBONE CREEK AND BOAT BASIN NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS	CONTRACT NUMBER 3939
CHECKED BY A. SCHEETZ	DATE 4/10/02		APPROVED BY — DATE —
COST/SCHEDULE-AREA			APPROVED BY — DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 4-1 — REV 0

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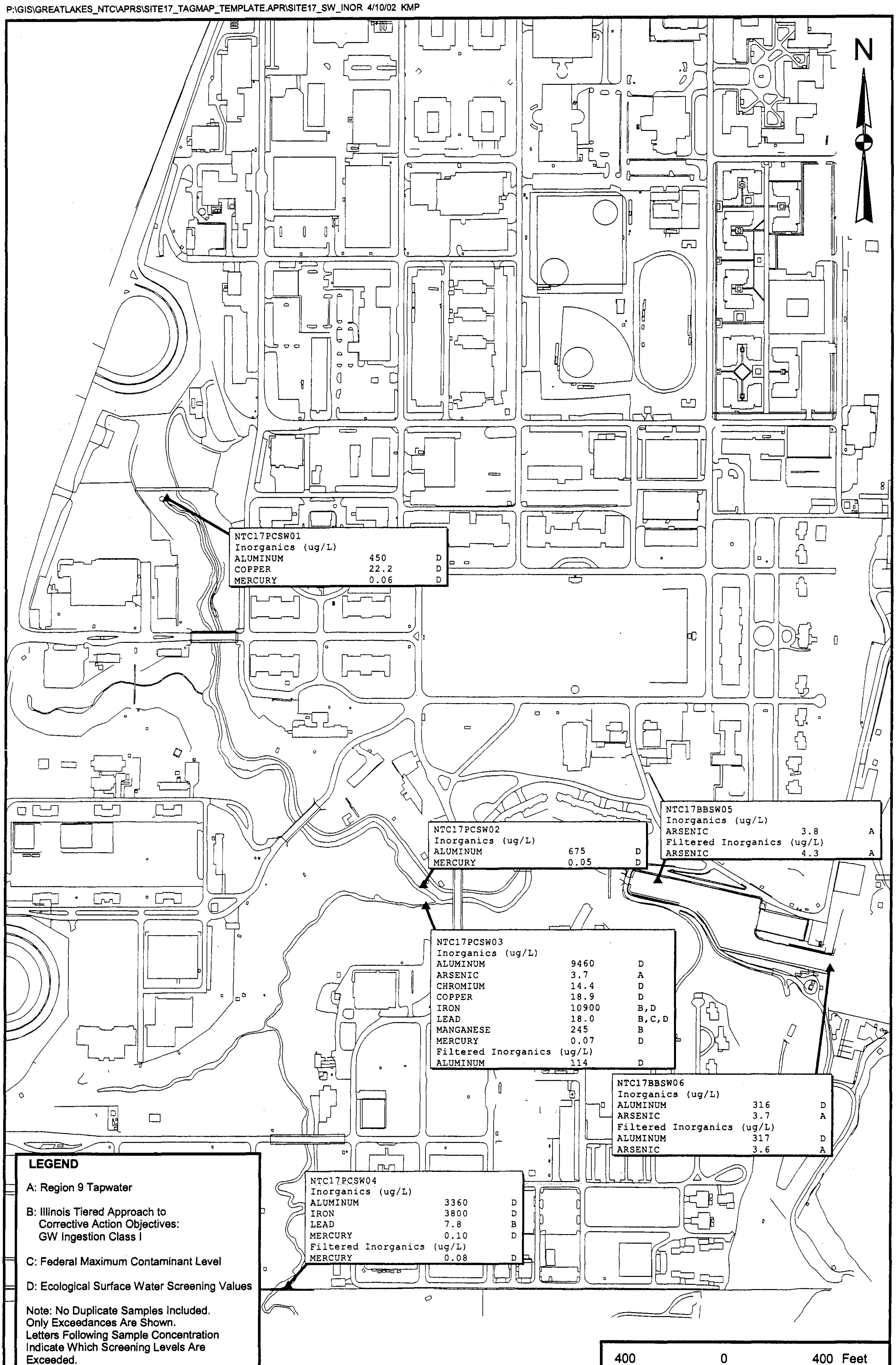
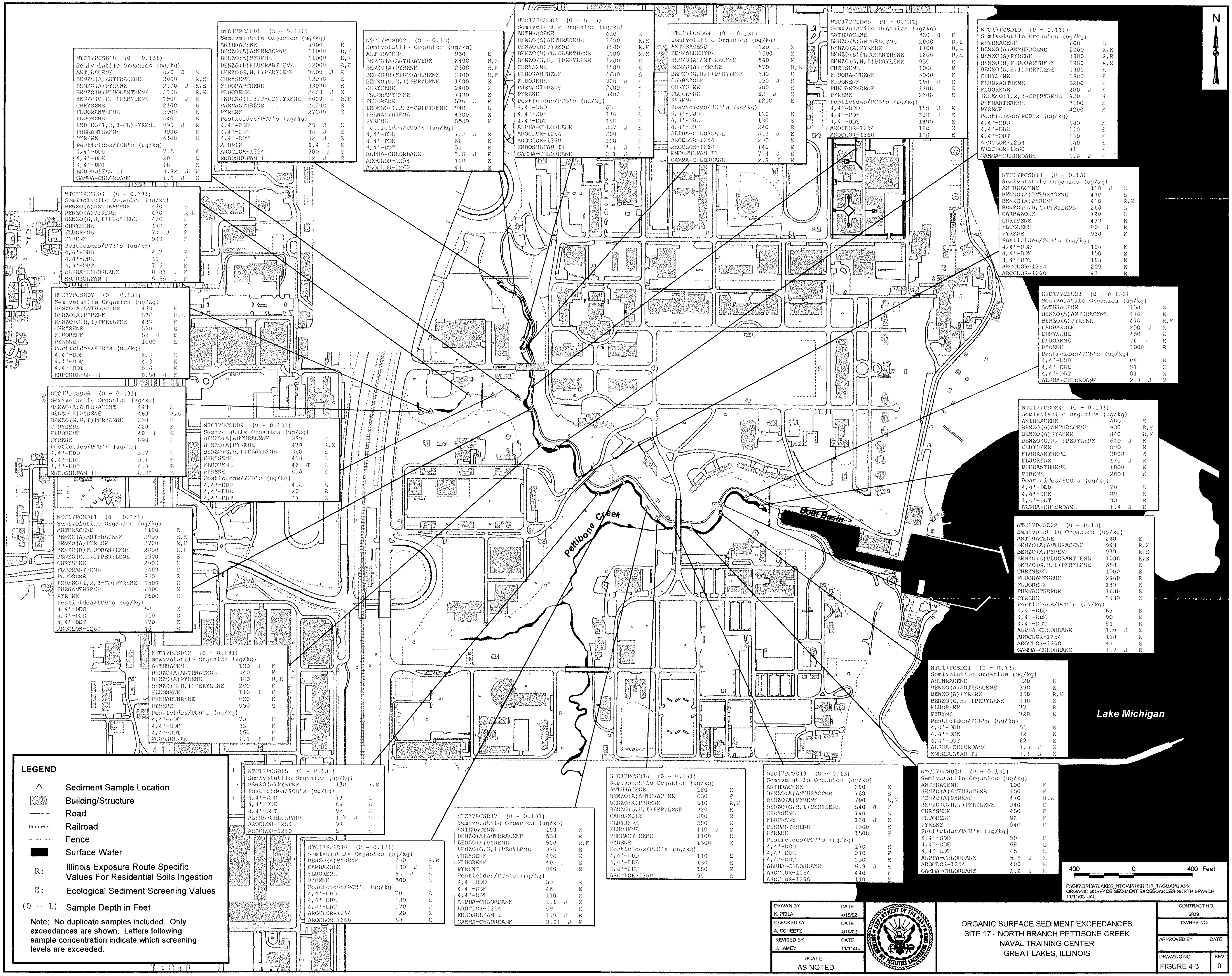


DRAWN BY: K. PEILA	DATE: 4/10/02		CONTRACT NUMBER: 3939	
CHECKED BY: A. SCHEETZ	DATE: 4/10/02	INORGANIC SURFACE WATER EXCEEDANCES SITE 17 - PETTIBONE CREEK AND BOAT BASIN NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS	APPROVED BY	DATE
COST/SCHEDULE-AREA			APPROVED BY	DATE
SCALE: AS NOTED			DRAWING NO. FIGURE 4-2	REV 0


N
NTC17PCSD10 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 820 J E
BENZO(A)ANTHRACENE 2000 R,E
BENZO(A)PYRENE 2100 J R,E
BENZO(B)FLUORANTHENE 2100 R,E
BENZO(G,H,I)PERYLENE 1500 J E
CHRYSENE 2100 E
FLUORANTHENE 5900 E
FLUORENE 440 E
INDENO(1,2,3-CD)PYRENE 990 J R
PHENANTHRENE 3900 E
PYRENE 4400 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 7.5 E
4,4'-DDE 20 E
4,4'-DDT 18 E
ENDOSULFAN II 0.82 J E
GAMMA-CHLORDANE 1.0 J E
NTC17PCSD01 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 4000 E
BENZO(A)ANTHRACENE 11000 R,E
BENZO(A)PYRENE 11000 R,E
BENZO(B)FLUORANTHENE 12000 R,E
BENZO(G,H,I)PERYLENE 7500 J E
CHRYSENE 12000 E
FLUORANTHENE 33000 E
FLUORENE 2400 J E
INDENO(1,2,3-CD)PYRENE 5800 J R,E
PHENANTHRENE 24000 E
PYRENE 27000 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 25 J E
4,4'-DDE 36 J E
4,4'-DDT 32 J E
ALDRIN 6.4 J E
AROCLOR-1254 300 J E
ENDOSULFAN II 12 J E
NTC17PCSD02 (0 - 0.13)
Semivolatile Organics (ug/kg)
ANTHRACENE 930 E
BENZO(A)ANTHRACENE 2400 R,E
BENZO(A)PYRENE 2300 R,E
BENZO(B)FLUORANTHENE 2400 R,E
BENZO(G,H,I)PERYLENE 1600 E
CHRYSENE 2400 E
FLUORANTHENE 7400 E
FLUORENE 570 J E
INDENO(1,2,3-CD)PYRENE 940 R
PHENANTHRENE 4800 E
PYRENE 5500 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 7.2 J E
4,4'-DDE 66 E
4,4'-DDT 51 E
ALPHA-CHLORDANE 2.5 J E
AROCLOR-1254 110 E
AROCLOR-1260 49 E
NTC17PCSD03 (0 - 0.13)
Semivolatile Organics (ug/kg)
ANTHRACENE 410 E
BENZO(A)ANTHRACENE 1400 R,E
BENZO(A)PYRENE 1500 R,E
BENZO(B)FLUORANTHENE 1500 R,E
BENZO(G,H,I)PERYLENE 1200 E
CHRYSENE 1500 E
FLUORANTHENE 4600 E
FLUORENE 320 J E
PHENANTHRENE 2600 E
PYRENE 3400 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 65 E
4,4'-DDE 110 E
4,4'-DDT 190 E
ALPHA-CHLORDANE 3.7 J E
AROCLOR-1254 200 E
AROCLOR-1260 150 E
ENDOSULFAN II 4.1 J E
GAMMA-CHLORDANE 2.1 J E
NTC17PCSD04 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 120 J E
BENZALDEHYDE 1500 E
BENZO(A)ANTHRACENE 560 E
BENZO(A)PYRENE 570 R,E
BENZO(G,H,I)PERYLENE 530 E
CARBAZOLE 150 J E
CHRYSENE 600 E
FLUORENE 62 J E
PYRENE 1200 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 120 E
4,4'-DDE 130 E
4,4'-DDT 240 E
ALPHA-CHLORDANE 4.3 J E
AROCLOR-1254 290 E
AROCLOR-1260 140 E
ENDOSULFAN II 7.4 J E
GAMMA-CHLORDANE 2.9 J E
NTC17PCSD05 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 320 J E
BENZO(A)ANTHRACENE 1000 R,E
BENZO(A)PYRENE 1100 R,E
BENZO(B)FLUORANTHENE 1200 R,E
BENZO(G,H,I)PERYLENE 930 E
CHRYSENE 1000 E
FLUORANTHENE 3000 E
FLUORENE 190 J E
PHENANTHRENE 1700 E
PYRENE 2300 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 150 J E
4,4'-DDE 200 J E
4,4'-DDT 1800 E
AROCLOR-1254 160 E
AROCLOR-1260 110 E
NTC17PCSD13 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 600 E
BENZO(A)ANTHRACENE 2000 R,E
BENZO(A)PYRENE 1900 R,E
BENZO(B)FLUORANTHENE 1900 R,E
BENZO(G,H,I)PERYLENE 1300 E
CHRYSENE 1900 E
FLUORANTHENE 5200 E
FLUORENE 280 J E
INDENO(1,2,3-CD)PYRENE 920 R
PHENANTHRENE 3100 E
PYRENE 4200 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 100 E
4,4'-DDE 110 E
4,4'-DDT 150 E
AROCLOR-1254 140 E
AROCLOR-1260 41 E
GAMMA-CHLORDANE 1.6 J E
NTC17PCSD14 (0 - 0.13)
Semivolatile Organics (ug/kg)
ANTHRACENE 110 J E
BENZO(A)ANTHRACENE 440 E
BENZO(A)PYRENE 410 R,E
BENZO(G,H,I)PERYLENE 260 E
CARBAZOLE 720 E
CHRYSENE 430 E
FLUORENE 80 J E
PYRENE 930 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 100 E
4,4'-DDE 150 E
4,4'-DDT 190 E
AROCLOR-1254 200 E
AROCLOR-1260 43 E
NTC17PCSD08 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)ANTHRACENE 430 E
BENZO(A)PYRENE 470 R,E
BENZO(G,H,I)PERYLENE 420 E
CHRYSENE 470 E
FLUORENE 74 J E
PYRENE 940 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 4.7 E
4,4'-DDE 11 E
4,4'-DDT 7.5 E
ALPHA-CHLORDANE 0.81 J E
ENDOSULFAN II 0.55 J E
NTC17PCSD07 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)ANTHRACENE 470 E
BENZO(A)PYRENE 530 R,E
BENZO(G,H,I)PERYLENE 430 E
CHRYSENE 530 E
FLUORENE 54 J E
PYRENE 1000 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 2.3 E
4,4'-DDE 4.3 E
4,4'-DDT 5.6 E
ENDOSULFAN II 0.58 J E
NTC17PCSD23 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 150 E
BENZO(A)ANTHRACENE 470 E
BENZO(A)PYRENE 470 R,E
CARBAZOLE 250 J E
CHRYSENE 450 E
FLUORENE 76 J E
PYRENE 1000 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 89 E
4,4'-DDE 91 E
4,4'-DDT 81 E
ALPHA-CHLORDANE 2.3 J E
NTC17PCSD06 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)ANTHRACENE 440 E
BENZO(A)PYRENE 460 R,E
BENZO(G,H,I)PERYLENE 230 E
CHRYSENE 480 E
FLUORENE 40 J E
PYRENE 890 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 3.7 E
4,4'-DDE 5.1 E
4,4'-DDT 4.9 E
ENDOSULFAN II 0.52 J E
NTC17PCSD09 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)ANTHRACENE 390 E
BENZO(A)PYRENE 470 R,E
BENZO(G,H,I)PERYLENE 360 E
CHRYSENE 410 E
FLUORENE 46 J E
PYRENE 810 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 4.4 E
4,4'-DDE 20 E
4,4'-DDT 17 E
NTC17PCSD24 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 400 E
BENZO(A)ANTHRACENE 930 R,E
BENZO(A)PYRENE 840 R,E
BENZO(G,H,I)PERYLENE 610 J E
CHRYSENE 890 E
FLUORANTHENE 2000 E
FLUORENE 170 J E
PHENANTHRENE 1800 E
PYRENE 2000 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 78 E
4,4'-DDE 89 E
4,4'-DDT 93 E
ALPHA-CHLORDANE 1.4 J E
Boat Basin
Pettibone Creek
NTC17PCSD11 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 1100 E
BENZO(A)ANTHRACENE 2900 R,E
BENZO(A)PYRENE 2700 R,E
BENZO(B)FLUORANTHENE 2800 R,E
BENZO(G,H,I)PERYLENE 1500 E
CHRYSENE 2900 E
FLUORANTHENE 8400 E
FLUORENE 850 E
INDENO(1,2,3-CD)PYRENE 1500 R
PHENANTHRENE 6400 E
PYRENE 6600 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 58 E
4,4'-DDE 110 E
4,4'-DDT 170 E
AROCLOR-1260 46 E
NTC17PCSD22 (0 - 0.13)
Semivolatile Organics (ug/kg)
ANTHRACENE 240 E
BENZO(A)ANTHRACENE 990 R,E
BENZO(A)PYRENE 970 R,E
BENZO(B)FLUORANTHENE 1000 R,E
BENZO(G,H,I)PERYLENE 650 E
CHRYSENE 1000 E
FLUORANTHENE 2000 E
FLUORENE 180 E
PHENANTHRENE 1600 E
PYRENE 2100 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 88 E
4,4'-DDE 90 E
4,4'-DDT 81 E
ALPHA-CHLORDANE 1.9 J E
AROCLOR-1254 110 E
AROCLOR-1260 41 E
GAMMA-CHLORDANE 1.7 J E
NTC17PCSD12 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 120 J E
BENZO(A)ANTHRACENE 340 E
BENZO(A)PYRENE 300 R,E
BENZO(G,H,I)PERYLENE 200 E
FLUORENE 110 J E
PHENANTHRENE 820 E
PYRENE 850 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 73 E
4,4'-DDE 53 E
4,4'-DDT 160 E
ENDOSULFAN I 1.1 J E
NTC17PCSD21 (0 - 0.13)
Semivolatile Organics (ug/kg)
ANTHRACENE 120 E
BENZO(A)ANTHRACENE 380 E
BENZO(A)PYRENE 330 R,E
BENZO(G,H,I)PERYLENE 230 E
FLUORENE 77 E
PYRENE 720 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 51 E
4,4'-DDE 42 E
4,4'-DDT 62 E
ALPHA-CHLORDANE 1.3 J E
ENDOSULFAN II 1.1 J E
Lake Michigan
LEGEND
Sediment Sample Location
Building/Structure
Road
Railroad
Fence
Surface Water
R: Illinois Exposure Route Specific Values For Residential Soils Ingestion
E: Ecological Sediment Screening Values
(0 - 1) Sample Depth in Feet
Note: No duplicate samples included. Only exceedances are shown. Letters following sample concentration indicate which screening levels are exceeded.
NTC17PCSD15 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 130 R,E
Pesticides/PCB's (ug/kg)
4,4'-DDD 73 E
4,4'-DDE 68 E
4,4'-DDT 92 E
ALPHA-CHLORDANE 1.7 J E
AROCLOR-1254 97 E
AROCLOR-1260 51 E
NTC17PCSD18 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 280 E
BENZO(A)ANTHRACENE 630 E
BENZO(A)PYRENE 510 R,E
BENZO(G,H,I)PERYLENE 320 E
CARBAZOLE 380 E
CHRYSENE 590 E
FLUORENE 110 J E
PHENANTHRENE 1100 E
PYRENE 1300 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 110 E
4,4'-DDE 130 E
4,4'-DDT 150 E
AROCLOR-1260 55 E
NTC17PCSD19 (0 - 0.13)
Semivolatile Organics (ug/kg)
ANTHRACENE 290 E
BENZO(A)ANTHRACENE 760 E
BENZO(A)PYRENE 790 R,E
BENZO(G,H,I)PERYLENE 540 J E
CHRYSENE 740 E
FLUORENE 120 J E
PHENANTHRENE 1300 E
PYRENE 1500 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 170 E
4,4'-DDE 210 E
4,4'-DDT 230 E
ALPHA-CHLORDANE 6.9 J E
AROCLOR-1254 440 E
AROCLOR-1260 110 E
NTC17PCSD20 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 100 E
BENZO(A)ANTHRACENE 450 E
BENZO(A)PYRENE 470 R,E
BENZO(G,H,I)PERYLENE 340 E
CHRYSENE 450 E
FLUORENE 92 E
PYRENE 940 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 50 E
4,4'-DDE 68 E
4,4'-DDT 65 E
ALPHA-CHLORDANE 5.9 J E
AROCLOR-1254 400 E
GAMMA-CHLORDANE 1.9 J E
NTC17PCSD17 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 150 E
BENZO(A)ANTHRACENE 530 E
BENZO(A)PYRENE 500 R,E
BENZO(G,H,I)PERYLENE 320 E
CHRYSENE 490 E
FLUORENE 40 J E
PYRENE 990 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 30 E
4,4'-DDE 46 E
4,4'-DDT 110 E
ALPHA-CHLORDANE 1.1 J E
AROCLOR-1254 69 E
ENDOSULFAN II 1.8 J E
GAMMA-CHLORDANE 0.91 J E
NTC17PCSD16 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 240 R,E
CARBAZOLE 130 J E
FLUORENE 65 J E
PYRENE 500 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 78 E
4,4'-DDE 130 E
4,4'-DDT 170 E
AROCLOR-1254 120 E
AROCLOR-1260 53 E
400 0 400 Feet
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ORGANIC SURFACE SEDIMENT EXCEEDANCES-NORTH BRANCH
11/11/03 JAL
DRAWN BY K. PEILA DATE 4/10/02
CHECKED BY A. SCHEETZ DATE 4/10/02
REVISED BY J. LAMEY DATE 11/11/03
SCALE AS NOTED
ORGANIC SURFACE SEDIMENT EXCEEDANCES
SITE 17 - NORTH BRANCH PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
CONTRACT NO. 3939
OWNER NO.
APPROVED BY DATE
DRAWING NO. FIGURE 4-3
REV. 0

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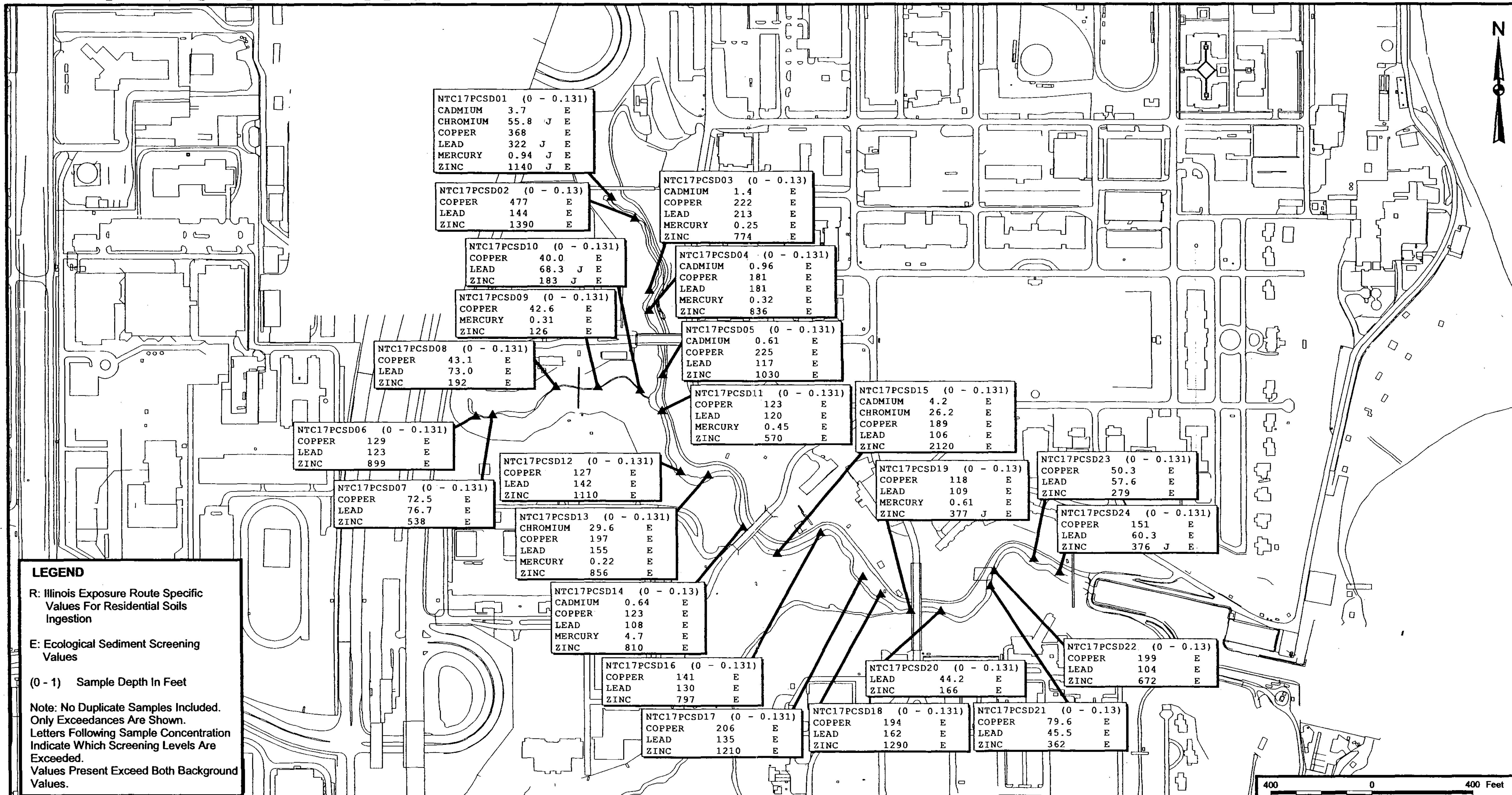
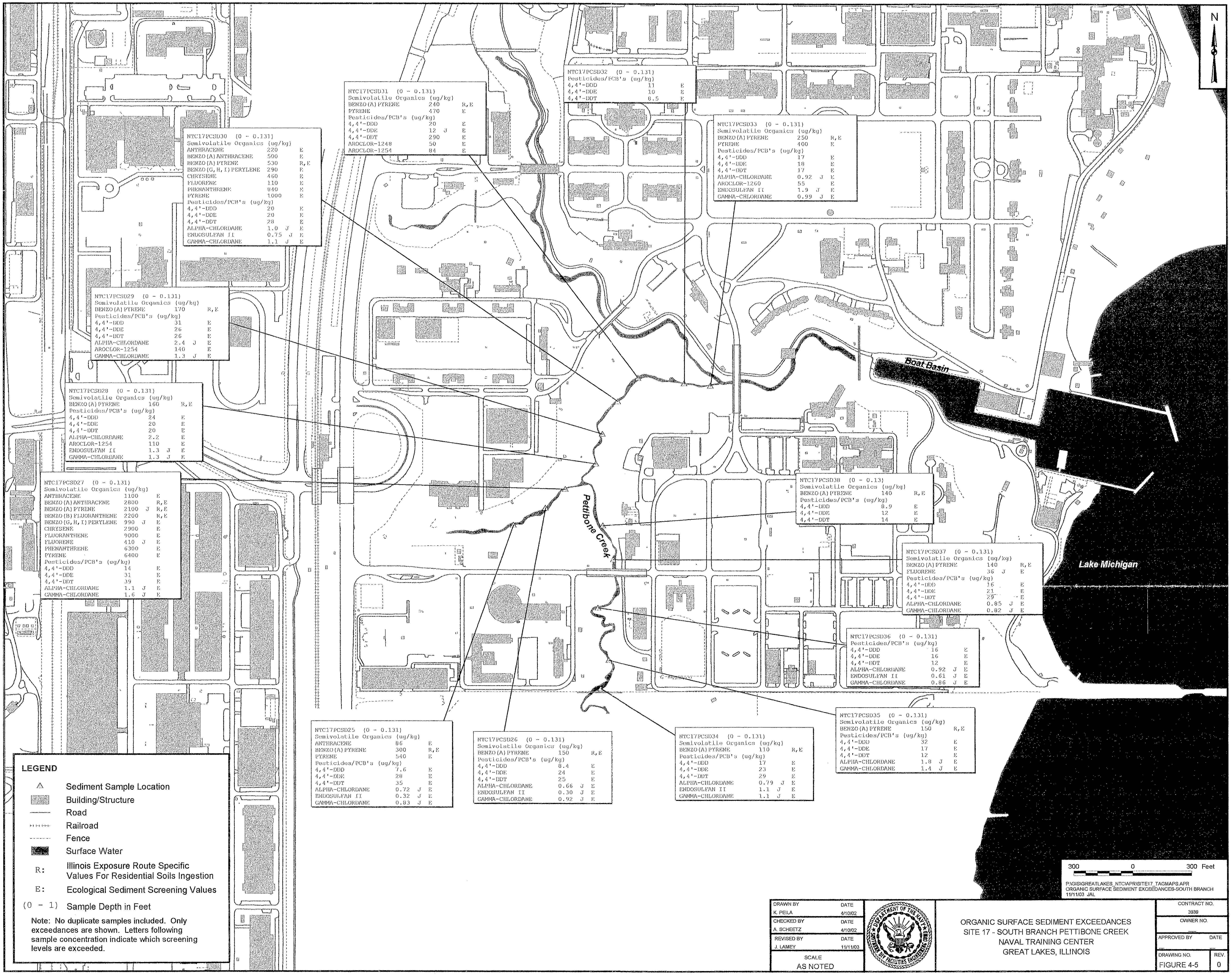


NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: K. PEILA — DATE: 4/10/02
CHECKED BY: A. SCHEETZ — DATE: 4/10/02
COST/SCHED-AREA
SCALE: AS NOTED

INORGANIC SURFACE SEDIMENT EXCEEDANCES
SITE 17 - NORTH BRANCH PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO. 3939
APPROVED BY — DATE
APPROVED BY — DATE
DRAWING NO. FIGURE 4-4 — REV. 0


N
NTC17PCSD32 (0 - 0.131)
Pesticides/PCB's (ug/kg)
4,4'-DDD 11 E
4,4'-DDE 10 E
4,4'-DDT 6.5 E
NTC17PCSD31 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 240 R,E
PYRENE 470 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 20 E
4,4'-DDE 12 J E
4,4'-DDT 290 E
AROCLOR-1248 50 E
AROCLOR-1254 84 E
NTC17PCSD33 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 250 R,E
PYRENE 400 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 17 E
4,4'-DDE 18 E
4,4'-DDT 17 E
ALPHA-CHLORDANE 0.92 J E
AROCLOR-1260 55 E
ENDOSULFAN II 1.9 J E
GAMMA-CHLORDANE 0.99 J E
NTC17PCSD30 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 220 E
BENZO(A)ANTHRACENE 500 E
BENZO(A)PYRENE 530 R,E
BENZO(G,H,I)PERYLENE 290 E
CHRYSENE 460 E
FLUORENE 110 E
PHENANTHRENE 840 E
PYRENE 1000 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 20 E
4,4'-DDE 20 E
4,4'-DDT 28 E
ALPHA-CHLORDANE 1.0 J E
ENDOSULFAN II 0.75 J E
GAMMA-CHLORDANE 1.1 J E
NTC17PCSD29 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 170 R,E
Pesticides/PCB's (ug/kg)
4,4'-DDD 31 E
4,4'-DDE 26 E
4,4'-DDT 26 E
ALPHA-CHLORDANE 2.4 J E
AROCLOR-1254 140 E
GAMMA-CHLORDANE 1.3 J E
Boat Basin
NTC17PCSD28 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 160 R,E
Pesticides/PCB's (ug/kg)
4,4'-DDD 24 E
4,4'-DDE 20 E
4,4'-DDT 20 E
ALPHA-CHLORDANE 2.2 E
AROCLOR-1254 110 E
ENDOSULFAN II 1.3 J E
GAMMA-CHLORDANE 1.3 J E
NTC17PCSD27 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 1100 E
BENZO(A)ANTHRACENE 2800 R,E
BENZO(A)PYRENE 2100 J R,E
BENZO(B)FLUORANTHENE 2200 R,E
BENZO(G,H,I)PERYLENE 990 J E
CHRYSENE 2900 E
FLUORANTHENE 9000 E
FLUORENE 410 J E
PHENANTHRENE 6300 E
PYRENE 6400 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 14 E
4,4'-DDE 31 E
4,4'-DDT 39 E
ALPHA-CHLORDANE 1.1 J E
GAMMA-CHLORDANE 1.6 J E
Pettibone Creek
NTC17PCSD38 (0 - 0.13)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 140 R,E
Pesticides/PCB's (ug/kg)
4,4'-DDD 8.9 E
4,4'-DDE 12 E
4,4'-DDT 14 E
NTC17PCSD37 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 140 R,E
FLUORENE 36 J E
Pesticides/PCB's (ug/kg)
4,4'-DDD 16 E
4,4'-DDE 21 E
4,4'-DDT 29 E
ALPHA-CHLORDANE 0.85 J E
GAMMA-CHLORDANE 0.82 J E
Lake Michigan
NTC17PCSD36 (0 - 0.131)
Pesticides/PCB's (ug/kg)
4,4'-DDD 16 E
4,4'-DDE 16 E
4,4'-DDT 12 E
ALPHA-CHLORDANE 0.92 J E
ENDOSULFAN II 0.61 J E
GAMMA-CHLORDANE 0.86 J E
NTC17PCSD35 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 150 R,E
Pesticides/PCB's (ug/kg)
4,4'-DDD 32 E
4,4'-DDE 17 E
4,4'-DDT 12 E
ALPHA-CHLORDANE 1.8 J E
GAMMA-CHLORDANE 1.4 J E
NTC17PCSD25 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 86 E
BENZO(A)PYRENE 300 R,E
PYRENE 540 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 7.6 E
4,4'-DDE 28 E
4,4'-DDT 35 E
ALPHA-CHLORDANE 0.72 J E
ENDOSULFAN II 0.32 J E
GAMMA-CHLORDANE 0.83 J E
NTC17PCSD26 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 150 R,E
Pesticides/PCB's (ug/kg)
4,4'-DDD 8.4 E
4,4'-DDE 24 E
4,4'-DDT 25 E
ALPHA-CHLORDANE 0.66 J E
ENDOSULFAN II 0.30 J E
GAMMA-CHLORDANE 0.92 J E
NTC17PCSD34 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 110 R,E
Pesticides/PCB's (ug/kg)
4,4'-DDD 17 E
4,4'-DDE 23 E
4,4'-DDT 29 E
ALPHA-CHLORDANE 0.79 J E
ENDOSULFAN II 1.1 J E
GAMMA-CHLORDANE 1.1 J E
LEGEND
Sediment Sample Location
Building/Structure
Road
Railroad
Fence
Surface Water
R: Illinois Exposure Route Specific Values For Residential Soils Ingestion
E: Ecological Sediment Screening Values
(0 - 1) Sample Depth in Feet
Note: No duplicate samples included. Only exceedances are shown. Letters following sample concentration indicate which screening levels are exceeded.
300 0 300 Feet
P:\GIS\GREATLAKES_NTC\APR\SITE17_TAGMAPS.APR
ORGANIC SURFACE SEDIMENT EXCEEDANCES-SOUTH BRANCH
11/11/03 JAL
DRAWN BY K. PEILA DATE 4/10/02
CHECKED BY A. SCHEETZ DATE 4/10/02
REVISED BY J. LAMEY DATE 11/11/03
SCALE AS NOTED
ORGANIC SURFACE SEDIMENT EXCEEDANCES
SITE 17 - SOUTH BRANCH PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
CONTRACT NO. 3939
OWNER NO.
APPROVED BY DATE
DRAWING NO. FIGURE 4-5
REV. 0

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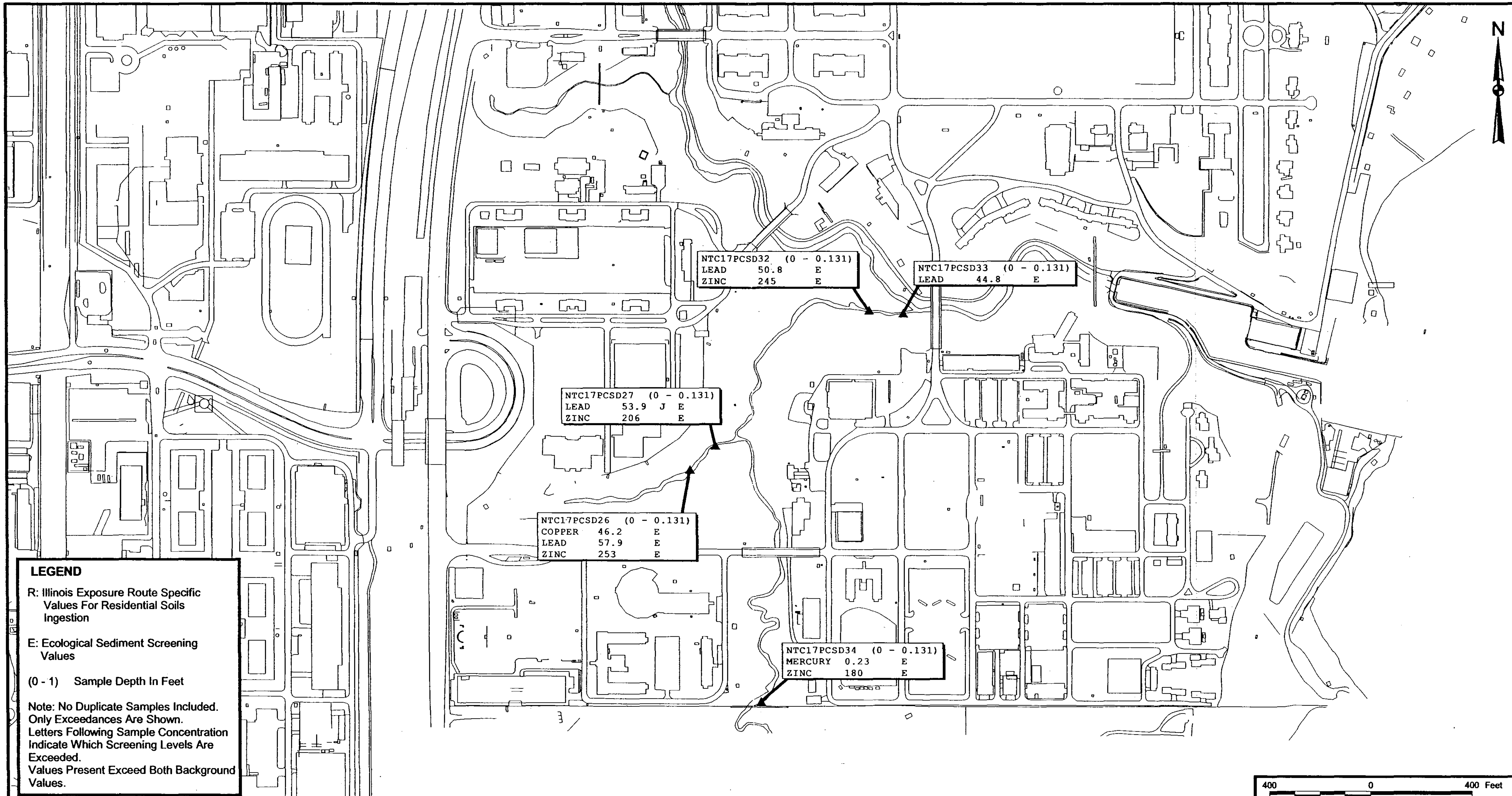
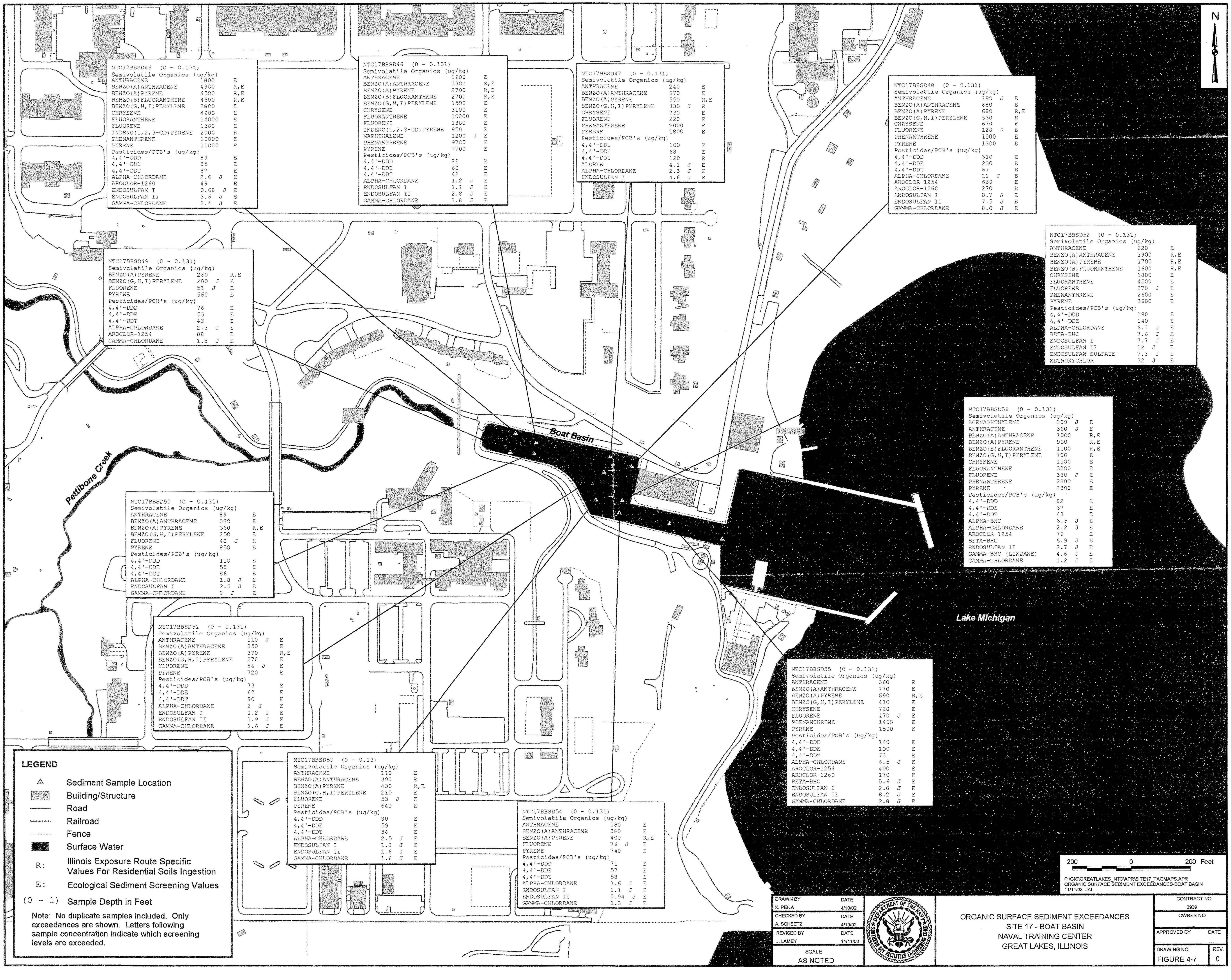


NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

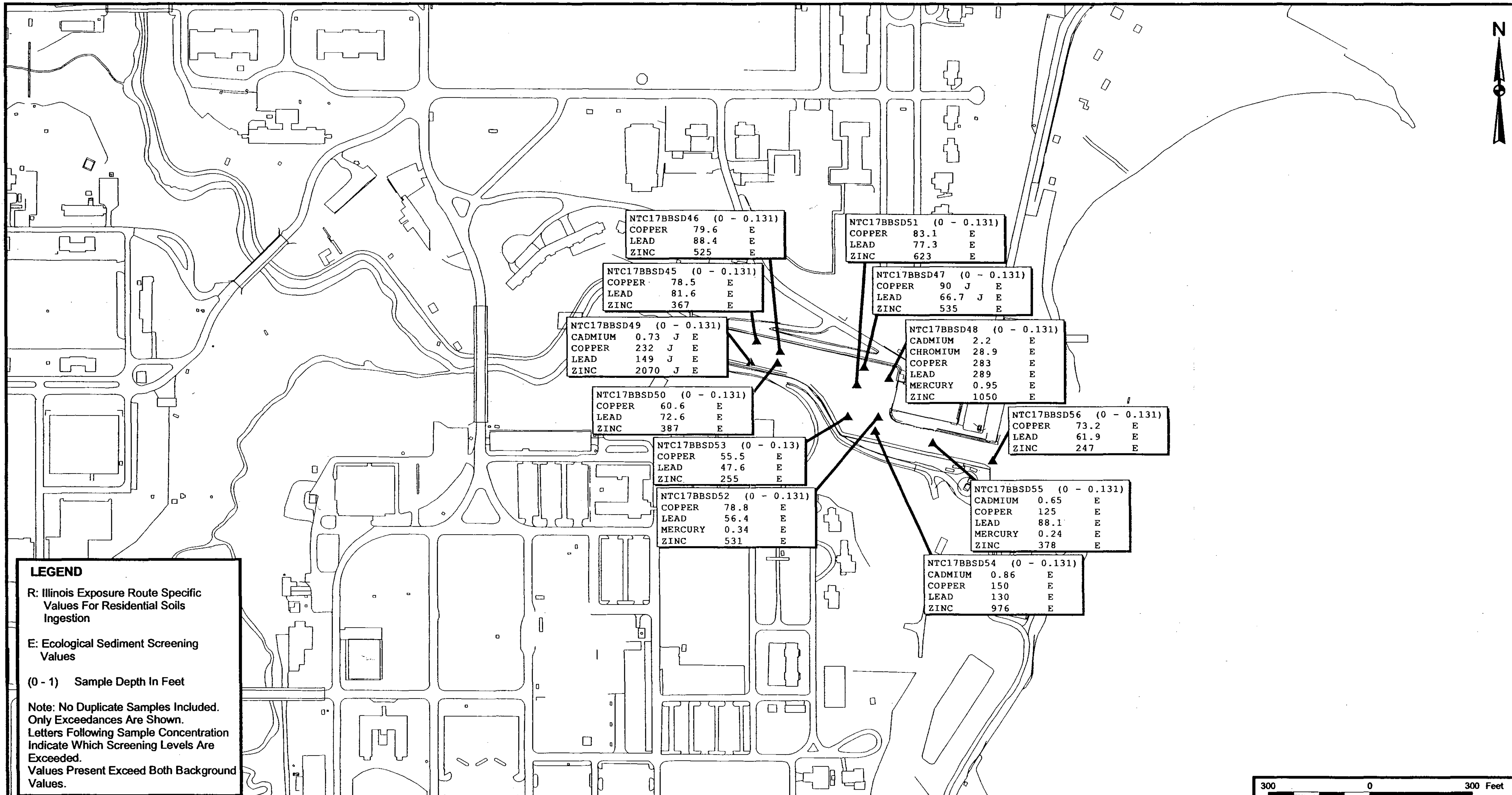
DRAWN BY K. PEILA DATE 4/10/02
CHECKED BY A. SCHEETZ DATE 4/10/02
COST/SCHED-AREA
SCALE AS NOTED

INORGANIC SURFACE SEDIMENT EXCEEDANCES
SITE 17 - SOUTH BRANCH PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO. 3939
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 4-6 REV. 0


N
NTC17BBSD45 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 1800 E
BENZO(A)ANTHRACENE 4900 R,E
BENZO(A)PYRENE 4500 R,E
BENZO(B)FLUORANTHENE 4500 R,E
BENZO(G,H,I)PERYLENE 2800 E
CHRYSENE 4900 E
FLUORANTHENE 14000 E
FLUORENE 1300 E
INDENO(1,2,3-CD)PYRENE 2000 R
PHENANTHRENE 10000 E
PYRENE 11000 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 89 E
4,4'-DDE 85 E
4,4'-DDT 87 E
ALPHA-CHLORDANE 2.6 J E
AROCLOR-1260 49 E
ENDOSULFAN I 0.68 J E
ENDOSULFAN II 3.6 J E
GAMMA-CHLORDANE 2.4 J E
NTC17BBSD46 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 1900 E
BENZO(A)ANTHRACENE 3300 R,E
BENZO(A)PYRENE 2700 R,E
BENZO(B)FLUORANTHENE 2700 R,E
BENZO(G,H,I)PERYLENE 1500 E
CHRYSENE 3100 E
FLUORANTHENE 10000 E
FLUORENE 1300 E
INDENO(1,2,3-CD)PYRENE 950 R
NAPHTHALENE 1200 J E
PHENANTHRENE 9700 E
PYRENE 7700 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 82 E
4,4'-DDE 60 E
4,4'-DDT 42 E
ALPHA-CHLORDANE 1.2 J E
ENDOSULFAN I 1.1 J E
ENDOSULFAN II 2.8 J E
GAMMA-CHLORDANE 1.8 J E
NTC17BBSD47 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 240 E
BENZO(A)ANTHRACENE 670 E
BENZO(A)PYRENE 550 R,E
BENZO(G,H,I)PERYLENE 330 J E
CHRYSENE 730 E
FLUORENE 220 E
PHENANTHRENE 2000 E
PYRENE 1800 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 100 E
4,4'-DDE 68 E
4,4'-DDT 120 E
ALDRIN 4.1 J E
ALPHA-CHLORDANE 2.3 J E
ENDOSULFAN I 4.6 J E
NTC17BBSD48 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 190 J E
BENZO(A)ANTHRACENE 680 E
BENZO(A)PYRENE 680 R,E
BENZO(G,H,I)PERYLENE 630 E
CHRYSENE 670 E
FLUORENE 120 J E
PHENANTHRENE 1000 E
PYRENE 1300 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 310 E
4,4'-DDE 230 E
4,4'-DDT 67 E
ALPHA-CHLORDANE 11 J E
AROCLOR-1254 660 E
AROCLOR-1260 270 E
ENDOSULFAN I 8.7 J E
ENDOSULFAN II 7.5 J E
GAMMA-CHLORDANE 8.0 J E
NTC17BBSD52 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 620 E
BENZO(A)ANTHRACENE 1900 R,E
BENZO(A)PYRENE 1700 R,E
BENZO(B)FLUORANTHENE 1600 R,E
CHRYSENE 1800 E
FLUORANTHENE 4500 E
FLUORENE 270 J E
PHENANTHRENE 2600 E
PYRENE 3600 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 190 E
4,4'-DDE 140 E
ALPHA-CHLORDANE 6.7 J E
BETA-BHC 7.6 J E
ENDOSULFAN I 7.7 J E
ENDOSULFAN II 12 J E
ENDOSULFAN SULFATE 7.3 J E
METHOXYCHLOR 32 J E
NTC17BBSD49 (0 - 0.131)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 260 R,E
BENZO(G,H,I)PERYLENE 200 J E
FLUORENE 51 J E
PYRENE 560 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 76 E
4,4'-DDE 55 E
4,4'-DDT 43 E
ALPHA-CHLORDANE 2.3 J E
AROCLOR-1254 88 E
GAMMA-CHLORDANE 1.8 J E
NTC17BBSD56 (0 - 0.131)
Semivolatile Organics (ug/kg)
ACENAPHTHYLENE 200 J E
ANTHRACENE 360 J E
BENZO(A)ANTHRACENE 1000 R,E
BENZO(A)PYRENE 900 R,E
BENZO(B)FLUORANTHENE 1100 R,E
BENZO(G,H,I)PERYLENE 700 E
CHRYSENE 1100 E
FLUORANTHENE 3200 E
FLUORENE 330 J E
PHENANTHRENE 2300 E
PYRENE 2300 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 82 E
4,4'-DDE 67 E
4,4'-DDT 43 E
ALPHA-BHC 6.5 J E
ALPHA-CHLORDANE 2.2 J E
AROCLOR-1254 79 E
BETA-BHC 6.9 J E
ENDOSULFAN II 2.7 J E
GAMMA-BHC (LINDANE) 4.6 J E
GAMMA-CHLORDANE 1.2 J E
Boat Basin
Pettibone Creek
Lake Michigan
NTC17BBSD50 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 89 E
BENZO(A)ANTHRACENE 380 E
BENZO(A)PYRENE 360 R,E
BENZO(G,H,I)PERYLENE 250 E
FLUORENE 40 J E
PYRENE 850 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 110 E
4,4'-DDE 55 E
4,4'-DDT 86 E
ALPHA-CHLORDANE 1.8 J E
ENDOSULFAN I 2.5 J E
GAMMA-CHLORDANE 2 J E
NTC17BBSD51 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 110 J E
BENZO(A)ANTHRACENE 350 E
BENZO(A)PYRENE 370 R,E
BENZO(G,H,I)PERYLENE 270 E
FLUORENE 54 J E
PYRENE 720 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 73 E
4,4'-DDE 62 E
4,4'-DDT 90 E
ALPHA-CHLORDANE 2 J E
ENDOSULFAN I 1.2 J E
ENDOSULFAN II 1.9 J E
GAMMA-CHLORDANE 1.6 J E
NTC17BBSD55 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 360 E
BENZO(A)ANTHRACENE 770 E
BENZO(A)PYRENE 690 R,E
BENZO(G,H,I)PERYLENE 410 E
CHRYSENE 720 E
FLUORENE 170 J E
PHENANTHRENE 1400 E
PYRENE 1500 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 140 E
4,4'-DDE 100 E
4,4'-DDT 73 E
ALPHA-CHLORDANE 6.5 J E
AROCLOR-1254 400 E
AROCLOR-1260 170 E
BETA-BHC 5.6 J E
ENDOSULFAN I 2.8 J E
ENDOSULFAN II 8.2 J E
GAMMA-CHLORDANE 2.8 J E
LEGEND
Sediment Sample Location
Building/Structure
Road
Railroad
Fence
Surface Water
R: Illinois Exposure Route Specific Values For Residential Soils Ingestion
E: Ecological Sediment Screening Values
(0 - 1) Sample Depth in Feet
Note: No duplicate samples included. Only exceedances are shown. Letters following sample concentration indicate which screening levels are exceeded.
NTC17BBSD53 (0 - 0.13)
Semivolatile Organics (ug/kg)
ANTHRACENE 110 E
BENZO(A)ANTHRACENE 390 E
BENZO(A)PYRENE 430 R,E
BENZO(G,H,I)PERYLENE 210 E
FLUORENE 53 J E
PYRENE 640 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 80 E
4,4'-DDE 59 E
4,4'-DDT 34 E
ALPHA-CHLORDANE 2.5 J E
ENDOSULFAN I 1.8 J E
ENDOSULFAN II 1.6 J E
GAMMA-CHLORDANE 1.6 J E
NTC17BBSD54 (0 - 0.131)
Semivolatile Organics (ug/kg)
ANTHRACENE 180 E
BENZO(A)ANTHRACENE 360 E
BENZO(A)PYRENE 400 R,E
FLUORENE 76 J E
PYRENE 740 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 71 E
4,4'-DDE 57 E
4,4'-DDT 58 E
ALPHA-CHLORDANE 1.6 J E
ENDOSULFAN I 1.1 J E
ENDOSULFAN II 0.94 J E
GAMMA-CHLORDANE 1.3 J E
200 0 200 Feet
P:\GIS\GREATLAKES_NTC\APR\SITE17_TAGMAPS.APR
ORGANIC SURFACE SEDIMENT EXCEEDANCES-BOAT BASIN
11/11/03 JAL
DRAWN BY DATE
K. PEILA 4/10/02
CHECKED BY DATE
A. SCHEETZ 4/10/02
REVISED BY DATE
J. LAMEY 11/11/03
SCALE
AS NOTED
DEPARTMENT OF THE NAVY
SOUTHERN DIV FACILITIES ENGINEERING COMD
ORGANIC SURFACE SEDIMENT EXCEEDANCES
SITE 17 - BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
CONTRACT NO.
3939
OWNER NO.
APPROVED BY DATE
DRAWING NO.
FIGURE 4-7
REV.
0

P:\GIS\GREATLAKES_NTC\APRS\SITE17_TAGMAP_TEMPLATE.APR\SITE17_BB_INOR_01 4/10/02 KMP

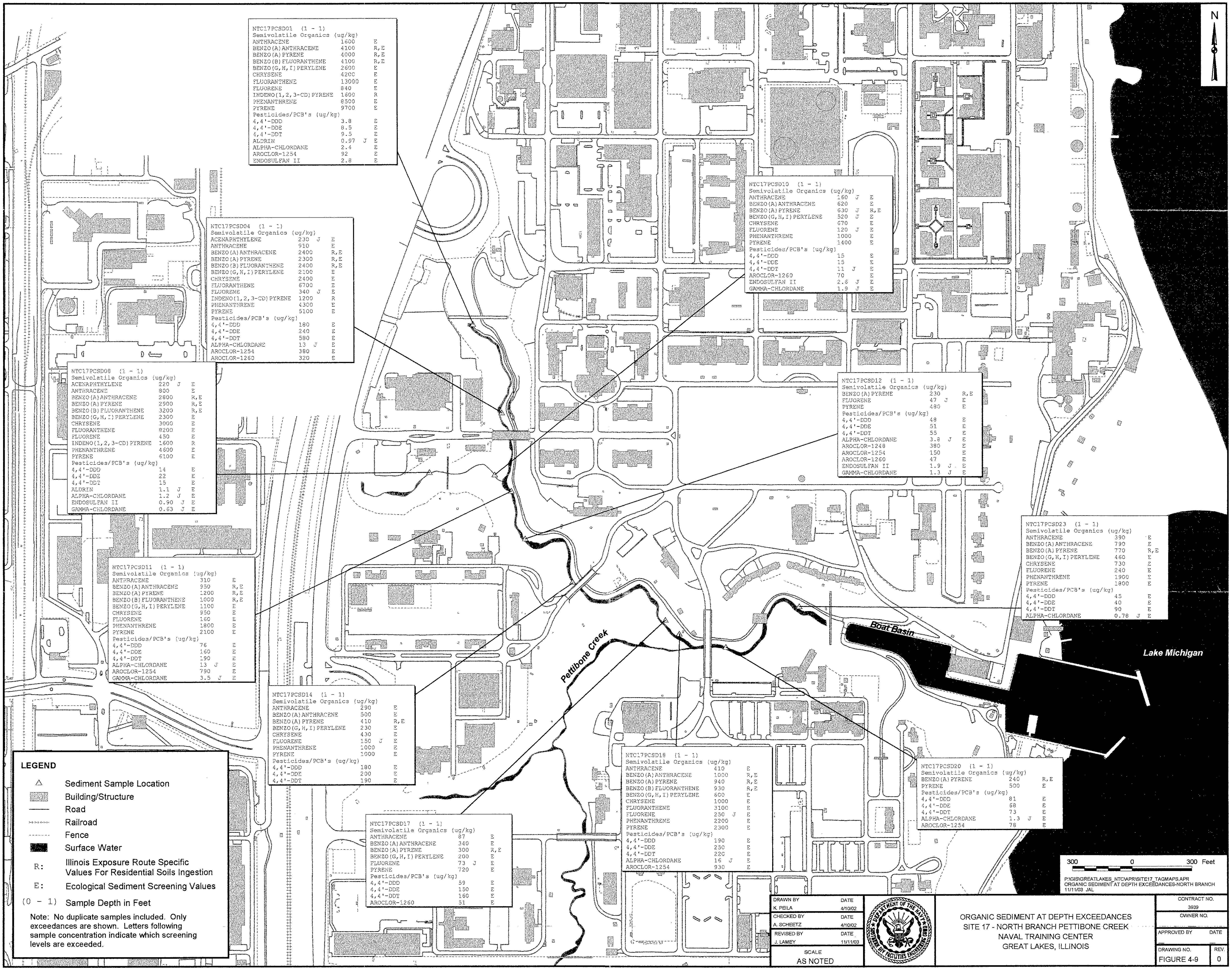


NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

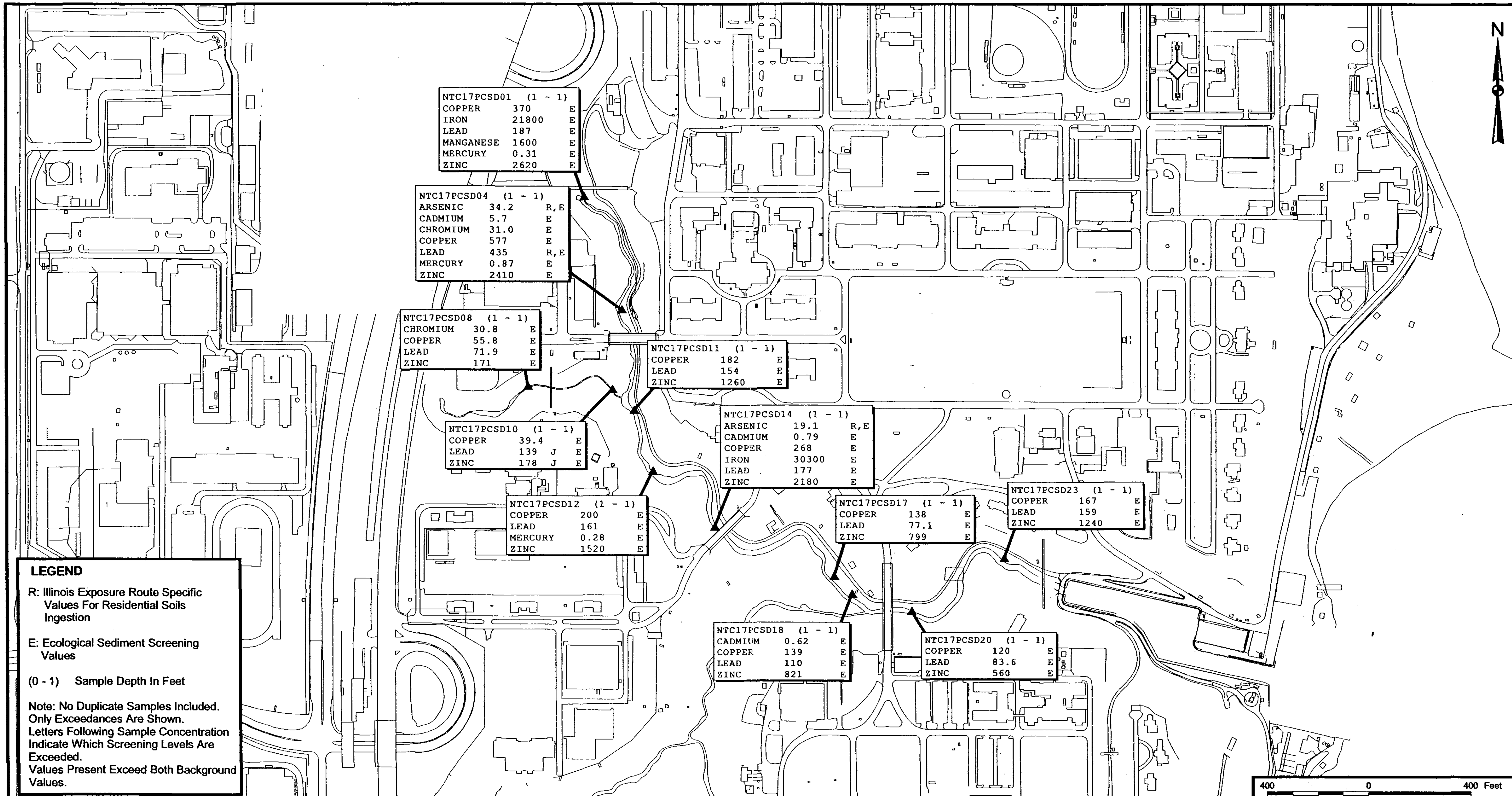
DRAWN BY K. PEILA — DATE 4/10/02
CHECKED BY A. SCHEETZ — DATE 4/10/02
COST/SCHED-AREA
SCALE AS NOTED

INORGANIC SURFACE SEDIMENT EXCEEDANCES
SITE 17 - BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO. 3939
APPROVED BY — DATE
APPROVED BY — DATE
DRAWING NO. FIGURE 4-8 — REV. 0


N
NTC17PCSD01 (1 - 1)
Semivolatile Organics (ug/kg)
ANTHRACENE 1600 E
BENZO(A)ANTHRACENE 4100 R,E
BENZO(A)PYRENE 4000 R,E
BENZO(B)FLUORANTHENE 4100 R,E
BENZO(G,H,I)PERYLENE 2600 E
CHRYSENE 4200 E
FLUORANTHENE 13000 E
FLUORENE 840 E
INDENO(1,2,3-CD)PYRENE 1600 R
PHENANTHRENE 8500 E
PYRENE 9700 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 3.8 E
4,4'-DDE 8.5 E
4,4'-DDT 9.5 E
ALDRIN 0.97 J E
ALPHA-CHLORDANE 2.4 E
AROCLOR-1254 92 E
ENDOSULFAN II 2.8 E
NTC17PCSD10 (1 - 1)
Semivolatile Organics (ug/kg)
ANTHRACENE 160 J E
BENZO(A)ANTHRACENE 620 E
BENZO(A)PYRENE 630 J R,E
BENZO(G,H,I)PERYLENE 520 J E
CHRYSENE 670 E
FLUORENE 120 J E
PHENANTHRENE 1000 E
PYRENE 1400 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 15 E
4,4'-DDE 15 E
4,4'-DDT 11 J E
AROCLOR-1260 70 E
ENDOSULFAN II 2.6 J E
GAMMA-CHLORDANE 1.9 J E
NTC17PCSD04 (1 - 1)
Semivolatile Organics (ug/kg)
ACENAPHTHYLENE 230 J E
ANTHRACENE 910 E
BENZO(A)ANTHRACENE 2400 R,E
BENZO(A)PYRENE 2300 R,E
BENZO(B)FLUORANTHENE 2400 R,E
BENZO(G,H,I)PERYLENE 2100 E
CHRYSENE 2400 E
FLUORANTHENE 6700 E
FLUORENE 340 J E
INDENO(1,2,3-CD)PYRENE 1200 R
PHENANTHRENE 4300 E
PYRENE 5100 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 180 E
4,4'-DDE 240 E
4,4'-DDT 580 E
ALPHA-CHLORDANE 13 J E
AROCLOR-1254 380 E
AROCLOR-1260 320 E
NTC17PCSD08 (1 - 1)
Semivolatile Organics (ug/kg)
ACENAPHTHYLENE 220 J E
ANTHRACENE 800 E
BENZO(A)ANTHRACENE 2800 R,E
BENZO(A)PYRENE 2900 R,E
BENZO(B)FLUORANTHENE 3200 R,E
BENZO(G,H,I)PERYLENE 2300 E
CHRYSENE 3000 E
FLUORANTHENE 8200 E
FLUORENE 450 E
INDENO(1,2,3-CD)PYRENE 1600 R
PHENANTHRENE 4600 E
PYRENE 6100 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 14 E
4,4'-DDE 22 E
4,4'-DDT 15 E
ALDRIN 1.1 J E
ALPHA-CHLORDANE 1.2 J E
ENDOSULFAN II 0.90 J E
GAMMA-CHLORDANE 0.63 J E
NTC17PCSD12 (1 - 1)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 230 R,E
FLUORENE 47 J E
PYRENE 480 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 48 E
4,4'-DDE 51 E
4,4'-DDT 55 E
ALPHA-CHLORDANE 3.8 J E
AROCLOR-1248 380 E
AROCLOR-1254 150 E
AROCLOR-1260 47 E
ENDOSULFAN II 1.9 J E
GAMMA-CHLORDANE 1.3 J E
NTC17PCSD23 (1 - 1)
Semivolatile Organics (ug/kg)
ANTHRACENE 390 E
BENZO(A)ANTHRACENE 790 E
BENZO(A)PYRENE 770 R,E
BENZO(G,H,I)PERYLENE 460 E
CHRYSENE 730 E
FLUORENE 240 E
PHENANTHRENE 1900 E
PYRENE 1800 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 45 E
4,4'-DDE 40 E
4,4'-DDT 90 E
ALPHA-CHLORDANE 0.78 J E
NTC17PCSD11 (1 - 1)
Semivolatile Organics (ug/kg)
ANTHRACENE 310 E
BENZO(A)ANTHRACENE 950 R,E
BENZO(A)PYRENE 1200 R,E
BENZO(B)FLUORANTHENE 1000 R,E
BENZO(G,H,I)PERYLENE 1100 E
CHRYSENE 950 E
FLUORENE 160 E
PHENANTHRENE 1800 E
PYRENE 2100 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 76 E
4,4'-DDE 160 E
4,4'-DDT 190 E
ALPHA-CHLORDANE 13 J E
AROCLOR-1254 790 E
GAMMA-CHLORDANE 3.5 J E
Boat Basin
Lake Michigan
Pettibone Creek
NTC17PCSD14 (1 - 1)
Semivolatile Organics (ug/kg)
ANTHRACENE 290 E
BENZO(A)ANTHRACENE 500 E
BENZO(A)PYRENE 410 R,E
BENZO(G,H,I)PERYLENE 230 E
CHRYSENE 430 E
FLUORENE 150 J E
PHENANTHRENE 1000 E
PYRENE 1000 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 180 E
4,4'-DDE 200 E
4,4'-DDT 190 E
NTC17PCSD18 (1 - 1)
Semivolatile Organics (ug/kg)
ANTHRACENE 410 E
BENZO(A)ANTHRACENE 1000 R,E
BENZO(A)PYRENE 940 R,E
BENZO(B)FLUORANTHENE 930 R,E
BENZO(G,H,I)PERYLENE 600 E
CHRYSENE 1000 E
FLUORANTHENE 3100 E
FLUORENE 250 J E
PHENANTHRENE 2200 E
PYRENE 2300 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 190 E
4,4'-DDE 250 E
4,4'-DDT 220 E
ALPHA-CHLORDANE 16 J E
AROCLOR-1254 930 E
NTC17PCSD20 (1 - 1)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 240 R,E
PYRENE 500 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 81 E
4,4'-DDE 68 E
4,4'-DDT 73 E
ALPHA-CHLORDANE 1.3 J E
AROCLOR-1254 78 E
NTC17PCSD17 (1 - 1)
Semivolatile Organics (ug/kg)
ANTHRACENE 87 E
BENZO(A)ANTHRACENE 340 E
BENZO(A)PYRENE 300 R,E
BENZO(G,H,I)PERYLENE 200 E
FLUORENE 73 J E
PYRENE 720 E
Pesticides/PCB's (ug/kg)
4,4'-DDD 59 E
4,4'-DDE 150 E
4,4'-DDT 160 E
AROCLOR-1260 51 E
LEGEND
Sediment Sample Location
Building/Structure
Road
Railroad
Fence
Surface Water
R: Illinois Exposure Route Specific Values For Residential Soils Ingestion
E: Ecological Sediment Screening Values
(0 - 1) Sample Depth in Feet
Note: No duplicate samples included. Only exceedances are shown. Letters following sample concentration indicate which screening levels are exceeded.
300 0 300 Feet
P:\GIS\GREATLAKES_NTC\APR\SITE17_TAGMAPS.APR
ORGANIC SEDIMENT AT DEPTH EXCEEDANCES-NORTH BRANCH
11/11/03 JAL
DRAWN BY K. PEILA DATE 4/10/02
CHECKED BY A. SCHEETZ DATE 4/10/02
REVISED BY J. LAMEY DATE 11/11/03
SCALE AS NOTED
DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ORGANIC SEDIMENT AT DEPTH EXCEEDANCES
SITE 17 - NORTH BRANCH PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
CONTRACT NO. 3939
OWNER NO.
APPROVED BY DATE
DRAWING NO. FIGURE 4-9
REV. 0

P:\GIS\GREATLAKES_NTC\APRS\SITE17_TAGMAP_TEMPLATE.APR\SITE17_NB_INOR_02 4/10/02 KMP



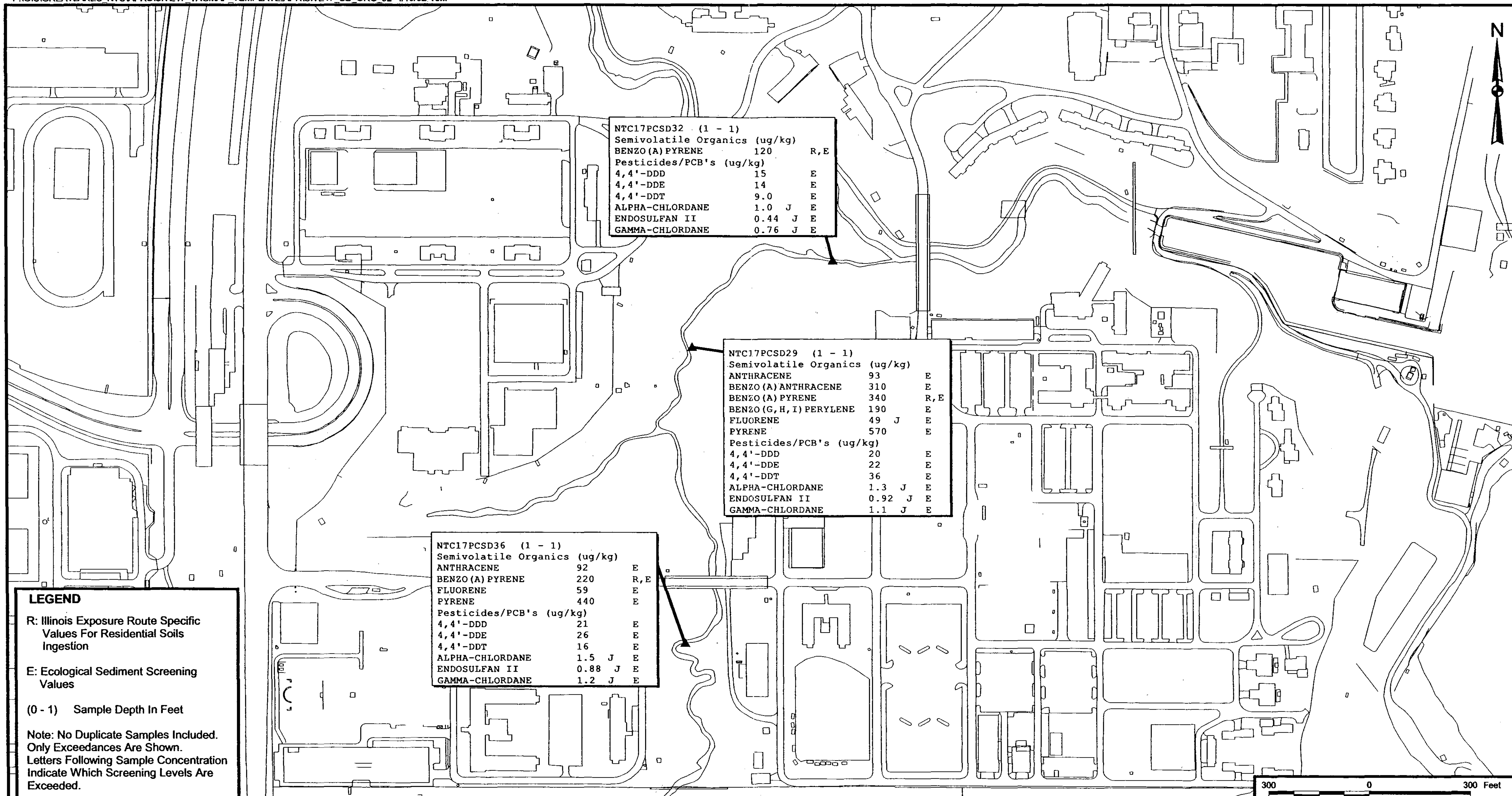
NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY K. PEILA DATE 4/10/02
CHECKED BY A. SCHEETZ DATE 4/10/02
COST/SCHED-AREA
SCALE AS NOTED

INORGANIC SEDIMENT AT DEPTH EXCEEDANCES
SITE 17 - NORTH BRANCH PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO. 3939
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 4-10 REV. 0

P:\GIS\GREATLAKES_NTC\APRS\SITE17_TAGMAP_TEMPLATE.APR\SITE17_SB_ORG_02 4/10/02 KMP



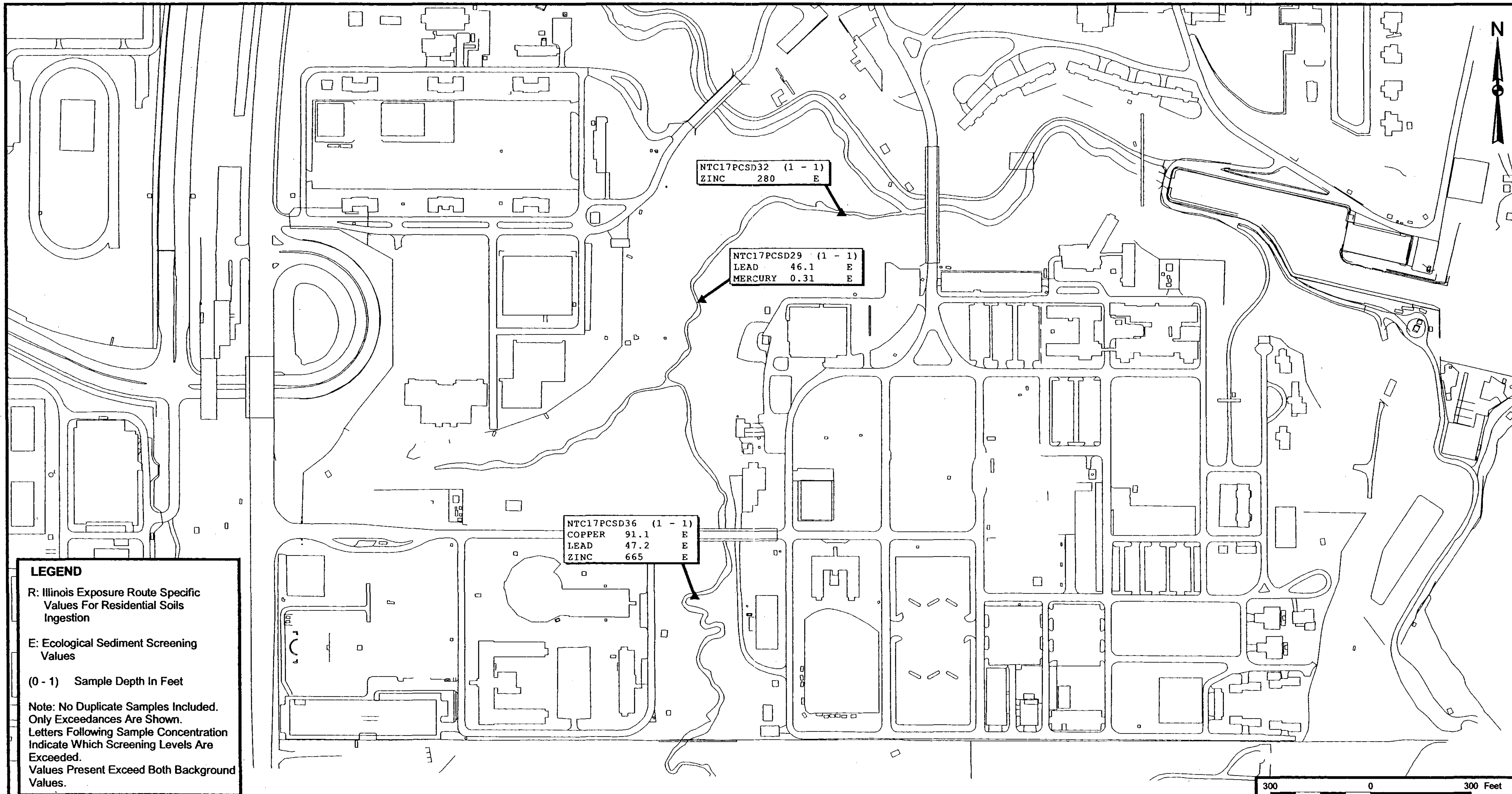
NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: K. PEILA — DATE: 4/10/02
CHECKED BY: A. SCHEETZ — DATE: 4/10/02
COST/SCHED-AREA
SCALE: AS NOTED

ORGANIC SEDIMENT AT DEPTH EXCEEDANCES
SITE 17 - SOUTH BRANCH PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

CONTRACT NO. 3939
APPROVED BY — DATE
APPROVED BY — DATE
DRAWING NO. FIGURE 4-11 — REV. 0

P:\GIS\GREATLAKES_NTC\APRS\SITE17_TAGMAP_TEMPLATE.APR\SITE17_SB_INOR_02 4/10/02 KMP

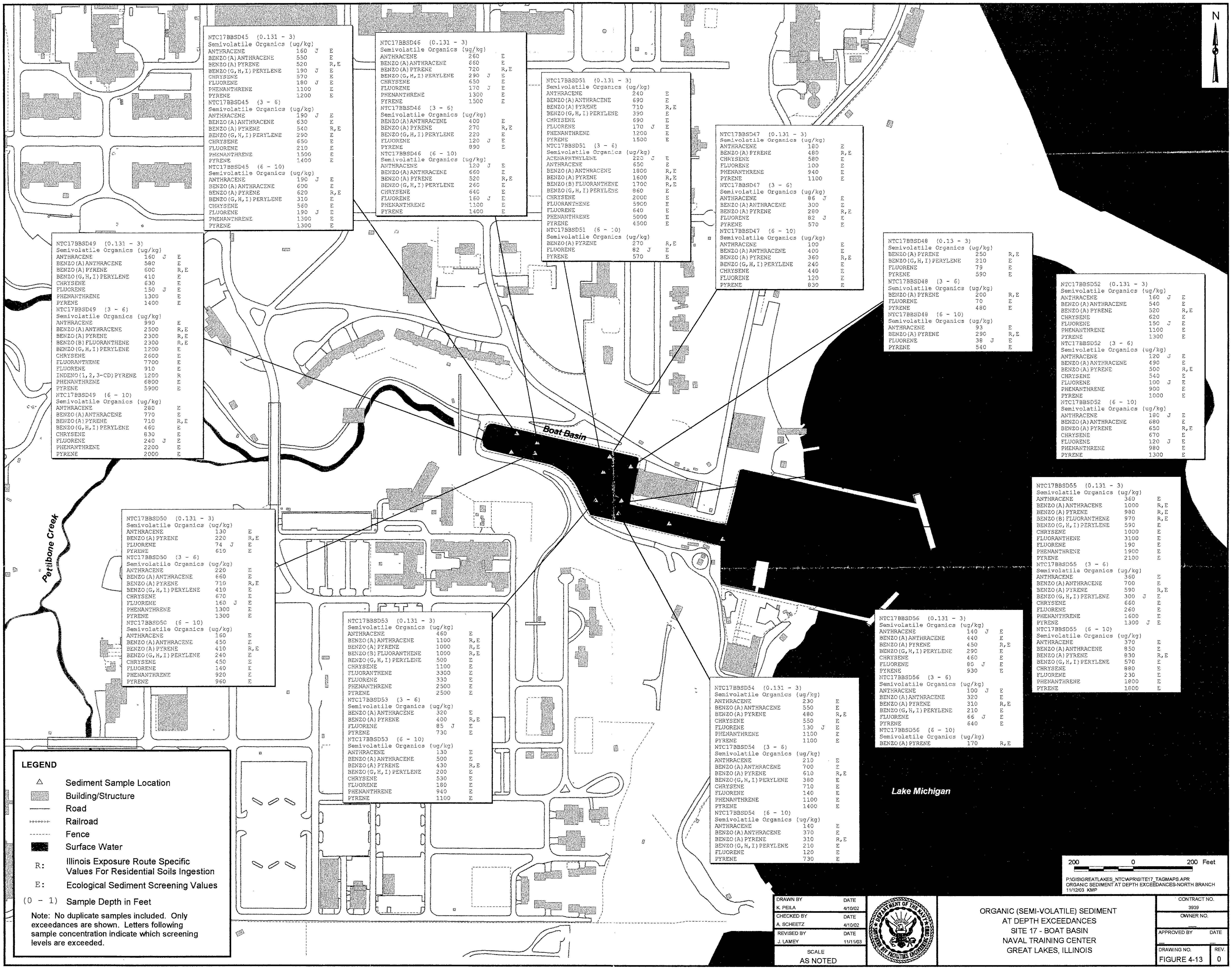


NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

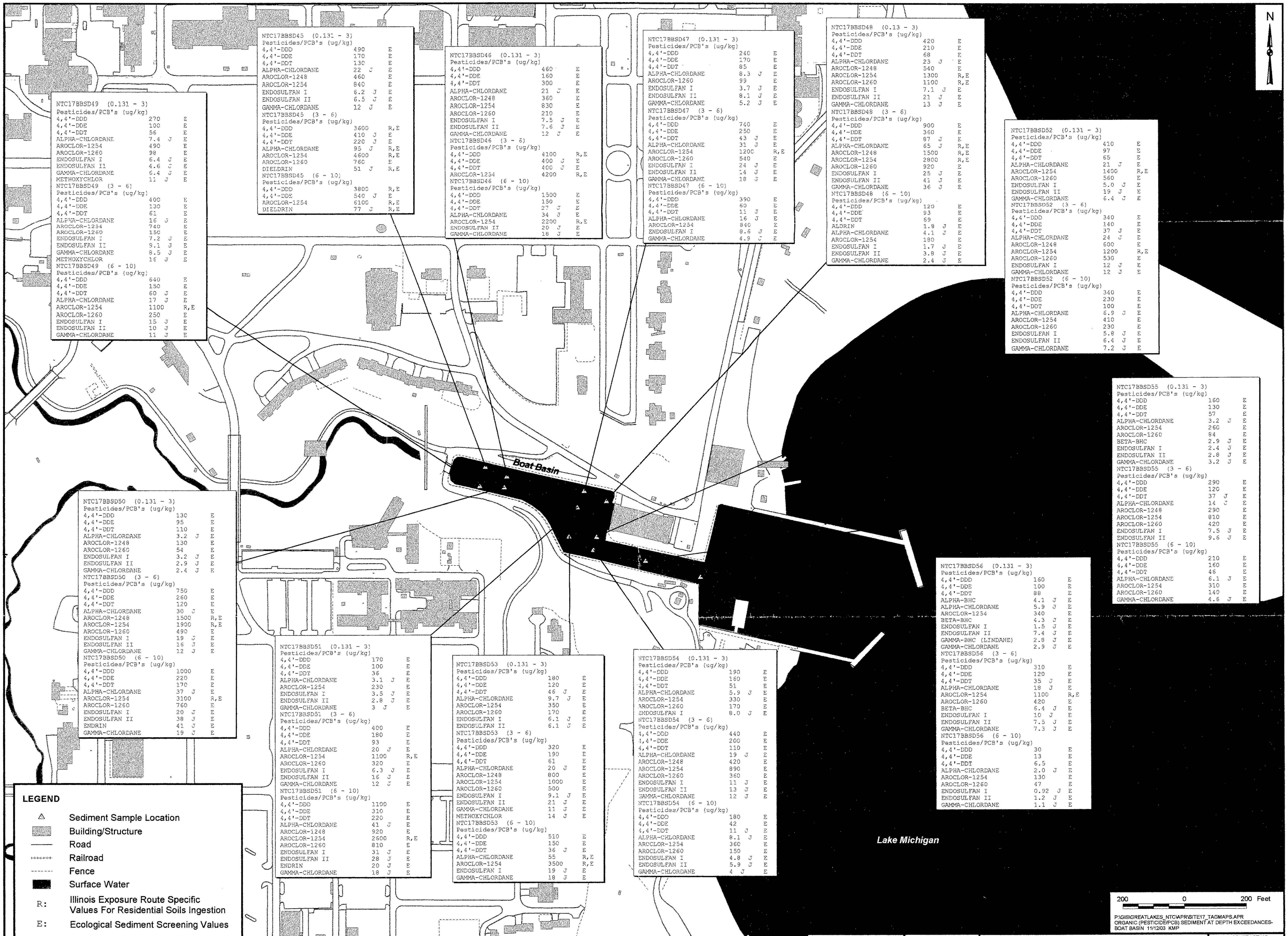
DRAWN BY: K. PEILA — DATE: 4/10/02
CHECKED BY: A. SCHEETZ — DATE: 4/10/02
COST/SCHED-AREA
SCALE: AS NOTED

INORGANIC SEDIMENT AT DEPTH EXCEEDANCES
SITE 17 - SOUTH BRANCH PETTIBONE CREEK
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

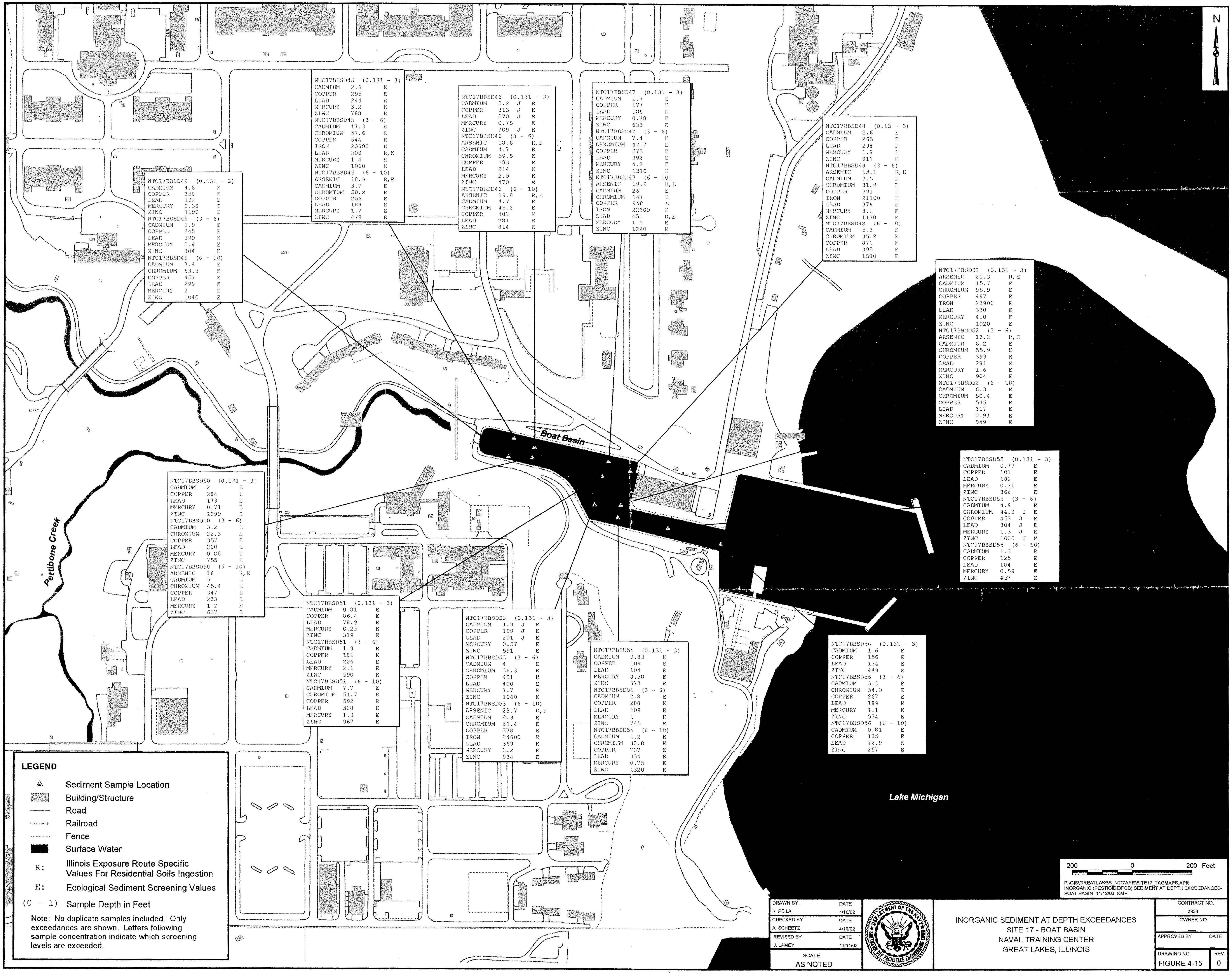
CONTRACT NO. 3939
APPROVED BY — DATE
APPROVED BY — DATE
DRAWING NO. FIGURE 4-12 — REV. 0



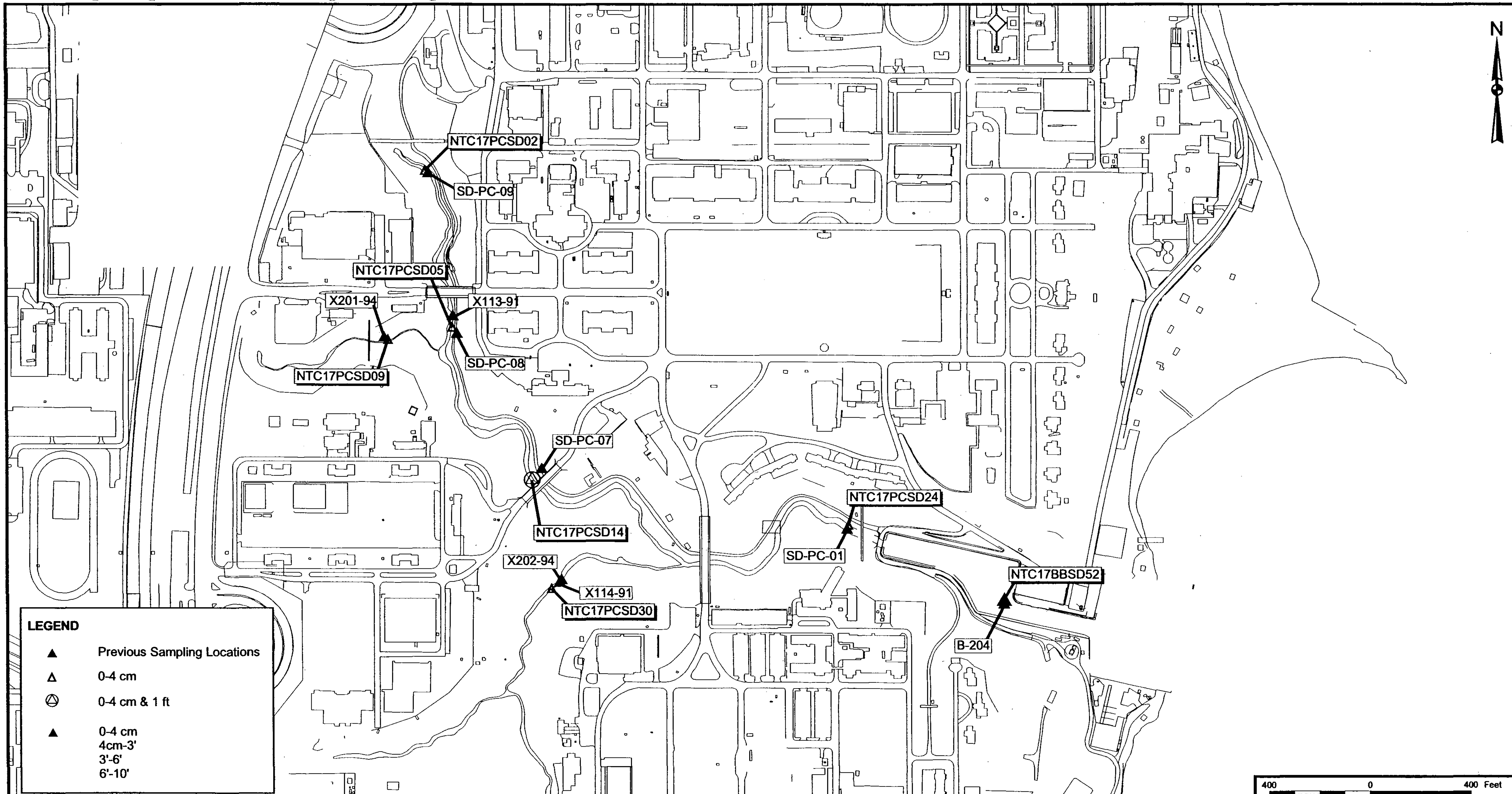
NTC17BBSD45 (0.131 - 3)
Semivolatile Organics (ug/kg)
ANTHRACENE 160 J E
BENZO(A)ANTHRACENE 550 E
BENZO(A)PYRENE 520 R,E
BENZO(G,H,I)PERYLENE 190 J E
CHRYSENE 570 E
FLUORENE 180 J E
PHENANTHRENE 1100 E
PYRENE 1200 E
NTC17BBSD45 (3 - 6)
Semivolatile Organics (ug/kg)
ANTHRACENE 190 J E
BENZO(A)ANTHRACENE 630 E
BENZO(A)PYRENE 540 R,E
BENZO(G,H,I)PERYLENE 290 E
CHRYSENE 650 E
FLUORENE 210 E
PHENANTHRENE 1500 E
PYRENE 1400 E
NTC17BBSD45 (6 - 10)
Semivolatile Organics (ug/kg)
ANTHRACENE 190 J E
BENZO(A)ANTHRACENE 600 E
BENZO(A)PYRENE 620 R,E
BENZO(G,H,I)PERYLENE 310 E
CHRYSENE 560 E
FLUORENE 190 J E
PHENANTHRENE 1300 E
PYRENE 1300 E
NTC17BBSD46 (0.131 - 3)
Semivolatile Organics (ug/kg)
ANTHRACENE 260 E
BENZO(A)ANTHRACENE 660 E
BENZO(A)PYRENE 720 R,E
BENZO(G,H,I)PERYLENE 290 J E
CHRYSENE 650 E
FLUORENE 170 J E
PHENANTHRENE 1300 E
PYRENE 1500 E
NTC17BBSD46 (3 - 6)
Semivolatile Organics (ug/kg)
BENZO(A)ANTHRACENE 400 E
BENZO(A)PYRENE 270 R,E
BENZO(G,H,I)PERYLENE 220 E
FLUORENE 120 J E
PYRENE 890 E
NTC17BBSD46 (6 - 10)
Semivolatile Organics (ug/kg)
ANTHRACENE 120 J E
BENZO(A)ANTHRACENE 660 E
BENZO(A)PYRENE 520 R,E
BENZO(G,H,I)PERYLENE 260 E
CHRYSENE 640 E
FLUORENE 160 J E
PHENANTHRENE 1100 E
PYRENE 1400 E
NTC17BBSD51 (0.131 - 3)
Semivolatile Organics (ug/kg)
ANTHRACENE 240 E
BENZO(A)ANTHRACENE 690 E
BENZO(A)PYRENE 710 R,E
BENZO(G,H,I)PERYLENE 390 E
CHRYSENE 690 E
FLUORENE 170 J E
PHENANTHRENE 1200 E
PYRENE 1500 E
NTC17BBSD51 (3 - 6)
Semivolatile Organics (ug/kg)
ACENAPHTHYLENE 220 J E
ANTHRACENE 650 E
BENZO(A)ANTHRACENE 1800 R,E
BENZO(A)PYRENE 1600 R,E
BENZO(B)FLUORANTHENE 1700 R,E
BENZO(G,H,I)PERYLENE 860 E
CHRYSENE 2000 E
FLUORANTHENE 5900 E
FLUORENE 640 E
PHENANTHRENE 5000 E
PYRENE 4500 E
NTC17BBSD51 (6 - 10)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 270 R,E
FLUORENE 82 J E
PYRENE 570 E
NTC17BBSD47 (0.131 - 3)
Semivolatile Organics (ug/kg)
ANTHRACENE 180 E
BENZO(A)PYRENE 480 R,E
CHRYSENE 580 E
FLUORENE 100 E
PHENANTHRENE 940 E
PYRENE 1100 E
NTC17BBSD47 (3 - 6)
Semivolatile Organics (ug/kg)
ANTHRACENE 86 J E
BENZO(A)ANTHRACENE 300 E
BENZO(A)PYRENE 280 R,E
FLUORENE 82 J E
PYRENE 570 E
NTC17BBSD47 (6 - 10)
Semivolatile Organics (ug/kg)
ANTHRACENE 100 E
BENZO(A)ANTHRACENE 400 E
BENZO(A)PYRENE 360 R,E
BENZO(G,H,I)PERYLENE 240 E
CHRYSENE 440 E
FLUORENE 120 E
PYRENE 830 E
NTC17BBSD48 (0.13 - 3)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 250 R,E
BENZO(G,H,I)PERYLENE 210 E
FLUORENE 79 E
PYRENE 590 E
NTC17BBSD48 (3 - 6)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 200 R,E
FLUORENE 70 E
PYRENE 480 E
NTC17BBSD48 (6 - 10)
Semivolatile Organics (ug/kg)
ANTHRACENE 93 E
BENZO(A)PYRENE 290 R,E
FLUORENE 38 J E
PYRENE 540 E
NTC17BBSD49 (0.131 - 3)
Semivolatile Organics (ug/kg)
ANTHRACENE 160 J E
BENZO(A)ANTHRACENE 580 E
BENZO(A)PYRENE 600 R,E
BENZO(G,H,I)PERYLENE 410 E
CHRYSENE 630 E
FLUORENE 150 J E
PHENANTHRENE 1300 E
PYRENE 1400 E
NTC17BBSD49 (3 - 6)
Semivolatile Organics (ug/kg)
ANTHRACENE 990 E
BENZO(A)ANTHRACENE 2500 R,E
BENZO(A)PYRENE 2300 R,E
BENZO(B)FLUORANTHENE 2300 R,E
BENZO(G,H,I)PERYLENE 1200 E
CHRYSENE 2600 E
FLUORANTHENE 7700 E
FLUORENE 910 E
INDENO(1,2,3-CD)PYRENE 1200 R
PHENANTHRENE 6800 E
PYRENE 5900 E
NTC17BBSD49 (6 - 10)
Semivolatile Organics (ug/kg)
ANTHRACENE 280 E
BENZO(A)ANTHRACENE 770 E
BENZO(A)PYRENE 710 R,E
BENZO(G,H,I)PERYLENE 460 E
CHRYSENE 830 E
FLUORENE 240 J E
PHENANTHRENE 2200 E
PYRENE 2000 E
NTC17BBSD52 (0.131 - 3)
Semivolatile Organics (ug/kg)
ANTHRACENE 160 J E
BENZO(A)ANTHRACENE 540 E
BENZO(A)PYRENE 520 R,E
CHRYSENE 620 E
FLUORENE 150 J E
PHENANTHRENE 1100 E
PYRENE 1300 E
NTC17BBSD52 (3 - 6)
Semivolatile Organics (ug/kg)
ANTHRACENE 120 J E
BENZO(A)ANTHRACENE 490 E
BENZO(A)PYRENE 500 R,E
CHRYSENE 540 E
FLUORENE 100 J E
PHENANTHRENE 900 E
PYRENE 1000 E
NTC17BBSD52 (6 - 10)
Semivolatile Organics (ug/kg)
ANTHRACENE 180 J E
BENZO(A)ANTHRACENE 680 E
BENZO(A)PYRENE 650 R,E
CHRYSENE 670 E
FLUORENE 120 J E
PHENANTHRENE 980 E
PYRENE 1300 E
Boat Basin
Petibone Creek
NTC17BBSD50 (0.131 - 3)
Semivolatile Organics (ug/kg)
ANTHRACENE 130 E
BENZO(A)PYRENE 220 R,E
FLUORENE 74 J E
PYRENE 610 E
NTC17BBSD50 (3 - 6)
Semivolatile Organics (ug/kg)
ANTHRACENE 220 E
BENZO(A)ANTHRACENE 660 E
BENZO(A)PYRENE 710 R,E
BENZO(G,H,I)PERYLENE 410 E
CHRYSENE 670 E
FLUORENE 160 J E
PHENANTHRENE 1300 E
PYRENE 1300 E
NTC17BBSD50 (6 - 10)
Semivolatile Organics (ug/kg)
ANTHRACENE 160 E
BENZO(A)ANTHRACENE 450 E
BENZO(A)PYRENE 410 R,E
BENZO(G,H,I)PERYLENE 240 E
CHRYSENE 450 E
FLUORENE 140 E
PHENANTHRENE 920 E
PYRENE 960 E
NTC17BBSD55 (0.131 - 3)
Semivolatile Organics (ug/kg)
ANTHRACENE 360 E
BENZO(A)ANTHRACENE 1000 R,E
BENZO(A)PYRENE 980 R,E
BENZO(B)FLUORANTHENE 970 R,E
BENZO(G,H,I)PERYLENE 590 E
CHRYSENE 1000 E
FLUORANTHENE 3100 E
FLUORENE 190 E
PHENANTHRENE 1900 E
PYRENE 2100 E
NTC17BBSD55 (3 - 6)
Semivolatile Organics (ug/kg)
ANTHRACENE 360 E
BENZO(A)ANTHRACENE 700 E
BENZO(A)PYRENE 590 R,E
BENZO(G,H,I)PERYLENE 300 J E
CHRYSENE 660 E
FLUORENE 260 E
PHENANTHRENE 1600 E
PYRENE 1300 J E
NTC17BBSD55 (6 - 10)
Semivolatile Organics (ug/kg)
ANTHRACENE 370 E
BENZO(A)ANTHRACENE 850 E
BENZO(A)PYRENE 830 R,E
BENZO(G,H,I)PERYLENE 570 E
CHRYSENE 880 E
FLUORENE 230 E
PHENANTHRENE 1800 E
PYRENE 1800 E
NTC17BBSD53 (0.131 - 3)
Semivolatile Organics (ug/kg)
ANTHRACENE 460 E
BENZO(A)ANTHRACENE 1100 R,E
BENZO(A)PYRENE 1000 R,E
BENZO(B)FLUORANTHENE 1000 R,E
BENZO(G,H,I)PERYLENE 500 E
CHRYSENE 1100 E
FLUORANTHENE 3300 E
FLUORENE 330 E
PHENANTHRENE 2500 E
PYRENE 2500 E
NTC17BBSD53 (3 - 6)
Semivolatile Organics (ug/kg)
BENZO(A)ANTHRACENE 320 E
BENZO(A)PYRENE 400 R,E
FLUORENE 85 J E
PYRENE 730 E
NTC17BBSD53 (6 - 10)
Semivolatile Organics (ug/kg)
ANTHRACENE 130 E
BENZO(A)ANTHRACENE 500 E
BENZO(A)PYRENE 430 R,E
BENZO(G,H,I)PERYLENE 200 E
CHRYSENE 530 E
FLUORENE 180 E
PHENANTHRENE 940 E
PYRENE 1100 E
NTC17BBSD56 (0.131 - 3)
Semivolatile Organics (ug/kg)
ANTHRACENE 140 J E
BENZO(A)ANTHRACENE 440 E
BENZO(A)PYRENE 450 R,E
BENZO(G,H,I)PERYLENE 290 E
CHRYSENE 460 E
FLUORENE 80 J E
PYRENE 930 E
NTC17BBSD56 (3 - 6)
Semivolatile Organics (ug/kg)
ANTHRACENE 100 J E
BENZO(A)ANTHRACENE 320 E
BENZO(A)PYRENE 310 R,E
BENZO(G,H,I)PERYLENE 210 E
FLUORENE 66 J E
PYRENE 640 E
NTC17BBSD56 (6 - 10)
Semivolatile Organics (ug/kg)
BENZO(A)PYRENE 170 R,E
NTC17BBSD54 (0.131 - 3)
Semivolatile Organics (ug/kg)
ANTHRACENE 230 E
BENZO(A)ANTHRACENE 550 E
BENZO(A)PYRENE 480 R,E
CHRYSENE 550 E
FLUORENE 130 J E
PHENANTHRENE 1100 E
PYRENE 1100 E
NTC17BBSD54 (3 - 6)
Semivolatile Organics (ug/kg)
ANTHRACENE 210 E
BENZO(A)ANTHRACENE 700 E
BENZO(A)PYRENE 610 R,E
BENZO(G,H,I)PERYLENE 380 E
CHRYSENE 710 E
FLUORENE 140 E
PHENANTHRENE 1100 E
PYRENE 1400 E
NTC17BBSD54 (6 - 10)
Semivolatile Organics (ug/kg)
ANTHRACENE 140 E
BENZO(A)ANTHRACENE 370 E
BENZO(A)PYRENE 310 R,E
BENZO(G,H,I)PERYLENE 210 E
FLUORENE 120 E
PYRENE 730 E
Lake Michigan
N
LEGEND
Sediment Sample Location
Building/Structure
Road
Railroad
Fence
Surface Water
R: Illinois Exposure Route Specific Values For Residential Soils Ingestion
E: Ecological Sediment Screening Values
(0 - 1) Sample Depth in Feet
Note: No duplicate samples included. Only exceedances are shown. Letters following sample concentration indicate which screening levels are exceeded.
200 0 200 Feet
P:\GIS\GREATLAKES_NTC\APR\SITE17_TAGMAPS.APR
ORGANIC SEDIMENT AT DEPTH EXCEEDANCES-NORTH BRANCH
11/12/03 KMP
DRAWN BY K. PEILA DATE 4/10/02
CHECKED BY A. SCHEETZ DATE 4/10/02
REVISED BY J. LAMEY DATE 11/11/03
SCALE AS NOTED
ORGANIC (SEMI-VOLATILE) SEDIMENT
AT DEPTH EXCEEDANCES
SITE 17 - BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
CONTRACT NO. 3939
OWNER NO.
APPROVED BY DATE
DRAWING NO. FIGURE 4-13
REV. 0



DRAWN BY K. PEILA — DATE 4/10/02		ORGANIC (PESTICIDE/PCB) SEDIMENT AT DEPTH EXCEEDANCES SITE 17 - BOAT BASIN NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS	CONTRACT NO. 3939
CHECKED BY A. SCHEETZ — DATE 4/10/02			OWNER NO.
REVISED BY J. LAMEY — DATE 11/11/03			APPROVED BY — DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4-14 — REV. 0


N
NTC17BBSD45 (0.131 - 3)
CADMIUM 2.6 E
COPPER 295 E
LEAD 244 E
MERCURY 3.2 E
ZINC 788 E
NTC17BBSD45 (3 - 6)
CADMIUM 17.3 E
CHROMIUM 57.6 E
COPPER 644 E
IRON 20600 E
LEAD 503 R,E
MERCURY 1.4 E
ZINC 1060 E
NTC17BBSD45 (6 - 10)
ARSENIC 18.9 R,E
CADMIUM 3.7 E
CHROMIUM 50.2 E
COPPER 256 E
LEAD 188 E
MERCURY 1.7 E
ZINC 479 E
NTC17BBSD46 (0.131 - 3)
CADMIUM 3.2 J E
COPPER 313 J E
LEAD 270 J E
MERCURY 0.75 E
ZINC 709 J E
NTC17BBSD46 (3 - 6)
ARSENIC 18.6 R,E
CADMIUM 4.7 E
CHROMIUM 59.5 E
COPPER 183 E
LEAD 214 E
MERCURY 2.5 E
ZINC 470 E
NTC17BBSD46 (6 - 10)
ARSENIC 19.0 R,E
CADMIUM 4.7 E
CHROMIUM 45.2 E
COPPER 482 E
LEAD 281 E
ZINC 814 E
NTC17BBSD47 (0.131 - 3)
CADMIUM 1.7 E
COPPER 177 E
LEAD 189 E
MERCURY 0.78 E
ZINC 653 E
NTC17BBSD47 (3 - 6)
CADMIUM 7.4 E
CHROMIUM 43.7 E
COPPER 573 E
LEAD 392 E
MERCURY 4.2 E
ZINC 1310 E
NTC17BBSD47 (6 - 10)
ARSENIC 19.9 R,E
CADMIUM 26 E
CHROMIUM 147 E
COPPER 948 E
IRON 22300 E
LEAD 451 R,E
MERCURY 1.5 E
ZINC 1290 E
NTC17BBSD48 (0.13 - 3)
CADMIUM 2.6 E
COPPER 265 E
LEAD 298 E
MERCURY 1.8 E
ZINC 911 E
NTC17BBSD48 (3 - 6)
ARSENIC 13.1 R,E
CADMIUM 3.5 E
CHROMIUM 31.9 E
COPPER 391 E
IRON 21100 E
LEAD 379 E
MERCURY 3.1 E
ZINC 1130 E
NTC17BBSD48 (6 - 10)
CADMIUM 5.3 E
CHROMIUM 35.2 E
COPPER 871 E
LEAD 395 E
ZINC 1580 E
NTC17BBSD49 (0.131 - 3)
CADMIUM 4.6 E
COPPER 358 E
LEAD 152 E
MERCURY 0.38 E
ZINC 1190 E
NTC17BBSD49 (3 - 6)
CADMIUM 1.9 E
COPPER 245 E
LEAD 190 E
MERCURY 0.4 E
ZINC 804 E
NTC17BBSD49 (6 - 10)
CADMIUM 7.4 E
CHROMIUM 53.8 E
COPPER 457 E
LEAD 299 E
MERCURY 2 E
ZINC 1040 E
NTC17BBSD52 (0.131 - 3)
ARSENIC 20.3 R,E
CADMIUM 15.7 E
CHROMIUM 95.9 E
COPPER 497 E
IRON 23900 E
LEAD 330 E
MERCURY 4.0 E
ZINC 1020 E
NTC17BBSD52 (3 - 6)
ARSENIC 13.2 R,E
CADMIUM 6.2 E
CHROMIUM 55.9 E
COPPER 393 E
LEAD 281 E
MERCURY 1.6 E
ZINC 904 E
NTC17BBSD52 (6 - 10)
CADMIUM 6.3 E
CHROMIUM 50.4 E
COPPER 545 E
LEAD 317 E
MERCURY 0.91 E
ZINC 949 E
Boat Basin
NTC17BBSD55 (0.131 - 3)
CADMIUM 0.77 E
COPPER 101 E
LEAD 101 E
MERCURY 0.31 E
ZINC 366 E
NTC17BBSD55 (3 - 6)
CADMIUM 4.9 E
CHROMIUM 44.8 J E
COPPER 453 J E
LEAD 304 J E
MERCURY 1.3 J E
ZINC 1000 J E
NTC17BBSD55 (6 - 10)
CADMIUM 1.3 E
COPPER 125 E
LEAD 104 E
MERCURY 0.59 E
ZINC 457 E
Pettibone Creek
NTC17BBSD50 (0.131 - 3)
CADMIUM 2 E
COPPER 284 E
LEAD 173 E
MERCURY 0.71 E
ZINC 1090 E
NTC17BBSD50 (3 - 6)
CADMIUM 3.2 E
CHROMIUM 26.3 E
COPPER 357 E
LEAD 200 E
MERCURY 0.86 E
ZINC 755 E
NTC17BBSD50 (6 - 10)
ARSENIC 16 R,E
CADMIUM 5 E
CHROMIUM 45.4 E
COPPER 347 E
LEAD 233 E
MERCURY 1.2 E
ZINC 637 E
NTC17BBSD51 (0.131 - 3)
CADMIUM 0.81 E
COPPER 86.4 E
LEAD 78.9 E
MERCURY 0.25 E
ZINC 319 E
NTC17BBSD51 (3 - 6)
CADMIUM 1.9 E
COPPER 181 E
LEAD 226 E
MERCURY 2.1 E
ZINC 590 E
NTC17BBSD51 (6 - 10)
CADMIUM 7.7 E
CHROMIUM 51.7 E
COPPER 592 E
LEAD 328 E
MERCURY 1.3 E
ZINC 967 E
NTC17BBSD53 (0.131 - 3)
CADMIUM 1.9 J E
COPPER 199 J E
LEAD 201 J E
MERCURY 0.57 E
ZINC 591 E
NTC17BBSD53 (3 - 6)
CADMIUM 4 E
CHROMIUM 36.3 E
COPPER 401 E
LEAD 400 E
MERCURY 1.7 E
ZINC 1040 E
NTC17BBSD53 (6 - 10)
ARSENIC 28.7 R,E
CADMIUM 9.3 E
CHROMIUM 61.4 E
COPPER 378 E
IRON 24600 E
LEAD 369 E
MERCURY 3.2 E
ZINC 934 E
NTC17BBSD54 (0.131 - 3)
CADMIUM 0.83 E
COPPER 109 E
LEAD 104 E
MERCURY 0.38 E
ZINC 373 E
NTC17BBSD54 (3 - 6)
CADMIUM 2.8 E
COPPER 288 E
LEAD 209 E
MERCURY 1 E
ZINC 745 E
NTC17BBSD54 (6 - 10)
CADMIUM 4.2 E
CHROMIUM 32.8 E
COPPER 737 E
LEAD 334 E
MERCURY 0.75 E
ZINC 1320 E
NTC17BBSD56 (0.131 - 3)
CADMIUM 1.6 E
COPPER 156 E
LEAD 134 E
ZINC 449 E
NTC17BBSD56 (3 - 6)
CADMIUM 3.5 E
CHROMIUM 34.0 E
COPPER 267 E
LEAD 189 E
MERCURY 1.1 E
ZINC 574 E
NTC17BBSD56 (6 - 10)
CADMIUM 0.81 E
COPPER 135 E
LEAD 72.9 E
ZINC 257 E
Lake Michigan
LEGEND
Sediment Sample Location
Building/Structure
Road
Railroad
Fence
Surface Water
R: Illinois Exposure Route Specific Values For Residential Soils Ingestion
E: Ecological Sediment Screening Values
(0 - 1) Sample Depth in Feet
Note: No duplicate samples included. Only exceedances are shown. Letters following sample concentration indicate which screening levels are exceeded.
200 0 200 Feet
P:\GIS\GREATLAKES_NTC\APR\SITE17_TAGMAPS.APR
INORGANIC (PESTICIDE/PCB) SEDIMENT AT DEPTH EXCEEDANCES-BOAT BASIN 11/12/03 KMP
DRAWN BY DATE
K. PEILA 4/10/02
CHECKED BY DATE
A. SCHEETZ 4/10/02
REVISED BY DATE
J. LAMEY 11/11/03
SCALE
AS NOTED
DEPARTMENT OF THE NAVY
SOUTHERN DIV FACILITIES ENGINEERING COMD
INORGANIC SEDIMENT AT DEPTH EXCEEDANCES
SITE 17 - BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
CONTRACT NO.
3939
OWNER NO.
APPROVED BY DATE
DRAWING NO.
FIGURE 4-15
REV.
0

P:\GIS\GREATLAKES_NTC\SITE7_SITE17 SAMPLE LOCATIONS\SITE17_DATACOMPARISON_2001 4/11/02 KMP



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: K. PEILA — DATE: 4/11/02

CHECKED BY: A. SCHEETZ — DATE: 4/11/02

COST/SCHED-AREA

SCALE: AS NOTED

DATA COMPARISON
HISTORICAL vs. TtNUS
2001 INVESTIGATION
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
GREAT LAKES, ILLINOIS

CONTRACT NO. 3939

APPROVED BY — DATE

APPROVED BY — DATE

DRAWING NO. FIGURE 4-16 — REV. 0

5.0 CHEMICAL FATE AND TRANSPORT ANALYSIS

Knowledge of a contaminant's potential to migrate and persist in an environmental medium is critical when evaluating the potential for a chemical to elicit an adverse human health or ecological effect. This section contains information on various aspects of contaminant fate and transport and the chemical properties affecting contaminant migration at Site 17. Section 5.1 contains a general discussion of the various chemical and physical properties of significant contaminants detected in the media. Section 5.2 reviews the various contaminant transport pathways. Section 5.3 presents a brief discussion of contaminant persistence, and Section 5.4 presents a summary of contaminant migration.

5.1 CHEMICAL AND PHYSICAL PROPERTIES IMPACTING FATE AND TRANSPORT

Table 5-1 presents the physical and chemical properties of the organic compounds detected at Site 17. Environmental fate and transport characteristics of inorganics detected at Site 17 are provided in Table 5-2. These properties can be used to determine the environmental mobility and fate of site contaminants. The properties of interest include the following:

- Specific gravity
- Vapor pressure
- Water solubility
- Octanol/water partition coefficient
- Organic carbon partition coefficient
- Henry's Law constant
- Bioconcentration factor
- Mobility Index

Empirically determined literature values of the water solubility, octanol/water partition coefficient, organic carbon partition coefficient, vapor pressure, Henry's Law constant, bioconcentration factor, and specific gravity are presented, when available. Calculated values that were obtained using approximation methods, are presented when literature values are not available. A discussion of the environmental significance of each of these parameters follows.

5.1.1 Specific Gravity

Specific gravity is the ratio of the weight of a given volume of pure chemical at a specified temperature to the weight of the same volume of water at a given temperature. A chemical's specific gravity determines whether it will float or sink if it is present in water as a pure chemical or at very high concentrations. Chemicals with a specific gravity greater than 1 tend to sink, whereas chemicals with a specific gravity less than 1 tend to float.

Some of the VOCs (ketones and some monocyclic aromatics [toluene]) have a specific gravity less than 1. Other VOCs (halogenated aliphatics), PAHs, PCBs, phthalate esters, and pesticides have a specific gravity greater than 1.

5.1.2 Vapor Pressure

Vapor pressure provides an indication of the rate that a chemical volatilizes from both soil and water. It is of primary importance at environmental interfaces such as surface soil/air and surface water/air. Volatilization is not as important when evaluating contaminated groundwater and subsurface soils that are not exposed to the atmosphere. Vapor pressures for VOCs and nitrogen-containing compounds are generally many times higher than vapor pressures for PAHs, pesticides, and PCBs. Chemicals with higher vapor pressures are expected to enter the atmosphere much more readily than chemicals with lower vapor pressures. Volatilization is a significant loss process for VOCs in surface water or surface soil. Volatilization is not significant for inorganics. Surface sediments at Site 17 do not contain high concentrations of VOCs. Therefore, volatilization from surface sediment may not be an important loss mechanism at Site 17.

5.1.3 Water Solubility

The rate a chemical is leached from a waste deposit by infiltrating precipitation is proportional to its water solubility. More soluble chemicals are more readily leached than less soluble chemicals. VOC compounds are usually several orders of magnitude more water soluble than PAHs, pesticides, and PCBs.

The solubility of inorganics is strongly influenced by their valence state(s) and forms (hydroxides, oxides, carbonates, etc.). The solubility is also dependent on pH, Eh (oxidation-reduction potential), temperature, and other ionic species in solution (the Debye-Huckel theory). The solubility products reported in the literature vary with the type of complex formed, but generally it can be noted that, for example, cadmium and copper complexes are more soluble than lead and nickel complexes.

5.1.4 Octanol/Water Partition Coefficient

The octanol/water partition coefficient (K_{ow}) is a measure of the equilibrium partitioning of chemicals between octanol and water. A linear relationship between the K_{ow} and the uptake of chemicals by fatty tissues of animal and human receptors (the bioconcentration factor) has been established (Lyman et al., 1990). The K_{ow} is also used to estimate bioconcentration factors in aquatic organisms. It is useful in characterizing the sorption of compounds by organic soils where experimental values are not available. Pesticides and PCBs are several orders of magnitude more likely to partition to fatty tissues than the more soluble VOCs.

5.1.5 Organic Carbon Partition Coefficient

The organic carbon partition coefficient (K_{oc}) indicates the tendency of a chemical to adhere to soil particles containing organic carbon. Chemicals with high K_{oc}s generally have low water solubilities and vice versa. This parameter may be used to infer the relative rates at which the more mobile chemicals (ketones, monocyclic aromatics, and halogenated aliphatics) are transported in the groundwater. Chemicals such as most pesticides, PAHs, and PCBs are relatively immobile in the soil and are preferentially bound to the soil. These compounds are not subject to groundwater transport to the extent that compounds with higher water solubilities are. However, these immobile chemicals are easily transported by erosional processes when they are present in surface soils.

5.1.6 Henry's Law Constant

Both the vapor pressure and the water solubility help determine volatilization rates from surface water bodies and groundwater. The ratio of these two parameters (the Henry's Law constant) is used to calculate the equilibrium chemical concentrations in the vapor (air) phase versus the liquid (water) phase for the dilute solutions commonly encountered in environmental settings. In general, chemicals having a Henry's Law constant of less than 1×10^{-5} atm-m^3/mole, such as pesticides and PCBs, should volatilize very little and be present only in minute amounts in the atmosphere or soil gas. For chemicals with a Henry's Law constant greater than 5×10^{-3} atm-m^3/mole, such as many of the VOCs (halogenated aliphatics), volatilization and diffusion in soil gas could be significant.

5.1.7 Bioconcentration Factor

The bioconcentration factor (BCF) represents the ratio of aquatic-animal-tissue concentration to water concentration. The ratio is both contaminant- and species-specific. When site-specific values are not measured, literature values are used or the BCF is derived from the octanol/water coefficient. Many of the pesticides, PCBs, and PAHs will bioconcentrate at levels 3 to 5 orders of magnitude greater than those concentrations found in the water, whereas VOCs and nitrogen-containing compounds are not as readily bioconcentrated.

5.1.8 Distribution Coefficient

The distribution coefficient (K_d) is a measure of the equilibrium distribution of a chemical or ion in soil/water systems. The distribution of organic chemicals is a function of both the K_{oc} and the amount of organic carbon in the soil. For ions (e.g., metals), K_d is the ratio of the concentration adsorbed on soil surfaces to the concentration in water. Distribution coefficients for metals vary over several orders of magnitude because the K_d is dependent on the size and charge of the ion and the soil properties governing exchange sites on soil surfaces. Coulomb's Law predicts that the ion with the smallest hydrated radius and the largest charge will be preferentially accumulated over ions with larger radii and smaller charges.

5.1.9 Mobility Index

The Mobility Index (MI) is a quantitative assessment of mobility that uses water solubility (S), vapor pressure (VP), and the K_{oc} (Laskowski, 1983). It is defined as

$$MI = \log ((S*VP)/K_{oc})$$

A scale to evaluate MI as presented by Ford and Gurba (1994) is

Relative MI	Mobility Description
> 5	extremely mobile
0 to 5	very mobile
-5 to 0	slightly mobile
-10 to –5	immobile
< -10	very immobile

Of the chemicals detected at Site 17, chlorinated solvents and ketones generally have MIs greater than 5 and are considered extremely mobile. The MIs of monocyclic aromatics, such as toluene and phenol, range from 0 to 5 and these chemicals are classified as very mobile. Lighter molecular weight PAHs, such as naphthalene, have MIs ranging form –5 to 0 and are considered slightly mobile and the heavier molecular weight PAHs (e.g., benzo(a)pyrene) are classified as very immobile, with MIs less than –10. The MIs of phthalate esters detected at Site 17 range from –2.93 (di-n-butylphthalate) to –7.5 (bis(2-ethylhexyl)phthalate) and are, therefore, classified as slightly mobile to immobile. The MIs of pesticides detected at Site 17 range from –0.637 (delta-BHC) to –15.8 (DDT) with most of the pesticides having MIs less than –10. Therefore, pesticides are generally considered to be very immobile in soil. The MIs of PCBs are less than –10 and these chemicals are classified as very immobile. The MIs for chemicals detected at Site 17 are presented in Table 5-1.

5.2 CONTAMINANT TRANSPORT PATHWAYS

This section presents a brief overview of contaminant fate and transport issues at Site 17. Based on the evaluation of existing conditions at Site 17, the following potential contaminant transport pathways have been identified.

- Leaching of sediment contaminants to surface water
- Migration of contaminants in surface water
- Volatilization from sediment
- Erosion and runoff of contaminated particles with sediment and deposition in surface water bodies.

5.2.1 Leaching of Sediment Contaminants to Surface Water

Contaminants that adhere to sediment particles or have accumulated in sediment pore spaces can leach and migrate to the surface water. The rate and extent of this migration are influenced by the physical and chemical properties of the soil and of the contaminant.

The surface water and sediment data discussed in Section 4.0, Nature and Extent of Contamination, at Site 17 appear to indicate that the sediment contaminants are not leaching to the surface water bodies within Site 17.

5.2.2 Migration of Contaminants in Surface Water

Contaminants in surface water can migrate as dissolved constituents in the direction of surface water flow. Three general processes govern the migration of dissolved contaminants caused by the flow of water: movement caused by the flow of surface water, movement caused by the irregular mixing of water, and chemical mechanisms occurring during the movement of surface water. In addition, sediment particles can disassociate from the sediment into surface water and migrate by one of the aforementioned methods.

5.2.3 Volatilization from Sediment

VOCs were detected in surface sediment, sediment at depth, and surface water at Site 17. Since VOCs are typically very mobile, they may volatilize into ambient air. VOC vapors in sediment at depth may migrate through the overlying soil layers and into ambient air. Studies have shown that vapors can move either horizontally or vertically in the subsurface. Upon entering ambient air vapors are not expected to persist for long periods of time; half-lives in the atmosphere are typically measured in hours or a few days. Vapors may also be released directly to ambient air from sediment during excavation activities.

The concentrations of VOCs (methylene chloride) detected in the surface sediment samples were low enough that volatilization from the sediment to ambient air is not expected to be a major transport pathway at Site 17.

5.2.4 Erosion and Runoff of Contaminated Sediment Particles and Subsequent Deposition in Surface Water Bodies

Chemicals adhering to particulate matter in sediment may migrate by erosional processes, such as rainwater runoff, to drainage ditches or streams. This is a potentially important migration mechanism for environmentally immobile chemicals (i.e., PAHs, PCBs, pesticides, and metals) that tend to bind to sediment. The contaminated sediment particles may be moved by runoff or the intermittent flow in drainage ditches and be deposited in nearby streams. Sediment data from samples collected from water bodies in Site 17 indicate that erosional processes may have contributed to the presence of PAHs, PCBs, pesticides, and metals at this site.

5.3 CHEMICAL PERSISTENCE

The persistence of various classes of chemicals is discussed in this section. Several transformation mechanisms affect chemical persistence, such as hydrolysis, biodegradation, photolysis, and oxidation/reduction reactions. The following general classes of compounds are discussed:

- Ketones (e.g., 2-butanone and acetone)
- Monocyclic aromatics (e.g., phenol and toluene)
- Halogenated aliphatics (chloroform, tetrachloroethene and degradation products)
- PAHs (e.g., naphthalene, benzo(a)pyrene, pyrene)
- Phthalate esters (bis(2-ethylhexyl)phthalate)
- Pesticides (e.g., dieldrin, DDT and metabolites, chlordanes)
- PCBs (e.g., Aroclor-1254 and Aroclor-1260)
- Metals

5.3.1 Ketones

Ketones are highly volatile and soluble, and these two characteristics dominate the fate of these compounds in the environment. Hydrolysis is generally not a significant fate process for this class of chemicals, nor is bioconcentration significant, based on the low K_{ow}s (Howard, 1990).

Acetone is completely miscible in water and is unlikely to adsorb to soil or sediments or bioaccumulate. It has a high vapor pressure and, once released to the air, photolysis and reaction with hydroxyl radicals result in an average half-life of 22 days (Howard, 1990).

2-Butanone (methyl ethyl ketone) may be removed from soil by direct photolysis, volatilization, or aerobic biodegradation. It is also susceptible to leaching and may be found in groundwater. If released to surface water, it is subject to direct photolysis and has an estimated atmospheric half-life of about 14 days. 2-Butanone does not significantly bioconcentrate or adsorb to soil and is expected to biodegrade under aerobic and anaerobic conditions (TOXNET, October 2001).

5.3.2 Monocyclic Aromatics

Monocyclic aromatic compounds such as phenol are not considered to be persistent in the environment, particularly in comparison to chemicals such as PCBs and pesticides. Monocyclic aromatics are subject to degradation via the actions of both soil and aquatic microorganisms. The biodegradation of these compounds in the soil matrix is dependent on the abundance of microflora, macronutrient availability, soil reaction (pH), temperature, etc.

Although these compounds are amenable to microbial degradation, it is not anticipated that degradation will occur at an appreciable rate, although macronutrient availability is not known. In the event that these compounds discharge to surface water bodies, volatilization and biodegradation may occur relatively rapidly. For example, a reported first-order biodegradation rate constant for benzene is 0.11 day^{-1} in aquatic systems (Lyman et al., 1990). This corresponds to an aquatic half life of approximately 6 days. Other monocyclic aromatics are subject to similar degradation processes in aquatic environments (USEPA, December 1982).

Additional environmental degradation processes, such as hydrolysis and photolysis, are considered to be insignificant fate mechanisms for monocyclic aromatics in aquatic systems (USEPA, December 1982). However, some monocyclic aromatics such as toluene have been shown to undergo clay-, mineral-, and soil-catalyzed oxidation (Dragun, 1988).

5.3.3 Halogenated Aliphatics

In general, halogenated aliphatic hydrocarbons are subject to abiotic dehydrohalogenation. This process is an elimination reaction that results in the formation of an ethene from a saturated halogenated compound. Research indicates that microbial degradation of highly chlorinated ethanes is a relatively slow process. Hydrolysis, photolysis, and oxidation are generally not considered to be significant fate processes for the chlorinated ethanes.

Under certain conditions, volatilization is a significant fate process for these compounds. Volatilization is only significant at the air-soil or air-water interface. Compounds such as chloroform and methylene chloride volatilize rapidly to the atmosphere from soil or surface water due to low adsorption properties. Adsorption should not be considered as an important fate for these types of compounds when compared to more hydrophobic compounds. BCF factors indicate that these compounds should not bioaccumulate.

Photolysis is not considered to be a relevant degradation mechanism for this class of compounds . Limited hydrolysis of saturated aliphatics (i.e., alkanes) may occur, but it does not appear to be a significant degradation mechanism for unsaturated species (i.e., alkenes) (USEPA, December 1982).

5.3.4 PAHs

PAHs have very low solubilities, vapor pressures, and Henry's Law constants and high K_{oc}s and K_{ow}s. As discussed in Section 5.1.9, the lower-molecular-weight PAHs (e.g., acenaphthene, anthracene, fluorene, phenanthrene) are more environmentally mobile than the higher-molecular-weight PAHs and are more likely to leach to groundwater. The high-molecular-weight PAHs [e.g., benzo(a)pyrene, benz(a)anthracene, chrysene, etc.] are less mobile and tend to adhere to soil particles. Therefore, PAHs in soil are much more likely to bind to soil and be transported via mass transport mechanisms than to go into solution. PAHs are subject to degradation via aerobic bacteria but may be relatively persistent in the absence of microbial population or macronutrients such as phosphorus and nitrogen.

Bioconcentration of PAHs in aquatic organisms is greater for the higher-molecular-weight compounds than the lower-molecular-weight compounds. PAHs can be bioaccumulated from water, sediments, or lower organisms in the food chain.

Landspreading applications have indicated that PAHs are highly amenable to microbial degradation in soil. The rate of degradation is influenced by temperature, pH, oxygen concentrations, initial chemical concentrations, and moisture. Photolysis, hydrolysis, and oxidation are not important fate processes for the degradation of PAHs in soil (ATSDR, April 1989).

The most important fates of PAHs in water are photooxidation, chemical oxidation, and biodegradation. PAHs do not contain functional groups that are susceptible to hydrolytic action, and hydrolysis is considered to be an insignificant degradation mechanism. The rate of photodegradation is influenced by water depth, turbidity, and temperature. Benzo(a)pyrene and chrysene are reported to be resistant to photodegradation. PAHs may also be oxidized by chlorination and ozonation and may be metabolized by microbes under oxygenated conditions (ATSDR, April 1989).

5.3.5 Phthalate Esters

Phthalate esters are considered to be relatively persistent chemicals in the environment. Although numerous studies have demonstrated that phthalate esters undergo biodegradation, it appears that this is a slow process in both soil and surface water. Certain microorganisms have been shown to excrete products that increase the solubility of phthalate esters and enhance their biodegradation (Gibbions and Alexander, 1989).

Biodegradation of bis(2-ethylhexyl) phthalate and di-n-butyl phthalate in water is an important fate mechanism. However, hydrolysis of bis(2-ethylhexyl) phthalate is very slow, with a calculated half-life of 2000 years. In soil, microorganisms appear to be capable of degrading di-n-butyl phthalate rapidly. Bioaccumulation is also a significant fate process. Photolysis and volatilization are considered to be insignificant degradation mechanisms (USEPA, December 1979; Howard, 1989).

5.3.6 Pesticides

Whether pesticides are sprayed, dusted, or applied directly to the soil, the soil is the ultimate sink for these chemicals. Surface soil runoff may carry pesticides to adjacent surface water bodies where they are likely to settle in the sediment. Bioconcentration of pesticides in the food chain is another important fate mechanism. Hydrolysis, oxidation, and photolysis are not generally important fate mechanisms for pesticides in soil or water. Hydrolysis half-lives for several pesticides are reported in periods of months to years (USEPA, December 1979). Some of the more common pesticides used in the past are discussed below.

- **4,4'-DDT and its metabolites** are considered to be persistent chemicals. They undergo extensive adsorption to soil and are not highly soluble. Biodegradation may occur under both aerobic and anaerobic conditions in the presence of certain soil microorganisms. Under aerobic conditions, 4,4'-DDT may be transformed to DDE, and under anaerobic conditions, 4,4'-DDD may result. These compounds are, however, somewhat volatile, with a reported half-life of 100 days for 4,4'-DDT. They are highly lipophilic and therefore readily bioaccumulate (ATSDR, October 1992). 4,4'-DDT is no longer produced in the United States.

- **Aldrin** is readily converted to **dieldrin.** Dieldrin is a particularly persistent pesticide but is no longer registered for general use. In soil, dieldrin will persist for long periods (more than 7 years) and may slowly evaporate. It does not readily leach to groundwater. Once in surface waters (via runoff), dieldrin adsorbs strongly to sediments and bioconcentrates and slowly photodegrades. Biodegradation and hydrolysis are not significant (Howard, 1991 and ATSDR, February 1992).

- **Endrin and its metabolites** are no longer produced or used in the United States. These compounds will remain in the soil and do not leach significantly, with half-lives of more than 14 years in sediments. One common transportation and degradation mechanism is photochemical degradation. In water, endrin would not be expected to biodegrade or hydrolyze to any significant extent and therefore will bioconcentrate in aquatic organisms (USEPA, 1985).

- **Chlordane** is extremely persistent in the environment and in some soils may persist for greater than 20 years. Volatilization is an important removal mechanism in water and soil. Leaching to the groundwater may occur at sites with high levels of organic solvents.

- **Heptachlor** was restricted to underground termite control in 1983. Heptachlor epoxide is formed by the biological transformation of heptachlor in the environment. These compounds sorb strongly to soil. Heptachlor is subject to biodegradation (forming heptachlor epoxide that is highly resistant to biodegradation) and hydrolysis. Bioconcentration of both compounds is significant, and volatilization and photolysis are very slow (Howard, 1991).

5.3.7 PCBs

PCBs are considered to be very persistent organic chemicals. Biodegradation is the only process known to transform PCBs under environmental conditions, and only the lighter compounds are measurably biodegraded (USEPA, December 1979). Although some fungi (e.g., Phanaerochaete chrysosporium) may biodegrade PCBs, such fungi may not exist in local soil. There is experimental evidence to suggest that heavier PCBs (five or more chlorines per molecule) can undergo photolytic degradation, but there are no data to suggest that this process operates under environmental conditions (USEPA, December 1979). Base-, acid-, and neutral-promoted hydrolysis are considered to be inconsequential degradation mechanisms for PCBs (USEPA, December 1982).

5.3.8 Metals

Metals are highly persistent environmental contaminants. They do not biodegrade, photolyze, hydrolyze, or otherwise breakdown. The major fate mechanisms for metals are adsorption to the soil matrix (as compared to being part of the soil structure) and bioaccumulation.

The mobility of metals is influenced primarily by their physical and chemical properties, in combination with the physical and chemical characteristics of the soil matrix. Factors that assist in predicting the mobility of inorganic species are the soil/pore water pH, soil/pore water (Eh), and cation exchange capacity. The mobility of metals generally increases with decreasing soil pH and cation exchange capacity (see Table 5-2).

5.4 CONTAMINANT FATE AND TRANSPORT

This discussion focuses on some of the major types of contaminants found at the site.

5.4.1 VOCs

VOCs are typically considered to be fairly soluble with a low capacity for retention by soil organic carbon; therefore, these are the organic compounds most frequently detected in surface water. VOCs may migrate through the soil column as infiltrating precipitation solubilizes them after they were released through a spill or subsurface waste burial. Some fraction of these chemicals is retained by the soil, but most continues migrating downward to the water table. In the water table, VOCs migrate primarily laterally, with the hydraulic gradient. Again, some portion may be retained by the saturated soil.

Compounds such as toluene have a specific gravity less than that of water. If a spill is large enough these compounds may move through the soil column as a bulk liquid until they reach the water table. Therefore, instead of going into solution, the majority of the release may remain as a discrete layer on top of the water of the water table, with some going into solution at the water/contaminant interface.

Compounds with specific gravities greater than that of water (e.g., methylene chloride) are often used in industrial applications such as degreasing. If a spill of these solvents is large enough they may also migrate as a bulk liquid but will not stop at the water table (i.e., they will mix and sink into the aquifer).

Methylene chloride was the only VOC detected in sediment samples from Pettibone Creek or the Boat Basin. In addition, acetone, 2-butanone, bromodichloromethane, chlorodibromomethane, chloroform, cis-1,2-dichloroethene, tetrachloroethene, toluene, trichloroethene and vinyl chloride were detected in the surface water samples from North Pettibone Creek. Acetone was also detected in the four other surface water samples. As expected, the data indicate that the VOCs have a low capacity for retention by soil organic carbon and VOCs are more often detected in surface water samples. These data indicate that there is no appreciable migration of VOCs from the surface to the subsurface sediments. Since there is little migration from the surface to the subsurface soils, it also stands to reason that the sediment is not the source of the VOCs in the surface water in this area. Conversely, the surface water is not the source of the VOCs in the surface sediment samples.

5.4.2 PAHs

PAHs are generally considered to be fairly immobile in the environment. They are large molecules with high organic carbon partition coefficients and low solubilities when compared to the VOCs. These compounds, generally do not migrate vertically through soil to a great extent. Instead, they are more likely to adhere to soil particles and be transported with the soil particles via surface runoff and erosional processes. Their limited presence in sediment may stem from surface erosion, and their absence in surface water is consistent with their ability to bind to soil and sediment.

PAHs were detected in the surface sediment samples and in sediment at depth samples more frequently than in water samples. The data reinforced the understanding that PAHs are fairly immobile in the environment. The presence of the PAHs in the sediment samples may be attributable to erosion of the surface soil and deposition of the material in the creek and surface water bodies or it may be attributable to increased vehicle traffic and road construction in the area of Site 17.

5.4.3 Pesticides

Like PAHs, pesticides as a class are not considered to be very mobile in the environment. These chemicals, upon application or disposal, tend to remain fixed to soil particles. Migration of pesticides occurs primarily by erosion which can account for their presence in surface water and sediment.

Like the PAHs, pesticides were detected in the surface sediment samples and in the sediment at depth samples more frequently than in surface water samples. The data reinforce the understanding that pesticides are fairly immobile in the environment. The presence of the pesticides in the sediment may be due to the erosion of the surface soil and deposition in the creek and surface water bodies.

5.4.4 PCBs

PCBs are considered to be very persistent organic chemicals. Biodegradation is the only process known to transform PCBs under environmental conditions, and only the lighter compounds are measurably biodegraded (USEPA, December 1979). Base-, acid-, and neutral-promoted hydrolysis are considered to be inconsequential degradation mechanisms for PCBs (USEPA, December 1982).

PCBs were detected in sediment samples in North Pettibone Creek and the Boat Basin of Site 17. The presence of PCBs in the sediment is most likely the result of erosion of the surface soil and deposition in the creek. PCBs were not detected in the surface water samples, indicating that PCBs are fairly immobile in the environment.

5.4.5 Inorganics

Because inorganics are frequently incorporated into the soil matrix and remain bound to particulate matter, they also migrate from the source areas via erosion.

There are some instances, however, where inorganics are found at such concentrations or in such forms (i.e., oxidation states) that they may migrate in solution. First it is possible that uncontrolled industrial activities could saturate all available exchange sites in soil in the immediate vicinity of the activity and result in an inorganic being mobilized. Seems inorganics are more mobile under acidic conditions that may be the case in environments where metal plating-type activities occurred. Finally, an inorganic solution may be used in some industrial applications. In these cases, it is possible for inorganics to migrate vertically through the soil column and reach the groundwater. Therefore, the inorganics detected in surface water samples may represent the total of dissolved inorganics (as a result of the processes just described) and inorganics adhering to suspended soil present in the water samples.

Inorganics are naturally occurring substances, therefore it is not unusual that they were detected in the media at Site 17. Because inorganics tend to adhere to particulate matter (similar to PAHs and PCBs), their release and migration patterns are similar to these chemicals. Inorganic contamination at some sites may have been the result of past smelting and refining operations north of NTC Great Lakes. The presence of beryllium, calcium, chromium, copper, lead, nickel, silver, and zinc at Site 17 may be related to these past operations.

TABLE 5-1

ENVIRONMENTAL FATE AND TRANSPORT PARAMETERS FOR ORGANIC CHEMICALS
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Chemical	Specific Gravity (@ 20/4°C)(1)	Vapor Pressure (mm Hg @ 20°C)(1)	Solubility (mg/L @ 20°C)(1)	Octanol/Water Partition Coefficient(1)	Organic Carbon Partition Coefficient(2)	Henry's Law Constant (atm-m3/mole)(1)	Bioconcentration Factor (mg/L/mg/kg)(2)	Mobility Index log((solubility*VP)/K_{oc})
KETONES								
2-Butanone	0.8054	1.0E+2 (25°C)	2.75E+05	1.82E+00	4.44E+0(3)	4.66E-5 (25°C)	9.3E-1(4)	6.79E+00
Acetone	0.7899	2.66E+2 (25°C)	Miscible	5.75E-01	7.08E+03 (5)	4.276E-5 (25°C)	3.81E-1(4)	NA
MONOCYCLIC AROMATICS								
Phenol	1.0576	3.5E-1 (25°C)	8E+4 (25°C)	2.88E+01	2.88E+01 (5)	1.3E-6 (25°C)	9.40E+00	2.99E+00
Toluene	0.8669	2.8E+1 (25°C)	5.15E+02	4.90E+02	1.82E+02 (5)	5.92E-3 (25°C)	1.48E+02	1.90E+00
HALOGENATED ALIPHATICS								
Bromodichloromethane	2.38	5.45E+00 (25°C)	2.70E+03	2.16E+00	6.31E+01	7.83E-04	9.00E+00	2.37E+00
Chloroform	1.4832	1.60E+02	9.3E+3 (25°C)	9.33E+01	3.98E+01 (5)	3.39E-3 (25°C)	2.60E+01	4.57E+00
cis-1,2-Dichloroethene	1.2837	2.02E+2 (25°C)	8.00E+02	1.58E+02	3.55E+01 (5)	4.08E-3 (24.8°C)	1.4E+1(6)	3.66E+00
Chlorodibromomethane	1.405	1.36E+03	NA	3.55E+01	1.06E+03	9.20E+02	3.50E+01	NA
Methylene chloride	1.3266	4.29E+2 (25°C)	1.67E+4 (25°C)	1.78E+01	1.17E+01 (5)	3.19E-3 (25°C)	6.00E+00	5.79E+00
Tetrachloroethene	1.6227	1.9E+1 (25°C)	1.5E+2 (25°C)	3.39E+02	1.55E+02 (5)	2.685E-2 (25°C)	2.52E+02	1.26E+00
Trichloroethene	1.4624	7.10E+01	1.10E+03	5.13E+02	1.66E+02	1.03E-02	9.70E+01	2.67E+00
Vinyl chloride	0.9106	2.58E+03	1.1E+3 (25°C)	3.98E+00	1.86E+01 (5)	2.78E-2 (25°C)	5.70E+00	5.18E+00
POLYNUCLEAR AROMATIC HYDROCARBONS (PAHs)								
2-Methylnaphthalene	1.0058	1E+1 (105°C)	2.6E+1 (25°C)	7.24E+03	7.27E+2 (3)	4.99E-4 (25°C)	5.1E+2 (4)	-4.47E-01
Acenaphthylene	1.02	2.30E-02	1.61E+01	1.17E+04	2.00E+03	1.14E-04	3.80E+02	-3.73E+00
Anthracene	1.283 (25/4°C)	1.95E-4 (25°C)	1.29E+0 (25°C)	2.82E+04	2.95E+04 (5)	8.6E-5 (25°C)	4.70E+03	-8.07E+00
Benzaldehyde	1.05	1.27E-01	2.00E+03	3.02E+01	3.4E+01-1.5E+02	4.23E-05	4.2E+00-7.8E+00	8.7E-01 - 1.7E+00
Benzo(a)anthracene	1.274	5.00E-09	1E-2 (24°C)	4.07E+05	3.98E+05 (5)	6.60E-07	5.30E+04	-1.59E+01
Benzo(a)pyrene	1.351	5.00E-09	3.8E-3 (25°C)	9.55E+05	1.02E+06 (5)	4.9E-7 (25°C)	1.40E+05	-1.67E+01
Benzo(b)fluoranthene	NA	5.00E-07	1.2E-3 (25°C)	3.72E+06	1.23E+06 (5)	1.20E-05	1.40E+05	-1.53E+01
Benzo(g,h,i)perylene	1.35	1.00E-10	2.6E-4 (25°C)	1.70E+07	1.60E+06	1.4E-7 (25°C)	3.50E+05	-1.98E+01
Benzo(k)fluoranthene	NA	9.59E-11	5.5E-4 (25°C)	6.92E+06	1.23E+06 (5)	1.04E-03	1.40E+05	-1.94E+01
Carbazole	1.1	1.37E-06	7.48E+00	3.89E+03	3.39E+03	1.53E-08	5.01E+02	-8.52E+00
Chrysene	1.274 (20°C)	6.3E-9 (25°C)	6E-3 (25°C)	4.07E+05	3.98E+05 (5)	1.05E-6 (25°C)	5.30E+04	-1.60E+01
Dibenzo(a,h)anthracene	1.282	1.00E-10	5E-4 (25°C)	9.33E+05	3.80E+06 (5)	7.3E-8 (25°C)	6.90E+05	-1.99E+01
Dibenzofuran	1.0886	4.40E-02	4.22E+00	1.32E+04	8.13E+03	NA	8.00E+02	-4.64E+00
Fluoranthene	1.252	5.0E-6 (25°C)	2.65E-1 (25°C)	2.14E+05	1.07E+05 (5)	6.5E-6 (25°C)	1.20E+04	-1.09E+01
Fluorene	1.202	1.00E+01	1.98E+00	1.62E+04	1.38E+04	6.36E-05	3.80E+03	-2.84E+00
Indeno(1,2,3-cd)pyrene	NA	1E-10 (25°C)	6.20E-02	4.57E+07	3.47E+06 (5)	6.95E-8 (25°C)	3.50E+05	-1.77E+01
Naphthalene	1.162	8.2E-2 (25°C)	3E+1 (25°C)	2.34E+03	2.00E+03 (5)	4.83E-4 (25°C)	4.20E+02	-2.91E+00
Phenanthrene	0.980 (4°C)	1E+0 (118.2°C)	8.16E-1 (21°C)	2.88E+04	1.40E+04	3.93E-5 (25°C)	4.70E+03	-4.23E+00
Pyrene	1.271 (23/4°C)	2.5E+0 (200°C)	1.6E-1 (26°C)	1.51E+05	1.05E+05 (5)	5.1E-6 (25°C)	1.20E+04	-5.42E+00
PHTHALATE ESTERS								
Bis(2-ethylhexyl)phthalate	0.99 (20/20°C)	1.2E+0 (200°C)	4E-1 (25°C)	2.00E+05	1.51E+07 (5)	3.00E-07	2.30E+08	-7.50E+00
Butylbenzylphthalate	1.113	8.60E-06	7.10E-01	6.92E+04	5.75E+04	1.26E-06	7.72E+02	-9.97E+00
Di-n-butylphthalate	1.047 (20/20°C)	1E-1 (115°C)	4E+2 (25°C)	1.58E+05	3.39E+04 (5)	2.8E-7 (25°C)	4.70E+04	-2.93E+00
MISCELLANEOUS SEMIVOLATILE ORGANICS								
Caprolactam	1.02 (75°C)	1.90E-03	5.25E+06	6.60E-01	6.40E+00	2.53E-08 (25°C)	3.20E+00	3.19E+00

TABLE 5-1

ENVIRONMENTAL FATE AND TRANSPORT PARAMETERS FOR ORGANIC CHEMICALS
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Chemical	Specific Gravity (@ 20/4°C)(1)	Vapor Pressure (mm Hg @ 20°C)(1)	Solubility (mg/L @ 20°C)(1)	Octanol/Water Partition Coefficient(1)	Organic Carbon Partition Coefficient(2)	Henry's Law Constant (atm-m3/mole)(1)	Bioconcentration Factor (mg/L/mg/kg)(2)	Mobility Index log((solubility*VP)/K_{oc})
PESTICIDES								
4,4'-DDD	1.476	1.0E-06 (30°C)	1.6E-1 (24°C)	9.77E+05	1.00E+06 (5)	2.16E-05	1.80E+05	-1.28E+01
4,4'-DDE	NA	6.50E-06	4.00E-02	4.90E+05	4.47E+06 (5)	2.34E-05	8.90E+05	-1.32E+01
4,4'-DDT	1.5 (15/4°C)	1.50E-07	3.1E-3 (25°C)	1.55E+06	2.63E+06 (5)	3.89E-5 (25°C)	8.00E+06	-1.58E+01
Aldrin	1.18	2.31E-05	1.80E-01	3.16E+06	2.45E+06	6.97E-03	1.10E+02	-1.18E+01
alpha-BHC	1.87	4.50E-05	2.00E+00	6.31E+03	1.23E+03	1.05E-05	2E+02 - 2E+03	-7.14E+00
alpha-Chlordane (7)	1.61 (25°C)	1E-5 (25°C)	5.60E-02	6.03E+02	1.20E+05	4.79E-05 (25°C)	4.00E+04	-1.13E+01
beta-BHC	1.89	2.80E-07	7.00E-01	6.03E+03	1.06E+03	6.90E-07	6.31E+02	-9.73E+00
delta-BHC	1.87	1.75E-05	1.7E+01 (24°C)	1.38E+04	7.1E+02 - 2.7E+03	3.84E-07	8.00E+02	- 6.37E-01 - -6.96E-01
Dieldrin	1.75	1.8E-7 (25°C)	1.86E-01	1.23E+04	2.14E+04 (5)	5.84E-5 (25°C)	7.10E+02	-1.18E+01
Endosulfan I (8)	1.745 (20/20°C)	2.40E-5 (25°C)	5.1E-01(6)	1.26E+04(6)	2.04E+03(6)	1.12E-05(6)	2.9E+02(9)	-8.22E+00
Endosulfan II	1.745 (20/20°C)	2.40E-5 (25°C)	5.1E-01(6)	1.26E+04(6)	2.04E+03(6)	1.12E-05(6)	2.9E+02(9)	-8.22E+00
Endosulfan sulfate	NA	9.00E-03	1.17E-01	3.66E+00	3.76E+00	4.70E-07	3.56E+02	-3.55E+00
Endrin	1.65 (25°C)	2.0E-7 (25°C)	2.5E-01(6)	1.15E+05(6)	1.08E+04(6)	7.52E-06(6)	1.8E+03(9)	-1.13E+01
Endrin aldehyde	1.65 (25°C)	2.0E-7 (25°C)	2.5E-01(6)	1.15E+05(6)	1.08E+04(6)	7.52E-06(6)	1.8E+03(9)	-1.13E+01
Endrin ketone	NA	NA	NA	NA	NA	NA	NA	NA
gamma-BHC (Lindane)	1.61 (25°C)	1E-5 (25°C)	6.80E+00	5.37E+03	1.07E+03	1.40E-05	4.00E+04	-1.13E+01
gamma-Chlordane (7)	1.61 (25°C)	1E-5 (25°C)	5.60E-02	6.03E+02	1.20E+05	4.79E-05 (25°C)	4.00E+04	-1.13E+01
Heptachlor epoxide	NA	3.00E-04	3.5E-1(15°C)	5.00E+00	8.32E+04	3.90E-04	7.50E+03	-8.90E+00
Methoxychlor	1.41 (25°C)	NA	4.0E-02 (24°C)	4.91E+00	1.07E+05	1.60E-05	8.10E+03	NA
PCBs								
Aroclor-1254	1.50 (25°C)(2)	7.71E-5(2)	3.1E-2(2)	1.1E+6(2)	5.30E+05	2.6E-3(2)	1.30E+05	-1.13E+01
Aroclor-1260	1.58 (25°C)(2)	4.05E-5(2)	2.7E-3(2)	1.4E+7(2)	6.70E+06	7.4E-1(2)	1.30E+06	-1.38E+01

NA - Not Available.
1 EPA, September 1992, Handbook of RCRA Groundwater Monitoring Constituents: Chemical and Physical Properties.
2 USEPA, December 1982, Aquatic Fate Process Data for Organic Priority Pollutants.
3 Lyman et al., 1990; Equation 4-5.
4 Lyman et al., 1990, Eq. 5-2.
5 EPA, July 1996, Soil Screening Guidance.
6 Lyman et al., 1990; Equation 5-3, Handbook of Chemical Property Estimation Methods.
7 Chlordane data used.
8 Endosulfan II data used.
9 ATSDR, October 1989, Toxicity Profile for Xylenes.

TABLE 5-2

RELATIVE MOBILITIES OF INORGANICS AS A FUNCTION OF ENVIRONMENTAL CONDITIONS (Eh,pH)
SITE 17
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

	Environmental Conditions			
	Oxidizing	**Acidic**	**Neutral/Alkaline**	**Reducing**
Very High			Se	
High	Se, Zn	Se, Zn, Cu, Ni, Hg,Ag		
Medium	Cu, Ni, Hg, Ag, As, Cd	As, Cd	As, Cd	
Low	Pb, Ba, Se	Pb, Ba, Be	Pb, Ba, Be	
Very Low	Fe, Cr	Cr	Cr, Zn, Cu, Ni, Hg, Ag	Cr, Se, Zn, Cu, Ni, Hg, Pb, Ba, Be, Ag

Notes:

As = Arsenic
Ag = Silver
Ba = Barium
Be = Beryllium
Cd = Cadmium
Cr = Chromium
Cu = Copper
Fe = Iron
Hg = Mercury
Ni = Nickel
Pb = Lead
Se = Selenium
Zn = Zinc

6.0 HUMAN HEALTH RISK ASSESSMENT

This section presents results of the Human Health Risk Assessment (HHRA) for Site 17 (Pettibone Creek and the Boat Basin) at NTC Great Lakes. The objective of the risk assessment is to determine whether detected concentrations of chemicals at the site pose a significant threat to potential human receptors under current and/or future land uses. The potential risks to human receptors are estimated based on the assumption that no further actions would be taken to control contaminant releases. The results of the baseline HHRA are also used to focus the evaluation of remedial action alternatives, if action is required.

USEPA [(e.g., RAGS-Part A (USEPA, December 1989) and RAGS-Part E (USEPA, September 2001)] and Illinois EPA (i.e., TACO, online March 2002) risk assessment guidance were used to evaluate potential human health risks for Site 17. The risk assessment is reported according to the guidelines of the Risk Assessment Guidance for Superfund (RAGS), Human Health Evaluation Manual, Part D: Standardized Planning, Reporting, and Review of Superfund Risk Assessments [RAGS-Part D (USEPA, January 1998)].

Three major aspects of chemical contamination and environmental fate and transport must be considered to evaluate potential risks: (1) contaminants with toxic characteristics must be found in environmental media and must be released by either natural processes or by human action, (2) potential exposure points must exist, and (3) human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If any one of the factors listed above is absent from a site, the exposure route is regarded as incomplete, and no potential risks are considered to exist for human receptors. To address these aspects of risk evaluation, a HHRA consists of five components: (1) Data Evaluation and Selection of COPCs, (2) Exposure Assessment, (3) Toxicity Assessment, (4) Risk Characterization, and (5) Uncertainty Analysis. The following sections discuss details of these components as they pertain to Pettibone Creek and the Boat Basin.

Methods for selection of COPCs evaluated quantitatively in the baseline HHRA and those chemicals identified as COPCs for Site 17 are described in Section 6.1, Data Evaluation. The data evaluation section is primarily concerned with the selection of COPCs that are representative of the types and magnitudes of potential human health effects. The COPC screening process involves the comparison of maximum site concentrations to risk-based screening levels and other health-based standards. A brief discussion of data usability is also provided.

Section 6.2, Exposure Assessment, identifies potential receptor populations and exposure pathways by which receptors may come in contact with contaminants at the site. Potential exposure routes under current and future land uses are developed from information on source areas, chemical concentrations, chemical release mechanisms, patterns of human activity, and other pertinent information. A concise conceptual site model illustrates the potential receptors and exposure pathways evaluated in the baseline risk assessment. The exposure assessment also includes the calculation of quantitative estimates of chemical intake for each identified receptor, pathway, and route of exposure under reasonable maximum exposure (RME) and central tendency exposure (CTE) scenarios. Equations and relevant exposure input parameters used in estimating chemical intakes are provided.

Section 6.3, Toxicity Assessment, presents the chemical-specific toxicity criteria for the identified COPCs that are used in the quantification of potential human health risks. These toxicity criteria, when integrated with the estimated chemical intakes developed in the exposure assessment, provide the basis for quantifying potential human health risks.

Section 6.4, Risk Characterization, presents the methods used for characterizing risks associated with noncarcinogenic and carcinogenic effects for exposure to COPCs. Calculated numerical risks for potential receptors at Site 17 are also summarized and discussed in this section.

Section 6.5, Uncertainty Analysis, presents a discussion of the uncertainties associated with the risk evaluation for Site 17. The uncertainty assessment is an important part of the risk assessment process because the quantitative risk estimates developed in the risk characterization are based on a number of assumptions (concerning exposure, land use, toxicity, etc.) that contain various degrees of uncertainty.

6.1 DATA EVALUATION

Data evaluation involves the compilation and assessment of analytical data. The main objective of the data evaluation is to develop a media-specific list of COPCs that are used to quantitatively determine potential human health risks for site media. A discussion of data quality and data usability for the Site 17 surface water and sediment samples is presented in Appendix B. This appendix summarizes and presents the results of data validation conducted for the data sets used in the risk assessment.

6.1.1 Data Usability

Analytical data for surface water and sediment are used in the HHRA for Site 17. The data were collected as part of the RI field effort performed by TtNUS in September 2001. These data are expected to adequately characterize potential risks for direct and inadvertent exposure to contaminated site media.

Quantitative analytical results from the 2001 field investigation were used in the risk evaluation. Field measurements and data regarded as unreliable (i.e., qualified as "R" during the data validation process) were not used in the quantitative risk assessment.

The qualification of data during the data validation process is not expected to compromise the results of the baseline HHRA. Analytical data qualified as estimated ("J" or "UJ") were used, even though the reported positive concentrations or sample-specific quantitation limits may be somewhat imprecise. The use of estimated data adds to the uncertainty associated with the risk assessment; however, the associated uncertainty is expected to be negligible compared with the other uncertainties inherent in the risk evaluation process (i.e., uncertainties with land uses, exposure scenarios, toxicological criteria, etc.). Analytical data qualified for blank contamination ("B") were used in the baseline risk assessment. When determining exposure point concentrations via statistical procedures, chemicals qualified "B" or nondetected were conservatively assumed to be present at concentrations equal to one-half the sample-specific quantitation limits.

The historical data was used to focus the investigation to the chemicals of concern and was used to compare the concentrations of the COPC and evaluate how the concentrations changed over time. Because of uncertainties associated with data quality, historical data collected during previous investigations were not used to quantitatively assess potential risks related to the HHRA and ERA in this RI/RA for Site 17. The quality of the historical data is not completely documented and some of the data may not have been validated. There is no evidence that there is a problem with the validity of the past data since some/most of the data was generated for Illinois EPA or EPA Region 5 and this in itself is a reason to say that the data are valid. The proposed field investigation was developed to be comprehensive. Thus, the uncertainty associated with the elimination of the historical data from the quantitative risk assessment is not expected to be significant.

The historical data were not used to determine/calculate the human health and ecological risks at the site because based on concentration trends that have occurred over time, the historical data would have skewed the risk assessment calculations/analysis to show that the risks at the site were greater (the historical data had higher concentrations of PCBs, pesticides, metals) than they actually are as of today based on the data that was collected for this RI/RA. The HHRA and ERA provides a snap shot of the risks at the site as of today based on the data that was collected for this RI/RA.

6.1.2 Selection of Chemicals of Potential Concern (COPCs)

COPCs were selected through a qualitative screening process in order to limit the number of chemicals and exposure routes quantitatively evaluated in the risk assessment to only those site-related constituents that dominate overall potential risks. Screening by use of USEPA and Illinois EPA risk-based concentrations and Illinois EPA background concentrations were used to focus the risk assessment on potential chemicals of concern (i.e., COPCs) and exposure routes.

In general, a chemical is selected as a COPC and retained for further quantitative risk evaluation if (1) the maximum detection in a sampled medium exceeds the lowest risk-based concentration and (2) the chemical is determined to be present at concentrations exceeding background. Chemicals eliminated from further evaluation at this time are assumed to present minimal risks to potential human receptors.

6.1.2.1 COPC Screening Criteria

Several screening criteria were used to identify COPCs for Site 17. Screening concentrations based on risk-based cleanup objectives (TACO) developed by Illinois EPA (Illinois EPA, online, March 2002) and risk-based concentrations developed by USEPA Region 9 [referred to as Preliminary Remediation Goals (PRGs)] (USEPA, November 2000a) were used, as well as other USEPA criteria. The risk-based screening concentrations correspond to a systemic hazard quotient (HQ) of 0.1 for noncarcinogens or an incremental lifetime cancer risk of 1×10^{-6} for carcinogens. Note that the Illinois EPA and USEPA Region 9 PRGs for noncarcinogens are based on an HQ of 1.0 while the screening concentrations are based on an HQ of 0.1. The screening concentrations are based on an HQ of 0.1 to account for the potential cumulative effects of several chemicals affecting the same target organ or producing the same adverse noncarcinogenic effect. Risk-based screening concentrations are not available for some chemicals detected at Site 17. The approach for evaluating these chemicals is discussed in Section 6.1.2.3. The screening levels used for each medium in the risk assessment are briefly discussed below.

Screening Levels for Sediment

Screening levels are currently not available for human exposure to sediment. Therefore, USEPA Region 9 risk-based concentrations for residential soil were used as the basis of the sediment screening levels. The use of residential soil screening levels for sediment COPC identification is regarded as a conservative approach because exposure to sediment is expected to be less than exposure to soil. For example, the residential soil screening levels assume that a potential receptor is exposed to chemicals in soil 350 days per year. It is unlikely that a receptor would be exposed to sediment at this frequency in the Great Lakes area because of the long cold winters. In addition, the residential screening levels for noncarcinogens are conservatively based on the exposure of young children (0 to 6 years of age) to chemicals in soil. It is highly unlikely that very young children would be able to gain access to the sediments in Pettibone Creek and the Boat Basin on the continuous basis assumed by the screening levels. Another factor increasing the conservatism in the use of Region 9 soil PRGs is the fact that they are based on combined ingestion, dermal, and inhalation exposure pathways. However, only the ingestion and dermal pathways are applicable to sediment at Site 17. Therefore, applying residential soil screening levels to sediment is extremely conservative.

COPCs were selected for sediment by comparing detected site concentrations to screening levels based on the following:

- Illinois EPA Tier 1 Soil Remediation Objectives for Residential Properties (Illinois EPA, online, March 2002) for the Soil Ingestion Exposure Route
- USEPA Region 9 PRGs for Residential Soil (USEPA, November 2000a)

If the maximum concentration of a constituent exceeds either of these criteria and the constituent is considered to be present at concentrations greater than the concentrations of inorganic chemicals in background sediment provided in Illinois EPA's Evaluation of Illinois Sieved Stream Sediment Data, 1982-1995. (Illinois EPA, August 1997), the chemical is selected as a COPC for sediment and carried through to the quantitative risk assessment. A diagram of the COPC selection process for sediment is provided in Figure A-13, Section A of the QAPP (TtNUS, July 2001).

USEPA Generic SSLs for transfers from soil to air and for migration to groundwater are not considered to be appropriate for sediment screening because of high moisture content associated with sediment matrices.

<u>Screening Concentrations for Surface Water</u>

COPCs in surface water were selected by comparing maximum concentrations with Illinois EPA and USEPA drinking water criteria and ambient water quality criteria (AWQC). The use of drinking water and AWQC screening levels for surface water is a highly conservative approach to COPC selection because surface water in Pettibone Creek and the Boat Basin is not currently used and will not be used in the future as a potable water source. In addition, potential human exposure to surface water at Site 17 is expected to be limited to incidental exposures (such as that which occurs during periodic recreational use), which is significantly less than the daily exposure assumed in the development of the tap water screening criteria. The following screening criteria were used to select COPCs for surface water in Pettibone Creek and the Boat Basin:

- Illinois EPA Tier 1 Groundwater Remediation Objectives for Class 1 Groundwater (Illinois EPA, online, March 2002)
- USEPA Region 9 PRGs for Tap Water (USEPA, November 2000a)
- USEPA MCLs (USEPA, Summer 2000)
- Federal (USEPA, April 1999) and State (Illinois EPA, August 1999) AWQC for ingestion of water and fish

If the maximum concentration of a constituent exceeds any of these criteria, the chemical is selected as a COPC and carried through to the quantitative risk assessment.

Screening Concentrations for Ingestion of Fish

COPCs in fish tissue (assumed caught in the Boat Basin) were identified by comparing estimated fish tissue concentrations with screening levels based on USEPA Region 3 RBCs (USEPA, April 2002a) for fish ingestion. The Region 3 RBCs are based on the assumption that a receptor ingests 54 grams of fish per day, 350 days per year for 30 years and that one hundred percent of the fish ingested is from the contaminated source. The use of the Region 3 screening levels is considered conservative because it is unlikely that fish caught in the Boat Basin would constitute a significant fraction of an individual's diet. Because no actual fish tissue data are available, concentrations in fish tissue were estimated by multiplying maximum detected sediment concentrations by chemical-specific biota sediment accumulation factors (BSAFs) (ORNL, August 1988). The methodology for estimating fish tissue concentrations is presented in Section 7.3.

6.1.2.2 COPC Screening of Lead

Limited criteria are available to evaluate the potential risks associated with lead. There are no risk-based concentrations for this chemical because the USEPA has not derived toxicity values for lead. However, recommended screening levels for lead in soil are used to indicate the need for response activities.

Guidance from both the Office of Prevention, Pesticides, and Toxic Substances (OPPTS) and the Office of Solid Waste and Emergency Response (OSWER) recommend 400 mg/kg as the lowest screening level for lead-contaminated soil in a residential setting, where children are frequently present (USEPA, July 1994). This value is used for COPC screening. Applying the OSWER screening level to sediments is conservative because the screening level is based on residential exposure to soil by young children (0 to 6 year of age). A more suitable screening level would be the 2,000 to 5,000 mg/kg range identified by OPPTS as an appropriate range for areas where contact with soil by children in a residential setting is less frequent.

At this time, no screening level is available for non-residential exposure to lead in surface water. Therefore, the Safe Drinking Water Act (SDWA) Action Level at the tap of 15 µg/L (USEPA, Summer 2000) was used as the screening level for lead in surface water. The use of the SDWA screening level (based on the assumption of daily residential use (ingestion of two liters of water per day) for surface water is conservative because surface water in Pettibone Creek and the Boat Basin is not currently used and will not be used in the future as a source of drinking water. In addition, potential human exposure to surface water at Site 17 is expected to be limited to incidental exposures (such as that which occurs during periodic recreational use), which is significantly less than the daily exposure assumed for the SDWA screening level.

6.1.2.3 Essential Nutrients and Chemicals without Toxicity Criteria

The essential nutrients calcium, magnesium, potassium, and sodium are not included in the COPC screening process for Site 17. These inorganic chemicals are naturally abundant in environmental matrices and are only toxic at high doses and, because of the lack of toxicity criteria, risk-based COPC screening levels are not available for these chemicals.

Risk-based screening levels are also currently not available for several constituents detected at Site 17 (e.g., acenaphthylene, benzo(g,h,i)perylene, 2-methylnaphthalene, phenanthrene, delta-BHC, endosulfans, chlordanes, and endrin ketone). Therefore, screening levels available for surrogate chemicals were used as screening levels for these constituents. The use of surrogates is recommended by USEPA Region 1 (USEPA, August 1999). In the COPC selection for Site 17, the screening level for acenaphthene is used as a surrogate for acenaphthylene, pyrene for benzo(g,h,i)perylene and phenanthrene, naphthalene for 2-methylnaphthalene, alpha-BHC for delta BHC, endrin for endrin ketone, chlordane for chlordane compounds, and endosulfan for endosulfan compounds.

6.1.2.4 Determination of Site-Related Chemicals

Chemicals found at concentrations indicative of background concentrations are not considered to be site-related contaminants and were not retained as COPCs for the quantitative risk assessment. In order to determine whether inorganic chemicals in sediment are present at concentrations greater than background, the maximum detected concentrations of inorganic chemicals were compared to background concentrations provided by Illinois EPA in the Tiered Approach for Evaluation and Remediation of Product Releases to Sediments (Illinois EPA, September 2000).

Only inorganic chemicals in sediment were screened based on background data because only background criteria for inorganics were available. Some organic compounds are often found at low concentrations in background samples and the detected concentrations usually reflect non-site-related, anthropogenic sources of contamination (e.g., automobile exhausts). However, historical information and information from this investigation were reviewed to determine whether the organic chemicals present in the site samples are attributable to site-related activities or other non-site-related anthropogenic sources. A discussion of organic and inorganic chemicals detected in Pettibone Creek and the Boat Basin that may be attributable to non-site related, anthropogenic sources is presented in Section 6.2.1.1.

Background was not used in the COPC screening of surface water because background concentrations are currently not available for surface water.

The results of the COPC selection process for Site 17 are provided in the remainder of this section.

6.1.3 <u>COPC Selection for Site 17</u>

This section presents results of the COPC selection process for sediment, surface water, and fish tissue at Site 17. The Pettibone Creek system consists of north and south branches that merge and flow east into Lake Michigan via the Boat Basin. The north and south branches are treated as two separate exposure units (EUs) for risk assessment purposes. Therefore, three EUs are evaluated in this HHRA: North Branch Pettibone Creek, South Branch Pettibone Creek, and the Boat Basin. The COPC screening process and the results of the COPC screening are presented in Tables 6-1 through 6-5.

6.1.3.1 Selection of COPCs in Sediment - North Branch of Pettibone Creek

Twenty-four sediment samples were collected in North Branch of Pettibone Creek from a depth interval of 0 to 4 centimeters. As described in the QAPP (TtNUS, July 2001), the samples were collected at intervals designed to provide adequate spatial coverage of the creek. Table 6-1 presents the results of the COPC screening for sediment in the North Branch of Pettibone Creek. The following chemicals were retained as COPCs:

- PAHs – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene
- 4,4'-DDT
- Aroclor-1254
- Inorganics – arsenic, cadmium, chromium (total), copper, mercury, thallium

These constituents were identified as COPCs in sediment because their maximum concentrations exceeded one or more of the human health risk screening levels for residential land use and Illinois EPA background concentrations described in Section 6.1.2.4. As discussed previously, the use of residential soil COPC screening levels for sediment is conservative because exposure to sediment is likely to be less than that assumed in the development of the USEPA Region 9 PRGs and Illinois EPA Remediation Objectives for soil. Two constituents (iron and manganese) were present at maximum concentrations greater than the screening concentrations but less than the Illinois EPA background levels. Therefore, these metals were not considered to be site-related contaminants, were eliminated as COPCs, and were not evaluated in the quantitative risk assessment.

6.1.3.2 Selection of COPCs in Sediment - South Branch of Pettibone Creek

Fourteen sediment samples were collected in South Branch of Pettibone Creek from a depth interval of 0 to 4 centimeters. As described in the QAPP (TtNUS, July 2001), the samples were collected at intervals designed to provide adequate spatial coverage of the Creek. Table 6-2 presents the results of the COPC screening for sediment in the South Branch of Pettibone Creek. The following chemicals were retained as COPCs:

- PAHs – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene
- Thallium

These constituents were identified as COPCs in sediment because maximum concentrations exceeded one or more of the human health risk screening levels for residential land use and Illinois EPA background concentrations described in Section 6.1.2.4. As discussed previously, the use of residential soil COPC screening levels for sediment is conservative because exposure to sediment is likely to be less than that assumed for soil. Three constituents (arsenic, iron, and manganese) were present at maximum concentrations greater than the screening concentrations but less than the Illinois EPA background levels. Therefore, these metals were not considered to be site-related contaminants, were eliminated as COPCs, and were not evaluated in the quantitative risk assessment.

6.1.3.3 Selection of COPCs in Sediment - Boat Basin

Twelve sediment samples were collected in the Boat Basin from a depth interval of 0 to 4 centimeters. As described in the QAPP (TtNUS, July 2001), the samples were collected at intervals designed to provide adequate spatial coverage of the Boat Basin area. Table 6-3 presents the results of the COPC screening for sediment in the Boat Basin. The following chemicals were retained as COPCs:

- PAHs – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene
- PCBs – Aroclor-1254, Aroclor-1260
- Inorganics – arsenic, iron

These constituents were identified as COPCs in sediment because their maximum concentrations exceeded one or more of the human health risk screening levels for residential land use and Illinois EPA background concentrations. As discussed previously, the use of residential soil COPC screening levels for sediment is conservative because exposure to sediment is likely to be less than that assumed in the development of the USEPA Region 9 PRGs and Illinois EPA Remediation Objectives for soil. One constituent (manganese) was present at a maximum concentration greater than the screening concentrations but less than the Illinois EPA background level. Therefore, manganese was not considered to be a site-related contaminant, was eliminated as a COPC, and was not evaluated in the quantitative risk assessment.

6.1.3.4 Selection of COPCs in Surface Water

Six surface water samples were collected in Site 17. Four samples were collected in Pettibone Creek (two samples in the North Branch and two samples in the South Branch) and two samples were collected in the Boat Basin. In Pettibone Creek, samples SW02 (North Branch) and SW03 (South Branch) were collected just above the point where the North and South Branches merge and samples SW01 (North Branch) and SW04 (South Branch) were collected further upstream of the confluence. In the Boat Basin, Sample SW05 was collected where the creek flows into Boat Basin and Sample SW06 was collected at the other end of the Boat Basin. Surface water is treated as one exposure unit (EU) for risk assessment purposes. Table 6-4 presents the results of the COPC screening for surface water. The following chemicals were retained as COPCs:

- VOCs – bromodichloromethane, chlorodibromomethane, chloroform, cis-1,2-dichlorethene, tetrachloroethene, trichloroethene, vinyl chloride
- Pesticides – 4,4'-DDD, 4,4'-DDE, 4,4'-DDT
- Inorganics – aluminum, arsenic, chromium (total), iron, lead, manganese, mercury

These constituents were identified as COPCs in surface water because their maximum concentrations exceeded one or more of the human health risk screening levels for tap water described in Section 6.1.2.1. As discussed previously, the use of residential drinking water screening levels for surface water is conservative because water in the creek and Boat Basin are not used as sources of domestic drinking water. No constituents were eliminated as COPCs on the basis of background because background concentrations are not available for surface water.

6.1.3.5 Selection of COPCs in Fish Tissue - Boat Basin

As discussed in Section 6.1.2.1, the fish tissue concentrations in the Boat Basin were calculated by multiplying maximum detected sediment concentrations by chemical-specific BSAFs. Table 6-5 presents the results of the COPC screening for fish. The following chemicals were retained as COPCs:

- Bis(2-Ethylhexyl) phthalate

- Pesticides – 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-BHC, alpha-chlordane, beta-BHC, delta-BHC, dieldrin, endrin ketone, gamma-BHC (Lindane), gamma-chlordane

- PCBs – Aroclor-1254, Aroclor-1260

- Inorganics – aluminum, antimony, beryllium, cadmium, chromium (total), cobalt, copper, iron, mercury, nickel, selenium, vanadium, zinc

These constituents were identified as COPCs in fish tissue because their maximum fish tissue concentrations (predicted from sediment concentrations and BSAFs) exceeded human health risk screening levels based on USEPA Region 3 RBCs for fish ingestion and background. Because the fish tissue concentrations are based on sediment concentrations, if a constituent was eliminated as a COPC in Boat Basin sediment on the basis of background, it was also eliminated as a COPC for fish tissue. One constituent (manganese) was present at a maximum concentration greater than the screening concentrations but less than the Illinois EPA background level. Therefore, manganese was not considered to be a site-related contaminant, was eliminated as a COPC, and was not evaluated in the quantitative risk assessment. As indicated in Table 6-5, beta-BHC and delta-BHC were selected as COPCs because their maximum concentrations exceeded the risk–based screening levels. These pesticides are classified as Class C carcinogens which, according to Illinois EPA, are not to be evaluated for cancer potential. Therefore, beta-BHC and delta-BHC were not evaluated in the quantitative risk assessment.

6.2 EXPOSURE ASSESSMENT

The exposure assessment defines and evaluates, quantitatively or qualitatively, the type and magnitude of human exposure to the chemicals present at or migrating from a site. The exposure assessment is designed to depict the physical setting of the site, identify potentially exposed populations and applicable exposure pathways, determine concentrations of COPCs to which receptors might be exposed, and estimate chemical intakes under the identified exposure scenarios. Actual or potential exposures at Site 17 were determined based on the most likely pathways of contaminant release and transport, as well as human activity patterns. A complete exposure pathway has three components: (1) a source of chemicals that can be released to the environment, (2) a route of contaminant transport through an environmental medium, and (3) an exposure or contact point for a human receptor.

6.2.1 Conceptual Site Model (CSM)

The development of a CSM is an essential component of the exposure assessment. The CSM integrates information regarding the physical characteristics of the site, exposed populations, sources of contamination, and contaminant mobility (fate and transport) to identify potential exposure routes and receptors to be evaluated in the risk assessment. A well-developed CSM allows for a better understanding of the risks at a site and aids risk managers in the identification of the potential need for remediation. The site-specific CSM for Site 17 is presented in this section and illustrated in Figure 6-1. The CSM, which essentially defines the nature of the environmental problem at the site, depicts the relationships among the following elements:

- Sources of contamination
- Contaminant release mechanisms
- Transport/migration pathways
- Exposure routes
- Potential receptors

The elements of the CSM, as they pertain to Site 17, are presented in the following sections.

6.2.1.1 Site Sources of Contamination

Site 17 consists of Pettibone Creek and the Boat Basin. The following sections present a brief description of these water bodies, the known sources of contamination, and the summary of the types of chemicals found in historical samples collected in the Creek and Boat Basin.

Pettibone Creek

The majority of the NTC Great Lakes activities occur on a plateau atop a steep bluff that rises 70 feet above Lake Michigan. Pettibone Creek originates in North Chicago and enters the base at the northwest corner of NTC Great Lakes, meandering through Main Side and terminating in Lake Michigan. Pettibone Creek flows through a ravine (named Pettibone Creek Ravine) that ranges from approximately 50 to 100 feet in height with 30 to 70-degree slopes and defines the boundaries between different areas of the Main Installation. The Pettibone Creek system consists of a north and south branch that merge and flow east into Lake Michigan via the Boat Basin. The north branch of Pettibone Creek begins outside of the Main Installation in an urbanized area zoned for light industry and is the discharge point for storm sewers within the City of North Chicago. The south branch originates in a residential area southwest of the Department of Veteran's Affairs Hospital, and flows to the east and then to the north through a private golf course before entering the Main Installation site. The Pettibone Creek study area ranges from the culvert at the northern end of North Branch Pettibone Creek and the golf course/NTC Great Lakes property limit of South Branch Pettibone Creek downstream to the west end of the bridge upstream of the Boat Basin.

Within NTC Great Lakes, Pettibone Creek ranges between 15 and 30 feet in width, and several inches to six feet in depth with an average flow of less than 10 cubic feet-per-second (cfs). Some low lying banks and small "flood plains" are found within the main banks of the creek. The creek sometimes floods its immediate low lying banks within the main banks. The main banks are generally steep and about 3 to 10 feet high. Flooding over top the higher banks is not known to have occurred.

Pettibone Creek is considered moderately impaired with respect to designated uses, support to aquatic life, and recreational swimming (Illinois EPA, August 1998). The causes of impairment include the presence of elevated concentrations of heavy metals and alterations in habitat. The site has received a variety of wastes from upstream industries, road runoff, storm sewers (storm sewers from a large section of the City of North Chicago and 30 NTC Great Lakes storm water sewer system outfalls are present along the creek banks), and runoff/discharges from local residential properties. Most of the contamination originated near the headwaters of the North Branch of Pettibone Creek. The upstream areas adjacent to industrial sites have been cleaned up and it is thought that additional releases to the creek should be insignificant. Nevertheless, there could be residual runoff into Pettibone Creek and the several upstream outfalls still permitted under the National Pollutant Discharge Elimination System. The stream sediments are contaminated with various compounds and elements and have been previously classified as "Special Waste". Sources of contamination include industrial point sources, urban runoff and storm water, atmospheric deposition of pollutants, and the presence of contaminated sediments. A previous investigation determined that semivolatiles (PAHs, PCBs, and pesticides) and heavy metals including copper, lead, and zinc were higher in samples collected upstream from the Main Installation, and offsite sources are likely to have contributed to contaminated sediments in Pettibone Creek and the Boat Basin (U.S. Navy, December 1993). In addition, sediment analysis from a harbor-dredging project showed moderate to high levels of PCBs, SVOCs, DDTs, arsenic, copper, lead, zinc, mercury, and ammonia nitrogen when compared to water quality standards or Lake Michigan background levels (U.S. Navy, June 1993).

Boat Basin

The original harbor and Boat Basin were constructed in 1906 with the outer breakwater structures added by 1923. Extensive erosion of Pettibone Creek is contributing to the silting-in of the Boat Basin and harbor. The most recent dredging operations of the harbor were in the early 1950s and the early 1970s. The Harbor Area is divided into three areas: the Boat Basin, the Inner Harbor, and the Outer Harbor.

The Boat Basin, which is approximately 2.6 acres, is the most protected portion of the Harbor, extending from the west end of the bridge upstream of the Boat Basin to the beginning of the inner harbor. It served as an area for boat slips when the water was deeper. In June 1990, the water depth of the Boat Basin ranged from less than one foot to five feet. Access to the boat repair building used to be through the eastern portion of the Boat Basin, but, now, most vessels cannot access the boat repair building due to accumulated sediment. The Boat Basin was last dredged in 1972 and, therefore, sediments currently present in the basin have been accumulating over the past 30 years. A large depression was dredged at the end of Pettibone Creek near the Boat Basin spillway to serve as a sediment trap. Sediment can be removed relatively easily from this trap on a periodic basis. It has been estimated that some 30,000 cubic yard of material would have to be dredged from the Boat Basin to reestablish a desired water depth of 8 feet. Evidence from aerial photographs indicates that the Boat Basin would require dredging about once every 5-7 years (U.S. Navy, May 1990).

Previous sampling and analyses have found various classes of contaminants in the sediments and surface water of Pettibone Creek and the Boat Basin. These include VOCs, PAHs, pesticides, PCBs, and metals. The concentrations of copper, cyanide, lead, nickel, and zinc in Pettibone Creek and Boat Basin sediment samples exceeded the 1977 USEPA guidelines for classifying Great Lakes harbor sediments as "nonpolluted."

6.2.1.2 Contaminant Release Mechanisms and Transport/Migration Pathways

Releases of wastes from upstream industries, storm sewers, local residences, and road runoff have impacted Pettibone Creek and, ultimately, the Boat Basin. Potential receptors may be exposed either directly to contaminants in surface water or sediment by several exposure mechanisms, such as direct contact or incidental ingestion, or indirectly by the ingestion of fish. Based on information regarding past chemical releases at the site, plausible contaminant release and migration mechanisms include the following:

- Deposition of chemicals in surface water and sediment on the banks of Pettibone Creek (e.g., via surface water runoff or storm sewers outfalls)

- Transport of chemicals in surface water and sediment in Pettibone Creek to the surface water and sediment of the Boat Basin.

- Bioaccumulation of chemicals from the surface water and sediment of Pettibone Creek and the Boat Basin into aquatic animals.

6.2.1.3 Exposure Routes

The manner in which a receptor comes into contact with contaminants is generally the result of interactions between a receptor's behavior or lifestyle and contaminated medium. Potential receptors could come into contact with potentially contaminated surface water and sediment. Brief explanations of the potential routes of exposure per media are provided in this section.

<u>Surface Water and Sediment</u>

Potential receptors may come into direct contact with surface water and sediment (0 to 4 centimeters deep) in Pettibone Creek or the Boat Basin. Individuals may be exposed primarily via dermal contact and incidental ingestion but the frequency of exposure is expected to be less than typical residential or industrial exposures. Exposure via inhalation is expected to be minimal and was not quantitatively evaluated in the risk assessment.

Fish Tissue

Potential recreational receptors may ingest fish caught in the Boat Basin, as individuals have been observed fishing in the Boat Basin. Fish ingestion was evaluated with reference to information on recreational fish ingestion presented in the USEPA's Exposure Factor Handbook (USEPA, August 1997). For example, studies in the Exposure Factors Handbook provide estimates of the amount of recreationally caught fish ingested by fisherman in the United States.

6.2.1.4 Potential Receptors

Potential receptors could be exposed to surface water or sediment at Site 17 under current and future land uses. These receptors have been identified by analyzing current land use practices, potential future land use, and the identified areas of contamination in order to focus the risk assessment on potential site-related exposures. The general receptor classes are:

- Adult and adolescent recreational users - Potential receptors under current/future land uses. These receptors were evaluated for exposure to surface water and sediment in Pettibone Creek and the Boat Basin. Exposure to surface water and sediment were evaluated for incidental ingestion and dermal exposure. Swimming is not known to occur and has not been observed in the Boat Basin. Therefore, the dermal exposure scenario assumes that receptors are exposed only while wading. Adult recreational users were also evaluated for ingestion of fish assumed caught in the Boat Basin.

6.2.2 Central Tendency Exposure (CTE) vs. Reasonable Maximum Exposure (RME)

Traditionally, exposures evaluated in the HHRA were based on the concept of a RME only, which is defined as "the maximum exposure that is reasonably expected to occur at a site" (USEPA, December 1989). However, recent risk assessment guidance (USEPA, May 1993) indicates the need to address an average case or CTE. To provide a full characterization of potential exposure, both RME and CTE were evaluated in the risk assessment for Site 17. The available guidance (USEPA, May 1993) concerning the evaluation of CTE is limited. Therefore, professional judgment is used when defining CTE conditions for a particular receptor at a site.

6.2.3 Exposure Point Concentrations (EPC)

The exposure point concentration, calculated for COPCs only, is a reasonable maximum estimate of the chemical concentration that is likely to be contacted over time by a receptor and is used to calculate estimated exposure intakes. The 95 percent upper confidence limit (UCL), which is based on the distribution of a data set, is considered to be the best estimate of the exposure concentration for data sets with 10 or more samples (USEPA, May 1992). The UCL was used as the exposure concentration to assess RME and CTE risks (USEPA, May 1993). For data sets with less than 10 samples, the UCL is considered to be a poor estimate of the mean, and the exposure concentration is defined as the maximum detected concentration. For Site 17, UCLs were selected as EPCs for most COPCs in sediment and fish tissue (except for some COPCs for which less than 10 data points were available) and maximum concentrations were selected as EPCs for surface water because only 6 surface water samples were collected.

Conventional statistical methods (e.g., the Shapiro-Wilk W-Test) were used to determine the distribution and UCL of a particular data set (Gilbert, 1987; USEPA, May 1992). Sample calculations for the statistical evaluation are presented in Appendix D.1. Analytical results reported as "non-detects" were assigned a concentration equal to one-half the sample-specific quantitation limit when calculating the UCLs.

The fish tissue concentrations used in risk assessment calculations were predicted based on measured sediment data. The 95 percent UCL or maximum concentration for sediment was multiplied by chemical-specific BSAFs to estimate chemical concentrations in fish tissue. The BSAFs and derived fish tissue concentrations are presented in Tables 6-5 and 6-6. The methodology for calculating the fish tissue concentrations is presented in the Ecological Risk Assessment (ERA), Section 7.0.

The following guidelines were used to calculate the EPCs:

- Site 17 was subdivided into the North and South Branches of Pettibone Creek, and the Boat Basin because contaminant sources, water flow and physical characteristics, and use by human receptors are different in these areas.

- If a data set contains less than 10 samples, the EPC for the RME and CTE cases was defined as the maximum detected concentration.

- If a data set contains 10 or more samples, the 95 percent UCL on the arithmetic mean, based on the distribution of the data set, is used as the EPC for the RME and CTE cases. The "best fit" distribution (normal or lognormal) is assumed if the data set distribution is undefined. The "best fit" is determined by comparing the W statistic calculated for the log-transformed data in the Shapiro-Wilk W-Test with the W statistic calculated for the untransformed data. If the W statistic for the untransformed data is greater than the W statistic for the log-transformed data, the data are assumed to be normally distributed. If not, a lognormal distribution is assumed. This approach is considered appropriate to the Site 17 data because, as shown in the RAGS Part D tables in Appendix D, the distributions of only a few COPCs were "undefined" and most of the data were found to be lognormally distributed.

The EPCs for COPCs in surface water, sediment, and fish tissue are presented in Table 6-6.

6.2.4 Chemical Intake Estimation

The methodologies and techniques used to estimate exposure via ingestion and dermal contact are presented in this section of the RI/RA. Chemical intakes for the identified potential receptor groups were calculated using USEPA risk assessment guidance (e.g., USEPA, December 1989 and September 2001) and presented in the risk assessment spreadsheets provided in Appendix D.2. Example risk calculations for each exposure route are included in Appendix D.3.

Noncarcinogenic intakes are estimated using the concept of an average annual exposure. Carcinogenic intakes are calculated as an incremental lifetime exposure that assumes a life expectancy of 70 years. Equations used to calculate estimated intakes are provided below. Values of the exposure parameters and assumptions regarding exposure for receptors and exposure pathways are presented in Tables 6-7 through 6-11.

6.2.4.1 Dermal Contact with Sediment

Direct physical contact with sediment may result in the dermal absorption of chemicals. Exposures associated with the dermal route are estimated using the following equation (USEPA, December 1989 and September 2001):

$$Intake_{si} = (C_{si})(SA)(AF)(ABS)(EF)(ED)(CF)/(BW \times AT)$$

where:

$Intake_{si}$	=	amount of chemical "i" absorbed during contact with sediment (mg/kg/day)
C_{si}	=	concentration of chemical "i" in sediment (mg/kg)
SA	=	skin surface area available for contact (cm^2/day)
AF	=	skin adherence factor (mg/cm^2)
ABS	=	absorption factor (dimensionless)
CF	=	conversion factor (1E-6 kg/mg)

EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
BW	=	body weight (kg)
AT	=	averaging time (days); for noncarcinogens, AT = ED x 365 days/yr; for carcinogens, AT = 70 yrs x 365 days/yr

Exposed surface areas of body available for dermal contact are determined for each receptor based on assumed human activities and clothing worn during exposure events. USEPA guidance (USEPA, August 1997 and September 2001) was used to develop the default assumptions concerning the amount of skin surface area available for contact for a receptor. The skin surface areas used in risk assessment calculations and the rationale for the selection of the surface areas are as follows:

- For adolescent recreational users, 25 percent of the total body surface area of an adolescent (aged 7 to 16) was assumed to be available for surface water and sediment contact. The RME value (3,820 cm^2) is derived from the 95th percentile surface area data and the CTE value (3,100 cm^2) is derived from the 50th percentile data, as provided in Table 6-6 of the Exposure Factors Handbook (USEPA, August 1997). Twenty-five percent of the total body surface area is recommended in the Exposure Factors Handbook (USEPA, August 1997) for outdoor soil contact. The assumption of 25 percent probably results in an overestimate of the exposed skin area, since the feet and lower legs are most likely to be exposed in the wading scenario assumed for Site 17.

- For adult recreational users, the feet, lower legs, hands, and arms of an adult male are assumed available for surface water and sediment contact. The RME value (9,190 cm^2) and the CTE value (7,770 cm^2) are derived from the 95^{th} and 50^{th} percentile surface areas of an adult male, respectively, as provided in Table 6-2 of the Exposure Factors Handbook (USEPA, August 1997).

Values of soil adherence factors and chemical-specific dermal absorption factors provided in RAGS-Part E (USEPA, September 2001) were used to evaluate risks from exposure to sediment for adults and adolescents. A soil adherence factor of 0.3 mg/cm^2 was used for the RME and 0.04 mg/cm^2 for the CTE. These adherence factors were derived from teens playing in moist conditions (Exhibit 3.3, USEPA, September 2001) and are considered to be representative of exposure to sediment based on the assumption that the sediment adheres to the skin and is not washed off by surface water.

The following absorption factors were used for the RME and CTE exposure scenarios (USEPA, September 2001):

- PCBs – 0.14
- PAHs – 0.13
- DDD, DDE, and DDT – 0.03
- Chlordane – 0.04
- Lindane – 0.04
- Arsenic – 0.03
- Cadmium – 0.001
- SVOCs – 0.1
- Other inorganics and VOCs – not evaluated for dermal contact with soil, as discussed in the dermal guidance (USEPA, September 2001).

Adult recreational users are assumed to be exposed to sediment 26 days/year for 7 years for the CTE and 52 days/year for 24 years for the RME. Adolescent recreational users are assumed to be exposed 26 days/year for 10 years for the CTE and 52 days/year for 10 years for the RME. These exposure frequencies assume that potential receptors enter the study areas two days per week in warm weather months for the RME and one day per week in the same period for the CTE.

6.2.4.2 Incidental Ingestion of Sediment

Incidental ingestion of sediment by potential receptors is assumed to coincide with dermal exposure. Exposures associated with incidental ingestion are estimated in the following manner (USEPA, December 1989):

$$Intake_{si} = (C_{si})(IR_s)(FI)(EF)(ED)(CF)/(BW \times AT)$$

where:

$Intake_{si}$	=	intake of contaminant "i" from sediment (mg/kg/day)
C_{si}	=	concentration of contaminant "i" in sediment (mg/kg)
IR_s	=	ingestion rate (mg/day)
FI	=	fraction ingested from contaminated source (dimensionless)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
CF	=	conversion factor (1E-6 kg/mg)

BW	=	body weight (kg)
AT	=	averaging time (days);
		for noncarcinogens, AT = ED x 365 days/yr;
		for carcinogens, AT = 70 yrs x 365 days/yr

Ingestion rates for the recreational users are set at 100 mg/day for the RME and 50 mg/day for the CTE (USEPA, May 1993). The same exposure frequencies and durations used in the estimation of dermal intakes were used to estimate exposure via incidental ingestion. A default value of 1.0 (USEPA, December 1989) was used for the fraction of sediment ingested from the contaminated source for the RME and CTE scenarios.

6.2.4.3 Dermal Contact with Surface Water

Dermal contact with surface water may occur while receptors are involved in recreational activities in Pettibone Creek or the Boat Basin. The following equation are used to assess exposures resulting from dermal contact with surface water (USEPA, September 2001):

$$DAD_{wi} = (DA_{event})(EV)(EF)(ED)(A)/(BW \times AT)$$

where:

DAD_{wi}	=	dermally absorbed dose of chemical "i" from water (mg/kg/day)
DA_{event}	=	absorbed dose per event (mg/cm^2-event)
EV	=	event frequency (events/day)
ED	=	exposure duration (yr)
EF	=	exposure frequency (days/yr)
A	=	skin surface area available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for noncarcinogens, AT = ED x 365 days/yr;
		for carcinogens, AT = 70 yrs x 365 days/yr

The absorbed dose per event (DA_{event}) is estimated using a nonsteady-state approach for organic compounds and a traditional steady-state approach for inorganics. For organics, the following equations apply:

$$\text{If } t_{event} < t^{*}, \text{ then: } DA_{event} = (2FA)(K_p)(C_{wi})(CF)\left(\frac{\sqrt{6T\ t_{event}}}{\pi}\right)$$

$$\text{If } t_{event} > t^{*}, \text{ then: } DA_{event} = (FA)(K_p)(C_{wi})(CF)\left(\frac{t_{event}}{1+B} + 2T\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right)$$

where:

t_{event}	=	duration of event (hr/event)
FA	=	fraction absorbed (dimensionless)
t^{*}	=	time it takes to reach steady-state conditions (hr)
K_p	=	permeability coefficient from water through skin (cm/hr)
C_{wi}	=	concentration of chemical "i" in water (mg/L)
T	=	lag time (hr)
π	=	constant (dimensionless; equal to 3.1416)
CF	=	conversion factor (1×10^{-3} L/cm^3)
B	=	partitioning constant derived by Bunge Model (dimensionless)

Values for the chemical-specific parameters (t^{*}, K_p, T, and B) were obtained from the current dermal guidance (USEPA, September 2001). The exposure times for the recreational users are assumed to be two hours per day for the RME and one hour per day for the CTE, based on professional judgement. The recreational users are assumed to be exposed two days per week in warm weather months for the RME (52 days/year) and one day a week in warm weather months for the CTE (26 days/year), based on professional judgement.

The following steady-state equation was used to estimate DA_{event} for inorganics:

$$DA_{event} = (K_p)(C_{wi})(t_{event})$$

The recommended default value of 1×10^{-3} is used for the dermal permeability of inorganic constituents, unless a chemical-specific value is provided in the USEPA guidance. For most metals, dermal absorption is not a significant pathway because penetration through the skin is minimal.

6.2.4.4 Ingestion Surface Water

Direct contact with surface water while wading or exploring could result in the inadvertent ingestion of small amounts of water. Intakes associated with ingestion of surface water were evaluated using the following equation (USEPA, December 1989):

$$Intake_{wi} = (C_{wi})(CR)(ET)(EF)(ED)/(BW \times AT)$$

where:

$Intake_{wi}$	=	intake of chemical "i" from water (mg/kg/day)
C_{wi}	=	concentration of chemical "i" in water (mg/L)
CR	=	contact rate for surface water (L/hr)
ET	=	exposure time for surface water (hr/day)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
BW	=	body weight (kg)
AT	=	averaging time (days); for noncarcinogens, AT = ED x 365 days/yr; for carcinogens, AT = 70 yrs x 365 days/yr

The same exposure times, frequencies, and durations used to assess dermal exposure to water were used to estimate intakes for ingestion of water. A contact rate of 0.05 L/hour is used for the adult and adolescent recreational users (USEPA, December 1989).

6.2.4.5 Fish Ingestion

The fish consumption exposure pathway is evaluated for adult recreational users. Since exposure for adolescent and adult recreational users is expected to be similar, exposure for the adolescent recreational users is not addressed quantitatively. Intakes for the fish ingestion exposure route are estimated using the following equation (USEPA, December 1989):

$$Intake = \frac{(Csed \times BSAF \times IR \times FI \times EF \times ED)}{(BW \times AT)}$$

where:

Intake	=	ingestion intake (mg/kg-day)
C_{sed}	=	chemical concentration in sediment (mg/kg)

BSAF	=	chemical-specific biota sediment accumulation factor (unitless)
IR	=	ingestion rate (kg/meal)
FI	=	fraction ingested from contaminated source (unitless)
EF	=	exposure frequency (meals/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days) for noncarcinogens, AT = ED x 365 days/yr; for carcinogens, AT = 70 yrs x 365 days/yr

The ingestion rates of contaminants in fish are assumed to be 0.02 kg/meal for the RME (Illinois Fish Contaminant Program, Illinois EPA, April 2002) and 0.008 kg/meal for the CTE (USEPA, August 1997). The fraction ingested from the contaminated source (FI) was assumed to be 0.1 (10%), as no specific information on the dietary habits of local residents is available. This assumes that 10 percent of the fish caught and ingested by the recreational fisherman comes from the study area.

6.3 TOXICITY ASSESSMENT

The objective of the toxicity assessment is to identify the potential health hazards and adverse effects in exposed populations. Quantitative estimates of the relationship between the magnitude and type of exposures and the severity or probability of human health effects are defined for the identified COPCs. Quantitative toxicity values determined during this component of the risk assessment are integrated with outputs of the exposure assessment to characterize the potential for the occurrence of adverse health effects for each receptor group.

The toxicity value used to evaluate noncarcinogenic health effects is the Reference Dose (RfD). Carcinogenic effects are quantified using the Cancer Slope Factor (CSF).

6.3.1 Toxicity Criteria

Oral and inhalation reference doses (RfDs) and cancer slope factors (CSFs) used in the site-specific risk assessment for Site 17 were obtained from the following primary literature sources:

- Integrated Risk Information System (IRIS) (USEPA, online, April 2002b)
- Annual Health Effects Assessment Summary Tables (HEAST) (USEPA, July 1997)
- National Center for Environmental Assessment (NCEA) Superfund Health Risk Technical Support Center

Although RfDs and CSFs can be found in several toxicological sources, USEPA's IRIS online database is the preferred source of toxicity values. This database is continuously updated and values presented have been verified by USEPA RfD and Carcinogenic Risk Assessment Verification Endeavor (CRAVE) work groups. The USEPA Region 9 PRG tables and Region 3 Risk-Based Concentration (RBC) tables are also used as a source of toxicity criteria. The RfDs and CSFs used to estimate risks for Site 17 are provided in Tables 6-12 and 6-13, respectively.

6.3.2 Toxicity Criteria for Dermal Exposure

RfDs and CSFs found in literature are typically expressed as administered doses; therefore, these values are considered to be inappropriate for estimating the risks associated with the dermal route of exposure. Oral dose-response parameters based on administered doses must be adjusted to absorbed doses before the comparison to estimated dermal exposure intakes is made. The adjustment is performed using chemical-specific absorption efficiencies published in available guidance (USEPA, September 2001) and the following equations:

$$RfD_{dermal} = (RfD_{oral})(ABS_{GI})$$

$$CSF_{dermal} = (CSF_{oral}) / (ABS_{GI})$$

where:

ABS_{GI} = absorption efficiency in the gastrointestinal tract

Absorption efficiencies used in the risk assessment reflect the USEPA's current dermal assessment guidance (USEPA, September 2001).

6.3.3 Toxicity Criteria for Carcinogenic Effects of Polynuclear Aromatic Hydrocarbons (PAHs)

Limited toxicity values are available to evaluate the carcinogenic effects from exposure to PAHs. The most extensively studied PAH is benzo(a)pyrene, classified by the USEPA as a probable human carcinogen. Although CSFs are available for benzo(a)pyrene, insufficient data are available to calculate CSFs for other carcinogenic PAHs. Toxic effects for other carcinogenic PAHs are evaluated by using the concept of toxic equivalents (TEFs), as presented in USEPA guidance (USEPA, July 1993). Carcinogenic PAHs are structurally and toxicologically similar. Because of these similarities with regard to human toxicity, the concentrations of the carcinogenic PAHs can be defined in terms of benzo(a)pyrene using TEFs which range from 0.1 to 0.001. The equivalent oral and inhalation CSFs for the other carcinogenic PAHs can be derived by multiplying the CSF of benzo(a)pyrene by the appropriate TEF.

6.3.4 Toxicity Criteria for Chromium

Toxicity criteria are available for two different forms of chromium, the trivalent state and the hexavalent state, of which the latter is considered to be more toxic. Chromium was evaluated assuming that 100 percent of the reported total chromium is hexavalent. When chromium, assumed to be all hexavalent, is estimated to be a significant contributor to risk, further evaluation regarding the presence and valence state of chromium may be necessary. The uncertainty associated with the assumption that all chromium is present as hexavalent chromium and the implications for the Site 17 HHRA are discussed the Uncertainty Analysis (Section 6.5).

6.3.5 Toxicity Profiles

Toxicological profiles for each COPC are presented in Appendix D.4. These brief profiles present a summary of the currently available literature on the carcinogenic and noncarcinogenic health effects associated with human exposure to the COPCs.

6.4 RISK CHARACTERIZATION

Potential risks (noncarcinogenic and carcinogenic) for human receptors resulting from the exposures outlined in the exposure assessment are quantitatively determined during the risk characterization component of the HHRA. A summary and discussion of the quantitative risk estimates are provided in Section 6.4.3. The numeric estimates of risk are presented in the risk assessment spreadsheets provided in Appendix D.2.

6.4.1 Quantitative Analysis

Quantitative estimates of risk were calculated according to risk assessment methods outlined in USEPA guidance (USEPA, December 1989). Lifetime cancer risks are expressed in the form of dimensionless probabilities, referred to as incremental lifetime cancer risks (ILCRs), based on CSFs. Noncarcinogenic risk estimates are presented in the form of HQs that are determined through a comparison of intakes with published RfDs.

ILCR estimates are generated for each COPC using estimated exposure intakes and published CSFs, as follows:

ILCR = Estimated Exposure Intake x CSF

An ILCR of 1×10^{-6} indicates that the exposed receptor has a one-in-one-million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million persons.

As mentioned previously, noncarcinogenic risks are assessed using the concept of HQs and Hazard Indices (HIs). The HQ for a COPC is the ratio of the estimated intake to the RfD, as follows:

HQ = (Estimated Exposure Intake) /(RfD)

An HI is generated by summing the individual HQs for the COPCs. The HI is not a mathematical prediction of the severity of toxic effects and therefore is not a true "risk"; it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects.

6.4.2 Comparison of Quantitative Risk Estimates to Benchmarks

Quantitative risk estimates are compared to typical benchmarks to interpret the quantitative risks and to aid risk managers in determining the need for remediation at a site. Calculated ILCRs are interpreted using the USEPA's "risk management range" (1×10^{-4} to 1×10^{-6}), while HIs are evaluated using a target value of 1.0.

The USEPA has defined the range of 1×10^{-4} to 1×10^{-6} as the ILCR "target range" for most hazardous waste facilities addressed under CERCLA and the Resource Conservation and Recovery Act (RCRA). Individual or cumulative ILCRs greater than 1×10^{-4} are typically considered to be not acceptable, while

ILCRs less than $1x10^{-6}$ are generally regarded as acceptable. Risk management decisions are necessary when the ILCR is within the $1x10^{-4}$ to $1x10^{-6}$ cancer risk range. Risks greater than $1x10^{-6}$ are discussed in Section 6.4.3.

An HI exceeding unity (1.0) indicates that there may be potential noncarcinogenic health risks associated with exposure. If an HI exceeds unity, a segregation of target organ effects associated with exposure to COPCs is performed. Only those chemicals that affect the same target organ(s) or exhibit similar critical effect(s) are regarded as truly additive. Consequently, it may be possible for a total cumulative HI to exceed 1.0, but have no anticipated adverse health effects if the COPCs do not affect the same target organ or exhibit the same critical effect.

6.4.3 Quantitative Risk Analysis

This section presents a summary of the HHRA for Site 17. Uncertainties associated with the risk estimates are discussed in Section 6.5. The methodology used to calculate the risks presented in this section is provided in Section 6.2. Quantitative risk estimates for potential human receptors were developed for those chemicals identified as COPCs. Potential noncarcinogenic and carcinogenic risks for adult and adolescent recreational users are summarized in Tables 6-14 and 6-15 for the RME and CTE scenarios, respectively. These tables include calculated risks for the 3 EUs evaluated in the HHRA. The RAGS-Part D Table 9s in Appendix D.2 provide chemical-specific risks and total HIs for affected target organs for each COPC in each exposure medium. Risks for each receptor are summed across the applicable exposure routes. A discussion of the estimated noncarcinogenic and carcinogenic risks is provided in the remainder of this section.

6.4.3.1 Risk Summary for Sediment - North Branch of Pettibone Creek

This section presents potential risks calculated for exposure to surface sediment in the North Branch of Pettibone Creek under the RME scenario.

Noncarcinogenic Risks – RME

As shown in Table 6-14, cumulative HIs for the adult (HI = 0.027) and adolescent (HI = 0.03) recreational users under the RME scenarios are less than unity (1.0), indicating that adverse noncarcinogenic effects are not anticipated for these receptors under the defined exposure conditions.

Carcinogenic Risks - RME

Cumulative ILCRs (Table 6-14) for the adult and adolescent recreational users (6.9×10^{-6} and 2.6×10^{-6}, respectively) are within the USEPA's risk management range, 1×10^{-6} to 1×10^{-4}.

As shown in the RAGS-Part D tables in Appendix D.2, the ILCRs greater than 1×10^{-6} are mainly the result of exposure to PAHs by ingestion and dermal contact with sediment. The ILCR for arsenic (adult ILCR = 1.2×10^{-6}) slightly exceeded 1×10^{-6}. Regarding arsenic, the maximum concentration (10.2 mg/kg) slightly exceeded the Illinois EPA sediment background concentration (8.0 mg/kg); arsenic concentrations in 21 of the 24 samples collected were less than the background level for sediment. In addition, the maximum concentration was less than Illinois EPA background soil concentrations within and outside of metropolitan areas in Illinois (Illinois EPA, online, March 2002). Therefore, it is likely that the concentrations of arsenic detected in Pettibone Creek are naturally occurring in the region.

6.4.3.2 Risk Summary for Sediment - South Branch of Pettibone Creek

This section presents potential risks calculated for exposure to surface sediment in the South Branch of Pettibone Creek under the RME scenario.

Noncarcinogenic Risks – RME

As shown in Table 6-14, cumulative HIs for the adult (HI = 0.0027) and adolescent (Hi = 0.0044) recreational users under the RME scenarios are less than unity (1.0), indicating that adverse noncarcinogenic effects are not anticipated for these receptors under the defined exposure conditions.

Carcinogenic Risks -RME

The cumulative ILCR (Table 6-14) for the adolescent recreational user (5.4×10^{-7}) is less than 1.0×10^{-6} and the ILCR for the adult (1.6×10^{-6}) slightly exceeds 1×10^{-6}.

As shown in the RAGS-Part D tables in Appendix D.2, the ILCRs greater than 1×10^{-6} are the result of exposure to PAHs by ingestion and dermal contact with sediment. However, as discussed above, it is likely that the presence of the PAHs in the sediments of Pettibone Creek are related to storm water discharges from storm water sewer systems and road runoff.

6.4.3.3 Risk Summary for Sediment - Boat Basin

This section presents potential risks calculated for exposure to surface sediment in the Boat Basin under the RME scenario.

Noncarcinogenic Risks – RME

As shown in Table 6-14, cumulative HIs for the adult (HI = 0.031) and adolescent (HI = 0.032) recreational users under the RME scenarios are less than unity (1.0), indicating that adverse noncarcinogenic effects are not anticipated for these receptors under the defined exposure conditions.

Carcinogenic Risks - RME

Cumulative ILCRs (Table 6-14) for the adult and adolescent recreational users (8.1×10^{-6} and 3.0×10^{-6}, respectively) are within the USEPA's risk management range, 1×10^{-6} to 1×10^{-4}.

As shown in the RAGS-Part D tables in Appendix D.2, the ILCRs greater than 1×10^{-6} are mainly the result of exposure to PAHs by ingestion and dermal contact with sediment. Arsenic (adult ILCR = 1.2×10^{-6}) slightly exceeded 1×10^{-6}. The concentrations of arsenic (maximum concentration = 9.9 mg/kg) are likely to be naturally occurring in the region.

6.4.3.4 Risk Summary for Surface Water

This section presents potential risks calculated for exposure to surface water within Site 17 under the RME scenario. As stated previously, six surface water samples were collected at various locations in Pettibone Creek and the Boat Basin. These surface water bodies were treated as one exposure unit for risk assessment purposes.

Noncarcinogenic Risks – RME

As shown in Table 6-14, cumulative HIs for the adult (HI = 0.036) and adolescent (HI = 0.035) recreational users under the RME scenarios are less than unity (1.0), indicating that adverse noncarcinogenic effects are not anticipated for these receptors under the defined exposure conditions.

Carcinogenic Risks - RME

The cumulative ILCRs (Table 6-14) for the adolescent recreational user (4.8×10^{-7}) and the adult recreational user (9.7×10^{-7}) are less than the lower limit of the USEPA's risk management range, 1×10^{-6}.

6.4.3.5 Risk Summary for Fish Ingestion - Boat Basin

This section presents potential risks calculated for ingestion of fish assumed to be caught in the Boat Basin under the RME scenario. The risks presented in this section reflect only fish caught in the Boat Basin and consumed by the recreational fisherman and do not account for ingestion of fish caught in other areas of Lake Michigan or by commercial fisherman.

Noncarcinogenic Risks – RME

As shown in Table 6-14, the cumulative HI for ingestion of fish under the RME scenario (6.6) is greater than unity (1.0), indicating that adverse noncarcinogenic health effects are possible under the defined exposure conditions. Most of the noncarcinogenic risk (approximately 83 percent) is due to exposure to Aroclor-1254 in fish tissue. As indicated previously, the HIs for fish ingestion were based on fish tissue concentrations that were estimated from sediment concentrations.

Carcinogenic Risks - RME

The cumulative ILCR (Table 6-14) for ingestion of fish assumed caught in the Boat Basin is 1.8×10^{-4} which exceeds the upper limit of the USEPA risk management range, 1×10^{-4}. As indicated in the RAGS-Part D tables in Appendix D.2, PCBs account for 66 percent of the total cancer risk, and pesticides account for the remainder of the risk.

The risks calculated for the ingestion of recreationally caught fish are subject to the following sources of uncertainty:

- The fish tissue concentrations were estimated from sediment concentrations and sediment bioaccumulation factors. Therefore, the calculated risks are based on concentrations estimated by a model and not on actual measured tissue concentrations.

- The fish tissue concentrations were calculated on the assumption that fish are continually exposed to contaminants in the surface sediment in the Boat Basin. This assumption would apply only to bottom feeding fish that spend most of their time in the study area. This assumption would not apply to game fish, such as trout, that are not bottom feeders and whose range would not be confined to the Boat Basin. Therefore, the risks based on the calculated concentrations are likely to be overestimated.

- The risks calculated for fish ingestion assume that 10 percent of the fish consumed by the recreational fisherman were caught in the Boat Basin (FI = 0.1). Although fishing has been observed in the Boat Basin, fishing does not appear to occur on a frequent basis. Consequently, potential risks based on an FI of 0.1 are probably overestimated.

- The risks calculated for fish ingestion for the RME scenario assume that the recreational fisherman eats 20 grams (Illinois EPA, April 2002) of fish caught in the Boat Basin per day. According to studies reported in the USEPA's Exposure Factors Handbook (USEPA, August 1997), the mean intakes for recreational fisherman ranged from 5-17 g/day and the recommended mean and 95th percentile values for recreational freshwater anglers are 8 g/day and 25 g/day, respectively. Based on the information provided in the Exposure Factors Handbook, the risks calculated using an ingestion rate of 20 grams per day are likely overestimated.

- PAHs and arsenic were detected in sediment samples in the Boat Basin but, based on comments from Illinois EPA (Illinois EPA, April 2002), these constituents were not included in the risk calculations for fish ingestion. Illinois EPA stated that "PAHs and arsenic should not be included in this pathway. Fish are able to metabolize low to moderate amounts of PAHs such that concentrations do not accumulate significantly. Fish are also able to metabolize arsenic, plus any that remains in the fish will be in a nontoxic form". The omission of PAHs and arsenic may result in an underestimation of potential risks. This issue is further discussed in Section 6.5.1.1 of the uncertainty analysis.

- Pesticide contamination is probably a result of historic use of these compounds throughout the watershed, particularly in developed areas. The presence of pesticides may be attributable to typical urban runoff from sources such as the golf course located near Pettibone Creek, from historical use of pesticides at the industrial facilities, or from historical use of pesticides at NTC Great Lakes.

6.4.4 Results of the CTE Evaluation

As discussed in Section 6.2.2, an evaluation of the potential risks associated with the CTE scenario is included to provide a measure of the central or average case exposure. Summaries of the estimated risks for the CTE scenarios are presented in Table 6-15.

HIs for adult and adolescent recreational users exposed to surface sediment and surface water in the North and South Branches of Pettibone Creek and in the Boat Basin under the CTE scenario are less than unity (1.0), indicating that adverse noncarcinogenic effects are not anticipated for these receptors under the defined exposure conditions.

ILCRs for adult and adolescent recreational users exposed to surface sediment and surface water in the North and South Branches of Pettibone Creek and in the Boat Basin for the CTE scenario are less than 1.0×10^{-6} indicating that the probability of these receptors incurring cancer are less than one in a million under CTE exposure assumptions.

The HI for the recreational fisherman eating fish caught in the Boat Basin is 2.6. As with the RME, the elevated HI is the result of exposure to Aroclor-1254. The cumulative ILCR for the adult recreational user is 2.1×10^{-5} which is within the USEPA target risk range, 1×10^{-6} to 1×10^{-4}. As with the RME scenario, the carcinogenic risks for the CTE are mainly due to exposure to PCBs in fish tissue using concentrations estimated from sediment concentrations.

6.5 UNCERTAINTY ANALYSIS

This section presents a brief summary of uncertainties inherent in the risk assessment and includes a discussion of how they may affect the quantitative risk estimates and conclusions of the risk analysis. The baseline HHRA for NTC Great Lakes Site 17 was performed in accordance with current USEPA, Illinois EPA, and Navy guidance. However, there are varying degrees of uncertainty associated with the baseline HHRA. The following sections discuss general uncertainties in risk assessment and uncertainties specific to the Site 17 risk assessment.

6.5.1 General Uncertainty in Risk Assessment

Uncertainty in the selection of COPCs is related to the current status of the predictive databases, the grouping of samples, and the procedures used to include or exclude constituents as COPCs. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route or scenario, the assumptions made to determine exposure point concentrations, and the predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing toxicity data needed to support dose-response relationships and the weight-of-evidence used to determine the carcinogenicity of COPCs. Uncertainty in risk characterization includes that associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier steps of the risk assessment process.

Whereas there are various sources of uncertainty, the direction of uncertainty can be influenced by the assumptions made throughout the risk assessment, including selection of COPCs and selection of values for dose-response relationships. Throughout the entire risk assessment, assumptions that consider safety factors are made so that the final calculated risks are overestimated and, therefore, conservative.

Generally, risk assessments carry two types of uncertainty: measurement and informational uncertainty. Measurement uncertainty refers to the usual variances that accompany scientific measurements. For example, this type of uncertainty is associated with analytical data collected for each site. The risk assessment reflects the accumulated variances of the individual values used.

Informational uncertainty stems from inadequate availability of information needed to complete the toxicity and exposure assessments. Often, this gap is significant, such as the absence of information on the effects of human exposure to low doses of a chemical, on the biological mechanism of action of a chemical, or the behavior of a chemical in soil.

Once the risk assessment is complete, the results must be reviewed and evaluated to identify the types and magnitude of uncertainty involved. Reliance on results from a risk assessment without consideration of uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assumptions, conservative estimates must be made to make sure that the particular assumptions made are protective of sensitive subpopulations and the maximum exposed individuals. If a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing a much larger uncertainty for the final results. This uncertainty is biased toward overpredicting both carcinogenic and noncarcinogenic risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

This interpretation is especially relevant when the risks exceed the point of departure for defining "acceptable" risk. For example, when risks calculated using a high degree of uncertainty are less than an acceptable risk level (i.e., 10^{-6}), the interpretation of no significant risk is typically straightforward. However, when risks calculated using a high degree of uncertainty exceed an acceptable risk level (i.e., 10^{-4}), a conclusion can be difficult unless uncertainty is considered.

6.5.1.1 Uncertainty in Selection of COPCs

A minor amount of uncertainty is associated with the selection of COPCs that may affect the numerical risk estimates presented in the risk assessment. The most significant issues related to uncertainty in COPC selection are the existing database (i.e., the use of validated and unvalidated sample results), the inclusion of chemicals potentially attributable to background, the screening levels that are used, and the absence of screening levels for a few chemicals detected in the site media. A brief discussion of each of these issues is provided in the remainder of this section.

Existing Databases

The data used in the risk assessment for Site 17 were obtained from samples collected as part of the RI/RA field effort performed by TtNUS in September 2001. No historical data were used for risk assessment purposes. However, the historical data have been evaluated qualitatively and were used to focus the investigation on compounds (e.g., PAHs, PCBs, pesticides, and metals) most likely to be present based on the industrial areas upgradient of NTC Great Lakes.

Ten percent of the analytical data were validated according to the methodology presented in Section B of the QAPP (TtNUS, July 2001). A summary of the data validation results and a review of data quality is provided in Appendix B. Qualification of data during the formal data validation process is not expected to compromise the results of the HHRA. Analytical data qualified as estimated were utilized, even though the reported positive concentrations or sample-specific quantitation limits may be somewhat imprecise. The use of estimated data adds to the uncertainty associated with the risk assessment; however, the associated uncertainty is expected to be negligible compared to the other uncertainties inherent in the risk evaluation process (i.e., uncertainties with land uses, exposure scenarios, toxicological criteria, etc.). Analytical data qualified for blank contamination were used in the baseline risk assessment. When determining exposure concentrations via statistical procedures, chemicals not detected were conservatively assumed to be present at concentrations equal to one-half the sample-specific quantitation limits. Analytical results for some chemicals qualified "R," unreliable, were not used in the risk assessment. Because only results of the most recent sampling events were used, the uncertainty in the calculated risks associated with the data is minimal. Some uncertainty is introduced into the risk assessment because only 10 percent of the data were validated. However, the validated data are expected to be representative of overall data quality and the effect of using the unvalidated data on the risk assessment should be negligible.

The database for surface water at Site 17 contains less than 10 samples. The fact that only a small number of samples are used to estimate risks can result in uncertainty both with regard to the COPC selection and in the EPCs used to estimate potential risks. The direction of the uncertainty is not known.

Chemicals Potentially Attributable to Background

No Base- or site-specific background data are available for NTC Great Lakes. Therefore, for purposes of COPC selection, metal concentrations in sediments were compared to background concentrations of inorganic chemicals in the Tiered Approach for Evaluation and Remediation of Product Releases to Sediments (Illinois EPA, September 2000). The use of non-site-specific background concentrations increases the uncertainty in the COPC selection process. The direction of the uncertainty is unknown (i.e., more or less conservative) but given the fact that only a few constituents were eliminated as COPCs on the basis of background, it is likely that use of the Illinois EPA background concentrations resulted in an overestimation of risk. In addition, the background comparison was performed by comparing maximum site concentrations with the Illinois EPA background concentrations. This method of screening inorganic compounds may result in retaining inorganic compounds as COPCs that would not have been identified as COPCs based on a more rigorous background evaluation (i.e., the use of statistical testing). Therefore, risks for sediment and fish tissue (which are derived from sediment concentrations) may be overestimated.

No background data are available for surface water. Therefore, COPCs were not selected based on background comparisons and consequently, the risks calculated for surface water exposures are likely to be overestimated.

COPC Screening Levels

The use of risk-based screening levels for surface water and sediment based on conservative land use scenarios (i.e., residential land use for sediment and ingestion of tap water for surface water), corresponding to an ILCR of 10^{-6} and HI of 0.1, should make certain that the significant contributors to risk from a site are evaluated. The elimination of chemicals that are present at concentrations that correspond to an ILCR less than 10^{-6} and an HI less than 0.1 should not affect the final conclusions of the risk assessment because these chemicals are not expected to cause a potential health concern at the concentrations detected.

In addition, the use of residential screening levels for sediment and surface water is conservative because exposure to these media is expected to be less than exposure to residential soil and tap water. For example, the residential soil screening levels assume that a potential receptor is exposed to chemicals 350 days per year. It is unlikely that a receptor would be exposed to surface water and sediment at this frequency in the Great Lakes area because of the long cold winters. Furthermore, the residential screening levels for noncarcinogens are conservatively based on the exposure of young children (0 to 6 years of age) to chemicals in soil. It is highly unlikely that very young children would be able to gain access to the sediments in Pettibone Creek and the Boat Basin on the continuous basis assumed by the screening levels. Therefore, applying residential soil screening levels to surface water and sediment is extremely conservative.

The screening levels for fish ingestion were based on USEPA Region 3 RBCs for fish ingestion (USEPA, November 2001). The Region 3 RBCs were used because they are the only risk-based values for ingestion of fish currently available. Use of the Region 3 values is conservative for the recreational scenario evaluated for Site 17 because the Region 3 RBCs are based on total fish ingestion (commercially and recreationally caught fish) and assume that potential receptors ingest 54 grams of fish per day (The risk assessment assumes that the recreational fish ingestion rates are 20 grams/day for the RME and 8 grams per day for the CTE).

PAHs and arsenic were detected in sediment samples in the Boat Basin and fish tissue concentrations for these constituents were calculated from the sediment concentrations (See Table 6-5), as discussed previously. However, based on comments from Illinois EPA (Illinois EPA, April 2002), PAHs and arsenic were not selected as COPCs and were not included in the risk calculations for fish ingestion. Illinois EPA stated that "PAHs and arsenic should not be included in this pathway. Fish are able to metabolize low to moderate amounts of PAHs such that concentrations do not accumulate significantly. Fish are also able to metabolize arsenic, plus any that remains in the fish will be in a nontoxic form". However, some literature sources (e.g., TOXNET, online, April 2002) indicate that bioaccumulation factors for PAHs can be "low to very high". If PAHs and arsenic were included in the risk assessment, the ILCR for fish ingestion (RME) would increase from 1.8×10^{-4} to 6.0×10^{-4}. Therefore, the omission of PAHs and arsenic may result in an underestimation of potential risks.

Absence of COPC Screening Levels

Because of the lack of toxicity criteria, USEPA Region 9 PRGs could not be calculated for calcium, magnesium, sodium, and potassium. This may lead to a slight underestimation of potential risks. However, these inorganics are essential nutrients, commonly detected in environmental media.

Risk-based screening levels are also currently not available for several constituents detected at Site 17 (e.g., acenaphthylene, benzo(g,h,i)perylene, 2-methylnaphthalene, phenanthrene, delta-BHC, endosulfans, chlordanes, and endrin ketone). Therefore, screening levels available for surrogate chemicals were used as screening levels for these constituents. The use of surrogates is recommended by USEPA Region 1 (USEPA, August 1999). In the COPC selection for Site 17, the screening level for acenaphthene is used as a surrogate for acenaphthylene, pyrene for benzo(g,h,i)perylene and phenanthrene, naphthalene for 2-methylnaphthalene, alpha-BHC for delta BHC, endrin for endrin ketone, chlordane for chlordane compounds, and endosulfan for endosulfan compounds. The direction of the uncertainty from the use of surrogate compounds is not known.

6.5.1.2 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises because of the methods used to calculate EPCs, the determination of land use conditions, the selection of receptors and scenarios, and the selection of exposure parameters. Each of these is discussed below.

Exposure Point Concentrations

Uncertainty is associated with the use of the 95 percent UCL on the mean concentration as the EPC. As a result of using the 95 percent UCL, the estimations of potential risk for the RME scenario are most likely to be overstated because this is a representation of the upper limit that potential receptors would be exposed to over the entire exposure period. In some cases, the maximum concentration was used as the EPC because datasets (e.g., surface water) contained less than 10 samples or because the UCL was greater than the maximum concentration. Use of the maximum concentration tends to overestimate potential risks because receptors are assumed to be exposed continuously to the maximum concentration for the entire exposure period. Uncertainty is also introduced when the nondetects are assigned a value of one-half the quantitation limit when calculating the EPC. This may either overestimate or underestimate the risks to potential receptors.

The fish tissue concentrations were estimated from sediment concentrations and sediment bioaccumulation factors. Therefore, there is uncertainty in the calculated risks because they are based on concentrations estimated by a model and not on actual measured tissue concentrations. In addition, the fish tissue concentrations were calculated on the assumption that fish are continually exposed to contaminants in the surface sediment in the Boat Basin. This assumption would apply only to bottom feeding fish that spend most of their time in the study area. This assumption would not apply to game fish, such as trout, that are not bottom feeders and whose range would not be confined to the Boat Basin. Therefore, the risks based on the calculated concentrations are likely to be overestimated.

Land Use

The current land use patterns in Pettibone Creek and the Boat Basin are well established, thereby reducing the uncertainty associated with land use assumptions. Land use at Site 17 is currently limited to recreational users and is expected to be used for these purposes in the future.

Exposure Routes and Receptor Identification

The determination of various receptor groups and exposure routes of potential concern was based on current land use observed at the site. Therefore, the uncertainty associated with the selection of exposure routes and potential receptors (i.e., recreational users) is minimal because they are considered to be well defined.

Exposure Parameters

Each exposure factor (for RME and CTE scenarios) selected for use in the risk assessment contains some associated uncertainty. Generally, exposure factors are based on surveys of physiological and lifestyle profiles across the United States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, USEPA guidelines (e.g., USEPA, March 1991) for the RME receptor were used, if applicable, which generally specify the use of the 95th percentile for most parameters. Therefore, the selected exposure factors for the RME receptor represent the upper bound of the observed or expected practices which are characteristic of the majority of the population. Because the USEPA does not currently provide exposure parameters for recreational surface water and sediment exposures, professional judgement was used to estimate the values of several exposure parameters for these pathways. For example, the recreational users were assumed to be exposed two days a week in warm weather months (52 days per year). When using professional judgement, an effort was made to be reasonably conservative. However, the use of professional judgement adds uncertainty to the risk assessment. The direction of the uncertainty is unknown.

Generally, uncertainty can be assessed quantitatively for many assumptions made in determining factors for calculating exposures and intakes. Many of these parameters were determined from statistical analyses on human population characteristics. Often, the database used to summarize a particular exposure parameter (i.e., body weight) is quite large. Consequently, the values chosen for such variables in the RME scenario have low uncertainty. For many parameters for which limited information exists (e.g., dermal absorption of chemicals from sediment, recreational exposure frequency, fish ingestion rates), greater uncertainty exists. For example, current USEPA guidance (USEPA, September 2001) does not provide dermal absorption factors for exposure to VOCs and most metals (except arsenic and cadmium) in soil. Therefore, risks for dermal contact from sediment are not evaluated for VOCs and metals other than arsenic and cadmium. Consequently, risks from exposure to sediment may be underestimated by omitting these constituents from the dermal risk assessment.

The risks calculated for fish ingestion for the RME scenario assume that the recreational fisherman consumes 20 grams (Illinois EPA, April 2002) of fish caught in the Boat Basin per day. According to studies reported in the USEPA's Exposure Factors Handbook (USEPA, August 1997), the mean intakes for recreational fisherman range from 5-17 g/day and the recommended mean and 95th percentile values for recreational freshwater anglers are 8 g/day and 25 g/day, respectively. Based on the information provided in the Exposure Factors Handbook, the risks calculated using an ingestion rate of 20 grams per day are likely overestimated.

The risks calculated for fish ingestion assume that 10 percent of the fish consumed by the recreational fisherman were caught in the Boat Basin (FI = 0.1). Although fishing has been observed in the Boat Basin, fishing does not appear to occur on a frequent basis. Consequently, potential risks based on an FI of 0.1 are probably overestimated.

Some of the exposure parameters used to calculate exposures and risks in this report are selected from a distribution of possible values including USEPA guidance (USEPA, March 1991 and May 1993) and dermal guidance (USEPA, August 1997 and September 2001). For the RME scenario, the value representing the 95th percentile is generally selected for each parameter to make sure that the assessment bounds the actual risks from a postulated exposure. This risk number is used in risk management decisions but does not indicate what a more average or typical exposure might be or what risk range might be expected for individuals in the exposed population. To address these issues, USEPA (USEPA, February 1992) has suggested the use of the CTE receptor, whose intake variables are often set at approximately the 50th percentile of the distribution. The risks for this receptor seek to incorporate the range of uncertainty associated with various intake assumptions. Some of the parameters presented in this risk assessment were estimated using professional judgment, although USEPA does provide limited guidance for the CTE evaluation (USEPA, May 1993).

Exposure parameters for the RME and CTE scenarios are presented in Tables 6-7 through 6-11. Results of the CTE evaluation (calculated risks) are presented in Section 6.4.4.

6.5.1.3 Uncertainty in the Toxicological Evaluation

Uncertainties associated with the toxicity assessment (determination of RfDs and CSFs and use of available criteria) are presented in this section.

Derivation of Toxicity Criteria

Uncertainty associated with the toxicity assessment is associated with hazard assessment and dose-response evaluations for the COPCs. The hazard assessment deals with characterizing the nature and strength of the evidence of causation or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans. Hazard assessment of carcinogenicity is evaluated as a weight-of-evidence determination, using the USEPA methods. Positive animal cancer test data suggest that humans contain tissue(s) that may manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue in humans. In the hazard assessment of noncancer effects, however, positive animal data often suggest the nature of the effects (i.e., the target tissues and type of effects) anticipated in humans.

Uncertainty in hazard assessment arises from the nature and quality of the animal and human data. Uncertainty is reduced when: similar effects are observed across species, strain, sex, and exposure route; the magnitude of the response is clearly dose related; pharmacokinetic data indicate a similar fate in humans and animals; postulated mechanisms of toxicity are similar for humans and animals; and the chemical of concern is structurally similar to other chemicals for which the toxicity is more completely characterized.

Uncertainty in the dose-response evaluation includes the determination of a CSF for the carcinogenic assessment and derivation of an RfD or reference concentration (RfC) for the noncarcinogenic assessment. Uncertainty is introduced from interspecies (animal to human) extrapolation which, in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate. Uncertainty also results from intraspecies variation. Most toxicity experiments are performed with animals that are very similar in age and genotype, so intragroup biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity including unusual sensitivity or tolerance to the COPC. Even toxicity data from human occupational exposures reflect a bias because only those individuals sufficiently healthy to attend work regularly (the "healthy worker effect") and those not unusually sensitive to the chemical are likely to be occupationally exposed. Finally, uncertainty arises from the quality of the key study from which the quantitative estimate is derived and the database. For cancer effects, the uncertainty associated with dose-response factors is mitigated by assuming the 95 percent upper bound for the CSF. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in nearly all quantitative estimations of human risk from animal data, is based on a nonthreshold assumption of carcinogenesis. Evidence suggests, however, that epigenetic carcinogens, as well as many genotoxic carcinogens, have a threshold below which they are noncarcinogenic. Therefore, the use of the linearized multistage model is conservative for chemicals that exhibit a threshold for carcinogenicity.

For noncancer effects, additional uncertainty factors may be applied in the derivation of the RfD or RfC to mitigate poor quality of the key study or gaps in the database. Additional uncertainty for noncancer effects arises from the use of an effect level in the estimation of an RfD or RfC, because this estimation is predicated on the assumption of a threshold below which adverse effects are not expected. Therefore, an uncertainty factor is usually applied to estimate a no-effect level. Additional uncertainty arises in estimation of an RfD or RfC for chronic exposure from subchronic data. Unless empirical data indicate that effects do not worsen with increasing duration of exposure, an additional uncertainty factor is applied to the no-effect level in the subchronic study. Uncertainty in the derivation of RfDs is mitigated by the use of uncertainty and modifying factors that normally range between 3 and 10. The resulting combination of uncertainty and modifying factors may reach 1,000 or more.

The derivation of dermal RfDs and CSFs from oral values may cause uncertainty. This is particularly the case when chemical-specific gastrointestinal absorption rates are not available in the literature or when only qualitative statements regarding absorption are available.

Uncertainty Associated with Evaluation of the Dermal Exposure Pathway

According to RAGS-Part E (USEPA, September 2001), risks from dermal absorption from soil are to be quantitatively evaluated for arsenic, cadmium, chlordane, 2,4-dichlorophenoxyacetic acid, DDT, TCDD (and other dioxins), PAHs, PCBs, pentachlorophenol, and SVOCs because of the limited guidance available to estimate exposure to soil via dermal contact for other constituents. Therefore, the dermal route of exposure is evaluated quantitatively for these chemicals only. Risks from dermal exposure to VOCs and metals (other than arsenic and cadmium) identified as COPCs for Site 17 were not quantified in the risk assessment. Consequently, potential risks may be underestimated by excluding these constituents from the dermal risk assessment calculations.

Quantitation of the dermal pathway for PAHs may add additional uncertainty to the risk assessment because it may not be appropriate to use the oral slope factor to evaluate risks from dermal exposure to PAHs (USEPA, December 1989). This is because PAHs are known to cause skin cancer at the point of contact, rather than from systemic action.

Uncertainty Associated with Evaluation of Arsenic

Arsenic was selected as a COPC for sediment and fish tissue. Although the more restrictive basis for evaluating risk associated with exposure to arsenic is to assume it is a carcinogen, carcinogenic effects are not the primary health effects expected to be manifested on exposure to arsenic. Scientific information indicates that humans are capable of metabolizing arsenic to expedite its elimination from the body (ATSDR, 1997). Its elimination from the body obviously mitigates the possibility for arsenic to manifest carcinogenic effects. Therefore, evaluating arsenic as a noncarcinogen would be more appropriate. However, arsenic was conservatively evaluated as a carcinogen in this risk assessment. Consequently, risks for this chemical are probably overestimated to some degree.

Specifically, the body methylates the arsenic to form monomethyl arsenic and dimethyl arsenic. A limited capacity exists for the body to methylate arsenic, but this limit is generally reached when the body's intake of arsenic exceeds approximately 500 µg/day. The maximum estimated concentration of arsenic in fish tissue at the site was 0.41 mg/kg. Assuming a fish ingestion rate of 20 grams per day, exposure to this concentration corresponds to an approximate intake of 8.2 µg-arsenic/day. This intake is well within the body's ability to metabolize arsenic. Although some humans may be more sensitive to arsenic, in that they are "poor methylators," the average exposure concentration for the site is usually orders of magnitude less than the normal limit of metabolic saturation and is most likely less than levels that would trigger responses in sensitive individuals.

Use of Chromium Toxicity Criteria

Chromium was identified as a COPC for surface water, sediment, and fish tissue in Pettibone Creek and the Boat Basin. Some uncertainty is associated with the evaluation of chromium that was assumed to be present in its hexavalent state. Because hexavalent chromium is considered to be more toxic than trivalent chromium, which is more common, risks for this chemical are probably overestimated to some degree. Since HIs for chromium (as hexavalent chromium) are less than unity (1.0) by more than an order of magnitude for the receptors evaluated at Site 17, the actual risks from exposure to chromium at the site are expected to be negligible.

Use of Aluminum, Copper, and Iron Toxicity Criteria

NCEA provisional RfDs are used to evaluate noncarcinogenic effects from exposure to aluminum, copper, and iron. The provisional RfDs for these chemicals are based on allowable intakes, rather than on adverse effect levels. Therefore, there is some degree of uncertainty associated with the use of the RfDs. Note that some USEPA regions (e.g., Region 1) consider the use of the oral RfD for aluminum, copper, and iron inappropriate and recommend that these metals not be quantitatively evaluated in risk assessments.

6.5.1.4 Uncertainty in the Risk Characterization

Uncertainty in risk characterization results primarily from assumptions made regarding additivity of effects from exposure to multiple COPCs from various exposure routes. High uncertainty exists when summing cancer risks for several substances across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Often compounds affect different organs, have different mechanisms of action, and differ in their fate in the body, so additivity may not be an appropriate assumption. However, the assumption of additivity is made to provide a conservative estimate of risk.

Finally, the risk characterization does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the COPCs. Therefore, the uncertainty regarding antagonistic or synergistic effects is ambiguous because potential human health risks may either be underestimated or overestimated.

6.6 SUMMARY AND CONCLUSIONS

Site 17, Pettibone Creek and the Boat Basin are located within NTC Great Lakes. Pettibone Creek flows through a ravine (named Pettibone Creek Ravine) that ranges from approximately 50 to 100 feet in height with 30 to 70-degree slopes and defines the boundaries between different areas of the Main Installation. The Pettibone Creek system consists of a north and south branch that merge and flow east into Lake Michigan via the Boat Basin. The North Branch of Pettibone Creek begins outside of the Main Installation in an urbanized area zoned for light industry and is the discharge point for storm sewers within the City of North Chicago and NTC Great Lakes. The South Branch originates in a residential area southwest of the Department of Veteran's Affairs Hospital, and flows to the east and then to the north through a private golf course before entering the Main Installation site. The Pettibone Creek study area ranges from the culvert at the northern end of North Branch Pettibone Creek and the golf course/NTC Great Lakes property limit of the South Branch Pettibone Creek downstream to the west end of the bridge upstream of the Boat Basin.

Adult and adolescent recreational users were evaluated as potential receptors in the HHRA for Site 17. These receptors were evaluated for exposure to surface water and sediment. Adult recreational users were also evaluated for exposure to fish assumed to be caught in the Boat Basin.

Potential risks associated with inhalation exposures are considered to be minimal and were not evaluated in the quantitative risk assessment. Inhalation of volatile emissions and fugitive dust from sediment were not considered to be appropriate for sediment because of high moisture content associated with sediment matrices. Although a number of VOCs were selected as COPCs in surface water samples collected mainly in the North Branch of Pettibone Creek (based on screening levels for residential ingestion of tap water), inhalation exposure from surface water emissions was considered to be relatively insignificant because of dilution by water and air, and because of the infrequent exposures expected to occur.

The list of COPCs for Site 17 includes the following:

Surface Sediment - North Branch of Pettibone Creek

Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, 4,4'-DDT, Aroclor-1254, arsenic, cadmium, chromium (total), copper, mercury, thallium

Surface Sediment - South Branch of Pettibone Creek

Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, thallium

Surface Sediment - Boat Basin

Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, Aroclor-1254, Aroclor-1260, arsenic, iron

Surface Water - Pettibone Creek and the Boat Basin

Bromodichloromethane, chlorodibromomethane, chloroform, cis-1,2-dichlorethene, tetrachloroethene, trichloroethene, vinyl chloride, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aluminum, arsenic, chromium (total), iron, lead, manganese, mercury

Fish Tissue - Boat Basin

bis(2-Ethylhexyl) phthalate, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-BHC, alpha-chlordane, beta-BHC, delta-BHC, dieldrin, endrin ketone, gamma-BHC (Lindane), gamma-chlordane, Aroclor-1254, Aroclor-1260, aluminum, antimony, beryllium, cadmium, chromium (total), cobalt, copper, iron, mercury, nickel, selenium, vanadium, zinc

Under current/future land use, quantitative estimates of noncarcinogenic and carcinogenic risks (HIs and ILCRs, respectively) were developed for adult and adolescent recreational users hypothetically exposed to COPCs in surface water, surface sediment, and fish ingestion.

Risks from Exposure to Surface Sediment

HIs for adult and adolescent recreational users in Pettibone Creek and the Boat Basin were less than unity (1.0). The ILCR for the adolescent recreational user for exposure to sediment in the South Branch of Pettibone Creek was less than 1.0×10^{-6}. The ILCR for the adult recreational user for exposure to surface sediment in the South Branch of Pettibone Creek (1.6×10^{-6}) was within the USEPA risk management range, 1.0×10^{-6} to 1.0×10^{-4}. ILCRs for adult (6.9×10^{-6}) and adolescent (2.6×10^{-6}) recreational users for exposure to surface sediment in the North Branch of Pettibone Creek and the Boat Basin were within the USEPA risk management range. Risks greater than 1.0×10^{-6} were mainly the result of exposure to PAHs.

Risks from Exposure to Surface Water

HIs for adult and adolescent recreational users from exposure to COPCs in Pettibone Creek and the Boat Basin were less than unity. The ILCRs for the adult and adolescent recreational users for exposure to surface water were less than 1.0×10^{-6}.

Risks from Exposure by Fish Ingestion

The ILCR for the ingestion of fish caught by the recreational fisherman (1.8×10^{-4}) exceeded 1.0×10^{-4} and the total HI (6.6) was greater than unity (1.0). As indicated in the RAGS-Part D tables in Appendix D.2, PCBs account for 66 percent of the total cancer risk for fish ingestion, and pesticides account for the remainder of the cancer risk. There are a number of significant uncertainties associated with the fish ingestion risks, including the fact that the fish tissue concentrations were not actual fish tissue concentrations but were estimated from sediment concentrations and sediment bioaccumulation factors. Other important sources of uncertainty for the fish ingestion scenario are: (1) the calculated fish tissue concentrations assume that fish are continually exposed to contaminants in the surface sediment in the

Boat Basin; (2) the risks calculated for fish ingestion assume that 10 percent of the fish consumed by the recreational fisherman were caught in the Boat Basin; (3) the risks for the RME scenario assume that the recreational fisherman eats 20 grams (Illinois EPA, April 2002) of fish caught in the Boat Basin per day; and (4) PAHs and arsenic were not included in the fish ingestion based on comments from Illinois EPA (Illinois EPA, April 2002). These factors, except for the omission of PAHs and arsenic, are conservative and may result in an overestimation of potential risks.

In summary, no significant potential health hazards are associated with exposure to COPCs in surface water and surface sediment under the recreational land use scenarios. The quantitative risk evaluation indicates that noncarcinogenic HIs were less than unity (1.0) for adult and adolescent recreational users. Carcinogenic risks were less than or within the USEPA's risk management range, 1×10^{-6} to 1×10^{-4}. The HIs and ILCRs estimated for recreational fisherman consuming fish contaminated with PCBs and pesticides exceeded USEPA benchmarks. However, these elevated risks were not based on actual measured fish tissue samples but rather on concentrations estimated by a model.

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TABLE 6-1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SEDIMENT
SITE 17- PETTIBONE CREEK - NORTH BRANCH
NTC GREAT LAKES
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Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Site 17 - North Branch Pettibone Creek

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used For Screening[1]	Background Value[2]	USEPA Region 9 PRG [3]		Potential ARAR/TBC Ingestion [4]	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
Volatiles (mg/kg)																
75-09-2	Methylene Chloride	0.011		0.011		PCSD0401	1/6	0.0053 - 0.0064	0.011	NA	8.9	C	85	TACO	No	BSL
Semivolatiles (mg/kg)																
91-57-6	2-Methylnaphthalene [6]	0.055	J	0.093	J	PCSD2301	3/6	0.36 - 0.41	0.093	NA	5.6	N	1600	TACO	No	BSL
208-96-8	Acenaphthylene	0.013	J	0.092	J	PCSD1001	8/24	0.4 - 16	0.092	NA	370	N	4700	TACO	No	BSL
120-12-7	Anthracene	0.037		4		PCSD0101	24/24	--	4	NA	2200	N	23000	TACO	No	BSL
100-52-7	Benzaldehyde	1.5		1.5		PCSD0401	1/6	0.35 - 0.42	1.5	NA	610	N	NA	NA	No	BSL
56-55-3	Benzo(a)anthracene	0.15		11		PCSD0101	24/24	--	11	NA	0.62	C	0.9	TACO	Yes	ASL
50-32-8	Benzo(a)pyrene	0.13		11		PCSD0101	24/24	--	11	NA	0.062	C	0.09	TACO	Yes	ASL
205-99-2	Benzo(b)fluoranthene	0.15		12		PCSD0101	24/24	--	12	NA	0.62	C	0.9	TACO	Yes	ASL
191-24-2	Benzo(g,h,i)perylene [6]	0.07		7.5	J	PCSD0101	23/24	0.085	7.5	NA	230	N	2300	TACO	No	BSL
207-08-9	Benzo(k)fluoranthene	0.078		6.3		PCSD0101	24/24	--	6.3	NA	6.2	C	9	TACO	Yes	ASL
117-81-7	Bis(2-ethylhexyl)phthalate	0.28	J	0.68		PCSD2301	6/6	--	0.68	NA	35	C	46	TACO	No	BSL
85-68-7	Butyl Benzyl Phthalate	0.037	J	0.037	J	PCSD1801	1/6	0.36 - 0.42	0.037	NA	1200	N	16000	TACO	No	BSL
105-60-2	Caprolactam	0.057	J	0.057	J	PCSD1801	1/6	0.36 - 0.42	0.057	NA	3100	N	NA	NA	No	BSL
86-74-8	Carbazole	0.075	J	0.72		PCSD1401	6/6	--	0.72	NA	24	C	32	TACO	No	BSL
218-01-9	Chrysene	0.15		12		PCSD0101	24/24	--	12	NA	62	C	88	TACO	No	.BSL
132-64-9	Dibenzofuran	0.037	J	0.25	J	PCSD1401	6/6	--	0.25	NA	29	N	NA	NA	No	BSL
206-44-0	Fluoranthene	0.38		33		PCSD0101	24/24	--	33	NA	230	N	3100	TACO	No	BSL
86-73-7	Fluorene	0.021	J	2.4	J	PCSD0101	24/24	--	2.4	NA	260	N	3100	TACO	No	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	0.07		5.8	J	PCSD0101	24/24	--	5.8	NA	0.62	C	0.9	TACO	Yes	ASL
85-01-8	Phenanthrene [6]	0.21		24		PCSD0101	24/24	--	24	NA	230	N	2300	TACO	No	BSL
108-95-2	Phenol	0.094	J	0.094	J	PCSD0401	1/6	0.35 - 0.42	0.094	NA	3700	N	47000	TACO	No	BSL
129-00-0	Pyrene	0.31		27		PCSD0101	24/24	--	27	NA	230	N	2300	TACO	No	BSL
Pesticides/PCBs (mg/kg)																
72-54-8	4,4'-DDD	0.0023		0.17		PCSD1901	24/24	--	0.17	NA	2.4	C	3	TACO	No	BSL
72-55-9	4,4'-DDE	0.0043		0.21		PCSD1901	24/24	--	0.21	NA	1.7	C	2	TACO	No	BSL
50-29-3	4,4'-DDT	0.0049		1.8		PCSD0501	24/24	--	1.8	NA	1.7	C	2	TACO	Yes	ASL
309-00-2	Aldrin	0.0064	J	0.0064	J	PCSD0101	1/24	0.0019 - 0.21	0.0064	NA	0.029	C	0.04	TACO	No	BSL
5103-71-9	Alpha-Chlordane [7]	0.00016	J	0.0069	J	PCSD1901	14/22	0.0019 - 0.21	0.0069	NA	1.6	C	1.8	TACO	No	BSL
11097-69-1	Aroclor-1254	0.056		0.44		PCSD1901	14/24	0.035 - 0.043	0.44	NA	0.22	C	1	TACO	Yes	ASL
11096-82-5	Aroclor-1260	0.041		0.15		PCSD0301	12/23	0.035 - 0.043	0.15	NA	0.22	C	1	TACO	No	BSL
60-57-1	Dieldrin	0.00023	J	0.0017	J	PCSD2101	6/22	0.018 - 0.21	0.0017	NA	0.03	C	0.04	TACO	No	BSL
959-98-8	Endosulfan I [8]	0.0011	J	0.0011	J	PCSD1201	1/24	0.0019 - 0.21	0.0011	NA	37	N	470	TACO	No	BSL
33213-65-9	Endosulfan II [8]	0.00052	J	0.012	J	PCSD0101	9/24	0.0041 - 0.21	0.012	NA	37	N	470	TACO	No	BSL
72-20-8	Endrin	0.0026	J	0.0026	J	PCSD0401	1/24	0.0019 - 0.21	0.0026	NA	1.8	N	23	TACO	No	BSL
7421-93-4	Endrin Aldehyde [9]	0.0033		0.0033		PCSD1001	1/24	0.0019 - 0.21	0.0033	NA	1.8	N	23	TACO	No	BSL
5103-74-2	Gamma-Chlordane [7]	0.00091	J	0.0029	J	PCSD0401	7/24	0.0019 - 0.21	0.0029	NA	1.6	C	1.8	TACO	No	BSL
1024-57-3	Heptachlor Epoxide	0.00013	J	0.0002	J	PCSD1001	3/24	0.0019 - 0.21	0.0002	NA	0.053	C	0.07	TACO	No	BSL

TABLE 6-1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SEDIMENT
SITE 17- PETTIBONE CREEK - NORTH BRANCH
NTC GREAT LAKES
PAGE 2 OF 2

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used For Screening[1]	Background Value[2]	USEPA Region 9 PRG [3]	Potential ARAR/TBC Ingestion [4]	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
Inorganics (mg/kg)															
7429-90-5	Aluminum	1960		4810		PCSD1001	24/24	--	4810	NA	7600 N	NA	NA	No	BSL
7440-36-0	Antimony	0.27		1.5		PCSD0101	11/24	0.29 - 0.87	1.5	NA	3.1 N	31	TACO	No	BSL
7440-38-2	**Arsenic**	3.7		10.4		PCSD0101	24/24	--	10.4	8	0.39 C	0.43	TACO	Yes	ASL
7440-39-3	Barium	17.2		122		PCSD0601	24/24	--	122	145	540 N	5500	TACO	No	BSL, BKG
7440-41-7	Beryllium	0.39		1.4		PCSD1501	18/24	0.24 - 0.36	1.4	NA	15 N	160	TACO	No	BSL
7440-43-9	**Cadmium**	0.11		4.2		PCSD1501	21/24	0.06	4.2	0.5	3.7 N	78	TACO	Yes	ASL
7440-70-2	Calcium	34300		110000		PCSD0601	24/24	--	110000	NA	NA N	NA	NA	No	NUT
7440-47-3	**Chromium** [10]	8.4		55.8	J	PCSD0101	24/24	--	55.8	16	30 C	230	TACO	Yes	ASL
7440-48-4	Cobalt	4		11.3		PCSD2101	24/24	--	11.3	NA	470 N	4700	TACO	No	BSL
7440-50-8	**Copper**	35.1		477		PCSD0201	24/24	--	477	38	290 N	2900	TACO	Yes	ASL
7439-89-6	Iron	8570	J	14900	J	PCSD0101	24/24	--	14900	18000	2300 N	NA	NA	No	BKG
7439-92-1	Lead	30.8		322	J	PCSD0101	24/24	--	322	28	400 N	400	TACO	No	BSL
7439-95-4	Magnesium	17900		51400		PCSD1201	24/24	--	51400	NA	NA N	NA	NA	No	NUT
7439-96-5	Manganese	243		662		PCSD0601	24/24	--	662	1300	180 N	3700	TACO	No	BKG
7439-97-6	**Mercury**	0.04		4.7		PCSD1401	24/24	--	4.7	0.07	2.3 N	23	TACO	Yes	ASL
7440-02-0	Nickel	8.1		23		PCSD1301	24/24	--	23	26	160 N	1600	TACO	No	BSL, BKG
7440-09-7	Potassium	292		798		PCSD1001	24/24	--	798	1500	NA N	NA	NA	No	NUT, BKG
7782-49-2	Selenium	0.46		6.6		PCSD1601	4/24	0.35 - 0.43	6.6	NA	39 N	390	TACO	No	BSL
7440-22-4	Silver	0.55		3.2		PCSD0401	8/24	0.09 - 0.57	3.2	5	39 N	390	TACO	No	BSL
7440-23-5	Sodium	128		658		PCSD1501	24/24	--	658	NA	NA N	NA	NA	No	NUT
7440-28-0	**Thallium**	0.74		2.1	J	PCSD1001	13/24	0.61 - 0.73	2.1	NA	0.52 N	6.3	TACO	Yes	ASL
7440-62-2	Vanadium	7.1		17.9		PCSD0901	24/24	--	17.9	NA	55 N	550	TACO	No	BSL
7440-66-6	Zinc	126		2120		PCSD1501	24/24	--	2120	80	2300 N	23000	TACO	No	BSL

1 Maximum concentration used as screening value
2 Illinois EPA Unsieved Stream Sediment Background
3 Based on Preliminary Remediation Goals, USEPA Region 9, November 2000, Residential land use (Cancer benchmark value = 1E-06, Hazard Quotient = 0.1).
4 Residential Soil Remediation Objective (SRO) for ingestion pathway, Illinois EPA, TACO, online March 2002.
5 Rationale Codes

Selection Reason — Above Screening Levels (ASL)

Deletion Reason — Maximum detected concentration is below background screening level (BKG)
Essential Nutrient (NUT)
Below Screening Levels (BSL)
No Toxicity Information (NTX)

6 2-Methylnaphthalene evaluated as naphthalene Benzo(g,h,i)perylene and phenanthrene evaluated as pyrene.
7 Alpha- and gamma-chlordane evaluated as chlordane.
8 Endosulfan I, and endosulfan II evaluated as endosulfan.
9 Endrin aldehyde evaluated as endrin.
10 Chromium evaluated as hexavalent chromium.
Chemical names in bold indicate that chemical was selected as a COPC

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
C = carcinogen
COPC = Chemical of Potential Concern
J = Estimated Value
N = noncarcinogen
NA = Not Applicable
TACO = Tiered Approach to Corrective Action Objectives, Illinois EPA, online March 2002.

TABLE 6-2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SEDIMENT
SITE 17- PETTIBONE CREEK - SOUTH BRANCH
NTC GREAT LAKES
PAGE 1 OF 2

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Site 17 - South Branch Pettibone Creek

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used For Screening[1]	Background Value[2]	USEPA Region 9 PRG [3]		Potential ARAR/TBC Ingestion [4]	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
Volatiles (mg/kg)																
75-09-2	Methylene Chloride	0.0089		0.0089		PCSD2901	1/2	0.0063	0.0089	NA	8.9	C	85	TACO	No	BSL
Semivolatiles (mg/kg)																
208-96-8	Acenaphthylene	0.025	J	0.051	J	PCSD3501	2/14	0.079 - 4.1	0.051	NA	370	N	4700	TACO	No	BSL
120-12-7	Anthracene	0.019		1.1		PCSD2701	14/14	--	1.1	NA	2200	N	23000	TACO	No	BSL
56-55-3	Benzo(a)anthracene	0.069		2.8		PCSD2701	14/14	--	2.8	NA	0.62	C	0.9	TACO	Yes	ASL
50-32-8	Benzo(a)pyrene	0.066		2.1	J	PCSD2701	14/14	--	2.1	NA	0.062	C	0.09	TACO	Yes	ASL
205-99-2	Benzo(b)fluoranthene	0.061		2.2		PCSD2701	14/14	--	2.2	NA	0.62	C	0.9	TACO	Yes	ASL
191-24-2	Benzo(g,h,i)perylene [6]	0.034		0.99	J	PCSD2701	14/14	--	0.99	NA	230	N	2300	TACO	No	BSL
207-08-9	Benzo(k)fluoranthene	0.034		1.3		PCSD2701	14/14	--	1.3	NA	6.2	C	9	TACO	No	BSL
117-81-7	Bis(2-ethylhexyl)phthalate	0.08	J	0.13	J	PCSD2901	2/2	--	0.13	NA	35	C	46	TACO	No	BSL
218-01-9	Chrysene	0.065		2.9		PCSD2701	14/14	--	2.9	NA	62	C	88	TACO	No	BSL
206-44-0	Fluoranthene	0.16		9		PCSD2701	14/14	--	9	NA	230	N	3100	TACO	No	BSL
86-73-7	Fluorene	0.013	J	0.41	J	PCSD2701	14/14	--	0.41	NA	260	N	3100	TACO	No	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	0.037		0.88	J	PCSD2701	14/14	--	0.88	NA	0.62	C	0.9	TACO	Yes	ASL
85-01-8	Phenanthrene [6]	0.085		6.3		PCSD2701	14/14	--	6.3	NA	230	N	2300	TACO	No	BSL
129-00-0	Pyrene	0.13		6.4		PCSD2701	14/14	--	6.4	NA	230	N	2300	TACO	No	BSL
Pesticides/PCBs (mg/kg)																
72-54-8	4,4'-DDD	0.0076		0.032		PCSD3501	14/14	--	0.032	NA	2.4	C	3	TACO	No	BSL
72-55-9	4,4'-DDE	0.01		0.031		PCSD2701	14/14	--	0.031	NA	1.7	C	2	TACO	No	BSL
50-29-3	4,4'-DDT	0.0085		0.29		PCSD3101	14/14	--	0.29	NA	1.7	C	2	TACO	No	BSL
5103-71-9	Alpha-Chlordane [7]	0.00035	J	0.0024	J	PCSD2901	13/14	0.02	0.0024	NA	1.6	C	1.8	TACO	No	BSL
12672-29-6	Aroclor-1248	0.05		0.05		PCSD3101	1/14	0.04 - 0.046	0.05	NA	0.22	C	1	TACO	No	BSL
11097-69-1	Aroclor-1254	0.084		0.14		PCSD2901	3/14	0.04 - 0.046	0.14	NA	0.22	C	1	TACO	No	BSL
11096-82-5	Aroclor-1260	0.055		0.055		PCSD3301	1/14	0.039 - 0.045	0.055	NA	0.22	C	1	TACO	No	BSL
60-57-1	Dieldrin	0.00016	J	0.0029		PCSD2801	12/13	0.02	0.0029	NA	0.03	C	0.04	TACO	No	BSL
33213-65-9	Endosulfan II [8]	0.0003	J	0.0019	J	PCSD3301	7/14	0.002 - 0.02	0.0019	NA	37	N	470	TACO	No	BSL
72-20-8	Endrin	0.00042	J	0.0013	J	PCSD2801	4/14	0.002 - 0.02	0.0013	NA	1.8	N	23	TACO	No	BSL
7421-93-4	Endrin Aldehyde [9]	0.004		0.004		PCSD3401	1/14	0.002 - 0.02	0.004	NA	1.8	N	23	TACO	No	BSL
5103-74-2	Gamma-Chlordane [7]	0.00031	J	0.0016	J	PCSD2701	12/14	0.002 - 0.02	0.0016	NA	1.6	C	1.8	TACO	No	BSL
1024-57-3	Heptachlor Epoxide	0.00015	J	0.00046	J	PCSD2801	4/14	0.002 - 0.02	0.00046	NA	0.053	C	0.07	TACO	No	BSL

TABLE 6-2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SEDIMENT
SITE 17- PETTIBONE CREEK - SOUTH BRANCH
NTC GREAT LAKES
PAGE 2 OF 2

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used For Screening (1)	Background Value (2)	USEPA Region 9 PRG (3)		Potential ARAR/TBC Ingestion (4)	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (5)
Inorganics (mg/kg)																
7429-90-5	Aluminum	1480		3760		PCSD3401	14/14	--	3760	NA	7600	N	NA	NA	No	BSL
7440-36-0	Antimony	0.33		0.49		PCSD3801	4/14	0.28 - 0.33	0.49	NA	3.1	N	31	TACO	No	BSL
7440-38-2	Arsenic	1.5		5.4		PCSD3401	14/14	--	5.4	8	0.39	C	0.43	TACO	No	BKG
7440-39-3	Barium	6.9		40.4		PCSD2601	14/14	--	40.4	145	540	N	5500	TACO	No	BSL, BKG
7440-41-7	Beryllium	0.13		0.44		PCSD2601	11/14	0.1 - 0.3	0.44	NA	15	N	160	TACO	No	BSL, BKG
7440-43-9	Cadmium	0.07		0.19		PCSD3401	9/14	0.06 - 0.07	0.19	0.5	3.7	N	78	TACO	No	BSL, BKG
7440-70-2	Calcium	25700		99100		PCSD2501	14/14	--	99100	NA	NA	N	NA	NA	No	NUT
7440-47-3	Chromium (10)	5.5		14.7		PCSD2601	14/14	--	14.7	16	30	C	230	TACO	No	BSL, BKG
7440-48-4	Cobalt	2.4		7.6		PCSD3101	14/14	--	7.6	NA	470	N	4700	TACO	No	BSL, BKG
7440-50-8	Copper	3.4		46.2		PCSD2601	14/14	--	46.2	38	290	N	2900	TACO	No	BSL
7439-89-6	Iron	4900		13100	J	PCSD2701	14/14	--	13100	18000	2300	N	NA	NA	No	BKG
7439-92-1	Lead	8.3		57.9		PCSD2601	14/14	--	57.9	28	400	N	400	TACO	No	BSL
7439-95-4	Magnesium	14100		54500		PCSD2501	14/14	--	54500	NA	NA	N	NA	NA	No	NUT
7439-96-5	Manganese	177		504		PCSD2501	14/14	--	504	1300	180	N	3700	TACO	No	BKG
7439-97-6	Mercury	0.02		0.23		PCSD3401	14/14	--	0.23	0.07	2.3	N	23	TACO	No	BSL
7440-02-0	Nickel	3.6		15.4		PCSD3101	14/14	--	15.4	26	160	N	1600	TACO	No	BSL, BKG
7440-09-7	Potassium	306		602		PCSD3401	14/14	--	602	1500	NA	N	NA	NA	No	NUT, BKG
7440-23-5	Sodium	78.3		205		PCSD2601	14/14	--	205	NA	NA	N	NA	NA	No	NUT
7440-28-0	**Thallium**	0.73	J	1.5		PCSD3401	7/14	0.69 - 0.79	1.5	NA	0.52	N	6.3	TACO	Yes	ASL
7440-62-2	Vanadium	6.8		13.2		PCSD3401	14/14	--	13.2	NA	55	N	550	TACO	No	BSL
7440-66-6	Zinc	31		253		PCSD2601	14/14	--	253	80	2300	N	23000	TACO	No	BSL

1 Maximum concentration used as screening value
2 Illinois EPA Unsieved Stream Sediment Background
3 Based on Preliminary Remediation Goals, USEPA Region 9, November 2000, Residential land use (Cancer benchmark value = 1E-06, Hazard Quotient = 0.1).
4 Residential Soil Remediation Objective (SRO) for ingestion pathway, Illinois EPA, TACO, online March 2002.
5 Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: Maximum detected concentration is below background screening level (BKG)
Essential Nutrient (NUT)
Below Screening Levels (BSL)
No Toxicity Information (NTX)

6 Benzo(g,h,i)perylene, and phenanthrene evaluated as pyrene.
7 Alpha- and gamma-chlordane evaluated as chlordane.
8 Endosulfan II evaluated as endosulfan.
9 Endrin aldehyde evaluated as endrin.
10 Chromium evaluated as hexavalent chromium.
Chemical names in bold indicate that chemical was selected as a COPC

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
C = carcinogen
COPC = Chemical of Potential Concern
J = Estimated Value
N = noncarcinogen
NA = Not Applicable
TACO = Tiered Approach to Corrective Action Objectives, Illinois EPA, online March 2002.

TABLE 6-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SEDIMENT
SITE 17- BOAT BASIN
NTC GREAT LAKES
PASGE 1 OF 2

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Site 17 - Boat Basin

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used For Screening[1]	Background Value[2]	USEPA Region 9 PRG [3]		Potential ARAR/TBC Ingestion [4]	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
Volatiles (mg/kg)																
75-09-2	Methylene Chloride	0.0066		0.0066		BBSD4701	1/1	--	0.0066	NA	8.9	C	85	TACO	No	BSL
Semivolatiles (mg/kg)																
208-96-8	Acenaphthylene	0.024	J	0.2	J	BBSD5601	6/12	0.42 - 3.9	0.2	NA	370	N	4700	TACO	No	BSL
120-12-7	Anthracene	0.049	J	1.9		BBSD4601	12/12	--	1.9	NA	2200	N	23000	TACO	No	BSL
56-55-3	Benzo(a)anthracene	0.25		4.9		BBSD4501	12/12	--	4.9	NA	0.62	C	0.9	TACO	Yes	ASL
50-32-8	Benzo(a)pyrene	0.26		4.5		BBSD4501	12/12	--	4.5	NA	0.062	C	0.09	TACO	Yes	ASL
205-99-2	Benzo(b)fluoranthene	0.28		4.5		BBSD4501	12/12	--	4.5	NA	0.62	C	0.9	TACO	Yes	ASL
191-24-2	Benzo(g,h,i)perylene [6]	0.2	J	2.8		BBSD4501	10/12	0.16 - 0.45	2.8	NA	230	N	2300	TACO	No	BSL
207-08-9	Benzo(k)fluoranthene	0.15		2.5		BBSD4501	12/12	--	2.5	NA	6.2	C	9	TACO	No	BSL
117-81-7	Bis(2-ethylhexyl)phthalate	0.61	J	0.61	J	BBSD4701	1/1	--	0.61	NA	35	C	46	TACO	No	BSL
218-01-9	Chrysene	0.27		4.9		BBSD4501	12/12	--	4.9	NA	62	C	88	TACO	No	BSL
206-44-0	Fluoranthene	0.73		14		BBSD4501	12/12	--	14	NA	230	N	3100	TACO	No	BSL
86-73-7	Fluorene	0.04	J	1.3		BBSD4501	12/12	--	1.3	NA	260	N	3100	TACO	No	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	0.15	J	2		BBSD4501	12/12	--	2	NA	0.62	C	0.9	TACO	Yes	ASL
91-20-3	Naphthalene	1.2	J	1.2	J	BBSD4601	1/12	0.36 - 4.2	1.2	NA	5.6	N	1600	TACO	No	BSL
85-01-8	Phenanthrene [6]	0.38		10		BBSD4501	12/12	--	10	NA	230	N	2300	TACO	No	BSL
129-00-0	Pyrene	0.56		11		BBSD4501	12/12	--	11	NA	230	N	2300	TACO	No	BSL
Pesticides/PCBs (mg/kg)																
72-54-8	4,4'-DDD	0.071		0.31		BBSD4801	12/12	--	0.31	NA	2.4	C	3	TACO	No	BSL
72-55-9	4,4'-DDE	0.055		0.23		BBSD4801	12/12	--	0.23	NA	1.7	C	2	TACO	No	BSL
50-29-3	4,4'-DDT	0.034		0.12		BBSD4701	11/12	0.046	0.12	NA	1.7	C	2	TACO	No	BSL
309-00-2	Aldrin	0.0041	J	0.0041	J	BBSD4701	1/12	0.0082 - 0.051	0.0041	NA	0.029	C	0.04	TACO	No	BSL
319-84-6	Alpha-Bhc	0.0065	J	0.0065	J	BBSD5601	1/12	0.0082 - 0.051	0.0065	NA	0.09	C	0.1	TACO	No	BSL
5103-71-9	Alpha-Chlordane [7]	0.0012	J	0.011	J	BBSD4801	12/12	--	0.011	NA	1.6	C	1.8	TACO	No	BSL
11097-69-1	Aroclor-1254	0.079		0.66		BBSD4801	4/12	0.036 - 0.044	0.66	NA	0.22	C	1	TACO	Yes	ASL
11096-82-5	Aroclor-1260	0.049		0.27		BBSD4801	3/12	0.036 - 0.047	0.27	NA	0.22	C	1	TACO	Yes	ASL
319-85-7	Beta-Bhc	0.0056	J	0.0076	J	BBSD5201	3/12	0.0082 - 0.051	0.0076	NA	0.32	C	0.1	TACO	No	BSL
319-86-8	Delta-Bhc	0.002	J	0.0085	J	BBSD5601	4/12	0.0082 - 0.021	0.0085	NA	0.09	C	0.1	TACO	No	BSL
60-57-1	Dieldrin	0.0015	J	0.013	J	BBSD4801	10/12	0.011 - 0.021	0.013	NA	0.03	C	0.04	TACO	No	BSL
959-98-8	Endosulfan I	0.00068	J	0.0087	J	BBSD4801	10/11	0.0097	0.0087	NA	37	N	470	TACO	No	BSL
33213-65-9	Endosulfan II [8]	0.00094	J	0.012	J	BBSD5201	9/11	0.015 - 0.021	0.012	NA	37	N	470	TACO	No	BSL
1031-07-8	Endosulfan Sulfate	0.0073	J	0.0073	J	BBSD5201	1/12	0.0082 - 0.051	0.0073	NA	37	N	470	TACO	No	BSL
72-20-8	Endrin	0.0013	J	0.0013	J	BBSD4601	1/12	0.0082 - 0.051	0.0013	NA	1.8	N	23	TACO	No	BSL
53494-70-5	Endrin Ketone	0.0047	J	0.0047	J	BBSD4501	1/12	0.0082 - 0.051	0.0047	NA	1.8	N	23	TACO	No	BSL
58-89-9	Gamma-Bhc (Lindane)	0.0046	J	0.0046	J	BBSD5601	1/12	0.0082 - 0.051	0.0046	NA	0.44	C	0.5	TACO	No	BSL
5103-74-2	Gamma-Chlordane [7]	0.0012	J	0.008	J	BBSD4801	10/12	0.021 - 0.046	0.008	NA	1.6	C	1.8	TACO	No	BSL
72-43-5	Methoxychlor	0.032	J	0.032	J	BBSD5201	1/12	0.082 - 0.51	0.032	NA	31	N	390	TACO	No	BSL

TABLE 6-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SEDIMENT
SITE 17- BOAT BASIN
NTC GREAT LAKES
PASGE 2 OF 2

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used For Screening[1]	Background Value[2]	USEPA Region 9 PRG [3]	Potential ARAR/TBC Ingestion [4]	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
Inorganics (mg/kg)															
7429-90-5	Aluminum	1300		6860		BBSD4801	12/12	--	6860	NA	7600 N	NA	NA	No	BSL
7440-36-0	Antimony	0.45		0.47		BBSD5301	2/12	0.36 - 0.8	0.47	NA	3.1 N	31	TACO	No	BSL
7440-38-2	**Arsenic**	3.4		9.9		BBSD4801	12/12	--	9.9	8	0.39 C	0.43	TACO	Yes	ASL
7440-39-3	Barium	12		57.8		BBSD4801	12/12	--	57.8	145	540 N	5500	TACO	No	BSL, BKG
7440-41-7	Beryllium	0.26		6.7	J	BBSD4901	10/12	0.32 - 0.47	6.7	NA	15 N	160	TACO	No	BSL
7440-43-9	Cadmium	0.23		2.2		BBSD4801	12/12	--	2.2	0.5	3.7 N	78	TACO	No	BSL
7440-70-2	Calcium	33500		86300	J	BBSD4901	12/12	--	86300	NA	NA N	NA	NA	No	NUT
7440-47-3	Chromium [10]	7.9		28.9		BBSD4801	12/12	--	28.9	16	30 C	230	TACO	No	BSL
7440-48-4	Cobalt	3.7		10.1		BBSD4801	12/12	--	10.1	NA	470 N	4700	TACO	No	BSL
7440-50-8	Copper	55.5		283		BBSD4801	12/12	--	283	38	290 N	2900	TACO	No	BSL
7439-89-6	**Iron**	7410		19200		BBSD4801	12/12	--	19200	18000	2300 N	NA	NA	Yes	ASL
7439-92-1	Lead	47.6		289		BBSD4801	12/12	--	289	28	400 N	400	TACO	No	BSL
7439-95-4	Magnesium	17200		46900	J	BBSD4901	12/12	--	46900	NA	NA N	NA	NA	No	NUT
7439-96-5	Manganese	226		731	J	BBSD4901	12/12	--	731	1300	180 N	3700	TACO	No	BKG
7439-97-6	Mercury	0.068		0.95		BBSD4801	12/12	--	0.95	0.07	2.3 N	23	TACO	No	BSL
7440-02-0	Nickel	8.9		31.5		BBSD5401	12/12	--	31.5	26	160 N	1600	TACO	No	BSL
7440-09-7	Potassium	180		1150		BBSD4801	12/12	--	1150	1500	NA N	NA	NA	No	NUT, BKG
7782-49-2	Selenium	0.66		1.2		BBSD4801	3/12	0.5 - 0.65	1.2	NA	39 N	390	TACO	No	BSL
7440-22-4	Silver	0.29		4.2		BBSD4801	12/12	--	4.2	5	39 N	390	TACO	No	BSL, BKG
7440-23-5	Sodium	136		487	J	BBSD4901	12/12	--	487	NA	NA N	NA	NA	No	NUT
7440-62-2	Vanadium	6		18.9		BBSD4801	12/12	--	18.9	NA	55 N	550	TACO	No	BSL
7440-66-6	Zinc	247		2070	J	BBSD4901	12/12	--	2070	80	2300 N	23000	TACO	No	BSL

1 Maximum concentration used as screening value
2 Illinois EPA Unsieved Stream Sediment Background
3 Based on Preliminary Remediation Goals, USEPA Region 9, November 2000, Residential land use (Cancer benchmark value = 1E-06, Hazard Quotient = 0.1).
4 Residential Soil Remediation Objective (SRO) for ingestion pathway, Illinois EPA, TACO, online March 2002.
5 Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: Maximum detected concentration is below background screening level (BKG)
Essential Nutrient (NUT)
Below Screening Levels (BSL)
No Toxicity Information (NTX)

6 Benzo(g,h,i)perylene, and phenanthrene evaluated as pyrene.
7 Alpha- and gamma-chlordane evaluated as chlordane.
8 Endosulfan II evaluated as endosulfan.
9 Endrin aldehyde evaluated as endrin.
10 Chromium evaluated as hexavalent chromium.
Chemical names in bold indicate that chemical was selected as a COPC

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
C = carcinogen
COPC = Chemical of Potential Concern
J = Estimated Value
N = noncarcinogen
NA = Not Applicable
TACO = Tiered Approach to Corrective Action Objectives, Illinois EPA, online March 2002.

TABLE 6-4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER
SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN
NTC GREAT LAKES

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Site 17

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used For Screening[1]	Background Value[2]	USEPA Region 9 PRG [3]		TACO Tier 1 Ingestion GRO[4]	Federal MCL [5]	Federal SMCL [6]	Federal AWQC [7]	Illinois WQC [8]	COPC Flag	Rationale for Contaminant Deletion or Selection [9]
Volatile Organics (ug/L)																			
78-93-3	2-Butanone	5.6		5.6		PCSW0101	1/6	5	5.6	NA	190	N	NA	NA	NA	NA	NA	No	BSL
67-64-1	Acetone	2.6	J	11		PCSW0101	5/6	10	11	NA	61	N	700	NA	NA	NA	NA	No	BSL
75-27-4	Bromodichloromethane	0.34	J	0.74	J	PCSW0201	2/6	1	0.74	NA	0.18	C	0.2	80	NA	0.56	NA	Yes	ASL
124-48-1	Chlorodibromomethane	0.59	J	0.59	J	PCSW0201	1/6	1	0.59	NA	0.13	C	140	80	NA	0.41	NA	Yes	ASL
67-66-3	Chloroform	0.42	J	1.2		PCSW0201	2/6	1	1.2	NA	0.16	C	0.2	80	NA	5.7	130	Yes	ASL
156-59-2	cis-1,2-Dichloroethene	1.1		9.2		PCSW0101	2/6	1	9.2	NA	6.1	N	70	70	NA	NA	NA	Yes	ASL
127-18-4	Tetrachloroethene	0.41	J	1.4		PCSW0101	2/6	1	1.4	NA	1.1	C	5	5	NA	0.8	NA	Yes	ASL
108-88-3	Toluene	0.7	J	0.7	J	PCSW0101	1/6	1	0.7	NA	72	N	1000	1000	NA	6800	5600	No	BSL
79-01-6	Trichloroethene	0.46	J	5.5		PCSW0101	2/6	1	5.5	NA	1.6	C	5	5	NA	2.7	29	Yes	ASL
75-01-4	Vinyl Chloride	0.77	J	0.77	J	PCSW0101	1/6	2	0.77	NA	0.041	C	2	2	NA	2	NA	Yes	ASL
Semivolatile Organics (ug/L)																			
84-74-2	Di-N-butyl phthalate	2.7	J	2.7	J	PCSW0101	1/6	10	2.7	NA	360	N	700	NA	NA	2700	NA	No	BSL
Pesticides (ug/L)																			
72-54-8	4,4'-DDD	0.0054	J	0.0054	J	PCSW0201	1/6	0.05	0.0054	NA	0.28	C	14	NA	NA	0.00083	0.00015	Yes	ASL
72-55-9	4,4'-DDE	0.0064	J	0.024	J	PCSW0201	3/5	0.05	0.024	NA	0.2	C	10	NA	NA	0.00059	0.00015	Yes	ASL
50-29-3	4,4'-DDT	0.029	J	0.029	J	PCSW0201	1/6	0.05	0.029	NA	0.2	C	6	NA	NA	0.00059	0.00015	Yes	ASL
959-98-8	Endosulfan I	0.01	J	0.01	J	BBSW0501	1/6	0.05	0.01	NA	22	N	42	NA	NA	110	NA	No	BSL
Inorganics (ug/L)																			
7429-90-5	Aluminum	44.8		9460		PCSW0301	6/6	0	9460	NA	3600	N	NA	NA	50	NA	NA	Yes	ASL
7440-38-2	Arsenic	3.7		3.8		BBSW0501	3/6	3.2	3.8	NA	0.045	C	50	10	NA	0.018	50	Yes	ASL
7440-39-3	Barium	16.8	J	61.8		PCSW0301	6/6	0	61.8	NA	260	N	2000	2000	NA	1000	1000	No	BSL
7440-41-7	Beryllium	0.26		0.26		PCSW0301	1/6	0.17	0.26	NA	7.3	N	4	4	NA	NA	NA	No	BSL
7440-70-2	Calcium	23200	J	91600		PCSW0101	6/6	0	91600	NA	NA	N	NA	NA	NA	NA	NA	No	NUT
7440-47-3	Chromium [8]	14.4		14.4		PCSW0301	1/6	1.8 - 5.6	14.4	NA	11	N	100	100	NA	NA	NA	Yes	ASL
7440-48-4	Cobalt	4.6		4.6		PCSW0301	1/6	2.9	4.6	NA	220	N	1000	NA	NA	NA	NA	No	BSL
7440-50-8	Copper	6.9		22.2		PCSW0101	5/6	2.4	22.2	NA	140	N	650	1300	1000	1000	NA	No	BSL
7439-89-6	Iron	84.4	J	10900		PCSW0301	6/6	0	10900	NA	1100	N	5000	NA	300	300	300	Yes	ASL
7439-92-1	Lead	3		18		PCSW0301	5/6	1.8	18	NA	NA	N	7.5	15	NA	NA	50	Yes	ASL
7439-95-4	Magnesium	7720		37400		PCSW0101	6/6	0	37400	NA	NA	N	NA	NA	NA	NA	NA	No	NUT
7439-96-5	Manganese	14.6	J	245		PCSW0301	6/6	0	245	NA	88	N	150	NA	50	50	150	Yes	ASL
7439-97-6	Mercury	0.05		0.1		PCSW0401	4/6	0.047	0.1	NA	1.1	N	2	2	NA	0.05	0.0031	Yes	ASL
7440-02-0	Nickel	12.5		12.5		PCSW0301	1/6	10.4	12.5	NA	73	N	100	NA	NA	610	NA	No	BSL
7440-09-7	Potassium	1270		6280		PCSW0301	6/6	0	6280	NA	NA	N	NA	NA	NA	NA	NA	No	NUT
7440-23-5	Sodium	13100		122000		PCSW0101	6/6	0	122000	NA	NA	N	NA	NA	NA	NA	NA	No	NUT
7440-62-2	Vanadium	2.9		15.6		PCSW0301	3/6	2.5	15.6	NA	26	N	49	NA	NA	NA	NA	No	BSL
7440-66-6	Zinc	28		150		PCSW0101	4/6	13.5 - 32.7	150	NA	1100	N	5000	NA	5000	5000	1000	No	BSL

1 Maximum concentration used as screening value
2 No background values are available for surface water at Site 17.
3 Based on Preliminary Remediation Goals, USEPA Region 9, November 2000, for Tap Water (Cancer benchmark value = 1E-06, Hazard Quotient = 0.1).
4 Illinois EPA 1996 TACO Class I Groundwater remediation objectives (Illinois EPA, online, March 2002)
5 Federal Maximum Contaminant Levels (USEPA, Summer 2000).
6 Illinois Environmental Protection Agency Ambient Water Quality Criteria.
7 Rationale Codes
  Selection Reason — Above Screening Levels (ASL)
  Deletion Reason — Maximum detected concentration is below background screening level (BKG); Essential Nutrient (NUT); Below Screening Levels (BSL)
8 Chromium evaluated as hexavalent chromium.

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
C = carcinogen
COPC = Chemical of Potential Concern
J = Estimated Value
MCL = Maximum Contaminant Level
NA = Not Applicable
N = noncarcinogen
SMCL = Secondary Maximum Contaminant Level

TABLE 6-5

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - FISH TISSUE
SITE 17- BOAT BASIN
NTC GREAT LAKES
PAGE 1 OF 2

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Fish Tissue
Exposure Point: Fish Tissue from Site 17 - Boat Basin

CAS Number	Chemical	Minimum Sediment Concentration	Minimum Qualifier	Maximum Sediment Concentration	Maximum Qualifier	Location of Maximum Sediment Concentration	Detection Frequency	Range of Sediment Detection Limits	Biotransfer Factor (sed to fish)[1]	Fish Tissue Concentration Used For Screening [2]	Sediment Background Value[3]	Potential ARAR/TBC Ingestion [4]		Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
Organic Volatiles (mg/kg)																
75-09-2	Methylene Chloride	0.0066		0.0066		BBSD4701	1/1	--	NA	NA	NA	NA	C	NA	No	BSL
Organic Semi-volatiles (mg/kg)																
208-96-8	Acenaphthylene [6]	0.024	J	0.2	J	BBSD5601	6/12	0.42 - 3.9	0.29	0.322	NA	8.1	N	EPA 3	No	BSL, NE
120-12-7	Anthracene	0.049	J	1.9		BBSD4601	12/12	--	0.29	3.06	NA	41	N	EPA 3	No	BSL, NE
56-55-3	Benzo(a)anthracene	0.25		4.9		BBSD4501	12/12	--	0.29	7.88	NA	0.0043	C	EPA 3	No	NE
50-32-8	Benzo(a)pyrene	0.26		4.5		BBSD4501	12/12	--	0.29	7.24	NA	0.00043	C	EPA 3	No	NE
205-99-2	Benzo(b)fluoranthene	0.28		4.5		BBSD4501	12/12	--	0.29	7.24	NA	0.0043	C	EPA 3	No	NE
191-24-2	Benzo(g,h,i)perylene	0.2	J	2.8		BBSD4501	10/12	0.16 - 0.45	0.29	4.5	NA	4.1	N	EPA 3	No	NE
207-08-9	Benzo(k)fluoranthene	0.15		2.5		BBSD4501	12/12	--	0.29	4.02	NA	0.043	C	EPA 3	No	NE
117-81-7	Bis(2-ethylhexyl)phthalate	0.61	J	0.61	J	BBSD4701	1/1	--	1	3.38	NA	0.23	C	EPA 3	Yes	ASL
218-01-9	Chrysene	0.27		4.9		BBSD4501	12/12	--	0.29	7.88	NA	0.43	C	EPA 3	No	NE
206-44-0	Fluoranthene	0.73		14		BBSD4501	12/12	--	0.29	22.5	NA	5.4	N	EPA 3	No	NE
86-73-7	Fluorene	0.04	J	1.3		BBSD4501	12/12	--	0.29	2.09	NA	5.4	N	EPA 3	No	BSL, NE
193-39-5	Indeno(1,2,3-cd)pyrene	0.15	J	2		BBSD4501	12/12	--	0.29	3.22	NA	0.0043	C	EPA 3	No	NE
91-20-3	Naphthalene	1.2	J	1.2	J	BBSD4601	1/12	0.36 - 4.2	0.29	1.93	NA	2.7	N	EPA 3	No	BSL, NE
85-01-8	Phenanthrene	0.38		10		BBSD4501	12/12	--	0.29	16.1	NA	4.1	N	EPA 3	No	NE
129-00-0	Pyrene	0.56		11		BBSD4501	12/12	--	0.29	17.7	NA	4.1	N	EPA 3	No	NE
Pesticides/PCBs (mg/kg)																
72-54-8	4,4'-DDD	0.071		0.31		BBSD4801	12/12	--	0.28	0.481	NA	0.013	C	EPA 3	Yes	ASL
72-55-9	4,4'-DDE	0.055		0.23		BBSD4801	12/12	--	7.7	9.82	NA	0.0093	C	EPA 3	Yes	ASL
50-29-3	4,4'-DDT	0.034		0.12		BBSD4701	11/12	0.046	1.67	1.11	NA	0.0093	C	EPA 3	Yes	ASL
309-00-2	Aldrin	0.0041	J	0.0041	J	BBSD4701	1/12	0.0082 - 0.051	1.8	0.0409	NA	0.00019	C	EPA 3	Yes	ASL
319-84-6	Alpha-BHC	0.0065	J	0.0065	J	BBSD5601	1/12	0.0082 - 0.051	1.8	0.0649	NA	0.0005	C	EPA 3	Yes	ASL
5103-71-9	Alpha-Chlordane [8]	0.0012	J	0.011	J	BBSD4801	12/12	--	4.77	0.291	NA	0.009	C	EPA 3	Yes	ASL
11097-69-1	Aroclor-1254	0.079		0.66		BBSD4801	4/12	0.036 - 0.044	1.85	6.77	NA	0.0016	C	EPA 3	Yes	ASL
11096-82-5	Aroclor-1260	0.049		0.27		BBSD4801	3/12	0.036 - 0.047	1.85	2.77	NA	0.0016	C	EPA 3	Yes	ASL
319-85-7	Beta-BHC	0.0056	J	0.0076	J	BBSD5201	3/12	0.0082 - 0.051	1.8	0.0759	NA	0.0018	C	EPA 3	Yes	ASL
319-86-8	Delta-BHC [9]	0.002	J	0.0085	J	BBSD5601	4/12	0.0082 - 0.021	1.8	0.0848	NA	0.0005	C	EPA 3	Yes	ASL
60-57-1	Dieldrin	0.0015	J	0.013	J	BBSD4801	10/12	0.011 - 0.021	1.8	0.13	NA	0.0002	C	EPA 3	Yes	ASL
959-98-8	Endosulfan I	0.00068	J	0.0087	J	BBSD4801	10/11	0.0097	1.8	0.0868	NA	0.81	N	EPA 3	No	BSL
33213-65-9	Endosulfan II [10]	0.00094	J	0.012	J	BBSD5201	9/11	0.015 - 0.021	1.8	0.12	NA	0.81	N	EPA 3	No	BSL
1031-07-8	Endosulfan Sulfate [10]	0.0073	J	0.0073	J	BBSD5201	1/12	0.0082 - 0.051	1.8	0.0729	NA	0.81	N	EPA 3	No	BSL
72-20-8	Endrin	0.0013	J	0.0013	J	BBSD4601	1/12	0.0082 - 0.051	1.8	0.013	NA	0.041	N	EPA 3	No	BSL
53494-70-5	Endrin Ketone [11]	0.0047	J	0.0047	J	BBSD4501	1/12	0.0082 - 0.051	1.8	0.0469	NA	0.041	N	EPA 3	Yes	ASL
58-89-9	Gamma-BHC (Lindane)	0.0046	J	0.0046	J	BBSD5601	1/12	0.0082 - 0.051	1.8	0.0459	NA	0.0024	C	EPA 3	Yes	ASL
5103-74-2	Gamma-Chlordane [8]	0.0012	J	0.008	J	BBSD4801	10/12	0.021 - 0.046	2.22	0.0985	NA	0.009	C	EPA 3	Yes	ASL
72-43-5	Methoxychlor	0.032	J	0.032	J	BBSD5201	1/12	0.082 - 0.51	1.8	0.319	NA	0.68	N	EPA 3	No	BSL

TABLE 6-5

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - FISH TISSUE
SITE 17- BOAT BASIN
NTC GREAT LAKES
PAGE 2 OF 2

CAS Number	Chemical	Minimum Sediment Concentration	Minimum Qualifier	Maximum Sediment Concentration	Maximum Qualifier	Location of Maximum Sediment Concentration	Detection Frequency	Range of Sediment Detection Limits	Biotransfer Factor (sed to fish)[1]	Fish Tissue Concentration Used For Screening [2]	Sediment Background Value[3]	Potential ARAR/TBC Ingestion [4]		Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
Inorganics (mg/kg)																
7429-90-5	**Aluminum**	1300		6860		BBSD4801	12/12	--	1	6174	NA	140	N	EPA 3	Yes	ASL
7440-36-0	**Antimony**	0.45		0.47		BBSD5301	2/12	0.36 - 0.8	1	0.423	NA	0.054	N	EPA 3	Yes	ASL
7440-38-2	Arsenic	3.4		9.9		BBSD4801	12/12	--	1	0.41	8	0.0021	C	EPA 3	No	NE
7440-39-3	Barium	12		57.8		BBSD4801	12/12	--	1	52.0	145	9.5	N	EPA 3	No	BKG
7440-41-7	**Beryllium**	0.26		6.7	J	BBSD4901	10/12	0.32 - 0.47	1	6.03	NA	0.27	N	EPA 3	Yes	ASL
7440-43-9	**Cadmium**	0.23		2.2		BBSD4801	12/12	--	1	0.38	0.5	0.14	N	EPA 3	Yes	ASL
7440-70-2	Calcium	33500		86300	J	BBSD4901	12/12	--	NA	86300	NA	NA	N		No	NUT
7440-47-3	**Chromium** [12]	7.9		28.9		BBSD4801	12/12	--	1	0.8381	16	0.41	N	EPA 3	Yes	ASL
7440-48-4	**Cobalt**	3.7		10.1		BBSD4801	12/12	--	1	10.1	NA	2.7	N	EPA 3	Yes	ASL
7440-50-8	**Copper**	55.5		283		BBSD4801	12/12	--	1	128	38	5.4	N	EPA 3	Yes	ASL
7439-89-6	**Iron**	7410		19200		BBSD4801	12/12	--	1	19200	18000	81	N	EPA 3	Yes	ASL
7439-92-1	Lead	47.6		289		BBSD4801	12/12	--	1	5.95	28	NA	N		No	BSL
7439-95-4	Magnesium	17200		46900	J	BBSD4901	12/12	--	NA	46900	NA	NA	N		No	NUT
7439-96-5	Manganese	226		731	J	BBSD4901	12/12	--	1	731	1300	19	N	EPA 3	No	BKG
7439-97-6	**Mercury** [13]	0.068		0.95		BBSD4801	12/12	--	1	0.31	0.07	0.014	N	EPA 3	Yes	ASL
7440-02-0	**Nickel**	8.9		31.5		BBSD5401	12/12	--	1	4.44	26	2.7	N	EPA 3	Yes	ASL
7440-09-7	Potassium	180		1150		BBSD4801	12/12	--	NA	1150	1500	NA	N		No	NUT, BKG
7782-49-2	**Selenium**	0.66		1.2		BBSD4801	3/12	0.5 - 0.65	1	1.08	NA	0.68	N	EPA 3	Yes	ASL
7440-22-4	Silver	0.29		4.2		BBSD4801	12/12	--	1	3.78	5	0.68	N	EPA 3	No	BKG
7440-23-5	Sodium	136		487	J	BBSD4901	12/12	--	NA	487	NA	NA	N		No	NUT
7440-62-2	**Vanadium**	6		18.9		BBSD4801	12/12	--	1	18.9	NA	0.95	N	EPA 3	Yes	ASL
7440-66-6	**Zinc**	247		2070	J	BBSD4901	12/12	--	1	1162	80	41	N	EPA 3	Yes	ASL

1 BSAF: Biota-sediment Accumulation Factor
2 Concentration in fish tissue (mg/kg) - estimated from maximum sediment concentration and BSAF (ORNL, August 1998).
3 Illinois EPA Unsieved Stream Sediment Background
4 Based on Risk-Based Concentrations (RBCs) from USEPA Region III RBC Tables. (Cancer benchmark value = 1E-06, Hazard Quotient = 0.1)
5 Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Maximum detected concentration is below background screening level (BKG)
Essential Nutrient (NUT)
Below Screening Levels (BSL)
No Toxicity Information (NTX)
Not Evaluated (NE) in the quantitative risk assessment based on Illinois EPA comments (Illinois EPA, April 2002)
6 Acenaphthylene evaluated as acenaphthene.
7 Benzo(g,h,i)perylene, and phenanthrene evaluated as pyrene.
8 Alpha- and gamma-chlordane evaluated as chlordane.
9 Delta BHC evaluated as alpha-BHC.
10 Endosulfan II and endosulfan sulfate evaluated as endosulfan.
11 Endrin ketone evaluated as endrin.
12 Chromium evaluated as hexavalent chromium.
13 Mercury evaluated as methylmercury.
Chemical names in bold indicate that chemical was selected as a COPC

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
C = carcinogen
COPC = Chemical of Potential Concern
J = Estimated Value
N = noncarcinogen
NA = Not Applicable

TABLE 6-6

EXPOSURE POINT CONCENTRATIONS (EPCs) FOR COPCs
SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN
NTC GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Exposure Point Concentration				
	Sediment[1]			Surface Water[2]	Fish Tissue [3]
	North Branch of Pettibone Creek (mg/kg)	South Branch of Pettibone Creek (mg/kg)	Boat Basin (mg/kg)	Pettibone Creek and the Boat Basin (µg/L)	Boat Basin (mg/kg)
Bromodichloromethane				0.74	
Chlorodibromomethane				0.59	
Chloroform				1.2	
cis-1,2-Dichloroethene				9.2	
Tetrachloroethene				1.4	
Trichloroethene				5.5	
Vinyl Chloride				0.77	
Benzo(a)anthracene	1.86	0.57	2.73		
Benzo(a)pyrene	1.87	0.538	2.25		
Benzo(b)fluoranthene	1.95	0.522	2.26		
Bis(2-ethylhexyl)phthalate					3.38[4]
Indeno(1,2,3-cd)pyrene	0.955	0.25	0.816		1.31
4,4'-DDD				0.0054	0.238
4,4'-DDE				0.024	4.82
4,4'-DDT	0.44			0.029	0.817
Aldrin					0.0409
Alpha-BHC					0.0649
Alpha-Chlordane					0.149
Aroclor-1254	0.257		0.371		3.81
Aroclor-1260			0.108		1.11
Dieldrin					0.0792
Endrin Ketone					0.0469
Gamma-BHC (Lindane)					0.0459
Gamma-Chlordane					0.0985
Aluminum				9,460	3,160
Antimony					0.337
Arsenic	6.4		6.21	3.8	
Beryllium					2.33
Cadmium	1.76				0.162
Chromium	19.2			14.4	0.449
Cobalt					6.71
Copper	220				72.7
Iron			13,600	10,900	13,600
Lead				18	
Manganese				245	
Mercury	0.538				0.114
Nickel				0.1	3.03
Selenium					0.529
Thallium	1.12	1.05			
Vanadium					12.3
Zinc					565

1 The exposure point concentration is the 95% upper confidence limit (UCL) based on distribution of the data set (best fit of normal or lognormal), unless otherwise noted.
2 Because of the limited number of samples (i.e., less than 10 samples), the exposure concentration is set at the maximum detected concentration.
3 Concentrations in fish tissue are calculated from sediment concentrations and BSAF.
4 Maximum detected concentration is used because the UCL exceeded the maximum.
Blank spaces indicate that the chemical is not a COPC for this medium.

TABLE 6-7

EXPOSURE FACTOR ASSUMPTIONS/INTAKE EQUATIONS FOR ADOLESCENT RECREATIONAL EXPOSURE TO SEDIMENT SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN NTC GREAT LAKES

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Csed	Chemical Concentration in Sediment	mg/kg	95% UCL	USEPA, May 1993	95%UCL	USEPA, May 1993	Ingestion Intake (mg/kg-day) =
	IR	Ingestion Rate of Soil	mg/day	100	USEPA, May 1993	50	USEPA, May 1993	Csed x IR x FI x EF x ED x CF
	FI	Fraction Ingested	unitless	1.0	Professional Judgement	1.0	Professional Judgement	BW x AT
	EF	Exposure Frequency	days/year	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	ED	Exposure Duration	years	10	Adolescent, Age 7 - 16	10	Adolescent, Age 7 - 16	
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	
	BW	Body Weight	kg	42	USEPA, August 1997	42	USEPA, August 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,650	USEPA, December 1989	3,650	USEPA, December 1989	
Dermal	Csed	Chemical Concentration in Sediment	mg/kg	95%UCL	USEPA, May 1993	95%UCL	USEPA, May 1993	Dermal Intake (mg/kg-day) =
	AF	Soil to Skin Adherence Factor	mg/cm^2	0.3	USEPA, September 2001	0.04	USEPA 2001	DAevent x SA x EF x ED
	SA	Skin Surface Area Available for Contact	cm^2/day	3,280	USEPA, August 1997	3,100	USEPA, August 1997	BW x AT
	ABS	Absorption Factor	unitless	chemical-specific	USEPA, September 2001	chemical-specific	USEPA, September 2001	DAevent = Csed x AF x ABS x CF
	EF	Exposure Frequency	days/year	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	ED	Exposure Duration	years	10	Adolescent, Age 7 - 16	10	Adolescent, Age 6 - 16	
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	
	BW	Body Weight	kg	42	USEPA, August 1997	42	USEPA, August 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,650	USEPA, December 1989	3,650	USEPA, December 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, DC. May.
USEPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002Fa/, Office of Research and Development, August.
USEPA, September 2001: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

TABLE 6-8

EXPOSURE FACTOR ASSUMPTIONS/INTAKE EQUATIONS FOR ADULT RECREATIONAL EXPOSURE TO SEDIMENT SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN NTC GREAT LAKES

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference(2)	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Csed	Chemical Concentration in Sediment	mg/kg	95% UCL	USEPA, May 1993	95%UCL	USEPA, May 1993	Ingestion CDI(3) (mg/kg-day) =
	IR	Ingestion Rate of Soil	mg/day	100	USEPA, May 1993	50	USEPA, May 1993	Csed x IR x FI x EF x ED x CF
	EF	Exposure Frequency	days/year	52.0	Professional Judgement (2 days per week in warm weather months)	26.0	Professional Judgement (1/2 the RME)	BW x AT
	FI	Fraction Ingested	unitless	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	years	24	USEPA, May 1993. Assumed length of residence for adult living near the site.	7	USEPA, May 1993. Assumed length of residence for adult living near the site.	
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	
	BW	Body Weight	kg	70	USEPA, December 1989	70	USEPA, December 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, December 1989	2,555	USEPA, December 1989	
Dermal	Csed	Chemical Concentration in Sediment	mg/kg	95%UCL	USEPA, May 1993	95%UCL	USEPA, May 1993	Dermal CDI(3) (mg/kg-day) =
	AF	Soil to Skin Adherence Factor	mg/cm^2	0.3	USEPA, September 2001	0.04	USEPA, September 2001	DAevent x SA x EF x ED
	SA	Skin Surface Area Available for Contact	cm^2/day	9,190	USEPA, August 1997	7,770	USEPA, August 1997	BW x AT
	ABS	Absorption Factor	unitless	chemical-specific	USEPA, September 2001	chemical-specific	USEPA, September 2001	DAevent = Csed x AF x ABS x CF
	EF	Exposure Frequency	days/year	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	ED	Exposure Duration	years	24	USEPA, May 1993. Assumed length of residence for adult living near the site.	7	USEPA, May 1993. Assumed length of residence for adult living near the site.	
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	
	BW	Body Weight	kg	70	USEPA, December 1989	70	USEPA, December 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, December 1989	2,555	USEPA, December 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, DC. May.
USEPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002Fa/, Office of Research and Development, August.
USEPA, September 2001: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

TABLE 6-9

EXPOSURE FACTOR ASSUMPTIONS/INTAKE EQUATIONS FOR ADOLESCENT RECREATIONAL EXPOSURE TO SURFACE WATER SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN NTC GREAT LAKES

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference[1]	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Csw	Chemical Concentration in Surface Water	mg/L	95% UCL	USEPA, May 1993	95%UCL	USEPA, May 1993	Ingestion CDI[2] (mg/kg-day) =
	CR	Contact Rate	L/hour	0.05	USEPA, December 1989	0.05	USEPA, December 1989	
	ET	Exposure Time	hours/event	2	Professional Judgement	1	Professional Judgement (1/2 the RME)	$\frac{Csw \times CR \times ET \times EF \times EV \times ED}{BW \times AT}$
	EF	Exposure Frequency	(days/year)	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	EV	Event Frequency	event/day	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	years	10	Adolescent, Age 7 - 16	10	Adolescent, Age 7 - 16	
	CF	conversion factor	mg/ug	0.001		0.001		
	BW	Body Weight	kg	42	USEPA, August 1997	42	USEPA, August 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,650	USEPA, December 1989	3,650	USEPA, December 1989	
Dermal	Cwater	Chemical Concentration in Groundwater	mg/L	95% UCL	USEPA, May 1993	95%UCL	USEPA, May 1993	DAD[3] (mg/kg-day) =
	DAevent	Absorbed Dose per Event	mg/cm2-event	chemical-specific	USEPA, Spetember 2001	chemical-specific	USEPA, Spetember 2001	
	EV	Event Frequency	event/day	1	Professional Judgement	1	Professional Judgement	$\frac{DAevent \times EV \times ED \times EF \times A}{BW \times AT}$
	ED	Exposure Duration	years	10	Adolescent, Age 7 - 16	10	Adolescent, Age 7 - 16	
	EF	Exposure Frequency	days/year	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	A	Skin Surface Available for Contact	cm2	3,820	USEPA, August 1997	3,100	USEPA, August 1997	
	t_{event}	Duration of Event	hour/event	2	Professional Judgement	1	Professional Judgement (1/2 the RME)	
	Kp	Permeability Coefficient from Water	cm/hour	chemical-specific	USEPA, Spetember 2001	chemical-specific	USEPA, Spetember 2001	
	τ	Lag Time	hour/event	chemical-specific	USEPA, Spetember 2001	chemical-specific	USEPA, Spetember 2001	
	t^*	Time to Reach Steady State	hour/event	chemical-specific	USEPA, Spetember 2001	chemical-specific	USEPA, Spetember 2001	
	B	Bunge Model Constant	dimensionless	chemical-specific	USEPA, Spetember 2001	chemical-specific	USEPA, Spetember 2001	
	BW	Body Weight	kg	42	USEPA, August 1997	42	USEPA, August 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,650	USEPA, December 1989	3,650	USEPA, December 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

USEPA, December 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, DC. May.

USEPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002Fa/, Office of Research and Development, August.

USEPA, September 2001: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

TABLE 6-10

EXPOSURE FACTOR ASSUMPTIONS/INTAKE EQUATIONS FOR ADULT RECREATIONAL EXPOSURE TO SURFACE WATER SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN NTC GREAT LAKES

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference(1)	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Csw	Chemical Concentration in Surface Water	ug/L	95% UCL	USEPA, May 1993	95%UCL	USEPA, May 1993	Ingestion CDI(2) (mg/kg-day) =
	CR	Contact Rate	L/hour	0.05	USEPA, December 1989	0.05	USEPA, December 1989	
	ET	Exposure Time	hours/event	2	Professional Judgement	1	Professional Judgement (1/2 the RME)	$\frac{Csw \times CR \times ET \times EF \times EV \times ED}{BW \times AT}$
	EF	Exposure Frequency	(days/year)	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	EV	Event Frequency	event/day	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	years	24	EPA 1993. Assumed length of residence for adult living near the site.	7	EPA 1993. Assumed length of residence for adult living near the site.	
	CF	conversion factor	mg/ug	0.001		0.001		
	BW	Body Weight	kg	70	USEPA, December 1989	70	USEPA, December 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, December 1989	2,555	USEPA, December 1989	
Dermal	Cwater	Chemical Concentration in Groundwater	mg/L	95% UCL	USEPA, May 1993	95%UCL	USEPA, May 1993	DAD (3) (mg/kg-day) =
	DAevent	Absorbed Dose per Event	mg/cm2-event	chemical-specific	USEPA, Spetember 2001	chemical-specific	USEPA, Spetember 2001	
	EV	Event Frequency	event/day	1	Professional Judgement	1	Professional Judgement	$\frac{DAevent \times EV \times ED \times EF \times A}{BW \times AT}$
	ED	Exposure Duration	years	24	USEPA , May 1993. Assumed length of residence for adult living near the site.	7	USEPA , May 1993. Assumed length of residence for adult living near the site.	
	EF	Exposure Frequency	days/year	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	A	Skin Surface Available for Contact	cm2	9,190	USEPA, August 1997	7,770	USEPA, August 1997	
	t_{event}	Duration of Event	hour/event	2	Professional Judgement	1	Professional Judgement (1/2 the RME)	
	Kp	Permeability Coefficient from Water	cm/hour	chemical-specific	USEPA, Spetember 2001	chemical-specific	USEPA, Spetember 2001	
	τ	Lag Time	hour/event	chemical-specific	USEPA, Spetember 2001	chemical-specific	USEPA, Spetember 2001	
	t*	Time to Reach Steady State	hour/event	chemical-specific	USEPA, Spetember 2001	chemical-specific	USEPA, Spetember 2001	
	B	Bunge Model Constant	dimensionless	chemical-specific	USEPA, Spetember 2001	chemical-specific	USEPA, Spetember 2001	
	BW	Body Weight	kg	70	USEPA, December 1989	70	USEPA, December 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, December 1989	2,555	USEPA, December 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, DC. May.

USEPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002Fa/, Office of Research and Development, August.

USEPA, September 2001: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

TABLE 6-11

EXPOSURE FACTOR ASSUMPTIONS/INTAKE EQUATIONS FOR ADULT RECREATIONAL EXPOSURE BY INGESTION OF FISH SITE 17 - BOAT BASIN NTC GREAT LAKES

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference[2]	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CFish	Chemical Concentration in Fish	mg/kg	Calculated by multiplying 95% UCL for Sediment by BASF	USEPA, May 1993	Calculated by multiplying 95% UCL for Sediment by BASF	USEPA, May 1993	Intake (mg/kg-day) = $\frac{Cfish \times IR \times FI \times EF \times ED}{BW \times AT}$
	IR	Ingestion Rate of fish	kg/meal	0.02	Illinois EPA, April 2002	0.008	USEPA, August 1997	
	FI	Fraction ingested from source	unitless	0.1	Professional Judgement	0.1	Professional Judgement	
	EF	Exposure Frequency	meals/year	365	USEPA, August 1997	365	USEPA, August 1997	
	ED	Exposure Duration	years	30	USEPA, May 1993	9	USEPA, May 1993	
	BW	Body Weight	kg	70	USEPA, December 1989	70	USEPA, December 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	10,950	USEPA, December 1989	3,285	USEPA, December 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.
USEPA, December 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002, December.
USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, DC. May.
USEPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002Fa/, Office of Research and Development, August.
Illinois EPA, 2002 - Comments on the Presentation and Draft Meeting Minutes for the March 28, 2002 Meeting Held at Great Lakes NTC, April 5.

TABLE 6-12

NON-CANCER TOXICITY DATA - ORAL/DERMAL
SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN
NTC GREAT LAKES

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD(1)	Dermal RfD Units	Primary Target Organ	Combined Uncertainty/ Modifying Factors (2)	Sources of RfD/Target Organ
Bromodichloromethane	Chronic	2.00E-02	mg/kg-day	1	2.00E-02	mg/kg-day	Renal Cytomegaly	UF = 1000	Iris
Chlorodibromomethane	Chronic	2.00E-02	mg/kg-day	1	2.00E-02	mg/kg-day	Hepatic Lesions	UF = 1000	Iris
Chloroform	Chronic	1.00E-02	mg/kg-day	1	1.00E-02	mg/kg-day	Liver	UF = 100	Iris
cis-1,2-Dichloroethene	Chronic	1.00E-02	mg/kg-day	1	1.00E-02	mg/kg-day	Circulatory		HEAST
Tetrachloroethene	Chronic	1.00E-02	mg/kg-day	1	1.00E-02	mg/kg-day	Body Weight - Liver	UF = 1000	Iris
Trichloroethene	Chronic	6.00E-03	mg/kg-day	1	6.00E-03	mg/kg-day	CNS		NCEA
Vinyl Chloride	Chronic	3.00E-03	mg/kg-day	1	3.00E-03	mg/kg-day	Liver	UF = 30	Iris
Benzo(g,h,I,)perylene (3)	Chronic	3.00E-02	mg/kg-day	1	3.00E-02	mg/kg-day	Kidney	UF = 3000	Iris
Bis(2-ethylhexyl)phthalate	Chronic	2.00E-02	mg/kg-day	1	2.00E-02	mg/kg-day	Liver	UF = 1000	Iris
Fluoranthene	Chronic	4.00E-02	mg/kg-day	1	4.00E-02	mg/kg-day	Blood - Kidney - Liver		Iris
Phenanthrene (3)	Chronic	3.00E-02	mg/kg-day	1	3.00E-02	mg/kg-day	Kidney	UF = 3000	Iris
Pyrene	Chronic	3.00E-02	mg/kg-day	1	3.00E-02	mg/kg-day	Kidney	UF = 3000	Iris
4,4'-DDT	Chronic	5.00E-04	mg/kg-day	1	5.00E-04	mg/kg-day	Liver	UF = 100	Iris
Aldrin	Chronic	3.00E-05	mg/kg-day	1	3.00E-05	mg/kg-day	Liver	UF = 1000	Iris
Alpha-Chlordane (4)	Chronic	5.00E-04	mg/kg-day	1	5.00E-04	mg/kg-day	Hepatic Effects	UF = 300	Iris
Aroclor-1254	Chronic	2.00E-05	mg/kg-day	1	2.00E-05	mg/kg-day	Immunological	UF = 300	Iris
Dieldrin	Chronic	5.00E-05	mg/kg-day	1	5.00E-05	mg/kg-day	Liver	UF = 100	Iris
Endrin Ketone (5)	Chronic	3.00E-04	mg/kg-day	1	3.00E-04	mg/kg-day	Liver - Neurological	UF = 100	Iris/ TACO
Gamma-BHC (Lindane)	Chronic	3.00E-04	mg/kg-day	1	3.00E-04	mg/kg-day	Kidney - Liver	UF = 1000	Iris
Gamma-Chlordane (4)	Chronic	5.00E-04	mg/kg-day	1	5.00E-04	mg/kg-day	Hepatic Effects	UF = 300	Iris
Aluminum	Chronic	1.00E+00	mg/kg-day	1	1.00E+00	mg/kg-day	Body Weight		NCEA
Antimony	Chronic	4.00E-04	mg/kg-day	0.15	6.00E-05	mg/kg-day	Circulatory	UF = 1000	Iris
Arsenic	Chronic	3.00E-04	mg/kg-day	1	3.00E-04	mg/kg-day	Skin - Cardiovascular	UF = 3	Iris
Beryllium	Chronic	2.00E-03	mg/kg-day			mg/kg-day	Gastrointestinal	UF = 300	Iris
Cadmium -water	Chronic	5.00E-04	mg/kg-day	0.025	1.25E-05	mg/kg-day	Kidney - Ingestion	UF = 10	Iris
Cadmium - soil	Chronic	1.00E-03	mg/kg-day	0.025	2.50E-05	mg/kg-day	Kidney - Ingestion	UF = 10	Iris
Chromium (6)	Chronic	3.00E-03	mg/kg-day	0.025	7.50E-05	mg/kg-day	Respiratory	UF = 300 MF = 3	Iris
Cobalt	Chronic	6.00E-02	mg/kg-day	1	6.00E-02	mg/kg-day	Cardiovascular, Neurological, Immuniological		NCEA
Copper	Chronic	3.71E-02	mg/kg-day	1	3.71E-02	mg/kg-day	Gastrointestinal		HEAST
Iron - Adult (7)	Chronic	6.00E-01	mg/kg-day	1	6.00E-01	mg/kg-day	Gastrointestinal		NCEA
Iron - Child (8)	Chronic	1.10E+00	mg/kg-day	1	1.10E+00	mg/kg-day	Gastrointestinal		NCEA
Manganese--soil	Chronic	1.4E-01	mg/kg-day	0.04	5.60E-03	mg/kg-day	Neurological	UF = 1	Iris
Manganese--water	Chronic	4.6E-02	mg/kg-day	0.04	1.84E-03	mg/kg-day	Neurological	UF = 1	Iris
Mercury	Chronic	3.00E-04	mg/kg-day	0.07	2.10E-05	mg/kg-day	Neurological - inh Immuniological - ing	UF = 30	Iris
Nickel	Chronic	2.00E-02	mg/kg-day	0.04	8.00E-04	mg/kg-day	Body Weight	UF = 300	Iris
Selenium	Chronic	5.00E-03	mg/kg-day	1	5.00E-03	mg/kg-day	Skin - Neurological	UF = 3	Iris
Thallium (9)	Chronic	8.00E-05	mg/kg-day	1	8.00E-05	mg/kg-day	Increased levels of SGOT and LDH	UF = 3000	Iris
Vanadium	Chronic	7.00E-03	mg/kg-day	0.026	1.82E-04	mg/kg-day	NOEL		HEAST
Zinc	Chronic	3.00E-01	mg/kg-day	1	3.00E-01	mg/kg-day	Blood	UF = 3	Iris

Source: Iris, Region 9 PRGs.
HEAST = Health Effects Assessment Summary Tables (USEPA, July 1997)
NCEA = USEPA National Center for Environmental Assessment (USEPA Region 9 PRG Table, November 2000)
1 RfD dermal = RfDoral x (Oral to Dermal Adjustment Factor) as given in RAGS Part E (USEPA, Sept. 2001).
2 Modifying Factor not shown if equal to unity.
3 Value given for Pyrene.
4 Value given for Chlordane.
6 Value given for hexavalent chromium.
7 Value issued by NCEA and reported in USEPA Region 3 RBC Tables (October 2001).
8 Value presented by NCEA in Risk Assessment Issue Paper for Derivation of a Provisional RfD for Iron (CASRN-7439-89-6), July 23, 1996.
9 Value given for Thallium Carbonate.

RfD = Reference dose
UF = Uncertainty Factor
MF = Modifying Factor
EPA 9 = USEPA Region 9 Preliminary Remediation Goals
NA = Not Available
TACO = Illinois Tiered Approach to Corrective Action Objectives.
NOEL = No-observed-effect-level.

TABLE 6-13

CANCER TOXICITY DATA - ORAL/DERMAL
SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN
NTC GREAT LAKES

Chemical of Potential Concern	Oral CSF	Oral to Dermal Adjustment Factor(1)	Adjusted Dermal Cancer Slope Factor(1)	Units	Weight of Evidence/ Cancer Guideline Description	Comments
Benzo(a)anthracene	7.3E-01	1	7.30E-01	$(mg/kg\text{-}day)^{-1}$	B2	NCEA
Benzo(a)pyrene	7.3E+00	1	7.30E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Benzo(b)fluoranthene	7.3E-01	1	7.30E-01	$(mg/kg\text{-}day)^{-1}$	B2	NCEA
Benzo(k)fluoranthene	7.3E-02	1	7.30E-02	$(mg/kg\text{-}day)^{-1}$	B2	NCEA
Bis(2-ethylhexyl)phthalate	1.4E-02	1	1.40E-02	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Chrysene	7.3E-03	1	7.30E-03	$(mg/kg\text{-}day)^{-1}$	B2	NCEA
Indeno(1,2,3-cd)pyrene	7.3E-01	1	7.30E-01	$(mg/kg\text{-}day)^{-1}$	B2	NCEA
4,4'-DDD	2.4E-01	1	2.40E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
4,4'-DDE	3.4E-01	1	3.40E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
4,4'-DDT	3.4E-01	1	3.40E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Aldrin	1.7E+01	1	1.70E+01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Alpha-BHC	6.3E+00	1	6.30E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Alpha-Chlordane (2)	3.5E-01	1	3.50E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Aroclor-1254	2.0E+00	1	2.00E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Aroclor-1260	2.0E+00	1	2.00E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Dieldrin	1.6E+01	1	1.60E+01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Gamma-BHC (Lindane)	1.3E+00	1	1.30E+00	$(mg/kg\text{-}day)^{-1}$	B2	HEAST
Gamma-Chlordane (2)	3.5E-01	1	3.50E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Arsenic	1.5E+00	1	1.50E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS

Source: Iris, Region 9 PRGs.
HEAST = Health Effects Assessment Summary Tables (USEPA,
NCEA = USEPA National Center for Environmental Assessment
(USEPA Region 9 PRG Table, November 2000)
1 CSFdermal = CSForal/(Oral to Dermal Adjustment Factor)
If no adjustment recommended, factor = 1.00.
Source: RAGS E (USEPA September 2001)
2 Value given for chlordane.

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity
NA - Not Available

Notes:
CSF = Cancer Slope Factor

TABLE 6-14

CUMULATIVE RISK SUMMARY - REASONABLE MAXIMUM EXPOSURE
SITE 17: PETTIBONE CREEK AND THE BOAT BASIN
NTC, GREAT LAKES, ILLINOIS

HAZARD INDEX

Exposure Route	North Branch Pettibone Creek		South Branch Pettibone Creek		Boat Basin	
	Adolescent Recreational User	Adult Recreational User	Adolescent Recreational User	Adult Recreational User	Adolescent Recreational User	Adult Recreational User
Ingestion of Surface Water					3.6E-02	2.2E-02
Dermal Contact with Surface Water					3.3E-02	4.8E-02
Total Risk from Surface Water					**6.9E-02**	**6.9E-02**
Incidental Ingestion of Sediment	2.2E-02	1.3E-02	4.4E-03	2.7E-03	2.1E-02	1.3E-02
Dermal Contact with Sediment	8.1E-03	1.4E-02	NE(1)	NE	1.1E-02	1.8E-02
Total Risk from Sediment					**3.2E-02**	**3.1E-02**
Ingestion of Fish Tissue						6.6E+00
Total Risk:	**3.0E-02**	**2.7E-02**	**4.4E-03**	**2.7E-03**	**1.0E-01**	**6.7E+00**

INCREMENTAL CANCER RISK

Exposure Route	North Branch Pettibone Creek		South Branch Pettibone Creek		Boat Basin	
	Adolescent Recreational User	Adult Recreational User	Adolescent Recreational User	Adult Recreational User	Adolescent Recreational User	Adult Recreational User
Ingestion of Surface Water					6.9E-07	1.0E-06
Dermal Contact with Surface Water					2.8E-07	7.6E-07
Total Risk from Surface Water					**9.7E-07**	**1.8E-06**
Incidental Ingestion of Sediment	1.3E-06	1.9E-06	2.4E-07	3.4E-07	1.5E-06	2.2E-06
Dermal Contact with Sediment	1.2E-06	5.0E-06	3.0E-07	1.2E-06	1.5E-06	6.0E-06
Total Risk from Sediment					**3.0E-06**	**8.1E-06**
Ingestion of Fish Tissue						1.8E-04
Total Risk:	**2.6E-06**	**6.9E-06**	**5.4E-07**	**1.6E-06**	**3.9E-06**	**1.8E-04**

Blank spaces indicate that the exposure pathway is not applicable to the specified receptor.
1 Not Evalauted for dermal contact because thallium was the only noncarcinogen selected as a COPC (See Section 6.2.4.1).

TABLE 6-15

CUMULATIVE RISK SUMMARY - CENTRAL TENDENCY EXPOSURE
SITE 17: PETTIBONE CREEK AND THE BOAT BASIN
NTC, GREAT LAKES, ILLINOIS

HAZARD INDEX

Exposure Route	North Branch Pettibone Creek		South Branch Pettibone Creek		Boat Basin	
	Adolescent Recreational User	Adult Recreational User	Adolescent Recreational User	Adult Recreational User	Adolescent Recreational User	Adult Recreational User
Ingestion of Surface Water					9.0E-03	5.4E-03
Dermal Contact with Surface Water					7.0E-03	1.1E-02
Total Risk from Surface Water					**1.6E-02**	**1.6E-02**
Incidental Ingestion of Sediment	5.5E-03	3.3E-03	1.1E-03	6.6E-04	5.3E-03	3.2E-03
Dermal Contact with Sediment	5.1E-04	7.7E-04	NE(1)	NE	6.8E-04	1.0E-03
Total Risk from Sediment					**5.9E-03**	**4.2E-03**
Ingestion of Fish Tissue						2.6E+00
Total Risk:	**6.0E-03**	**4.1E-03**	**1.1E-03**	**6.6E-04**	**2.2E-02**	**2.7E+00**

INCREMENTAL CANCER RISK

Exposure Route	North Branch Pettibone Creek		South Branch Pettibone Creek		Boat Basin	
	Adolescent Recreational User	Adult Recreational User	Adolescent Recreational User	Adult Recreational User	Adolescent Recreational User	Adult Recreational User
Ingestion of Surface Water					1.7E-07	7.2E-08
Dermal Contact with Surface Water					6.1E-08	5.8E-08
Total Risk from Surface Water					**2.3E-07**	**1.3E-07**
Incidental Ingestion of Sediment	3.3E-07	1.4E-07	5.9E-08	2.5E-08	3.7E-07	1.6E-07
Dermal Contact with Sediment	7.8E-08	8.2E-08	1.9E-08	2.0E-08	9.3E-08	9.8E-08
Total Risk from Sediment					**4.7E-07**	**2.6E-07**
Ingestion of Fish Tissue						2.1E-05
Total Risk:	**4.1E-07**	**2.2E-07**	**7.9E-08**	**4.5E-08**	**7.0E-07**	**2.1E-05**

Blank spaces indicate that the exposure pathway is not applicable to the specified receptor.
1 Not Evalauted for dermal contact because thallium was the only noncarcinogen selected as a COPC (See Section 6.2.4.1).

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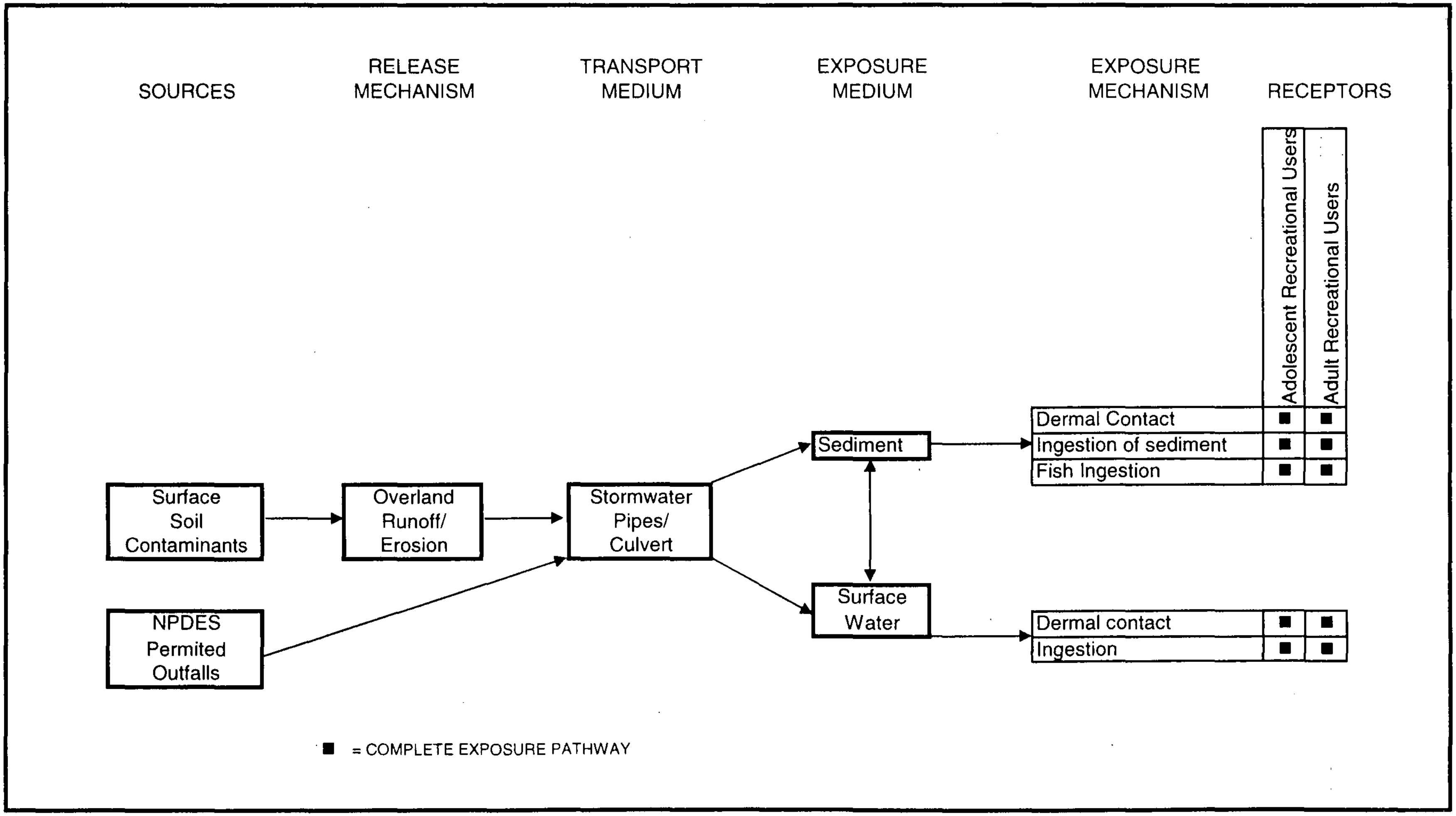
FIGURE 6-1

HUMAN HEALTH CONCEPTUAL SITE MODEL
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS



7.0 ECOLOGICAL RISK ASSESSMENT

The goal of the Ecological Risk Assessment (ERA) for Site 17 (Pettibone Creek and the Boat Basin) is to determine whether adverse ecological impacts are possible as a result of exposure to chemicals. A phased approach to the Screening-Level ERA (SERA) was used that relied on environmental chemistry data and field observations for the preliminary assessment. Biological sampling or testing was not conducted for this RI/RA. The SERA methodology used at NTC Great Lakes follows the guidance presented in the Final Guidelines for Ecological Risk Assessment (USEPA, April 1998), the Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, June 1997), and the Navy Policy for Conducting Ecological Risk Assessments (DON, April 1999), and the QAPP (TtNUS, July 2001) prepared for this project.

This ERA consists of Steps 1, 2, and 3a of the eight steps required by the USEPA guidance (USEPA, June 1997 and 1998) and the Navy Policy for Conducting Ecological Risk Assessments (DON, April 1999). Figure 7-1 presents the Navy's Ecological Risk Assessment Tiered Approach. The first two steps are the SERA. Step 3a is the first step of the Baseline Ecological Risk Assessment (BERA) and further refines the list of COPCs that were retained from the SERA and determines if Steps 3b through 7 of the BERA are necessary. Finally, Step 8, Risk Management, is incorporated throughout the ERA process, in cooperation with the Illinois EPA.

In the first phase of the ERA process (Steps 1 and 2), conservative exposure estimates are made for grouped or individual ecological receptors, and these exposure concentrations are compared to screening-levels and threshold toxicity values. The SERA includes the following considerations:

- Screening-level problem formulation
- Screening-level ecological effects evaluation
- Screening-level exposure estimate
- Screening-level risk calculation

7.1 SCREENING-LEVEL PROBLEM FORMULATION

The screening-level problem formulation for an ERA includes identification of potential receptor groups, COPCs, and the mechanisms for fate/transport and toxicity. Complete exposure pathways that exist on a site are determined at this stage to facilitate receptor selection. As part of receptor identification, site habitats and potential ecological receptors are described.

7.1.1 Environmental Setting

Pettibone Creek originates in North Chicago and enters the facility at the northwest corner of NTC Great Lakes, meandering through Main Side and terminating into Lake Michigan. Pettibone Creek flows through a ravine (named Pettibone Creek Ravine) that ranges from approximately 50 to 100 feet in height with 30- to 70-degree slopes and defines the boundaries between different areas of the Main Installation. The Pettibone Creek system consists of a north and south branch that merge and flow east into Lake Michigan via the Boat Basin. The North Branch of Pettibone Creek begins outside of the Main Installation in an urbanized area zoned for industry and is the discharge point for storm sewers within the City of North Chicago. The South Branch originates in a residential area south of the Department of Veteran's Affairs Hospital, and flows to the east and then to the north through a private golf course before entering the Main Installation site. A 2.6-acre (1.1-ha) boat basin was created at the mouth of Pettibone Creek. Slope and bluff substrates are in various stages of instability due in part to uncontrolled storm run-off and improper repair and maintenance techniques. The slopes of the ravine were found to be unstable at 37 locations and are eroding in specific areas, resulting in undercutting, bank slumping, and structural rotational failures (U.S. Navy, February 2001). Exposed storm sewers and bridge foundations may be contributing to the rapid soil erosion.

Pettibone Creek is considered moderately impaired with respect to designated uses: support to aquatic life and recreational swimming (Illinois EPA, August 1998). The causes of impairment include the presence of elevated concentrations of heavy metals, alterations in habitat, industrial point sources, urban runoff and storm water, channelization, atmospheric deposition of pollutants, and the presence of contaminated sediments. A previous investigation determined that semivolatiles and heavy metals including copper, lead, and zinc were higher in samples collected upstream from the Main Installation, and offsite sources are likely to have contributed to contaminated sediments in Pettibone Creek and the Boat Basin (U.S. Navy, June 1993). In addition, sediment analysis from a harbor-dredging project showed relatively moderate to high levels of PCBs, SVOCs, DDTs, arsenic, copper, lead, zinc, mercury, and ammonia nitrogen when compared to water quality standards or Lake Michigan background concentrations (U.S. Navy, June 1993).

Most of the native forests in areas adjoining the study area have been cleared for development with the remaining native vegetation restricted to the lake bluffs, ravine slopes, and creek bottoms. This combined with additional man-made disturbances has allowed invasive plants to dominate much of the landscape.

According to the Restoration and Maintenance Plan for the Pettibone Creek Ravine, canopy dominants include sugar maple (*Acer saccharum*) and cottonwood (*Populus deltoides).* Northern red oak (*Quercus rubra*), American elm (*Ulmus americana),* and boxelder (*Acer negundo)* are significant subordinants. Sugar maple and boxelder dominate the subcanopy. The shrub layer is dominated by saplings of boxelder, sugar maple, black cherry (*Prunus serotina),* and American elm, as well as dogwood (*Cornus florida*), bush honeysuckle (*Lonicera tatarica*), multiflora rose (*Rosa multiflora*) and eastern black current (*Ribes americanum*). Dominance in the herbaceous layer varies from place to place. Dominant species include garlic mustard (*Alliara petiolata*), bedstraw (*Galium aparine*), wild leek (*Allium tricoccum*), trout lilies (*Erythronium albidum* and *americanum*), wild onion (*Allium sp.*), hispid buttercup *(Ranunculus hispidus*), and false Solomon's seal (*Smilacina racemosa*). Garlic mustard, bedstraw, multiflora rose, bush honeysuckle, teasel (*Dipsacus sylvestris*), and burdock (*Arctium minus*) are the most obvious non-native species, and each of these can, at times, be invasive (Great Lakes Naval Training Center, July 2000).

Pettibone Creek provides potential habitat for fish, as do the Inner and Outer Harbors of the Main Installation. However, recent faunal surveys have not documented significant fish populations within Pettibone Creek, although a few individual fish were reported well upstream from the mouth of the creek. A 1989 investigation of Pettibone Creek found low species diversity in the indigenous fish. Creek chubs (*Semotilus atromaculatus*), fathead minnows (*Pimephales promelas*), green sunfish (*Lepomis cyanellus*), and white suckers (*Catostomus commersoni*) were the dominant species in this community. NTC Great Lakes personnel have observed salmon congregating upstream from the mouth of Pettibone Creek (U.S. Navy, September 1990). The reported salmon are most likely transient individuals and not part of permanent or self-sustaining populations of salmon in the creek.

Recent faunal surveys of the Main Installation have not documented the presence of amphibians or reptiles within Pettibone Ravine, the bluffs, or along the beaches, although potential habitat for these species is present (U.S. Navy, February 2001). Also, it is assumed for this ERA that benthic invertebrates inhabit the Creek, however, this has not been documented through field studies.

Recent bird surveys documented 34 species of breeding birds and 100 species of migratory birds within the Main Installation (U.S. Navy, October 1995 and August 2000). Some of the breeding birds identified in the survey are the belted kingfisher (*Ceryle alcyon*), downy woodpecker (*Picoides pubescens*), red-winged blackbird (*Agelaius phoeniceus*), and the cooper's hawk (*Accipiter cooperii*). The greatest concentration and diversity of species are found in Pettibone Ravine and along the bluffs and beach areas where human impacts are least.

Mammals likely or known to occur on the Main Installation include bat (species undetermined), coyote (*Canis latrans*), opossum (*Didelphis virginiana*), woodchuck (*Marmota monax*), meadow vole (*Microtus pennsylvanicus*), house mouse (*Mus musculus*), white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), gray squirrel (*Sciurus carolinensis*), eastern cottontail (*Sylvilagus floridanus*), and red fox (*Vulpes vulpes*) (Great Lakes Naval Training Center, July 2000). Larger species may be transient and have small populations due to limited amount of habitat, but smaller mammals that require less space have relatively large populations.

Ten species of plants on NTC Great Lakes are State-listed threatened or endangered plants. A few species of birds seen on the site are State-listed threatened or endangered, but were classified by the survey investigator as migrants, and not breeding birds. Section 3.2.3 of the "Implementation on an Integrated Natural Resources Management Plan at Naval Training Center, Great Lakes, Illinois (DON, February 2001), includes a more detailed discussion of the State-listed threatened or endangered plants and birds and their occurrences at NTC Great Lakes. Section 3.2.3 and Tables 3-6 and 3-7 of the plan list these species and their status and have been included in Appendix E.5 of this report. No species of mammals, fish, reptiles, amphibians, or invertebrates at the site are on the state-listed threatened and endangered species lists (DON, February 2001).

7.1.2 Contaminants Ecotoxicity and Fate and Transport

Based on the historical data from the site (see Sections 2 and 4), several classes of chemicals have the potential to be present at the site. These include VOCs, PAHs and other SVOCs, PCBs, pesticides, and metals. Appendix E.1 presents a brief discussion regarding the toxicity, potential food chain and trophic transfer, and fate and transport properties of each class of contaminants.

Physical and chemical characteristics of contaminants may affect their mobility, transport, and bioavailability in the environment. These characteristics include bioconcentration factors (BCFs), organic carbon partition coefficients, and octanol water partition coefficients. Section 5.0 discusses some of these factors as they relate to the fate and transport of the chemicals.

In addition to physical and chemical characteristics, the SERA specifically uses sediment to invertebrate and sediment to fish bioaccumulation factors (BAFs and BSAFs) to predict contaminant loading in invertebrates and fish species. The following are the sources of the BAFs and BSAFs that were used in the SERA:

- Fish BSAFs – PAHs, PCBs, and Pesticides: The Incidence and Severity of Sediment Contamination in Surface Waters of the United States, Volume 1: National Sediment Quality Survey (USEPA, September 1997). These BSAFs are used to estimate wet weight fish concentrations from chemical concentrations in the sediment. These are used as the primary estimator of fish concentrations when the chemical is detected in the sediment.

- Sediment Invertebrate BSAFs - PCBs and Inorganics: Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation (ORNL, August 1988). These BSAFs are used to estimate contaminant uploading from the sediment to benthic invertebrates. The 90% sediment to invertebrate BSAF is used for the conservative food chain model while the median sediment to invertebrate value is used for the average food chain model. For this document, the BSAFs for the inorganic chemicals are referred to as BAFs because that is the common terminology used for inorganic chemicals.

Contaminants that do not have BSAFs are assigned a default value of 1.0. Appendix E.1 presents a table with the BAFs and BSAFs that were used in this SERA.

7.1.3 Potential Exposure Pathways

Pettibone Creek may still be receiving contaminants via the storm sewers or upstream dischargers. Figure 7-2 presents the conceptual site model. Potential ecological receptors (e.g., benthic macroinvertebrates and fish) can be exposed to contaminants in the surface water and sediment of Pettibone Creek by direct contact and incidental ingestion of surface water and sediment. Also, mammals and birds can be exposed to contaminants in the surface water and sediment of Pettibone Creek by direct contact, ingestion of contaminated food items, and incidental ingestion of surface water and sediment. Exposure of terrestrial wildlife to contaminants in the surface water and sediment via dermal contact is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons are expected to minimize transfer of contaminants across dermal tissue. Therefore, the dermal pathway will not be evaluated in the SERA.

7.1.4 Endpoints

7.1.4.1 Assessment Endpoints

Assessment endpoints are an explicit expression of the environmental value that is to be protected (USEPA, June 1997). The selection of endpoints is based on the habitats present, the migration pathways of probable contaminants, and the routes that contaminants may take to enter receptors. For this SERA, the assessment endpoints are protecting the following groups of receptors from adverse effects of contaminants on their growth, survival, and reproduction:

- Benthic invertebrates
- Fish
- Piscivorous birds
- Carnivorous mammals

The following paragraphs discuss why the assessment endpoints were selected for this Screening-Level ERA.

Benthic Macroinvertebrates and Fish: Benthic macroinvertebrates and fish serve as a food source for higher trophic organisms (i.e., fish, amphibians, birds, mammals), and are likely to be present in Pettibone Creek and the Boat Basin. They may be at risk from direct exposure to contaminants in the surface water or sediment. Also, benthic invertebrates and fish can accumulate contaminants that may be transferred to the higher trophic organisms.

Piscivorous Birds and Carnivorous Mammals: Piscivorous birds and carnivorous mammals consume sediment invertebrates and fish that are potentially present in Pettibone Creek and the Boat Basin and may be exposed to contaminants through food items they consume. However, because Pettibone Creek and the Boat Basin do not support large fish populations, this exposure route is not expected to be significant.

7.1.4.2 Measurement Endpoints

Measurement endpoints are estimates of biological impacts (e.g., mortality, adverse effects on growth and reproduction) that are used to evaluate the assessment endpoints. The following measurement endpoints were used to evaluate the assessment endpoints in the SERA.

- No observed adverse effects levels (NOAELs) for surrogate wildlife species – Survival, reproductive, and/or developmental effects to piscivorous birds and carnivorous mammals were evaluated by comparing the ingested dose from contaminants in the surface water, sediment, and fish to NOAELs.

- Sediment screening values – Mortality and other adverse effects (i.e., those on growth, feeding rates, and behavior) to fish and benthic macroinvertebrates were evaluated by comparing the measured concentrations of chemicals in the sediment to screening values designed to be protective of ecological receptors.

- Surface water screening values – Mortality and other adverse effects (i.e., those on growth, feeding rates, and behavior) to aquatic organisms were evaluated by comparing the measured concentrations of chemicals in the surface water to screening values designed to be protective of ecological receptors.

7.1.4.3 Selection of Receptor Species

Many receptors in the aquatic environment are adequately described in general categories such as fish and sediment-dwelling (benthic) invertebrates. This is due to the general nature of the threshold values, effects values, or water quality criteria that are typically used to characterize risk for such organisms. Therefore, specific benthic invertebrates and fish species were not selected as indicator receptor species.

In order to evaluate potential risks to terrestrial wildlife, indicator species with known exposure factors (e.g., body weights and ingestion rates) were selected. Indicator wildlife species were selected for their preferred habitat, body size, sensitivity, home range, abundance, commercial or sport utilization, legal status, and functional role (e.g., predators). To be conservative, indicator species are typically small and have small home ranges. Species known to be sensitive to particular contaminants may be selected, or toxicity values for those species may be used. For example, mink are sensitive to PCBs for reproductive endpoints and therefore Toxicity Reference Values (TRVs) based on risks to minks were selected for exposure to PCBs at this site. The availability of exposure parameters such as body mass, feeding rate, and drinking rate was also a factor in selecting indicator species. The following indicator species were used for the food chain modeling (discussed in more detail later in the ERA):

- Carnivorous mammals: Raccoon
- Piscivorous birds: Belted Kingfisher

Receptor profiles for each of these species are presented in Appendix E.2

7.2 ECOLOGICAL EFFECTS VALUES

The preliminary ecological effects evaluation is an investigation of the relationship between the magnitude of exposure to a chemical and the nature and magnitude of adverse effects resulting from exposure. In addition to being a toxicity study, it may also include descriptions of apparent effects seen during the site visit. Toxicity thresholds are usually expressed in units of concentration when the medium of concern is in intimate contact with the receptor, such as surface water for aquatic organisms or sediment for sediment invertebrates. For other receptors, such as terrestrial vertebrates, toxicity data are typically available as doses, with units equal to mass of contaminant per unit of body mass per unit of time (usually mg/kg-day). The following sections describe the ecological effects values that were used in the SERA.

7.2.1 Surface Water Screening Values

The surface water screening values (SWSVs) used to select COPCs were compiled from several different sources (See Table 7-1) in coordination with Illinois EPA. The following bulleted list presents the order in which the sources were used and the paragraphs following the bulleted list describe the sources:

- Illinois EPA Water Quality Standards (WQS) (Illinois EPA, August 1999)
- Illinois EPA Water Quality Criteria (WQC) (Illinois EPA, June 2000)
- USEPA Recommended Water Quality Criteria (WQC) (USEPA, August 1999)
- Oak Ridge National Laboratory (ORNL) Surface Water Benchmarks (Suter and Tsao, June 1996)
- Screening Quick Reference Tables (SQuiRT) (Buchman, October 1999)
- USEPA Region III BTAG Screening Levels (USEPA, January 1995)

The Illinois EPA WQS are the concentrations of toxic substances that will not result in acute or chronic toxicity to aquatic life. Illinois EPA has also developed WQC for several chemicals that are used to evaluate the quality of surface water bodies (Illinois EPA, June 2000). Most of the metals values were based on dissolved metals in accordance with the Illinois WQS (Illinois EPA, August 1999). The values from Subpart E of the regulations were used because Pettibone Creek is located within the Lake Michigan Basin (Illinois EPA, August 1999). These values were selected first because they are specific to Illinois and are enforceable standards.

The USEPA Recommended WQC was developed by USEPA to provide states with guidance for developing their own criteria (USEPA, April 1999). These values are set to protect the majority of aquatic organisms from adverse impacts from contaminants in the surface water. These values were selected next because they are based on USEPA guidance.

The Suter and Tsao (June 1996) benchmarks were calculated for ORNL using Tier II methodology as described in the USEPA's Proposed Water Quality Guidance for the Great Lakes System (USEPA, April 1993). Tier II values were developed so that aquatic benchmarks could be established with fewer data than are required for the USEPA WQC. These values were selected next because they are commonly used as screening values in ecological risk assessments, however, most of them are not regulatory in nature.

Finally, SQuiRT and BTAG values were used when other sources had no established values for a given analyte. SQuiRT values (Buchman, October 1999) were compiled by the Coastal Protection and Restoration Division (CPR) of the National Oceanic and Atmospheric Administration (NOAA) to serve as initial screening values in identifying potential impacts of hazardous waste sites to coastal habitats. BTAG screening values were developed to serve as conservative guidelines for evaluating sample data collected from Superfund sites. BTAG values consider the most sensitive receptor organisms specific to contaminant and media.

7.2.2 Sediment Screening Values

The sediment screening values (SSVs) used to select COPCs were compiled from different sources in coordination with Illinois EPA (see Table 7-2). The following bulleted list presents the order in which the sources were used and the paragraphs following the bulleted list describe the sources:

- Illinois EPA Tiered Approach for Evaluation and Remediation of Petroleum Product Releases to Sediments (Illinois EPA, September 2000)
- Ecotox Thresholds (USEPA, January 1996)
- Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario (OMOE, August 1993)
- Assessment and Remediation of Contaminated Sediment (ARCS) Project Benchmarks (USEPA, January 1996)

The Illinois EPA has developed a Tiered Approach for Evaluation and Remediation of Petroleum Product Releases to Sediments (Illinois EPA, September 2000). The document lists baseline sediment cleanup objectives and alternate sediment cleanup objectives for several organic chemicals. These values were used first because they were developed by the Illinois EPA.

Evaluation of Illinois Stream Sediment Data 1982-1995 includes tables of sieved and unsieved sediment levels for non-elevated to highly elevated sediments (Illinois EPA, August 1997). The non-elevated values from Appendix A of the document (unsieved sediment) were compared to the site data to determine if a chemical should be retained as a COPC. For chemicals that are not listed in Appendix A of the document, the non-elevated levels from Table 5 of the document (sieved sediment) were used because the mean values in the sieved and unsieved data sets were not significantly different. The QAPP provides the justification for the collection of unsieved sediment samples at NTC Great Lakes (TtNUS, July 2001).

The Illinois EPA calculated/provided SSVs for several chemicals that were detected at NTC Great Lakes but did not have pre-established values. These values are presented in Table 7-2. Other sources in the literature were used to select screening values for chemicals that did not have Illinois EPA screening values as follows:

- The sediment Ecotox Thresholds (USEPA, January 1996) include draft USEPA Sediment Quality Criteria (SQC) that have been established for two contaminants (dieldrin and endrin), Sediment Quality Benchmarks (SQB) that have been established using equilibrium partitioning, and Effects Range-Low (ER-L) values (Long et al., January 1995). ER-L values were not used for screening purposes in this SERA because Long et al. studies were based on saltwater environments not representative of the freshwater conditions at NTC Great Lakes. The SQC and SQBs Ecotox Thresholds are based on an assumption of one percent (1%) organic carbon [10,000 mg/kg total organic carbon (TOC)]. The SQBs (USEPA, January 1996) are based on freshwater data.

- The Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario (OMOE, August 1993) are based on freshwater studies. The Lowest Effects Levels (LEL) (see below) were used as the screening values, when necessary and available. The Ontario Ministry of Environment and Energy (OMOE) guidelines establish three effects levels, as follows:

    - ***No Effect Level (NEL):*** Sediment will not affect fish or sediment-dwelling organisms. In addition, no transfer through the food chain and no effect on water quality is expected.

    - ***Lowest Effect Level (LEL):*** Sediment is considered marginally polluted but will not affect the majority of sediment-dwelling organisms.

- ***Severe Effect Level (SEL):*** Sediment is considered highly polluted and likely to affect the health of sediment-dwelling organisms.

- The National Biological Service produced a set of benchmarks for the USEPA Great Lakes National Program Office as part of the Assessment and Remediation of Contaminated Sediment (ARCS) Project (USEPA, 1996 as cited in Jones, et al., 1997). The benchmarks were developed with the same procedures that were used to develop the ER-L and ER-Ms (Long et al., January 1995), however, are representative of freshwater conditions. The three concentration levels include the no effect concentration, the probable effect concentration, and the threshold effect concentration, similar to OMOE effects levels.

7.2.3 Toxicity Reference Values

The screening values are not designed to screen out risks to piscivorous wildlife. Therefore, in addition to comparing the surface water and sediment concentrations to screening values, risk to piscivorous receptors from the contaminants in the sediment were determined by estimating the Chronic Daily Intake (CDI) and comparing the CDI to Toxicity Reference Values (TRVs) representing acceptable daily doses in mg/kg-day. The TRVs were taken from No-Observed-Adverse-Effect-Levels (NOAELs) and Lowest-Observed-Adverse-Effect-Levels (LOAELs) obtained from wildlife studies, when available. The majority of the TRVs were obtained from the ORNL Toxicological Benchmarks for Wildlife: 1996 Revision (Sample et al., 1996). Other sources for toxicity data were utilized, when necessary. The sources and endpoints for the NOAELs and LOAELs for terrestrial wildlife are presented in Appendix E.3.

7.3 EXPOSURE ESTIMATE

This section describes the potential or actual contact or co-occurrence of the contaminants with the receptors to determine their exposure dose.

Benthic invertebrates and fish are exposed to contaminants in the surface water and sediment through direct contact and/or ingestion of contaminated media. Therefore, the surface water and sediment concentrations are used as the exposure concentrations. However, the exposures of chemicals for mammals and birds are more complex, and need to account for bioaccumulation of chemicals in various food items. Therefore, exposure of the terrestrial receptors to the contaminants in the surface water, sediment, invertebrates, and fish were determined by estimating the daily doses in mg/kg-day using exposure dose equations. The following equations present the food chain model that was used to estimate daily intake for the piscivorous indicator species:

$$\text{CDI(inorganics)} = \frac{[(Cs * BAF_f * If) + (Cs * Is) + (Cw * Iw)] * H}{BW}$$

$$\text{CDI(organics)} = \frac{[(Cs * BSAF_f * \frac{\%L}{\%TOC}) * If) + (Cs * Is) + (Cw * Iw)] * H}{BW}$$

The following equations present the food chain model that was used to estimate daily intake for the carnivorous raccoon indicator species selected for modeling:

$$\text{CDI(inorganics)} = \frac{[(If * Cs * BAF_f)/2 + (If * Cs * BAF_i)/2 + (Iw * Cw) + (Is * Cs)}{BW}$$

$$\text{CDI(organics)} = \frac{[(If * Cs * BSAF_f)/2 + (If * Cs * BSAF_i * \frac{\%L}{\%TOC})/2 + (Iw * Cw) + (Is * Cs)}{BW}$$

Where:

CDI	=	Chronic daily intake (mg/kg-day)
Cs	=	Contaminant concentration in sediment (mg/kg)
BAF_f	=	Sediment-to fish bioaccumulation factor (for inorganics) (unitless)
BAF_i	=	Sediment-to invertebrate bioaccumulation factor (for inorganics) (unitless)
$BSAF_f$	=	Sediment-to fish bioaccumulation factor (for organics) (unitless)
$BSAF_i$	=	Sediment-to invertebrate bioaccumulation factor (for organics) (unitless)
If	=	Ingestion rate of food (kg/day)
%L	=	Percent lipids of the fish (assumed to be ≈3.56%)
%TOC	=	Percent total organic carbon of the sediment (%, see below)
Is	=	Rate of incidental sediment ingestion (kg/day)
Cw	=	Contaminant concentration in water using unfiltered metals data (mg/L)
Iw	=	Ingestion rate of water (L/day)
H	=	Contaminated area/home area range area ratio (unitless)
BW	=	Body weight (kg)

The following input parameters were used in the CDI equation for conservative models:

- Average surface water concentration
- Maximum sediment concentration
- Minimum receptor body weight for CDI equation
- Conservative receptor ingestion rate
- Home range equal to 1 (receptors spend 100% of their time at the site)

The following input parameters were used in the CDI equation for average exposure models:

- Average surface water and sediment concentration
- Average receptor body weight for CDI equation
- Average receptor ingestion rate
- Home range equal to 1 (receptors spend 100% of their time at the site)

Because Pettibone Creek at NTC Great Lakes is comprised of two branches and the Boat Basin, these areas were evaluated independently. The percent TOC varied with each branch of Pettibone Creek evaluated. The percent TOC used for the South Branch was 0.529%, North Branch was 0.39%, and the Boat Basin was 0.642% (see the food chain models in Appendix E.3). The percent lipid value for fish was assumed to be 3.56%, based on the calculation also provided in Appendix E.3. It was also assumed that the raccoon's diet was comprised of 50 percent fish and 50 percent invertebrates, and the belted kingfisher's diet was comprised fully (100 percent) of fish. PAHs were not included in the kingfisher food chain model because they are metabolized in fish tissue and do not accumulate; however, PAHs were included in the raccoon food chain model because it was assumed that 50 percent of the raccoon's diet was comprised of invertebrates that may not metabolize PAHs (Eisler, May 1987; USEPA, November 2000b). Sediment to fish BSAFs were used for the organic parameters in the belted kingfisher models. Only one sediment to fish BSAF was available for each parameter so it was used for the conservative and average food chain models. However, because sediment to fish BAFs are not available, the sediment to invertebrate BAFs were used for the modeling of bioaccumulation of inorganic constituents from sediment to fish. The sediment to invertebrate BAFs and BSAFs were used in both conservative and average input raccoon models. The 90^{th} percentile BAFs and BSAFs were used in the conservative input models, while the median BAFs and BSAFs were used in the average input food chain models.

The surrogate species exposure assumptions (i.e., ingestion rates and body weights) were obtained from the Wildlife Exposure Factors Handbook (USEPA, December 1993). Table 7-3 presents the exposure parameters that were used in the SERA. Appendix E.2 presents the values that were used to calculate the exposure parameters and a discussion of how they were calculated.

7.4 ECOLOGICAL RISK CHARACTERIZATION

The risk characterization compares the exposure concentration/dose to the ecological effects concentration/dose using an Ecological Effects Quotient (EEQ) approach. It is at this phase that the likelihood of adverse effects occurring as a result of exposure to a contaminant is evaluated. An EEQ less than "1.0" indicates that potential risk to the receptors is low. An EEQ greater than "1.0" does not indicate that potential receptors are at risk; it only indicates that the conservative screening values were exceeded and the data should be further evaluated. The EEQ is not an expression of probability and the meaning of values greater than "1.0" must be interpreted in light of uncertainties in ecological risk management.

The EEQ for the aquatic receptors were calculated as follows:

$$EEQ = \frac{C_{sw}}{SWSV} \text{ or } \frac{C_{sd}}{SSV}$$

Where: EEQ = Hazard Quotient, (unitless)

C_{sw} = Contaminant concentration in surface water, (μg/L)

C_{sd} = Contaminant concentration in sediment, 0028μg/kg or mg/kg)

SWSV = Surface Water Screening Value, (μg/L)

SSV = Sediment Screening Value, (μg/kg or mg/kg)

The EEQs for the piscivorous wildlife models were calculated as follows:

$$EEQ = \frac{Dose}{TRV}$$

Where: EEQ = Hazard Quotient, (unitless)

Dose = Daily Intake Dose, (mg/kg-day)

TRV = Toxicity Reference Value (NOAEL or LOAEL), (mg/kg-day)

7.5 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

As the first step in the ecological effects evaluation, COPCs were selected by comparing the contaminant concentrations in the surface water and sediment to screening values developed for each media. The COPCs were selected by comparing the maximum contaminant concentrations in the surface water or sediment to screening values presented in Tables 7-1 and 7-2. Calcium, magnesium, potassium, and sodium were not retained as COPCs in any medium because of their relatively low toxicity to ecological receptors and their high natural variability. Contaminants without screening values were retained as COPCs but were only evaluated qualitatively. Contaminants that were below associated screening values but are considered important bioaccumulative compounds (USEPA, February 2000) were also retained as COPCs. Also, those contaminants that were found at higher concentrations than the Illinois EPA background concentrations (Illinois EPA, August 1997) were retained as COPCs.

If a chemical was not detected at the reporting limit in any sample in a particular media, but the reporting limit exceeded the screening level, the chemical was not quantitatively carried through the risk assessment as a COPC. If a chemical was detected in at least one sample at levels greater than the reporting limit, one-half of the reporting limit was substituted for the non-detects for calculating summary statistics (e.g., mean concentrations).

7.5.1 <u>Risks to Benthic Invertebrates and Fish</u>

7.5.1.1 Sediment

One VOC, 14 SVOCs, 10 pesticides, three PCBs, and 21 inorganic chemicals were detected in the sediment samples from the South Branch of Pettibone Creek (Table 7-4). Ten SVOCs (anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, fluorene, phenanthrene, and pyrene), six pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, endosulfan II, and gamma-chlordane), three PCBs (Aroclor-1248, Aroclor-1254, and Aroclor-1260), and four inorganics (copper, lead, mercury, and zinc) were retained as COPCs because they are bioaccumulative and/or the maximum concentrations exceeded sediment COPC screening levels. Beryllium, thallium, and vanadium were retained as COPCs because no sediment COPC screening levels were available for these chemicals. In addition, three SVOCs (acenaphthylene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene), four pesticides (dieldrin, endrin, endrin aldehyde, and heptachlor epoxide), and four metals (arsenic, cadmium, chromium, and nickel) were retained because they are considered important bioaccumulative compounds even though their maximum concentrations did not exceed SSVs.

One VOC, 21 SVOCs, 12 pesticides, two PCBs, and 23 inorganic chemicals were detected in the sediment samples from the North Branch of Pettibone Creek (Table 7-5). Thirteen SVOCs (anthracene, benzaldehyde, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,I)perylene, carbazole, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene), 8 pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-chlordane, endosulfan I, endosulfan II, and gamma-chlordane), two PCBs (Aroclor-1254 and Aroclor-1260), and eight inorganics (arsenic, cadmium, chromium, copper, lead, mercury, manganese, and zinc) were retained as COPCs because they are bioaccumulative and/or the maximum concentrations exceeded sediment COPC screening levels. Caprolactam, beryllium, selenium, thallium, and vanadium were retained as COPCs because no sediment COPC screening levels were available for these chemicals. In addition, two SVOCs (acenaphthylene and benzo(k)fluoranthene), four pesticides (dieldrin, endrin, endrin aldehyde, and heptachlor epoxide), and two metals (nickel and silver) were retained as COPCs because they are considered bioaccumulative even though their maximum concentrations did not exceed SSVs.

One VOC, 15 SVOCs, 17 pesticides, two PCBs, and 22 inorganic chemicals were detected in the sediment samples from the Boat Basin of Site 17 (Table 7-6). Twelve SVOCs (acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene), 13 pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-BHC, alpha-chlordane, beta-BHC, endosulfan I, endosulfan II, endosulfan sulfate, gamma-BHC, gamma-chlordane, and methoxychlor), two PCBs (Aroclor-1254 and Aroclor-1260), and eight inorganics (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc) were retained as COPCs because they are bioaccumulative and/or the maximum concentrations exceeded sediment COPC screening levels. Delta-BHC, beryllium, selenium, and vanadium were retained as COPCs because no sediment COPC screening levels were available for these chemicals. In addition, two SVOCs (benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene), three pesticides (dieldrin, endrin, and endrin ketone) and one metal (silver) were retained as COPCs because they are considered bioaccumulative even though their maximum concentrations did not exceed the SSVs.

7.5.1.2 Surface Water

Ten VOCs, one SVOC, four pesticides, 18 inorganic chemicals (in the unfiltered samples), and 16 filtered inorganic chemicals were detected in the surface water samples from Site 17 (Table 7-7). Three pesticides (4,4'-DDD, 4,4'-DDE, and 4,4'-DDT) were retained as COPCs because maximum concentrations exceeded associated screening values and are bioaccumulative. Endosulfan I was retained as a COPC because it is bioaccumulative. Six unfiltered metals (aluminum, chromium, copper, iron, lead, and mercury) were retained as COPCs because the maximum concentrations exceeded surface water COPC screening levels and three metals (arsenic, lead, and zinc) were retained as COPCs because they are bioaccumulative compounds even though their maximum concentrations did not exceed the SWSVs. In addition, aluminum and mercury were the only metals detected in the filtered samples at concentrations that exceeded SWSVs, and were retained as COPCs. Arsenic, copper, lead, selenium, and zinc were additionally retained as COPCs for the filtered samples because they are bioaccumulative.

7.5.2 Risks to Terrestrial Wildlife

Tables 7-8 through 7-10 present a summary of detected chemicals and their calculated NOAEL and LOAEL EEQs based on maximum inputs (see section 7.3) in the terrestrial wildlife food chain models. Chemicals were retained as COPCs when their calculated NOAEL EEQ values exceeded "1.0".

One SVOC, four pesticides, three PCBs, and six metals were retained as COPCs for the South Branch (see Table 7-8). Twelve SVOCs, five pesticides, two PCBs, and eight metals were retained as COPCs for the North Branch (see Table 7-9). Ten SVOCs, five pesticides, two PCBs, and eight metals were retained as COPCs in the Boat Basin (see Table 7-10).

7.6 STEP 3A – REFINEMENT OF COPCS

Step 3a refines the list of COPCs from the SERA using less conservative benchmarks and more site-specific exposure assumptions (when and where available) to more realistically estimate potential risks to ecological receptors (i.e., invertebrates, aquatic receptors, and terrestrial wildlife) at NTC Great Lakes. This evaluation also includes (but is not necessarily limited to) a consideration of the following topics:

- Magnitude of criterion exceedance: Although risks may not relate directly to the magnitude of a criterion exceedance, the magnitude may be one factor used in a weight-of-evidence approach to determine the need for further site evaluation.

- Frequency of chemical detection: A chemical that was detected at a low frequency typically will be of less concern than a chemical detected at a high frequency provided that toxicity and concentrations of the contaminants are similar. All else being equal, chemicals detected frequently were given greater consideration than those detected relatively infrequently.

- Contaminant bioavailability: Many contaminants (especially metals) are present in the environment in forms that are typically not bioavailable and the limited bioavailability was considered when evaluating the exposures of receptors to site contaminants.

- Habitat: Although exceedences of criteria may occur, potential risks to ecological receptors may be minimal if there is little habitat for those receptors. Therefore, the extent of habitat was used qualitatively when considering the site for additional evaluation.

- Alternate Benchmarks: Less conservative values based on toxicity data were used to re-evaluate the chemicals that are retained as COPCs to determine if the detected concentrations exceed the higher effects levels (i.e., SEL and PEL values). These alternate values are presented and discussed in more detail in Appendix E.4.

- Realistic Food Chain Models: The exposure doses from the terrestrial food chain models were recalculated using less conservative exposure assumptions (e.g., average ingestion rates, body weights and contaminant concentrations) to determine an average risk. The doses were then compared to NOAELs and LOAELs in this step to further refine probable/improbable risks to ecological receptors.

7.6.1 Risks to Aquatic Receptors

7.6.1.1 Surface Sediment

Although Acid-Volatile Sulfides/Simultaneously Extracted Metals (AVS/SEM) results are not evaluated in the selection of COPCs, they are presented here in an effort to refine risks to ecological receptors from metals. Typically, the ultimate or potential bioavailability of many metals is related to the presence of acid-volatile sulfides in the sediment. AVS refers to the manner in which the metals are measured. When the ratio of the AVS is greater than the ratio of the SEM, most key metals of concern in sediment are bound to the sediment particles as sulfides, and therefore, unavailable to ecological receptors. Typically, AVS bind to finer sediment particles, such as silt.

Three sediment samples from each area were analyzed for AVS/SEM (see Table 7-11). In all cases, the summation of the simultaneously extracted metals (cadmium, copper, lead, nickel, and zinc) exceeded the concentration of acid-volatile sulfides. This indicates that metals are potentially bioavailabile in the South Branch, North Branch, and the Boat Basin, reflecting the very sandy sediment in the area.

7.6.1.1.1 South Branch of Pettibone Creek

SVOCs

Ten SVOCs (see Table 7-4) were retained as COPCs because maximum concentrations exceeded the SSVs. The maximum concentrations for COPCs were detected in sample NTC17PCSD2701. Anthracene was detected above the SSV at a maximum concentration of 1100 µg/kg. This is well below other alternate benchmarks including the SEL of 3700 µg/kg (OMOE, August 1993), the LAET of 2800 µg/kg (Cubbage et al., 1997), and the NEC of 1700 µg/kg (USEPA, 1996). Benzo(a)anthracene was detected at a maximum concentration of 2800 µg/kg, well below alternate benchmarks including the SEL of 14800 µg/kg, the LAET of 7700 µg/kg and the NEC of 3500 µg/kg. The maximum concentration of benzo(a)pyrene was 2100 µg/kg. This concentration is well below the SEL of 14400 µg/kg and the PAET of 9700 µg/kg. Benzo(b)fluoranthene was detected at a maximum concentration of 2200 µg/kg, which is below the only available alternate benchmark, LAET, at 16000 µg/kg. The maximum detected concentration of benzo(g,h,i)perylene at 990 µg/kg was below alternate benchmarks, including the SEL at 3200 µg/kg, the LAET at 1400 µg/kg, and the NEC at 3800 µg/kg. The maximum detected concentration of chrysene at 2900 µg/kg is below the alternate benchmarks of the SEL (4600 µ/kg), the LAET (11000 µg/kg), and the NEC (4000 µg/kg). Fluoranthene was detected at a maximum concentration of 9000 µg/kg, which is below the SEL at 10200 µg/kg and the LAET at 21000 µg/kg. Fluorene was detected at a maximum concentration of 410 µg/kg and is well below the SEL (1600 µg/kg), the LAET (4200 µg/kg), and the PEC (652 µg/kg). Phenanthrene and pyrene were detected at the maximum concentrations of 6300 µg/kg and 6400 µg/kg, respectively. These concentrations are below alternate benchmarks, including the SEL (9500 µg/kg and 8500 µg/kg, respectively) and the LAET (15000 µg/kg and 23000 µg/kg, respectively).

The area of elevated PAH concentrations appear to be isolated to the sample location at a fork in the South Branch. Upstream samples along the South Branch (including NTC17PCSD2601 and NTC17PCSD2801) and samples downstream to the North Branch have maximum detected total PAH concentrations less than or similar to the Illinois EPA Tier I screening value (Figure 4-7).

In summary, although 10 PAHs had maximum concentrations exceeding the conservative SSVs, maximum concentrations were detected in the same sample, which was bounded by samples with low concentrations, and were well below alternate screening benchmarks. Therefore, risks to aquatic receptors from PAHs are expected to be low. For these reasons, PAHs are not retained as COCs in the sediment of the South Branch of Pettibone Creek.

Pesticides

Three pesticides, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT, were retained as COPCs because the maximum concentrations exceeded associated SSVs. The maximum detected 4,4'-DDD concentration at 32 µg/kg in sample NTC17PCSD3501 was below the SEL of 60 µg/kg. The maximum concentration for 4,4'-DDE (31 µg/kg) was well below the SEL of 190 µg/kg and the PEL of 374 µg/kg while the maximum concentration for 4,4'-DDT in sample NTC17PCSD3101 at 290 µg/kg is above alternate available benchmarks. The maximum detected concentration of 290 µg/kg appears to be well bounded at sample NTC17PCSD3101, with lower concentrations of DDT upstream and downstream (Figure 4-7). The upstream (NTC17PCSD3001) and downstream (NTC17PCSD3201) sample concentrations (8.5 µg/kg and 28 µg/kg, respectively) are well below alternate benchmarks including the SEL at 120 µg/kg, and the PEL at 51.7 µg/kg. For these reasons, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT are not retained as COCs.

Three pesticides, alpha-chlordane, gamma-chlordane, and endosulfan II, were retained as COPCs because the maximum concentrations exceeded the SSVs. However, the maximum detected concentrations for alpha-chlordane (2.4 µg/kg) and gamma-chlordane (1.6 µg/kg) were below the conservative alternate benchmarks, including the LEL of 7 µg/kg and the Illinois EPA Tier II value of 6 µg/kg for chlordane. Endosulfan II was detected in half of the samples analyzed with a maximum concentration of 1.9 µg/kg at NTC17PCSD3301. This is below the EcoTox Threshold of 14 µg/kg (USEPA, January 1996). For these reasons, alpha-chlordane, gamma-chlordane, and endosulfan II are not retained as COCs.

PCBs

Aroclor-1248, Aroclor-1254, and Aroclor-1260 were retained as COPCs because the maximum concentrations (50 µg/kg, 140 µg/kg, and 55 µg/kg, respectively) exceeded the SSVs. However, the maximum detections were less than alternate benchmarks, including the PEL (189 µg/kg), and the SEL (5300 µg/kg) for total PCBs. In addition, the PCBs were detected infrequently. For these reasons, risks to aquatic receptors from these PCBs in the sediment are expected to be low and Aroclor-1248, Aroclor-1254, and Aroclor-1260 are not retained as COCs.

Metals

Copper was retained as a COPC because the maximum detected sediment concentration (46.2 mg/kg) in sample NTC17PCSD2601 exceeded the SSV (16 mg/kg) and was above background sediment concentrations (38 mg/kg). However, sample NTC17PCSD2601 is the only sample in which the copper concentration exceeds the SSV. The other detected concentrations were 27.3 mg/kg or below, well below the Illinois EPA background concentration of 38 mg/kg and alternative benchmark, including the SEL of 110 mg/kg (OMOE, August 1993). With these considerations, copper is not expected to adversely impact aquatic receptors and is not retained as a COC.

Lead was retained as a COPC because the maximum detected sediment concentration (57.9 mg/kg) in sample NTC17PCSD2601 exceeded the SSV of 31 mg/kg and was above the Illinois EPA background sediment concentration of 28 mg/kg. In addition to this sample, three other samples had lead concentrations exceeding the SSV, including NTC17PCSD2701, NTCPCSD3201, and NTCPCSD3301. However, the maximum sample concentration was below many alternative benchmarks including the NEC of 69 mg/kg (USEPA, January 1996), the SEL of 250 mg/kg (OMOE, August 1993), and the PAET of 490 mg/kg (Cubbage et al., July 1997). Therefore, risks to aquatic species from lead are expected to be unlikely and lead is not retained as a COC.

Mercury was retained as a COPC because the maximum detected sediment concentration (0.23 mg/kg) in sample NTC17PCSD3401 slightly exceeded the SSV of 0.20 mg/kg and was above background sediment concentrations (0.07 mg/kg). However this is the most upstream sample point of the South Branch and the downstream sample locations had mercury concentrations of 0.18 mg/kg or below. In addition, the maximum concentration is below the SEL of 2 mg/kg (OMOE, August 1993). With these considerations, risks to aquatic receptors from mercury are expected to be low and mercury is not retained as a COC.

Zinc was retained as a COPC because the maximum detected sediment concentration (253 mg/kg), also detected in sample NTC17PCSD2601, exceeded the SSV of 120 mg/kg and was above background sediment concentrations (80 mg/kg). The maximum sample concentration, however, was less than several alternate benchmarks, including the SEL of 820 mg/kg (OMOE, August 1993), the PAET of 1,000 mg/kg (Cubbage et al., July 1997), and the NEC of 541 mg/kg. With these considerations, zinc is not expected to adversely impact aquatic receptors and is not retained as a COC.

In summary, due to the conservative nature of the EEQ calculation, some PAHs, pesticides, PCBs, and metals were retained as COPCs. However, when comparing the data to available alternate benchmarks, it is clear that risks to aquatic receptors from PAHs, pesticides, PCBs, and metals in the South Branch are low and/or unlikely. For this reason, no chemicals have been retained as COCs in the South Branch.

7.6.1.1.2 North Branch of Pettibone Creek

SVOCs

Thirteen semi-volatile chemicals (see Table 7-5) were retained as COPCs because their maximum concentrations exceeded SSVs. Eleven of the semi-volatile constituents that were retained as COPCs were detected in all samples collected. Benzo(g,h,i)perylene was detected in all but one of the samples analyzed. However, benzaldehyde was detected in only one of six samples analyzed. Some PAHs are below certain alternate benchmarks, however, in all cases, maximum detected concentrations are considerably higher than the Illinois EPA Tier II values (Illinois EPA, 2000b) and many of the alternate benchmarks. Due to the frequency of relatively elevated detected concentrations, PAHs are retained as COCs.

Pesticides/PCBs

Six pesticides, including 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-chlordane, endosulfan I, endosulfan II, and gamma-chlordane and two PCBs (Aroclor-1254 and Aroclor-1260), were retained as COPCs because maximum detected concentrations in a variety of samples exceeded the SSVs.

4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected in the samples collected from the North Branch of Pettibone Creek. 4,4'-DDD was detected at a maximum concentration of 150 µg/kg, which is greater than the Illinois EPA Tier II of 20 µg/kg and the SEL of 60 µg/kg. 4,4'-DDE was detected at a maximum concentration of 210 µg/kg, which is greater than the Illinois EPA Tier II of 15 µg/kg and the SEL of 190 µg/kg, however, below the PEL of 374 µg/kg. 4,4'-DDT was detected at a maximum concentration of 1800 µg/kg in sample NTC17OCSD0501. Although other detected concentrations were considerably lower (240 µg/kg or below). The 4,4'-DDT concentrations are greater than the Illinois EPA Tier II of 7 µg/kg. Because risks to aquatic receptors are possible, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT are retained as COCs.

Aldrin and endosulfan I, retained as COPCs because their maximum concentrations exceeded SSVs, were each detected in only one of 24 samples. The low frequency of detection indicates that these contaminants are isolated in the North Branch and pose low risks to aquatic receptors. In addition, the detected concentration of aldrin (6.4 µg/kg) was below the SEL of 80 µg/kg. For these reasons, aldrin and endosulfan I are not retained as COCs.

Alpha-chlordane and gamma-chlordane were retained as COPCs because their maximum detected concentrations exceeded SSVs. However, the maximum detections for alpha-chlordane (6.9 µg/kg) and gamma-chlordane (2.9 µg/kg) are below the LEL for chlordane (7 µg/kg) and well below the SEL for chlordane (60 µg/kg). For this reason potential risks to aquatic receptors are not likely and the chlordane was not retained as COCs.

The maximum endosulfan II concentration (12 µg/kg) was reported for the most upstream sample location NTCPCSD0101. The other results were 7.4 µg/kg or less. However, the positive detections reported were greater than the Illinois EPA Tier II value of 0.5 µg/kg. Endosulfan II was retained as a COC.

Aroclor-1254 and Aroclor-1260 were retained as COPCs because maximum detected concentrations (440 µg/kg and 150 µg/kg, respectively) exceeded the associated SSVs (60 µg/kg and 5 µg/kg, respectively). These chemicals were detected in approximately half of the samples collected. The maximum detected concentrations of Aroclor-1254 were detected in sample NTC17PCSD1901 and in the next downstream sample NTC17PCSD2001 at 400 µg/kg. However, the other detected concentrations were 300 µg/kg or less. These concentrations are less than the SEL of 340 µg/kg and the Tier II value of 400 µg/kg. The maximum detected concentration for Aroclor-1260 in sample NTC17PCSD0301 at 150 µg/kg is also below the SEL of 240 µg/kg. For these reasons Aroclor-1254 and Aroclor-1260 are not considered to pose risks to aquatic receptors and are not retained as COCs.

Metals

Eight metals (arsenic, cadmium, chromium, copper, lead, mercury, manganese, and zinc) were retained as COPCs because maximum detected concentrations exceeded the associated SSVs. Arsenic, chromium, copper, lead, mercury, manganese, and zinc were detected in all of the samples analyzed. Cadmium was detected in 21 of 24 samples analyzed.

Arsenic was detected at a maximum concentration of 10.4 mg/kg in sample NTC17PCSD0101; the Illinois EPA background concentration is 8 mg/kg. However, the maximum detection is below alternate benchmarks, including the LEL of 33 mg/kg, the PAET of 19 mg/kg, and the PEL of 41.6 mg/kg. Additionally, the average concentration of 5.8 mg/kg is below the TEL (7.24 mg/kg), and the Illinois EPA background concentration (8 mg/kg). For these reasons, arsenic is not retained as a COC.

Cadmium was detected at a maximum concentration of 4.2 mg/kg in sample NTCPCSD1501. However, the maximum concentration is below alternate benchmarks, including the SEL of 10 mg/kg, the LAET of 7.6 mg/kg, and the PEL of 4.21 mg/kg. Chromium was detected at a maximum concentration of

55.8 mg/kg in sample NTC17PCSD0101, which is below the SEL of 110 mg/kg, and the PEL of 160 mg/kg. For these reasons, cadmium and chromium were not retained as COCs.

Manganese was detected at a maximum concentration of 662 mg/kg in sample NTCPCSD0601. The maximum concentration, however, is well below the Illinois EPA background concentration (1300 mg/kg), the SEL (1100 mg/kg), the PAET (1400 mg/kg), and the NEC (819 mg/kg). For these reasons, manganese was not retained as a COC.

Copper was detected at a maximum concentration of 477 mg/kg in sample NTCPCSD0201. This concentration along with other detections is well above the SSV, the Illinois EPA background concentration, and alternate benchmarks, including the SEL, the AET, and the PEL. For these reasons copper is retained as a COC. The maximum detected lead concentration (322 mg/kg) was detected in sample NTC17PCSD0101. As with copper, the maximum detection is well above the SSV, the Illinois EPA background concentration, and alternate benchmarks. Therefore, lead is retained as a COC. Mercury was detected at a maximum concentration in sample NTC17PCSD1401 at 4.7 mg/kg. As is the case with copper and lead, the maximum mercury concentration exceeds the SSV, the Illinois EPA background concentration, and the alternative benchmarks. For these reasons, mercury is retained as a COC. The maximum concentration of zinc was detected in sample NTC17PCSD1501 at 2120 mg/kg. The maximum concentration is well above the SSV, the Illinois EPA background concentration, and alternate benchmarks, excluding the AET (3200 mg/kg). Because the average detected zinc concentration (754 mg/kg) is also well above the SSV and the Illinois EPA background, a risk to aquatic receptors is possible. For these reasons, zinc is retained as a COC.

7.6.1.1.3 Boat Basin

SVOCs

Twelve SVOCs (see Table 7-6) were retained as COPCs because their maximum concentrations exceeded SSVs. Maximum concentrations were primarily detected in sample NTC17BBSD4501. Most of the SVOCs retained as COPCs were detected in the majority of the samples collected, excluding naphthalene and acenapthylene. The maximum detected concentrations reported for several SVOCs [anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, fluorene, phenanthrene, and pyrene] were greater than the Illinois EPA Tier II values, but were typically below the SEL and/or the LAET and PAET values. Also, the concentrations of total PAHs were greater than the Illinois EPA Tier II values in some samples. Therefore, the PAHs are retained as COCs.

Naphthalene was detected in one of 12 samples analyzed (NTCBBSD4601). This indicates that the chemical is well bounded (i.e., not detected in any upstream or downstream samples). In addition, the one detected concentration (1200 µg/kg) is below the LAET at 46000 µg/kg. For these reasons, naphthalene is not expected to pose a risk to benthic invertebrates and fish and is not retained as a COC.

Acenaphthylene was detected in half of the samples collected with a maximum concentration of 200 µg/kg in sample NTC17BBSD5601. This sample is from the most downstream sample. Acenaphthylene concentrations upstream of this sample were below the SSV (see Figure 4-11). Acenaphthylene was retained as a COPC; the EEQ calculated for this metal was 1.08 (the benchmark is 1.0). However, the maximum concentration is below the Illinois EPA Tier II value of 662 µg/kg. For these reasons, acenaphthylene is not expected to cause risk to aquatic receptors and is not retained as a COC.

Pesticides

Thirteen pesticides were retained as COPCs due to maximum concentration SSV exceedences. Typically, maximum concentrations were detected in samples NTCBBSD4701 and NTCBBSD4801.

4,4'-DDD was detected at a maximum concentration of 310 µg/kg. 4,4'-DDE was detected at a maximum concentration of 230 µg/kg which is greater than the Illinois EPA Tier II value of 15 µg/kg and the SEL of 190 µg/kg. The maximum detected concentration of 4,4'-DDT was 120 µg/kg, which is also well above the Illinois EPA Tier II value of 7 µg/kg. For these reasons, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDD are retained as COCs.

Aldrin, alpha-BHC, endosulfan sulfate, lindane, and methoxychlor were each detected in only one of 12 samples analyzed. Because these concentrations are considered to be isolated detections, these pesticides are not retained as COCs.

Alpha-chlordane was detected in the twelve samples analyzed with a maximum concentration of 11 µg/kg in sample NTCBBSD4801. However, the other detected concentrations (6.7 µg/kg or below) are less than the LEL of 7 µg/kg. For these reasons, alpha-chlordane is not likely to cause adverse effects to aquatic receptors and is not retained as a COC.

Endosulfan I and endosulfan II were detected at maximum concentrations of 8.7 µg/kg and 12 µg/kg, respectively and are both above the Illinois EPA Tier II value of 0.5 µg/kg for each chemical. These chemicals were detected in most of the samples. Endosulfan I and II are retained as COCs.

Gamma-chlordane was detected in 10 of 12 samples analyzed. The maximum detected concentration (8 µg/kg) in sample NTC17BBSD4801 is considered to be an isolated detection because the other sample concentrations (2.8 µg/kg or less) are less than the Illinois EPA Tier II value of 6 µg/kg and alternate benchmarks, including the LEL (7 µg/kg) and the PEL (4.79 µg/kg) for chlordane. For these reasons, gamma-chlordane is not retained as a COC.

Beta-BHC was detected at a maximum concentration of 7.6 µg/kg in sample NTCBBSD5201 which is well below the SEL of 210 µg/kg. Additionally, beta-BHC was only detected in three samples located in close proximity to each other. Consequently, beta-BHC was not retained as a COC.

PCBs

Aroclor-1254 and Aroclor-1260 were retained as COPCs because their maximum concentrations exceeded SSVs in sample NTC17PCSD4801. The maximum concentrations for Aroclor-1254 and Aroclor-1260 were 660 mg/kg and 270 mg/kg, respectively. These maximum detections are greater than the SEL of 340 µg/kg and 240 µg/kg, respectively and therefore, Aroclor-1254 and Aroclor-1260 are retained as COCs.

Metals

Eight metals including arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc, were retained as COPCs because their maximum concentrations exceeded SSVs. These metals were detected in the samples collected.

Arsenic was detected at a maximum concentration of 9.9 mg/kg; the Illinois EPA unsieved background concentration is 8 mg/kg. The maximum concentration detected in sample NTCBBSD4801 is well below alternate benchmarks, including the SEL of 33 mg/kg, the PAET of 19 mg/kg, and the PEL of 41.6 mg/kg. For this reason, arsenic is not likely to pose risks to aquatic receptors and is not retained as a COC.

The maximum detected concentration for cadmium was 2.2 mg/kg in sample NTCBBSD4801. This is well below alternate benchmarks including the SEL (10 mg/kg), the LAET (7.6 mg/kg), and the PEL (4.21 mg/kg). For this reason, cadmium is not retained as a COC.

The maximum chromium concentration (28.9 mg/kg) was also detected in sample NTCBBSD4801; the SSV is 26 mg/kg. The maximum concentration is well below alternate benchmarks, including the SEL of

110 mg/kg, the PAET of 110 mg/kg, and the TEL of 52.3 mg/kg. For this reason, chromium is not retained as a COC.

Mercury was detected at a maximum concentration of 0.95 mg/kg in sample NTCBBSD4801. The other sample concentrations were 0.34 mg/kg or below, which is less than alternate benchmarks, including the SEL at 2 mg/kg, the LAET at 0.56 mg/kg, and the PEL at 0.7 mg/kg. For this reason and because the maximum concentration is an isolated detection, mercury is not retained as a COC.

Nickel was detected at a maximum concentration of 31.5 mg/kg in sample NTC17BBSD5401; the SSV is 30 mg/kg. The maximum detected concentration is well below alternate benchmarks including the SEL of 75 mg/kg, the LAET of 46 mg/kg, and the PEL of 42.8 mg/kg. For this reason, nickel is not retained as a COC.

Copper, lead, and zinc were detected at maximum concentrations of 283 mg/kg, 289 mg/kg, and 2070 mg/kg, respectively. These metals were detected in the other samples at concentrations exceeding the SSVs (Figure 4-14). For this reason, copper, lead, and zinc were retained as COCs.

7.6.1.2 Surface Water

Pesticides

Four pesticides (see Table 7-7), Endosulfan I, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT, were retained as COPCs because their maximum concentrations exceeded SSVs. 4,4'-DDE was detected in three of six samples collected. 4,4'-DDD and 4,4'-DDT were detected only once in six samples collected. Maximum concentrations for these pesticides were reported for sample NTC17PCSW0201. The maximum detected concentration for 4,4'-DDD (0.0054 µg/L) is well below the secondary chronic Tier II value of 0.011 µg/L, which is based on risks to aquatic life (Suter and Tsao, June 1996). The detected concentration for 4,4'-DDT (0.029 µg/L) is greater than the secondary chronic Tier II value of 0.013 µg/L (Suter and Tsao, June 1996) but well below the acute national ambient water quality criteria (NAWQC) of 1.1 µg/L (USEPA, April 1999). When using 4,4'-DDT as a surrogate for 4,4'-DDE, the maximum detected concentration for 4,4'-DDE (0.024 µg/L) is also well below the acute NAWQ of 1.1 µg/L. For these reasons, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT are not expected to cause adverse effects to aquatic receptors and are not retained as COCs in the surface water.

Metals

Six metals (aluminum, chromium, copper, iron, lead, and mercury) were retained as COPCs because their maximum detected concentrations exceeded SSVs in unfiltered samples. Only two of these metals, aluminum and mercury, are detected at concentrations exceeding the SSVs in the filtered samples.

The maximum detected concentration of aluminum at 9460 µg/L (unfiltered) was above the SSV (87 µg/L) and well above the acute NAWQC (750 µg/L). Aluminum is retained as a COC for this reason. However, the maximum detection of aluminum in the filtered sample (317 µg/L) was below the acute NAWQC. Also, the average concentration (92 µg/L) was just slightly greater than the chronic SSV. Aluminum is typically found at concentrations greater than screening levels because it is an abundant natural element. It is not retained as a COC, however, because the average concentration is a good indicator of actual exposure concentration to aquatic receptors in surface water due to the flow of Pettibone Creek. Aquatic receptors are exposed to a range of concentrations, represented by the comparison of the AWQC to the average concentration. Additionally, the average concentration only slightly exceeds the chronic SSV. The risks from aluminum to aquatic receptors are likely negligible and low at most. Therefore, it would not be appropriate to retain aluminum as a COC.

Chromium was detected in only one of six samples at 14.4 µg/L in the unfiltered samples; the SSV is 11 µg/L. Also, the single detection is well below the chronic NAWQC of 74 µg/L for chromium III, and it was not detected in filtered samples. Metals concentrations in filtered samples are typically considered more bioavailable to aquatic organisms. For these reasons, chromium is not retained as a COC in surface water.

Copper was detected at a maximum concentration of 22.2 µg/L (unfiltered) in sample NTC17PCSW0101, the most upstream North Branch sample. Most of the other unfiltered detections are greater than the chronic NAWQC (9.0 µg/L). However, none of the filtered results exceeded the SWSV and for this reason, copper is not retained as a COC.

Iron was detected in the six unfiltered surface water samples with a maximum detection of 10900 µg/L in sample NTC17PCSW0301. Four of the six detections are below the chronic NAWQC of 1000 µg/L and none of the filtered results exceeded the SWSV. For these reasons, iron is not retained as a COC.

Lead was detected in five of six unfiltered samples with a maximum detection in sample NTC17PCSW0301. The maximum concentration of 18 µg/L barely exceeded the SSV of 16.5 µg/L, however the other concentrations were below the SSV. In addition, the maximum concentration is below the acute NAWQC of 65 µg/L and none of the filtered results exceeded the SWSV. For these reasons, lead is not retained as a COC in surface water.

Mercury was detected in four of six unfiltered samples with a maximum concentration of 0.1 µg/L, detected in sample NTC17PCSW0401. However, the maximum concentrations in the unfiltered and filtered samples are well below the chronic NAWQC of 0.77 µg/L. Therefore mercury is not retained as a COC.

7.6.2 Risks to Terrestrial Wildlife

Appendix E.3 presents EEQs calculated using the terrestrial wildlife model's NOAELs and LOAELs and based on average input parameters for the belted kingfisher and raccoon. The average concentrations detected in the surface water and sediment samples were used for the average food chain model. Metals data for average input calculations were based on unfiltered sample results.

Tables 7-12 through 7-14 present a summary of chemicals retained as COPCs and their calculated NOAEL and LOAEL EEQs based on average inputs (see section 7.3) in the terrestrial food chain models.

7.6.2.1 South Branch

The EEQs calculated for four pesticides, three PCBs, and five metals exceeded 1.0 when maximum/conservative exposure assumptions are evaluated using the food chain models (see Table 7-8). When reevaluating these chemicals with average input values in the food chain models (see Table 7-12), five pesticides, two PCBs, and five metals had calculated NOAEL EEQs greater than 1.0. Aroclor-1248, Aroclor-1254, 4,4'-DDD, endrin, endrin aldehyde, arsenic, chromium, mercury, and zinc had calculated NOAEL EEQs only slightly above 1.0; however, calculated LOAEL EEQs were less than 1.0, indicating that risks to terrestrial receptors from these chemicals are low. 4,4'-DDE, 4,4'-DDT, and lead had calculated LOAEL EEQs above 1.0 at 17, 7.6, and 1.3, respectively for the kingfisher; no chemicals had LOAEL EEQs greater than 1.0 for the raccoon. It is unlikely that kingfishers will obtain a significant portion of food from the South Branch of Pettibone Creek because the creek is small and there are not significant fish populations. Therefore, although the EEQs exceed 1.0, potential risks to piscivorous birds are expected to be low because of the low exposure potential. For these reasons, no chemicals are retained as COCs for food chain modeling.

7.6.2.2 North Branch

Ten SVOCs, five pesticides, two PCBs, and eight metals were retained as COPCs due to calculated NOAEL EEQs greater than 1.0 in the maximum/conservative inputs food chain models (see Table 7-9). When reevaluating these chemicals with average input values in the food chain models (see Table 7-13), one SVOC, two pesticides, two PCBs, and two metals had NOAEL EEQs greater than 1.0 but LOAEL EEQs less than 1.0. Due to the conservative nature of the average food chain models, risks to terrestrial receptors based on these low LOAEL values are unlikely and the chemicals are not retained as COCs. However, three pesticides, including 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT, and five metals, including chromium, copper, lead, mercury, and zinc, had LOAEL EEQs slightly exceeding 1.0. The LOAEL EEQs for the metals and 4,4'-DDD are just slightly greater than 1.0 (1.2 to 4.8). Therefore, after assuming that piscivorous birds would not obtain a significant portion of their food from the North Branch of Pettibone Creek, risks from these parameters are low and they are not retained as COCs. However, potential risks from 4,4'-DDE and 4,4'-DDT have higher LOAEL EEQs (94 and 43, respectively), so they are retained as COCs.

7.6.2.3 Boat Basin

Eight SVOCs, five pesticides, two PCBs, and eight metals were retained as COPCs due to NOAEL EEQs greater than 1.0 in the maximum/conservative inputs food chain models (see Table 7-10). When reevaluating these chemicals with average input values in the food chain models, no SVOCs had NOAEL or LOAEL EEQs greater than 1.0 in the raccoon model and only one SVOC had a NOAEL EEQ only slightly above 1.0 in the kingfisher model (see Table 7-14). Two PCBs, one pesticide, and one metal had calculated NOAEL EEQs slightly above 1.0 in the models. Due to the conservative assumptions of the food chain model and because LOAEL EEQs were below 1.0, these chemicals present little if any risk to terrestrial receptors and were not retained as COCs. Three pesticides including 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT, and five metals including copper, chromium, lead, mercury, and zinc had calculated LOAEL EEQs slightly above 1.0 in the kingfisher model and were retained as COCs.

7.7 ECOLOGICAL RISK UNCERTAINTY ANALYSIS

This section presents some of the uncertainties associated with the ERA.

7.7.1 <u>Measurement and Assessment Endpoints</u>

Measurement endpoints are used to evaluate the assessment endpoints that are selected for the SERA. For this SERA, the measurement endpoints are not the same as the assessment endpoints. Therefore, the measures are used to predict effects to the assessment endpoints by selecting surrogate species that will be evaluated.

Several endpoints were not quantitatively evaluated in this SERA. For example, risks to reptiles and amphibians were not quantitatively evaluated because exposure factors are not established for most species, and toxicity data are very limited.

7.7.2 Exposure Characterization

The contaminant dose to terrestrial wildlife is calculated using an equation that incorporates ingestion rates, body weights, bioaccumulation factors, and other exposure factors. These exposure factors were obtained from literature studies or predicted using various equations. Ingestion rates and body weights vary between species, especially between species inhabiting different areas.

Bioaccumulation of contaminants into various biological media (i.e., fish and invertebrates) depends on characteristics of the media such as pH, organic carbon, etc. Therefore, actual BAFs and BSAFs at the sites may be different than those used in the SERA that were obtained from literature sources. Also, bioavailability of chemicals is not considered in this SERA. The chemicals are assumed to be 100% bioavailable at the detected concentrations, which is unlikely to occur for contaminants in the environment.

There is uncertainty in the chemical data that were collected at the site. Measured concentrations of chemicals are only estimates of the true site chemical concentrations. For samples that are deliberately biased toward known or suspected high concentrations (i.e., collecting samples in depositional areas), predicted doses may be higher than actual doses to the receptors. This is because it is not likely that the receptor will feed only in contaminated areas.

Under the conservative exposure scenario, terrestrial wildlife are assumed to live and feed only at the site. These assumptions tend to over-predict risk because it is unlikely that most receptors obtain all their food from within the site boundaries. Less conservative exposure assumptions were used in the Step 3a refinement to calculate and refine exposure estimates for potential ecological receptors. An average CDI was calculated for chemicals that were retained as COPCs.

7.7.3 Ecological Effects Data

There is uncertainty in the ecological toxicity value comparison. The water quality criteria developed by USEPA in theory protects 95 percent of the exposed species. Therefore, some sensitive species present at the site may not be protected by the use of these criteria. With the exception of hardness for a few metals, the SWSVs do not account for site-specific factors such as TOC or pH that may affect toxicity. There may also be situations where the screening levels are over-predictive of risk if the sensitive species used to develop the criteria do not inhabit the site. Additional uncertainty exists in the benchmarks used for the screening process. For example, four inorganic chemicals (arsenic, copper, manganese, and silver) have SSVs less than the Illinois EPA background concentrations. The SSVs for these chemicals are overly conservative, and risks for these chemicals are possibly over predicted.

The toxicity of chemical mixtures is not well understood. The toxicity information used in the SERA for evaluating risk to the ecological receptors is for individual chemicals. Chemical mixtures can affect the organisms very differently than the individual chemicals because of synergistic or antagonistic effects.

Finally, toxicological data for some of the contaminants may not exist. Therefore, there is uncertainty in the conclusions involving the potential impacts to ecological receptors from these constituents.

7.7.4 Risk Characterization

Risks are projected if an EEQ is greater than or equal to unity (1.0) regardless of the magnitude of the EEQ. Although the relationship between the magnitude of an EEQ and toxicity is not necessarily linear, the magnitude of an EEQ can be used as rough approximation of the extent of potential risks, especially if there is sufficient confidence in the guideline used. Finally, there is uncertainty in how the predicted risks to individuals at the site translate into risk to the population in the area as a whole.

7.8 SUMMARY AND CONCLUSIONS

Several chemicals that were detected in the surface water and/or sediment were initially retained as COPCs because their chemical concentrations exceeded screening levels or they were bioaccumulative chemicals with EEQs greater than one based on the conservative exposure scenarios. These chemicals were then reevaluated in Step 3a of this ERA to determine which chemicals have the greatest potential for causing risks to ecological receptors, and therefore, should be retained as COCs for further discussion/evaluation. The two primary ecological endpoints evaluated in this ERA were aquatic organisms (i.e., fish and invertebrates) and mammals and birds that consume invertebrates and/or fish. Therefore, different lists of chemicals were retained as COCs for these different endpoints. Also note that there were different lists of COCs for each of the areas (i.e., the North Branch of Pettibone Creek, the South Branch of Pettibone Creek, the Boat Basin).

Table 7-15 lists the chemicals that were retained as COCs for each of the endpoints in each of the areas. No chemicals detected in the surface water were retained as COCs for risks to aquatic organisms. A few of the chemicals detected in the surface water were included in the food chain model, however, the drinking portion of the food chain models is insignificant for exposure because the chemicals concentrations in surface water are much lower than they are in sediment. Therefore, although some of the pesticides (4,4'-DDE and 4,4'-DDT) and metals were retained as COCs for the food chain model, it was because of the concentrations in the sediment, not in the surface water. Consequently, no chemicals in the surface water were retained as COCs for either of the primary endpoints.

No chemicals were retained as COCs for surface water or sediments in the South Branch of Pettibone Creek for aquatic receptors or mammals/birds. With the exception of a few sporadic elevated detections, the chemical concentrations in this branch are relatively low, and may represent a good background/reference location for comparisons to data (i.e., chemical and biological) collected in the North Branch and Boat Basin.

PAHs, several pesticides, and several metals in sediment samples were retained as COCs for risks to aquatic receptors in the North Branch of Pettibone Creek because they were detected at concentrations that exceeded many of the alternate benchmarks in several samples. Also, two pesticides (4,4'-DDE and 4,4'-DDT) were retained as COCs because they may cause risks to piscivorous birds. As observed from Figures 4-3 and 4-6, most of the elevated concentrations of these chemicals were detected in the most upstream sample that indicate that the predominant source of these chemicals appears to be off-site of NTC Great Lakes. In addition, the concentrations of pesticides are indicative of concentrations associated with typical applications of the pesticides when it was legal to do so. Therefore, although these chemicals were retained as COCs, the fact that they may not be site-related needs to be factored into the risk management decisions.

PAHs, several pesticides and PCBs, and several metals in sediment samples were retained as COCs for risks to aquatic receptors in the Boat Basin because they were detected at concentrations that exceeded many of the alternate benchmarks in several samples. Also, one pesticide (4,4'-DDE) was retained as a COC because the pesticide may cause risks to piscivorous birds. In addition, the concentrations of pesticides are indicative of concentrations associated with typical applications of the pesticides when it was legal to do so. Therefore, although these chemicals were retained as COCs, the fact that they may not be site-related needs to be factored into the risk management decisions.

In summary, several chemicals were retained as COCs in the North Branch of Pettibone Creek and the Boat Basin because they were detected at concentrations that exceeded many of the alternate benchmarks in several samples. This indicates that there may be potential risks to aquatic receptors from these chemicals. However, because these conclusions are based on literature values, there is uncertainty in the conclusions. Also, because of the large amount of soil erosion in the creek, there are physical stressors as well as chemical stressors that may be adding to the risks to aquatic organisms. These uncertainties could be reduced by conducting site-specific toxicity tests and/or biological surveys that could be used to determine site-specific risk-based screening levels.

Finally, pesticides were selected as COCs in the North Branch of Pettibone Creek and the Boat Basin because they may cause a risk to piscivorous birds that consume fish from the area. The risks are based on predicted fish tissue concentrations from the sediment concentrations that incorporate the assumed percent lipids of the fish and site-specific TOC of the sediment. The sediment in Pettibone Creek and the Boat Basin is very sandy with little TOC. Therefore, the predicted fish tissue concentrations of pesticides are much greater than the pesticide concentrations in the sediment. The literature values used to make these predictions may not represent actual site conditions. In addition, although the elevated pesticide detections are located in several samples along the creek and Boat Basin, the samples were biased toward depositional areas that are expected to have greater chemical concentrations that the rest of the creek. Also, based on the evaluation in Section 8 (Fish Tissue Uncertainty Analysis Evaluation with historical data), it appears that risks to piscivorous birds and mammals are overestimated. The amount of overestimation cannot be quantified with the existing data. For these reasons, there is considerable uncertainty in the conclusion of potential risks to piscivorous birds from chemical concentrations. These uncertainties could be further reduced by collecting forage fish tissue samples to determine actual chemical concentrations, or by conducting a biological survey to determine if there are adequate numbers of fish to comprise a significant portion of the diet for piscivorous birds.

In conclusion, the chemical data related to the SVOCs, PCBs, and metals indicate potential risks to aquatic organisms and piscivorous birds exposed to chemicals in the North Branch of Pettibone Creek and Boat Basin. The potential risks are based on literature data and can be better defined by conducting site-specific biological studies.

TABLE 7-1

**DERIVATION OF SURFACE WATER CRITERIA
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NTC GREAT LAKES, ILLINOIS**

PARAMETER	Value used for Screening Level	Illinois EPA WQS 1999		Illinois EPA WQC 2000a		USEPA WQC 1999		Suter and Tsao, 1996[11]			Additional Sources[10]
		Acute[3]	Chronic[3]	Acute	Chronic	Acute	Chronic	Acute	Chronic	LCV[1]	
Volatile Organics (ug/L)											
ACETONE	122,000			1,530,000	122,000			28,000	1500	1560	
BENZALDEHYDE											
BROMODICHLOROMETHANE	11,000										11,000[8]
2-BUTANONE	14,000							240,000	14,000	282,170[2]	
CARBON DISULFIDE	0.92							17	0.92	244[2]	
CHLORODIBROMOMETHANE	11,000										11,000[8]
CHLOROFORM	150			1870	150			490	28	1240	
CIS-1,2-DICHLOROETHENE	11,600										11,600[8]
METHYLENE CHLORIDE	1380			17,200	1380			26,000	2200	42,667[2]	
METHYL TERT-BUTYL ETHER											
PHENOL	100		100							200	
TETRACHLOROETHENE	152			1220	152			830	98	750	
TOLUENE	230			2000	230			120	9.8	1269[2]	
TRICHLOROETHENE	940			11,700	940			440	47	7257	
VINYL CHLORIDE	11,600										11,600[9]
Semi-Volatile Organics (ug/L)											
DI-N-BUTYL PHTHALATE	35							190	35	697	
DIETHYL PHTHALATE	210							1800	210	85,600	
Pesticides/PCBs (ug/L)											
4,4'-DDD	0.001					1.1[7]	0.001[7]	0.19	0.011	1.69[2]	
4,4'-DDE	0.001					1.1[7]	0.001[7]				
4,4'-DDT	0.001					1.1	0.001		0.013	0.016[2]	
ENDOSULFAN I	0.056					0.22	0.056		0.051		
Inorganics (ug/L)											
ALUMINUM	87					750	87			460	
ANTIMONY	30							180	30	610	
ARSENIC	148	340	148			340	150	66[12]	3.1[12]	48	
BARIUM	5000		5000					110	4.0		
BERYLLIUM	0.66							35	0.66	5.3	
CADMIUM	4.41	10.4	4.41			4.14[4]	0.41[4]			0.15	
CALCIUM											
CHORMIUM (III)	158	3311	158			1046[4]	136[4]			44	
CHROMIUM (VI)	11	16	11			16	11			2	
COBALT	23							1500	23	5.1	
COPPER	17.6	28.2	17.6			27.0[4]	16.9[4]			0.23	
IRON	1000		1000				1000			158	
LEAD	16.5	315	16.5			143[4]	5.59[4]			12.26	
MAGNESIUM											
MANGANESE	1000		1000					2300	120	1100	
MERCURY	0.0013	1.7	0.91/0.0013[6]			1.4	0.77		1.3[5]	0.23	
NICKEL	97.7	879	97.7			877[4]	97.4[4]			5	
POTASSIUM											
SELENIUM	5.0		5.0				5.0			88.32	
SODIUM											
THALLIUM	12							110	12	57	
VANADIUM	20							280	20	80	
ZINC	225	225	225			220[4]	222[4]			30	

1 - LCV = Lower chronic value for all organisms.
2 - LCV is an estimated value.
3 - Dissolved inorganics criteria were used except for barium, chromium (VI), and manganese. Values for cadmium, chromium (III), lead, nickel, and zinc are based on hardness (Illinois EPA, 1999). Hardness (210 mg/L) was calculated using the average filtered calcium (50.7 mg/L) and magnesium (20.3 mg/L) concentrations from the site.

Hardness (H) = average calcium concentration*2.497+ average manganese concentration*4.118

4 - Criteria derived from calculated hardness (210 mg/L) and the dissolved value for cadmium, chromium III, copper, lead, nickel, and zinc (USEPA, 2001).
5 - The chronic value is used as the benchmark to protect aquatic life.
6 - The 0.0013 ug/L value for mercury is based on protecting the wildlife consuming organism from the water body.
7 - The value for DDT was used as a surrogate.
8 - Buchmann, 1999
9 - Region III BTAG Screening Level (USEPA, 1995)
10 - Additional sources are only listed for chemicals for which no other criteria were available.
11- Values are Tier II secondary acute and chronic values.
12 - Hexavalent arsenic value.

TABLE 7-2

DERIVATION OF SEDIMENT SCREENING CRITERIA
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NTC GREAT LAKES, ILLINOIS
PAGE 1 OF 2

PARAMETER (mg/kg)	Screening Value	Illinois EPA Background (Illinois EPA, 1997)(1)	Illinois EPA (September, 2000)		EcoTox (USEPA, January 1996) [2]	OMOE, 1993		USEPA, 1996		
			Tier 1	Tier 2		LEL	SEL [2]	TEC	PEC	NEC
Volatile (mg/kg)										
METHYLENE CHLORIDE	0.018		0.018 [3]	0.26 [3]						
Semi-Volatile Organics (mg/kg)										
2-METHYLNAPHTHALENE	0.368		0.368 [4]	0.67 [4]						
ACENAPHTHYLENE	0.186		0.186 [5]	0.662 [5]						
ANTHRACENE	0.085		0.085	0.96		0.22	3.7	0.03162	0.54772	1.7
BENZALDEHYDE	0.0011		0.0011 [3]	0.004 [3]						
BENZO(A)ANTHRACENE	0.287		0.287	1.6		0.32	14.8	0.26	4.2	3.5
BENZO(A)PYRENE	0.073		0.073	2.5		0.37	14.4	0.35	0.3937	0.44
BENZO(B)FLUORANTHENE	0.886		0.886							
BENZO(G,H,I)PERYLENE	0.17					0.17	3.2	0.29	6.3	3.8
BENZO(K)FLUORANTHENE	8.86		8.86			0.24	13.4			
BIS(2-ETHYLHEXYL)PHTHALATE	130		130 [3,5]	92,000 [3,5]						
BUTYL BENZYL PHTHALATE	6		6 [3]	21 [3]	11					
CAPROLACTAM	NA									
CARBAZOLE	0.11		0.11 [3]	0.4 [3]						
CHRYSENE	0.4		0.4	2.8		0.34	4.6	0.5	5.2	4
DIBENZO(A,H)ANTHRACENE	0.06		0.06	0.26		0.06	1.3		0.0282	0.87
DIBENZOFURAN	0.91		0.91 [3]	3.2 [3]	2.0					
FLUORANTHENE	2.79		2.79	9.92		0.75	10.2	0.06423	0.83427	7.5
FLUORENE	0.035		0.035	0.64	0.54	0.19	1.6	0.03464	0.65192	1.8
INDENO(1,2,3-CD)PYRENE	2.5		2.5			0.2	3.2	0.078	0.83666	3.8
NAPHTHALENE	0.34		0.34	2.1	0.48			0.03275	0.68739	0.29
PHENANTHRENE	0.81		0.81	2.88		0.56	9.5			
PHENOL	140		140 [3]							
PYRENE	0.35		0.35	2.2		0.49	8.5	0.57	3.225	6.1
TOTAL PAHs	4		4	35		4	100	3.553	13.66	84.6
HMW PAHs	1.7							2.9	4.353	51
LMW PAHs	0.552							0.786	3.369	3.04
Pesticides/PCBs (mg/kg)										
ALDRIN	0.00051		0.00051 [3]			0.002	0.08			
ALPHA-BHC	0.000023		2.3E-05 [3]		0.004 [6]	0.006	0.1			
ALPHA-CHLORDANE	0.0005		0.0005 [3,7]	0.006 [3,7]		0.007 [7]	0.06 [7]			
4,4'-DDD	0.002		0.002 [3]	0.02 [3]		0.008	0.06			
4,4'-DDE	0.002		0.002 [3]	0.015 [3]		0.005	0.19			
4,4'-DDT	0.001		0.001 [3]	0.007 [3]		0.008	0.71			
TOTAL DDT	0.007					0.007	0.12			
AROCLOR-1248	0.03					0.03	1.5			
AROCLOR-1254	0.06					0.06	0.34			
AROCLOR-1260	0.005					0.005	0.24			
BETA-BHC	0.00037		0.00037 [3]		0.004 [6]	0.005	0.21			
DELTA-BHC										
DIELDRIN	0.05		0.05 [3]	0.18 [3]	0.052	0.002	0.91			
ENDOSULFAN I	0.00015		0.00015 [3,8]	0.0005 [3,8]	0.003					
ENDOSULFAN II	0.00015		0.00015 [3,8]	0.0005 [3,8]	0.014					
ENDOSULFAN SULFATE	0.0054				0.005 [8]					
ENDRIN	0.019		0.019 [3]	0.067 [3]	0.02 [9]	0.003	1.3			

TABLE 7-2

DERIVATION OF SEDIMENT SCREENING CRITERIA
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NTC GREAT LAKES, ILLINOIS
PAGE 2 OF 2

PARAMETER (mg/kg)	Screening Value	Illinois EPA Background (Illinois EPA, 1997)(1)	Illinois EPA (September, 2000)		EcoTox (USEPA, January 1996) [2]	OMOE, 1993		USEPA, 1996		
			Tier 1	Tier 2		LEL	SEL[2]	TEC	PEC	NEC
Volatile (mg/kg)										
ENDRIN ALDEHYDE	0.02				0.02 [10]	0.003 [10]	1.3 [10]			
ENDRIN KETONE	0.02				0.02 [10]	0.003 [10]	1.3 [10]			
GAMMA-BHC (LINDANE)	0.00039		0.00039 [3]		0.004	0.003	0.01			
GAMMA-CHLORDANE	0.0005		0.0005 [3,7]	0.006 [3,7]		0.007 [7]	0.06 [7]			
HEPTACHLOR EPOXIDE	0.005					0.005	0.05			
METHOXYCHLOR	0.0088		0.0088 [3,5]	0.031 [3,5]	0.019					
TOTAL PCBs	0.05		0.05 [3]	0.4 [3]		0.07	5.3	0.03162	0.24466	0.194
Inorganics (mg/kg)										
ALUMINUM	58030								58030	73160
ANTIMONY	2		2	25						
ARSENIC	6	8.0				6	33	12.1	57	92.9
BARIUM	NA	145 [11]								
BERYLLIUM	NA									
CADMIUM	0.6	0.5				0.6	10	0.592	11.7	41.1
CALCIUM	NA									
CHROMIUM	26	16.0				26	110	56	159	312
COBALT	50					50				
COPPER	16	38				16	110	28	77.7	54.8
IRON	20000	18000				20000	40000			
LEAD	31	28				31	250	34.2	396	68.7
MAGNESIUM	NA									
MANGANESE	460	1300				460	1100	1673	1081	819
MERCURY	0.2	0.07				0.2	2			
NICKEL	30	26 [11]	30	50		16	75	39.6	38.5	37.9
POTASSIUM	NA	1500 [11]								
SELENIUM	NA									
SILVER	1	5 [11]	1	2.2		0.5				
SODIUM	NA									
THALLIUM	NA									
VANADIUM	NA									
ZINC	120	80				120	820	159	1532	541

Notes:
ER-L values were not used on this table
1 - Illinois EPA Background values for unsieved data
2 - Values assume 1% organic carbon.
3 - Calculated using Illinois EPA unpublished derived water quality criteria (Illinois EPA, 2002)
4 - Total Methylnaphthalenes
5 - Value is provisional; insufficient toxicological data available to fully develop criteria pursuant to Illinois EPA document 35 IAC 302.Subpart F
6 - Lindane value
7 - Chlordane
8 - Endosulfan, mixed isomers
9 - USEPA L-SQG (USEPA, September 1993a,b)
10 - Endrin value used to create surrogate
11 - Illinois EPA Background values for sieved data

TABLE 7-3

EXPOSURE PARAMETERS FOR TEST SPECIES AND SURROGATE WILDLIFE SPECIES
NTC GREAT LAKES, ILLINOIS

Species	Body Weight (kg)			Food Ingestion Rate (kg/day)		Water Ingestion Rate (L/day)		Sediment Ingestion Rate (kg/day) (2)		Home Range (acres) (3)		
	Avg.	Min.	Max.	Avg.	Conserv.	Avg.	Conserv.	Avg.	Conserv.	Avg.	Min.	Max.
Surrogate Wildlife Species (1)												
Raccoon	6.865	5.34	8.86	1.3388	1.6512	0.5664	0.5698	0.125847	0.155213	385.5	266.9	504.1
Belted Kingfisher	0.152	0.136	0.17	0.0689	0.0758	0.0167	0.0187	0.001378	0.001516	1.16	0.39	2.19

Notes:
See Appendix E-2 for the source of calculation of the exposure factors
NA - Not Applicable
1 - USEPA, 1993 for all factors except sediment ingestion which is from Beyer (1994)
2 - The incidental soil ingestion rate is calculated by multiplying the food ingestion rate by the calculated incidental soil ingestion rate (0.094 for the raccoon and 0.02 for the belted kingfisher)
3 - Home range for the kingfisher is presented in km of shoreline

TABLE 7-4

ECOLOGICAL COPC SELECTION - SURFACE SEDIMENT
SOUTH BRANCH PETTIBONE CREEK
NTC GREAT LAKES, ILLINOIS
PAGE 1 OF 2

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Average of Positive Results(7)	Illinois EPA Background Concentration (3)	Sediment COPC Screening Level(4)	Ecological Effects Quotient (5)	Retained as a COPC? (6)	Rationale for Contaminant Deletion or Selection(8)
VOLATILE ORGANICS (UG/KG)											
METHYLENE CHLORIDE	1/2	8.9	8.9	NTC17PCSD2901	6.0	8.9		18	0.49	NO	BSL
SEMIVOLATILE ORGANICS (UG/KG)											
ACENAPHTHYLENE	2/14	25 J	51 J	NTC17PCSD3501	236	38		186	0.27	YES	BIO
ANTHRACENE	14/14	19	1100	NTC17PCSD2701	128	128		85	12.94	YES	ASL/BIO
BENZO(A)ANTHRACENE	14/14	69	2800	NTC17PCSD2701	360	360		287	9.76	YES	ASL/BIO
BENZO(A)PYRENE	14/14	66	2100 J	NTC17PCSD2701	327	327		73	28.77	YES	ASL/BIO
BENZO(B)FLUORANTHENE	14/14	61	2200	NTC17PCSD2701	324	324		886	2.48	YES	ASL/BIO
BENZO(G,H,I)PERYLENE	14/14	34	990 J	NTC17PCSD2701	173	173		170	5.82	YES	ASL/BIO
BENZO(K)FLUORANTHENE	14/14	34	1300	NTC17PCSD2701	182	182		8860	0.15	YES	BIO
BIS(2-ETHYLHEXYL)PHTHALATE	2/2	80 J	130 J	NTC17PCSD2901	105	105		130000	0.00	NO	BSL
CHRYSENE	14/14	65	2900	NTC17PCSD2701	371	371		400	7.25	YES	ASL/BIO
FLUORANTHENE	14/14	160	9000	NTC17PCSD2701	1061	1061		2790	3.23	YES	ASL/BIO
FLUORENE	14/14	13 J	410 J	NTC17PCSD2701	56	56		35	11.71	YES	ASL/BIO
INDENO(1,2,3-CD)PYRENE	14/14	37	880 J	NTC17PCSD2701	160	160		2500	0.35	YES	BIO
PHENANTHRENE	14/14	85	6300	NTC17PCSD2701	675	675		810	7.78	YES	ASL/BIO
PYRENE	14/14	130	6400	NTC17PCSD2701	784	784		350	18.29	YES	ASL/BIO
PESITICDES/PCBS (UG/KG)											
4,4'-DDD	14/14	7.6	32	NTC17PCSD3501	17.4	17.4	6.0	2	16.0	YES	ASL/BIO
4,4'-DDE	14/14	10	31	NTC17PCSD2701	19.9	19.9	6.0	2	15.5	YES	ASL/BIO
4,4'-DDT	14/14	8.5	290	NTC17PCSD3101	41.8	41.8	6.0	1	290	YES	ASL/BIO
ALPHA-CHLORDANE	13/14	0.35 J	2.4 J	NTC17PCSD2901	1.7	1.1	5.0	0.5	4.80	YES	ASL
AROCLOR-1248	1/14	50	50	NTC17PCSD3101	23.1	50.0		30	1.67	YES	ASL/BIO
AROCLOR-1254	3/14	84	140	NTC17PCSD2901	40.5	111		60	2.33	YES	ASL/BIO
AROCLOR-1260	1/14	55	55	NTC17PCSD3301	23.3	55.0		5	11.0	YES	ASL/BIO
DIELDRIN	12/13	0.16 J	2.9	NTC17PCSD2801	1.6	0.9	3.5	50	0.06	YES	BIO
ENDOSULFAN II	7/14	0.3 J	1.9 J	NTC17PCSD3301	2.4	0.9		0.15	12.7	YES	ASL/BIO
ENDRIN	4/14	0.42 J	1.3 J	NTC17PCSD2801	2.5	0.8	1.0	19	0.07	YES	BIO
ENDRIN ALDEHYDE	1/14	4	4	NTC17PCSD3401	2.8	4.0		20	0.20	YES	BIO
GAMMA-CHLORDANE	12/14	0.31 J	1.6 J	NTC17PCSD2701	1.7	1.0	5.0	0.5	3.20	YES	ASL
HEPTACHLOR EPOXIDE	4/14	0.15 J	0.46 J	NTC17PCSD2801	2.3	0.2	1.0	5	0.09	YES	BIO
INORGANICS (MG/KG)											
ALUMINUM	14/14	1480	3760	NTC17PCSD3401	2445	2445		58030	0.06	NO	BSL
ANTIMONY	4/14	0.33	0.49	NTC17PCSD3801	0.2	0.4		2	0.25	NO	BSL
ARSENIC	14/14	1.5	5.4	NTC17PCSD3401	4.0	4.0	8.0	6	0.90	YES	BIO
BARIUM	14/14	6.9	40.4	NTC17PCSD2601	22.3	22.3	145	NA	NA	NO	BKG
BERYLLIUM	11/14	0.13	0.44	NTC17PCSD2601	0.2	0.2		NA	NA	YES	NTX
CADMIUM	9/14	0.07	0.19	NTC17PCSD3401	0.1	0.1	0.5	0.6	0.32	YES	BIO

TABLE 7-4

ECOLOGICAL COPC SELECTION - SURFACE SEDIMENT
SOUTH BRANCH PETTIBONE CREEK
NTC GREAT LAKES, ILLINOIS
PAGE 2 OF 2

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Average of Positive Results(7)	Illinois EPA Background Concentration (3)	Sediment COPC Screening Level(4)	Ecological Effects Quotient (5)	Retained as a COPC? (6)	Rationale for Contaminant Deletion or Selection(6)
CALCIUM	14/14	25700	99100	NTC17PCSD2501	45171	45171		NA	NA	NO	NT
CHROMIUM	14/14	5.5	14.7	NTC17PCSD2601	9.3	9.3	16	26	0.57	YES	BIO
COBALT	14/14	2.4	7.6	NTC17PCSD3101	4.7	4.7		50	0.15	NO	BSL
COPPER	14/14	3.4	46.2	NTC17PCSD2601	17.8	17.8	38	16	2.89	YES	ASL/BIO
IRON	14/14	4900	13100 J	NTC17PCSD2701	9287	9287	18000	20000	0.66	NO	BSL/BKG
LEAD	14/14	8.3	57.9	NTC17PCSD2601	32.4	32.4	28	31	1.87	YES	ASL/BIO
MAGNESIUM	14/14	14100	54500	NTC17PCSD2501	24450	24450		NA	NA	NO	NT
MANGANESE	14/14	177	504	NTC17PCSD2501	317	317	1300	460	1.10	YES	ASL
MERCURY	14/14	0.02	0.23	NTC17PCSD3401	0.1	0.1	0.07	0.2	1.15	YES	ASL/BIO
NICKEL	14/14	3.6	15.4	NTC17PCSD3101	8.9	8.9	26	30	0.51	YES	BIO
POTASSIUM	14/14	306	602	NTC17PCSD3401	408	408	1500	NA	NA	NO	NT/BKG
SODIUM	14/14	78.3	205	NTC17PCSD2601	125	125		NA	NA	NO	NT
THALLIUM	7/14	0.73 J	1.5	NTC17PCSD3401	0.7	1.1		NA	NA	YES	NTX
VANADIUM	14/14	6.8	13.2	NTC17PCSD3401	9.2	9.2		NA	NA	YES	NTX
ZINC	14/14	31	253	NTC17PCSD2601	114	114	80	120	2.11	YES	ASL/BIO
MISCELLANEOUS PARAMETERS											
PH (S.U.)	14/14	7.9	8.5	NTC17PCSD2501	8.1	8.1		NA	NA	NO	NZ
TOTAL ORGANIC CARBON (MG/KG)	14/14	1400	16400	NTC17PCSD3301	5286	5286		NA	NA	NO	NZ

Shaded name indicates that constituent was selected as a COPC. Shaded values indicate that the site concentration(s) exceeds this particular criterion.

Footnotes:
1 Only the original of duplicate samples was considered for COPC selection. The duplicate was used for quality control purposes only.
2 The maximum detected concentration was used for screening purposes.
3 Illinois EPA Background values for unsieved and sieved data (Illinois EPA, 1997).
4 As presented in Table 7-2
5 Refer to Section 7.4 for ecological effects quotient calculation.
6 Rationale Codes:

For Selection as a COPC:
- ASL = Above COPC screening level.
- NTX = No toxicity information available.
- BIO = Bioaccumulative chemical.

For Elimination as a COPC:
- BSL = Below COPC screening level.
- NT = Nontoxic.
- BKG = Below Illinois EPA background levels.
- NZ = Not applicable because these parameters are used to characterize the sediments and/or cannot be used to evaluate ecological risks

7 The average of all results was calculated using 1/2 of the reporting limit for non-detected results

Definitions:
COPC = Chemical of Potential Concern
NA = Not Available.

ASSOCIATED SAMPLES
NTC17PCSD2501
NTC17PCSD2601
NTC17PCSD2701
NTC17PCSD2801
NTC17PCSD2901
NTC17PCSD3001
NTC17PCSD3101
NTC17PCSD3201
NTC17PCSD3301
NTC17PCSD3401
NTC17PCSD3501
NTC17PCSD3601
NTC17PCSD3701
NTC17PCSD3801

TABLE 7-5

ECOLOGICAL COPC SELECTION - SURFACE SEDIMENT
NORTH BRANCH PETTIBONE CREEK
NTC GREAT LAKES, ILLINOIS
PAGE 1 OF 2

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Average of Positive Results	Illinois EPA Background Concentration(3)	Sediment COPC Screening Level(4)	Ecological Effects Quotient (5)	COPC Flag (6)	Rationale for Contaminant Deletion or Selection(6)
VOLATILE ORGANICS (UG/KG)											
METHYLENE CHLORIDE	1/6	11	11	NTC17PCSD0401	4.25	11		18	0.61	NO	BSL
SEMIVOLATILE ORGANICS (UG/KG)											
2-METHYLNAPHTHALENE	3/6	55 J	93 J	NTC17PCSD2301	130	70.7		368	0.25	NO	BSL
ACENAPHTHYLENE	8/24	13 J	92 J	NTC17PCSD1001	728	51.1		186	0.49	YES	BIO
ANTHRACENE	24/24	37	4000	NTC17PCSD0101	443	443		85	47	YES	ASL/BIO
BENZALDEHYDE	1/6	1500	1500	NTC17PCSD0401	409	1500		1.1	1364	YES	ASL
BENZO(A)ANTHRACENE	24/24	150	11000	NTC17PCSD0101	1304	1304		287	38	YES	ASL/BIO
BENZO(A)PYRENE	24/24	130	11000	NTC17PCSD0101	1294	1294		73	151	YES	ASL/BIO
BENZO(B)FLUORANTHENE	24/24	150	12000	NTC17PCSD0101	1362	1362		886	14	YES	ASL/BIO
BENZO(G,H,I)PERYLENE	23/24	70	7500 J	NTC17PCSD0101	886	922		170	44	YES	ASL/BIO
BENZO(K)FLUORANTHENE	24/24	78	6300	NTC17PCSD0101	740	740		8860	0.71	YES	BIO
BIS(2-ETHYLHEXYL)PHTHALATE	6/6	280 J	680	NTC17PCSD2301	562	562		130000	0.01	NO	BSL
BUTYL BENZYL PHTHALATE	1/6	37 J	37 J	NTC17PCSD1801	167	37.0		6000	0.01	NO	BSL
CAPROLACTAM	1/6	57 J	57 J	NTC17PCSD1801	170	57.0		NA	NA	YES	NTX
CARBAZOLE	6/6	75 J	720	NTC17PCSD1401	284	284		110	6.55	YES	ASL
CHRYSENE	24/24	150	12000	NTC17PCSD0101	1351	1351		400	30.0	YES	ASL/BIO
DIBENZOFURAN	6/6	37 J	250 J	NTC17PCSD1401	118	118		910	0.27	NO	BSL
FLUORANTHENE	24/24	380	33000	NTC17PCSD0101	3772	3772		2790	11.8	YES	ASL/BIO
FLUORENE	24/24	21 J	2400 J	NTC17PCSD0101	270	270		35	69	YES	ASL/BIO
INDENO(1,2,3-CD)PYRENE	24/24	70	5800 J	NTC17PCSD0101	658	658		2500	2.3	YES	ASL/BIO
PHENANTHRENE	24/24	210	24000	NTC17PCSD0101	2498	2498		810	30	YES	ASL/BIO
PHENOL	1/6	94 J	94 J	NTC17PCSD0401	175	94.0		140000	0.0	NO	BSL
PYRENE	24/24	310	27000	NTC17PCSD0101	2974	2974		350	77	YES	ASL/BIO
PESTICIDES/PCBS (UG/KG)											
4,4'-DDD	24/24	2.3	170	NTC17PCSD1901	64.0	64.0	6	2	85	YES	ASL/BIO
4,4'-DDE	24/24	4.3	210	NTC17PCSD1901	82.9	82.9	6	2	105	YES	ASL/BIO
4,4'-DDT	24/24	4.9	1800	NTC17PCSD0501	173.8	174	6	1	1800	YES	ASL/BIO
ALDRIN	1/24	6.4 J	6.4 J	NTC17PCSD0101	13.1	6.4	1	0.51	12.5	YES	ASL/BIO
ALPHA-CHLORDANE	14/22	0.16 J	6.9 J	NTC17PCSD1901	10.3	2.5	5	0.5	13.8	YES	ASL/BIO
AROCLOR-1254	14/24	56	440	NTC17PCSD1901	120.2	192		60	7.3	YES	ASL/BIO
AROCLOR-1260	12/23	41	150	NTC17PCSD0301	47.9	74		5	30	YES	ASL/BIO
DIELDRIN	6/22	0.23 J	1.7 J	NTC17PCSD2101	13.5	0.7	3.5	50	0.03	YES	BIO
ENDOSULFAN I	1/24	1.1 J	1.1 J	NTC17PCSD1201	12.5	1.1		0.15	7.33	YES	ASL/BIO
ENDOSULFAN II	9/24	0.52 J	12 J	NTC17PCSD0101	12.6	3.2		0.15	80	YES	ASL/BIO
ENDRIN	1/24	2.6 J	2.6 J	NTC17PCSD0401	12.6	2.6	1	19	0.14	YES	BIO
ENDRIN ALDEHYDE	1/24	3.3	3.3	NTC17PCSD1001	13.0	3.3		20	0.17	YES	BIO
GAMMA-CHLORDANE	7/24	0.91 J	2.9 J	NTC17PCSD0401	11.1	1.73	5	0.5	5.80	YES	ASL/BIO
HEPTACHLOR EPOXIDE	3/24	0.13 J	0.2 J	NTC17PCSD1001	12.8	0.17	1	5	0.04	YES	BIO

TABLE 7-5

ECOLOGICAL COPC SELECTION - SURFACE SEDIMENT
NORTH BRANCH PETTIBONE CREEK
NTC GREAT LAKES, ILLINOIS
PAGE 2 OF 2

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Average of Positive Results	Illinois EPA Background Concentration(3)	Sediment COPC Screening Level(4)	Ecological Effects Quotient (5)	COPC Flag (6)	Rationale for Contaminant Deletion or Selection(6)
INORGANICS (MG/KG)											
ALUMINUM	24/24	1960	4810	NTC17PCSD1001	2742	2742		58030	0.08	NO	BSL
ANTIMONY	11/24	0.27	1.5	NTC17PCSD0101	0.4	0.62		2	0.75	NO	BSL
ARSENIC	24/24	3.7	10.4	NTC17PCSD0101	5.8	5.8	8	6	1.73	YES	ASL/BIO
BARIUM	24/24	17.2	122	NTC17PCSD0601	35.4	35.4	145	NA	NA	NO	BKG
BERYLLIUM	18/24	0.39	1.4	NTC17PCSD1501	0.6	0.7		NA	NA	YES	NTX
CADMIUM	21/24	0.11	4.2	NTC17PCSD1501	0.7	0.8	0.5	0.6	7.00	YES	ASL/BIO
CALCIUM	24/24	34300	110000	NTC17PCSD0601	58021	58021		NA	NA	NO	NT
CHROMIUM	24/24	8.4	55.8 J	NTC17PCSD0101	16.5	16.5	16	26	2.15	YES	ASL/BIO
COBALT	24/24	4 J	11.3	NTC17PCSD2101	6.0	6.0		50	0.23	NO	BSL
COPPER	24/24	35.1	477	NTC17PCSD0201	156	156	38	16	29.8	YES	ASL/BIO
IRON	24/24	8570 J	14900 J	NTC17PCSD0101	11758	11758	18000	20000	0.75	NO	BSL/BKG
LEAD	24/24	30.8	322 J	NTC17PCSD0101	118	118	28	31	10.4	YES	ASL/BIO
MAGNESIUM	24/24	17900	51400	NTC17PCSD1201	30188	30188		NA	NA	NO	NT
MANGANESE	24/24	243	662	NTC17PCSD0601	368	368	1300	460	1.44	YES	ASL
MERCURY	24/24	0.04	4.7	NTC17PCSD1401	0.4	0.4	0.1	0.2	23.5	YES	ASL/BIO
NICKEL	24/24	8.1	23	NTC17PCSD1301, NTC17PCSD1501	14.8	14.8	26	30	0.77	YES	BIO
POTASSIUM	24/24	292	798	NTC17PCSD1001	427	427	1500	NA	NA	NO	NT/BKG
SELENIUM	4/24	0.46	6.6	NTC17PCSD1601	0.50	2.0		NA	NA	YES	NTX/BIO
SILVER	8/24	0.55	3.2	NTC17PCSD0401	0.62	1.6	5	1	3.2	YES	BIO
SODIUM	24/24	128	658	NTC17PCSD1501	243	243		NA	NA	NO	NT
THALLIUM	13/24	0.74	2.1 J	NTC17PCSD1001	0.8	1.2		NA	NA	YES	NTX
VANADIUM	24/24	7.1	17.9	NTC17PCSD0901	10.7	10.7		NA	NA	YES	NTX
ZINC	24/24	126	2120	NTC17PCSD1501	754	754	80	120	17.67	YES	ASL/BIO
MISCELLANEOUS PARAMETERS (MG/KG)											
PH S.U.	24/24	7.9	8.4	NTC17PCSD0601	8.2	8.2		NA	NA	NO	NZ
TOTAL ORGANIC CARBON	24/24	1000	9240	NTC17PCSD0101	3896	3896		NA	NA	NO	NZ

Shaded name indicates that constituent was selected as a COPC. Shaded values indicate that the site concentration(s) exceeds this particular criterion.

Footnotes:
1 Only the original of duplicate samples was considered for COPC selection. The duplicate was used for quality control purposes only.
2 The maximum detected concentration was used for screening purposes.
3 Illinois EPA Background values for unsieved and sieved data (Illinois EPA, 1997).
4 As presented in Table 7-2
5 Refer to Section 7.4 for ecological effects quotient calculation.
6 Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level.
NTX = No toxicity information available.
BIO = Bioaccumulative chemical.

For Elimination as a COPC:
BSL = Below COPC screening level.
NT = Nontoxic.
BKG = Below Illinois EPA Background levels.
NZ = Not applicable because these parameters are used to characterize the sediments and/or cannot be used to evaluate ecological risks

Definitions:
COPC = Chemical of Potential Concern.
NA = Not Available.

ASSOCIATED SAMPLES

NTC17PCSD0101	NTC17PCSD1301
NTC17PCSD0201	NTC17PCSD1401
NTC17PCSD0301	NTC17PCSD1501
NTC17PCSD0401	NTC17PCSD1601
NTC17PCSD0501	NTC17PCSD1701
NTC17PCSD0601	NTC17PCSD1801
NTC17PCSD0701	NTC17PCSD1901
NTC17PCSD0801	NTC17PCSD2001
NTC17PCSD0901	NTC17PCSD2101
NTC17PCSD1001	NTC17PCSD2201
NTC17PCSD1101	NTC17PCSD2301
NTC17PCSD1201	NTC17PCSD2401

TABLE 7-6

ECOLOGICAL COPC SELECTION - SURFACE SEDIMENT
BOAT BASIN
NTC GREAT LAKES, ILLINOIS
PAGE 1 OF 2

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Average of Positive Results	Illinois EPA Background Concentration(3)	Sediment COPC Screening Level(4)	Ecological Effects Quotient (5)	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
VOLATILE ORGANICS (UG/KG)											
METHYLENE CHLORIDE	1/1	6.6	6.6	NTC17BBSD4701	6.6	6.6		18	0.37	NO	BSL
SEMIVOLATILE ORGANICS (UG/KG)											
ACENAPHTHYLENE	6/12	24 J	200 J	NTC17BBSD5601	378	103		186	1.08	YES	ASL/BIO
ANTHRACENE	12/12	49 J	1900	NTC17BBSD4601	501	501		85	22.4	YES	ASL/BIO
BENZO(A)ANTHRACENE	12/12	250	4900	NTC17BBSD4501	1248	1248		287	17.1	YES	ASL/BIO
BENZO(A)PYRENE	12/12	260	4500	NTC17BBSD4501	1128	1128		73	61.6	YES	ASL/BIO
BENZO(B)FLUORANTHENE	12/12	280	4500	NTC17BBSD4501	1142	1142		886	5.1	YES	ASL/BIO
BENZO(G,H,I)PERYLENE	10/12	200 J	2800	NTC17BBSD4501	634	730		170	16.5	YES	ASL/BIO
BENZO(K)FLUORANTHENE	12/12	150	2500	NTC17BBSD4501	645	645		8860	0.28	YES	BIO
BIS(2-ETHYLHEXYL)PHTHALATE	1/1	610 J	610 J	NTC17BBSD4701	610	610		130000	0.00	NO	BSL
CHRYSENE	12/12	270	4900	NTC17BBSD4501	1236	1236		400	12.3	YES	ASL/BIO
FLUORANTHENE	12/12	730	14000	NTC17BBSD4501	3591	3591		2790	5.0	YES	ASL/BIO
FLUORENE	12/12	40 J	1300	NTC17BBSD4501, NTC17BBSD4601	332	332		35	37.1	YES	ASL/BIO
INDENO(1,2,3-CD)PYRENE	12/12	150 J	2000	NTC17BBSD4501	482	482		2500	0.80	YES	BIO
NAPHTHALENE	1/12	1200 J	1200 J	NTC17BBSD4601	705	1200		340	3.5	YES	ASL
PHENANTHRENE	12/12	380	10000	NTC17BBSD4501	2653	2653		810	12.3	YES	ASL/BIO
PYRENE	12/12	560	11000	NTC17BBSD4501	2726	2726		350	31.4	YES	ASL/BIO
PESTICIDES/PCBS (UG/KG)											
4,4'-DDD	12/12	71	310	NTC17BBSD4801	117	117	6	2	155	YES	ASL/BIO
4,4'-DDE	12/12	55	230	NTC17BBSD4801	86.5	87	6	2	115	YES	ASL/BIO
4,4'-DDT	11/12	34	120	NTC17BBSD4701	63.8	68	6	1	120	YES	ASL/BIO
ALDRIN	1/12	4.1 J	4.1 J	NTC17BBSD4701	9.0	4.1	1	0.51	8.0	YES	ASL/BIO
ALPHA-BHC	1/12	6.5 J	6.5 J	NTC17BBSD5601	9.6	6.5	1	0.023	283	YES	ASL/BIO
ALPHA-CHLORDANE	12/12	1.2 J	11 J	NTC17BBSD4801	3.6	3.6	5	0.5	22.0	YES	ASL/BIO
AROCLOR-1254	4/12	79	660	NTC17BBSD4801	116	307		60	11.0	YES	ASL/BIO
AROCLOR-1260	3/12	49	270	NTC17BBSD4801	56.2	163		5	54.0	YES	ASL/BIO
BETA-BHC	3/12	5.6 J	7.6 J	NTC17BBSD5201	7.9	6.7		0.37	20.5	YES	ASL/BIO
DELTA-BHC	4/12	2 J	8.5 J	NTC17BBSD5601	6.1	5.9		NA	NA	YES	NTX/BIO
DIELDRIN	10/12	1.5 J	13 J	NTC17BBSD4801	4.7	4.02	3.5	50	0.26	YES	BIO
ENDOSULFAN I	10/11	0.68 J	8.7 J	NTC17BBSD4801	3.4	3.2		0.15	58.0	YES	ASL/BIO
ENDOSULFAN II	9/11	0.94 J	12 J	NTC17BBSD5201	5.4	4.6		0.15	80.0	YES	ASL/BIO
ENDOSULFAN SULFATE	1/12	7.3 J	7.3 J	NTC17BBSD5201	8.2	7.3		5.4	1.35	YES	ASL
ENDRIN	1/12	1.3 J	1.3 J	NTC17BBSD4601	9.2	1.3	1	19	0.07	YES	BIO
ENDRIN KETONE	1/12	4.7 J	4.7 J	NTC17BBSD4501	9.4	4.7		20	0.24	YES	BIO
GAMMA-BHC (LINDANE)	1/12	4.6 J	4.6 J	NTC17BBSD5601	9.5	4.6	1	0.39	11.8	YES	ASL/BIO
GAMMA-CHLORDANE	10/12	1.2 J	8 J	NTC17BBSD4801	4.8	2.5	5	0.5	16.0	YES	ASL
METHOXYCHLOR	1/12	32 J	32 J	NTC17BBSD5201	78.5	32	5	8.8	3.64	YES	ASL/BIO

TABLE 7-6

ECOLOGICAL COPC SELECTION - SURFACE SEDIMENT
BOAT BASIN
NTC GREAT LAKES, ILLINOIS
PAGE 2 OF 2

Chemical	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Average of Positive Results	Illinois EPA Background Concentration(3)	Sediment COPC Screening Level(4)	Ecological Effects Quotient (5)	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
INORGANICS (MG/KG)											
ALUMINUM	12/12	1300	6860	NTC17BBSD4801	2719	2719		58030	0.12	NO	BSL
ANTIMONY	2/12	0.45	0.47	NTC17BBSD5301	0.3	0.46		2	0.24	NO	BSL
ARSENIC	12/12	3.4	9.9	NTC17BBSD4801	5.4	5.4	8	6	1.65	YES	ASL/BIO
BARIUM	12/12	12	57.8	NTC17BBSD4801	25.9	25.9	145	NA	NA	NO	BKG
BERYLLIUM	10/12	0.26	6.7 J	NTC17BBSD4901	1.1	1.3		NA	NA	YES	NTX
CADMIUM	12/12	0.23	2.2	NTC17BBSD4801	0.7	0.65	0.5	0.6	3.67	YES	ASL/BIO
CALCIUM	12/12	33500	86300 J	NTC17BBSD4901	55792	55792		NA	NA	NO	NT
CHROMIUM	12/12	7.9	28.9	NTC17BBSD4801	12.6	12.6	16	26	1.11	YES	ASL
COBALT	12/12	3.7	10.1	NTC17BBSD4801	5.6	5.6		50	0.20	NO	BSL
COPPER	12/12	55.5	283	NTC17BBSD4801	116	116	38	16	17.7	YES	ASL/BIO
IRON	12/12	7410	19200	NTC17BBSD4801	11733	11733	18000	20000	0.96	NO	BSL
LEAD	12/12	47.6	289	NTC17BBSD4801	101	101	28	31	9.32	YES	ASL/BIO
MAGNESIUM	12/12	17200	46900 J	NTC17BBSD4901	28233	28233		NA	NA	NO	NT
MANGANESE	12/12	226	731 J	NTC17BBSD4901	386	386	1300	460	1.59	NO	BKG
MERCURY	12/12	0.068	0.95	NTC17BBSD4801	0.2	0.22	0.07	0.2	4.75	YES	ASL
NICKEL	12/12	8.9	31.5	NTC17BBSD5401	16.9	16.9	26	30	1.05	YES	ASL/BIO
POTASSIUM	12/12	180	1150	NTC17BBSD4801	386	386	1500	NA	NA	NO	NT
SELENIUM	3/12	0.66	1.2	NTC17BBSD4801	0.4	0.86		NA	NA	YES	NTX
SILVER	12/12	0.29	4.2	NTC17BBSD4801	1.0	0.97	5	1	4.20	YES	BIO
SODIUM	12/12	136	487 J	NTC17BBSD4901	236	236		NA	NA	NO	NT
VANADIUM	12/12	6	18.9	NTC17BBSD4801	10.2	10.2		NA	NA	YES	NTX
ZINC	12/12	247	2070 J	NTC17BBSD4901	662	662	80	120	17.3	YES	ASL/BIO
MISCELLANEOUS PARAMETERS (MG/KG)											
PH S.U.	12/12	7.2	8 J	NTC17BBSD5001	7.6	7.6		NA	NA	NA	NZ
TOTAL ORGANIC CARBON	11/12	1460	21800	NTC17BBSD4801	6415	6995		NA	NA	NA	NZ

Shaded name indicates that constituent was selected as a COPC. Shaded values indicate that the site concentration(s) exceeds this particular criterion.

Footnotes:
1 Only the original of duplicate samples was considered for COPC selection. The duplicate was used for quality control purposes only.
2 The maximum detected concentration was used for screening purposes.
3 Illinois EPA Background values for unsieved and sieved data (Illinois EPA, 1997).
4 As presented in Table 7-2
5 Refer to Section 7.4 for ecological effects quotient calculation.
6 Rationale Codes:

For Selection as a COPC:
ASL = Above COPC screening level.
NTX = No toxicity information available.
BIO = Bioaccumulative chemical.

For Elimination as a COPC:
BSL = Below COPC screening level.
NT = Nontoxic.
BKG = Below Illinois EPA Background level.
NZ [illegible]oplicable because these parameters are used to characterize the sediments and/or cannot be used to [illegible]te ecological risks

Definitions:
COPC = Chemical of Potential Concern.
NA = Not Available.

ASSOCIATED SAMPLES
NTC17BBSD4501
NTC17BBSD4601
NTC17BBSD4701
NTC17BBSD4801
NTC17BBSD4901
NTC17BBSD5001
NTC17BBSD5101
NTC17BBSD5201
NTC17BBSD5301
NTC17BBSD5401
NTC17BBSD5501
NTC17BBSD5601

TABLE 7-7

ECOLOGICAL COPC SELECTION - SURFACE WATER
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NTC GREAT LAKES, ILLINOIS
PAGE 1 OF 2

Parameter	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Average of Positive Results	Surface Water COPC Screening Level (3)	Ecological Effects Quotient (4)	COPC Flag (5)	Rationale for Contaminant Deletion or Selection(5)
VOLATILE ORGANICS (UG/L)										
2-BUTANONE	1/6	5.6	5.6	NTC17PCSW0101	3.02	5.6	14000	0.00	NO	BSL
ACETONE	5/6	2.6 J	11	NTC17PCSW0101	6.10	6.32	122000	0.00	NO	BSL
BROMODICHLOROMETHANE	2/6	0.34 J	0.74 J	NTC17PCSW0201	0.51	0.54	11000	0.00	NO	BSL
CHLORODIBROMOMETHANE	1/6	0.59 J	0.59 J	NTC17PCSW0201	0.52	0.59	11000	0.00	NO	BSL
CHLOROFORM	2/6	0.42 J	1.2	NTC17PCSW0201	0.60	0.81	150	0.01	NO	BSL
CIS-1,2-DICHLOROETHENE	2/6	1.1	9.2	NTC17PCSW0101	2.05	5.15	11600	0.00	NO	BSL
TETRACHLOROETHENE	2/6	0.41 J	1.4	NTC17PCSW0101	0.64	0.905	152	0.01	NO	BSL
TOLUENE	1/6	0.7 J	0.7 J	NTC17PCSW0101	0.53	0.7	230	0.00	NO	BSL
TRICHLOROETHENE	2/6	0.46 J	5.5	NTC17PCSW0101	1.33	2.98	940	0.01	NO	BSL
VINYL CHLORIDE	1/6	0.77 J	0.77 J	NTC17PCSW0101	0.96	0.77	11600	0.00	NO	BSL
SEMIVOLATILE ORGANICS (UG/L)										
DI-N-BUTYL PHTHALATE	1/6	2.7 J	2.7 J	NTC17PCSW0101	4.62	2.7	35	0.08	NO	BSL
PESTICIDES/PCBS (UG/L)										
4,4'-DDD	1/6	0.0054 J	0.0054 J	NTC17PCSW0201	0.022	0.0054	0.001	5.40	YES	ASL/BIO
4,4'-DDE	3/5	0.0064 J	0.024 J	NTC17PCSW0201	0.018	0.01347	0.001	24.0	YES	ASL/BIO
4,4'-DDT	1/6	0.029 J	0.029 J	NTC17PCSW0201	0.026	0.029	0.001	29.0	YES	ASL/BIO
ENDOSULFAN I	1/6	0.01 J	0.01 J	NTC17BBSW0501	0.023	0.01	0.056	0.18	YES	BIO
INORGANICS (UG/L)										
ALUMINUM	6/6	44.8	9460	NTC17PCSW0301	2384	2384	87	108.7	YES	ASL
ARSENIC	3/6	3.7	3.8	NTC17BBSW0501	2.67	3.7	148	0.03	YES	BIO
BARIUM	6/6	16.8 J	61.8	NTC17PCSW0301	43.37	43.4	5000	0.01	NO	BSL
BERYLLIUM	1/6	0.26	0.26	NTC17PCSW0301	0.11	0.26	0.66	0.39	NO	BSL
CALCIUM	6/6	23200 J	91600	NTC17PCSW0101	55483	55483	NA	NA	NO	NT
CHROMIUM	1/6	14.4	14.4	NTC17PCSW0301	3.89	14.4	11	1.31	YES	ASL/BIO
COBALT	1/6	4.6	4.6	NTC17PCSW0301	1.98	4.6	23	0.20	NO	BSL
COPPER	5/6	6.9	22.2	NTC17PCSW0101	12.32	14.54	17.6	1.26	YES	ASL/BIO
IRON	6/6	84.4 J	10900	NTC17PCSW0301	2810	2810	1000	10.9	YES	ASL
LEAD	5/6	3	18	NTC17PCSW0301	6.67	7.82	16.5	1.09	YES	ASL/BIO
MAGNESIUM	6/6	7720	37400	NTC17PCSW0101	22970	22970	NA	NA	NO	NT
MANGANESE	6/6	14.6 J	245	NTC17PCSW0301	83.13	83.1	1000	0.25	NO	NT
MERCURY	4/6	0.05	0.1	NTC17PCSW0401	0.05	0.07	0.0013	76.9	YES	ASL/BIO
NICKEL	1/6	12.5	12.5	NTC17PCSW0301	6.42	12.5	97.7	0.13	YES	BIO
POTASSIUM	6/6	1270	6280	NTC17PCSW0301	3992	3992	NA	NA	NO	NT
SODIUM	6/6	13100	122000	NTC17PCSW0101	59917	59917	NA	NA	NO	NT
VANADIUM	3/6	2.9	15.6	NTC17PCSW0301	4.83	8.4	20	0.78	NO	BSL
ZINC	4/6	28	150	NTC17PCSW0101	56.15	78.45	225	0.67	YES	BIO

TABLE 7-7

ECOLOGICAL COPC SELECTION - SURFACE WATER
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NTC GREAT LAKES, ILLINOIS
PAGE 2 OF 2

Parameter	Frequency of Detection (1)	Minimum Concentration (1)	Maximum Concentration (1)(2)	Location of Maximum Concentration	Average of All Results	Average of Positive Results	Surface Water COPC Screening Level (3)	Ecological Effects Quotient (4)	COPC Flag (5)	Rationale for Contaminant Deletion or Selection(5)
FILTERED INORGANICS (UG/L)										
ALUMINUM	5/6	25.5	317	NTC17BBSW0601-F	92.23	109	87	3.64	YES	ASL
ARSENIC	2/6	3.6	4.3	NTC17BBSW0501-F	2.38	3.95	148	0.03	YES	BIO
BARIUM	6/6	16.8	53.3	NTC17PCSW0101-F	31.08	31.1	5000	0.01	NO	BSL
CADMIUM	1/6	0.58	0.58	NTC17PCSW0101-F	0.29	0.58	4.41	0.13	NO	BSL
CALCIUM	6/6	23500 J	87500	NTC17PCSW0101-F	50717	50717	NA	NA	NO	NT
COPPER	5/6	2.9	10.7	NTC17PCSW0101-F, NTC17PCSW0301-F	6.67	7.76	17.6	0.61	YES	BIO
IRON	5/6	78 J	429	NTC17BBSW0601-F	182	215	1000	0.43	NO	BSL
LEAD	1/6	3.3	3.3	NTC17BBSW0601-F	1.53	3.3	16.5	0.20	YES	BIO
MAGNESIUM	6/6	7840	35700	NTC17PCSW0101-F	20307	20307	NA	NA	NO	NT
MANGANESE	6/6	14.6 J	46.3	NTC17PCSW0101-F	25.32	25.3	1000	0.05	NO	BSL
MERCURY	1/6	0.08	0.08	NTC17PCSW0401-F	0.03	0.08	0.0013	61.5	YES	ASL
POTASSIUM	6/6	1360	5150	NTC17PCSW0101-F	3095	3095	NA	NA	NO	BSL
SELENIUM	1/6	4.4	4.4	NTC17PCSW0101-F	2.31	4.4	5	0.88	YES	BIO
SODIUM	6/6	13400	115000	NTC17PCSW0101-F	57700	57700	NA	NA	NO	NT
VANADIUM	1/6	2.8	2.8	NTC17PCSW0201-F	1.51	2.8	20	0.14	NO	BSL
ZINC	4/6	5.6	111	NTC17PCSW0101-F	29.79	39.6	225	0.49	YES	BIO

Shaded name indicates that constituent was selected as a COPC. Shaded values indicate that site concentration(s) exceed this particular criterion.

Footnotes:
1 Only the original of duplicate samples was considered for COPC selection. The duplicate was used for quality control purposes only.
2 The maximum detected concentration was used for screening purposes.
3 As presented in Table 7-1
4 Refer to Section 7.4 for ecological effects quotient calculation.
5 Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level.
BIO = Bioaccumulative chemical.

For Elimination as a COPC:
BSL = Below COPC screening level.
NT = Nontoxic.
BKG = Below Illinois EPA Background level.

Definitions:
COPC = Chemical of Potential Concern
NA = Not Available

ASSOCIATED SAMPLES
NTC17BBSW0501
NTC17BBSW0501-F
NTC17BBSW0601
NTC17BBSW0601-F
NTC17PCSW0101
NTC17PCSW0101-F
NTC17PCSW0201
NTC17PCSW0201-F
NTC17PCSW0301
NTC17PCSW0301-F
NTC17PCSW0401
NTC17PCSW0401-F

TABLE 7-8

**SOUTH BRANCH PETTIBONE CREEK
TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-MAXIMUM CONCENTRATIONS
NTC GREAT LAKES, ILLINOIS**

Parameter	Raccoon NOAEL	Raccoon LOAEL	Belted Kingfisher NOAEL	Belted Kingfisher LOAEL
SEMIVOLATILE ORGANICS				
ACENAPHTHYLENE	2.5E-02	2.5E-03	NC	NC
ANTHRACENE	5.3E-03	5.3E-04	NC	NC
BENZO(K)FLUORANTHENE	6.3E-01	6.3E-02	NC	NC
FLUORENE	1.6E-02	8.0E-03	NC	NC
PYRENE	4.1E-01	2.5E-01	NC	NC
PESITICDES/PCBS				
4,4'-DDD	1.9E-02	3.8E-03	1.2E+01	1.2E+00
4,4'-DDE	3.2E-01	6.4E-02	3.2E+02	3.2E+01
4,4'-DDT	7.0E-01	1.4E-01	6.5E+02	6.5E+01
ALPHA-CHLORDANE	2.7E-03	1.3E-03	2.0E-02	4.0E-03
AROCLOR-1248	2.4E+01	2.4E+00		
AROCLOR-1254	9.9E+00	9.9E-01	5.4E+00	5.4E-01
AROCLOR-1260	3.9E+00	3.9E-01	2.1E+00	2.1E-01
DIELDRIN	3.0E-01	3.0E-02	2.5E-01	2.5E-02
ENDOSULFAN I	7.1E-06	7.1E-07	1.4E-07	1.4E-08
ENDOSULFAN II	2.6E-02	2.6E-03	1.3E-03	1.3E-04
ENDRIN	2.9E-02	2.9E-03	8.8E-01	8.8E-02
ENDRIN ALDEHYDE	8.9E-02	8.9E-03	2.7E+00	2.7E-01
GAMMA-CHLORDANE	8.7E-04	4.4E-04	6.2E-03	1.2E-03
HEPTACHLOR EPOXIDE	9.5E-03	9.5E-04		
INORGANICS				
ARSENIC	9.2E+00	9.2E-01	1.2E+00	4.2E-01
CADMIUM	1.0E-01	1.0E-02	7.4E-02	5.4E-03
CHROMIUM	9.2E-01	2.3E-01	8.4E+00	1.7E+00
COPPER	1.7E+00	1.3E+00	5.6E-01	4.3E-01
LEAD	1.5E+00	1.5E-01	2.9E+01	2.9E+00
MERCURY	4.8E+00	2.9E+00	2.0E+01	2.0E+00
NICKEL	1.1E-01	5.5E-02	1.1E-01	8.2E-02
ZINC	8.2E-01	4.1E-01	9.9E+00	1.1E+00

Notes:

- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- This table only presents the EEQs for contaminants that had EEQs greater than 1.0 using the maximum input parameters, and were detected above background concentrations

EEQ - Ecological Efects Quotient
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration
NC - PAHs were not included in the kingisher food chain model (see Section 7.3)

TABLE 7-9

NORTH BRANCH PETTIBONE CREEK
TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-MAXIMUM CONCENTRATIONS
NTC GREAT LAKES, ILLINOIS

Parameter	Raccoon NOAEL	Raccoon LOAEL	Belted Kingfisher NOAEL	Belted Kingfisher LOAEL
SEMIVOLATILE ORGANICS				
2-METHYLNAPHTHALENE	3.6E-03	3.6E-04	NC	NC
ACENAPHTHYLENE	5.5E-02	5.5E-03	NC	NC
ANTHRACENE	2.4E-02	2.4E-03	NC	NC
BENZALDEHYDE				
BENZO(A)ANTHRACENE	6.5E+00	6.5E-01	NC	NC
BENZO(B)FLUORANTHENE	7.1E+00	7.1E-01	NC	NC
BENZO(G,H,I)PERYLENE	4.4E+00	4.4E-01	NC	NC
BENZO(K)FLUORANTHENE	3.7E+00	3.7E-01	NC	NC
BIS(2-ETHYLHEXYL)PHTHALATE	5.9E-02	5.9E-03	3.1E+00	3.1E-01
BUTYLBENZYL PHTHALATE	3.7E-04	1.3E-04		
CARBAZOLE	4.3E-01	4.3E-02		
CHRYSENE	7.1E+00	7.1E-01	NC	NC
DIBENZOFURAN				
DI-N-BUTYL PHTHALATE	5.2E-07	1.6E-07	3.4E-03	3.4E-04
FLUORANTHENE	1.6E+00	7.8E-01	NC	NC
FLUORENE	1.1E-01	5.7E-02	NC	NC
INDENO(1,2,3-CD)PYRENE	3.4E+00	3.4E-01	NC	NC
PHENANTHRENE	1.4E+01	1.4E+00	NC	NC
PHENOL	2.5E-02	1.2E-02		
PYRENE	2.1E+00	1.3E+00	NC	NC
PESTICIDES/PCBS				
4,4'-DDD	1.2E-01	2.5E-02	8.7E+01	8.7E+00
4,4'-DDE	2.9E+00	5.8E-01	2.9E+03	2.9E+02
4,4'-DDT	5.7E+00	1.1E+00	5.5E+03	5.5E+02
ALDRIN	8.7E-02	1.7E-02		
ALPHA-CHLORDANE	1.0E-02	5.2E-03	7.8E-02	1.6E-02
AROCLOR-1254	3.6E+01	3.6E+00	2.3E+01	2.3E+00
AROCLOR-1260	1.2E+01	1.2E+00	7.9E+00	7.9E-01
DIELDRIN	2.3E-01	2.3E-02	2.0E-01	2.0E-02
ENDOSULFAN I	2.0E-02	2.0E-03	1.0E-03	1.0E-04
ENDOSULFAN II	2.2E-01	2.2E-02	1.1E-02	1.1E-03
ENDRIN	7.7E-02	7.7E-03	2.4E+00	2.4E-01
ENDRIN ALDEHYDE	9.8E-02	9.8E-03	3.0E+00	3.0E-01
GAMMA-CHLORDANE	2.1E-03	1.1E-03	1.5E-02	3.1E-03
HEPTACHLOR EPOXIDE	5.4E-03	5.4E-04		
INORGANICS				
ARSENIC	1.8E+01	1.8E+00	2.4E+00	8.0E-01
CADMIUM	2.3E+00	2.3E-01	1.6E+00	1.2E-01
CHROMIUM	3.5E+00	8.7E-01	3.2E+01	6.3E+00
COPPER	1.7E+01	1.3E+01	5.8E+00	4.4E+00
LEAD	8.5E+00	8.5E-01	1.6E+02	1.6E+01
MERCURY	9.8E+01	5.9E+01	4.2E+02	4.2E+01
NICKEL	1.7E-01	8.3E-02	1.7E-01	1.2E-01
SELENIUM	1.1E+01	6.8E+00	9.4E+00	4.7E+00
SILVER	6.0E-01	6.0E-02		
ZINC	6.9E+00	3.5E+00	8.3E+01	9.2E+00

Notes:
- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- This table only presents the EEQs for contaminants that had EEQs greater than 1.0 using the maximum input parameters, and were detected above background concentrations

EEQ - Ecological Efects Quotient
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration
NC - PAHs were not included in the kingisher food chain model (see Section 7.3)

TABLE 7-10

BOAT BASIN
TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-MAXIMUM CONCENTRATIONS
NTC GREAT LAKES, ILLINOIS

Parameter	Raccoon NOAEL	Raccoon LOAEL	Belted Kingfisher NOAEL	Belted Kingfisher LOAEL
SEMIVOLATILE ORGANICS				
ACENAPHTHYLENE	8.6E-02	8.7E-03	NC	NC
ANTHRACENE	8.2E-03	8.2E-04	NC	NC
BENZO(A)ANTHRACENE	2.1E+00	2.1E-01	NC	NC
BENZO(A)PYRENE	1.9E+00	2.0E-01	NC	NC
BENZO(B)FLUORANTHENE	1.9E+00	2.0E-01	NC	NC
BENZO(G,H,I)PERYLENE	1.2E+00	1.2E-01	NC	NC
BENZO(K)FLUORANTHENE	1.1E+00	1.1E-01	NC	NC
BIS(2-ETHYLHEXYL)PHTHALATE	3.5E-02	3.5E-03	1.7E+00	1.7E-01
CHRYSENE	2.1E+00	2.1E-01	NC	NC
DI-N-BUTYL PHTHALATE	5.2E-07	1.6E-07	3.4E-03	3.4E-04
FLUORANTHENE	4.8E-01	2.4E-01	NC	NC
FLUORENE	4.5E-02	2.3E-02	NC	NC
INDENO(1,2,3-CD)PYRENE	8.6E-01	8.7E-02	NC	NC
NAPHTHALENE	1.3E-02	1.3E-03	NC	NC
PHENANTHRENE	4.3E+00	4.3E-01	NC	NC
PYRENE	6.3E-01	3.8E-01	NC	NC
PESTICIDES/PCBS				
4,4'-DDD	1.6E-01	3.3E-02	9.7E+01	9.7E+00
4,4'-DDE	2.0E+00	3.9E-01	2.0E+03	2.0E+02
4,4'-DDT	2.4E-01	4.9E-02	2.2E+02	2.2E+01
ALDRIN	3.5E-02	7.1E-03		
ALPHA-BHC	8.0E-01	8.0E-02	6.5E-02	1.6E-02
ALPHA-CHLORDANE	1.0E-02	5.1E-03	7.6E-02	1.5E-02
AROCLOR-1254	4.4E+01	4.4E+00	2.1E+01	2.1E+00
AROCLOR-1260	1.8E+01	1.8E+00	8.6E+00	8.6E-01
BETA-BHC	3.3E-02	6.6E-03	7.6E-02	1.9E-02
DELTA-BHC	9.2E-03	4.6E-03	8.5E-02	2.1E-02
DIELDRIN	1.1E+00	1.1E-01	9.4E-01	9.4E-02
ENDOSULFAN I	1.0E-01	1.0E-02	4.8E-03	4.8E-04
ENDOSULFAN II	1.4E-01	1.4E-02	6.7E-03	6.7E-04
ENDOSULFAN SULFATE	8.4E-02	8.4E-03	4.1E-03	4.1E-04
ENDRIN	2.4E-02	2.4E-03	7.2E-01	7.2E-02
ENDRIN KETONE	8.8E-02	8.8E-03	2.6E+00	2.6E-01
GAMMA-BHC (LINDANE)	9.9E-04	9.9E-05	1.3E-02	1.3E-03
GAMMA-CHLORDANE	3.6E-03	1.8E-03	2.6E-02	5.1E-03
METHOXYCHLOR	1.4E-02	6.9E-03		
INORGANICS				
ARSENIC	1.7E+01	1.7E+00	2.3E+00	7.6E-01
CADMIUM	1.2E+00	1.2E-01	8.6E-01	6.3E-02
CHROMIUM	1.8E+00	4.5E-01	1.6E+01	3.3E+00
COPPER	1.0E+01	7.7E+00	3.4E+00	2.6E+00
LEAD	7.6E+00	7.6E-01	1.5E+02	1.5E+01
MERCURY	2.0E+01	1.2E+01	8.4E+01	8.4E+00
NICKEL	2.3E-01	1.1E-01	2.3E-01	1.7E-01
SELENIUM	2.0E+00	1.2E+00	1.7E+00	8.5E-01
SILVER	7.8E-01	7.8E-02		
ZINC	6.7E+00	3.4E+00	8.1E+01	9.0E+00

Notes:

- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- This table only presents the EEQs for contaminants that had EEQs greater than 1.0 using the maximum input parameters, and were detected above background concentrations

EEQ - Ecological Efects Quotient
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration
NC - PAHs were not included in the kingisher food chain model (see Section 7.3)

TABLE 7-11

AVS AND SEM DATA IN PETTIBONE CREEK AND THE BOAT BASIN
NTC GREAT LAKES, ILLINOIS

Parameters	SOUTH BRANCH SAMPLES[1]			NORTH BRANCH SAMPLES[1]			BOAT BASIN SAMPLES[2]		
	2701 9/23/2001	**3601** 9/24/2001	**3701** 9/24/2001	**1101** 9/23/2001	**1701** 9/22/2001	**2101** 9/22/2001	**4504** 9/7/2001	**5104** 9/6/2001	**5301** 9/6/2001
SEM (mg/kg)									
CADMIUM	0.28J	0.12	0.15	0.55	0.43	0.28	2.8	1.8	0.39
COPPER	29J	5.2	9.1	128	119	31.9	251	210	71.7
LEAD	30.2J	11.3	19.2	63.7	72	26.9	120	194	40.4
NICKEL	3.5J	1.7	2.9	7.3	5	3.8	51.5	17	6.2
ZINC	137J	26.4	41.8	248	270	155	628	725	334
ACID VOLATILE SULFIDE	9.2U	10.3U	11.5	8.7U	8.4U	9.6U	10.6U	25.2	30.8
SEM (μmol/g)[3]									
CADMIUM	0.002	0.001	0.001	0.005	0.004	0.002	0.0249	0.016	0.0035
COPPER	0.46	0.08	0.14	2.01	1.87	0.50	3.95	3.30	1.13
LEAD	0.15	0.05	0.09	0.31	0.35	0.13	0.58	0.94	0.19
NICKEL	0.06	0.03	0.05	0.12	0.09	0.06	0.88	0.29	0.11
ZINC	2.10	0.40	0.64	3.79	4.13	2.37	9.60	11.09	5.11
ACID VOLATILE SULFIDE	0.29	0.32	0.36	0.27	0.26	0.30	0.33	0.79	0.96
TOTAL SEM[4]	2.76	0.57	0.93	6.24	6.44	3.07	15.04	15.63	6.54
SEM-AVS[5]	2.47	0.25	0.57	5.97	6.18	2.77	14.71	14.85	5.58

Notes:

Shaded values exceed the sediment screeening value

1 Sample I.d.'s are preceded with "NTC17PCSD-"

2 Sample I.d.'s are preceded with "NTC17BBSD-"

3 SEM (μmol/g) was obtained by dividing the chemical concentration (reported in mg/kg by the laboratory) by the chemical molecular weight

4 Total SEM is a summation of cadmium, copper, lead, nickel, and zinc concentrations in μmol/g

5 SEM-AVS is obtained by subtracting the acid volatile sulfide concentration from the total SEM

Data Qualifiers:

J Value is estimated due to technical noncompliances

U Nondetect result

TABLE 7-12

SOUTH BRANCH PETTIBONE CREEK
TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-AVERAGE CONCENTRATIONS
NTC GREAT LAKES, ILLINOIS

Parameter	Raccoon NOAEL	Raccoon LOAEL	Belted Kingfisher NOAEL	Belted Kingfisher LOAEL
SEMIVOLATILE ORGANICS				
ACENAPHTHYLENE	1.2E-02	1.2E-03	NC	NC
ANTHRACENE	3.9E-04	3.9E-05	NC	NC
BENZO(K)FLUORANTHENE	5.6E-02	5.6E-03	NC	NC
FLUORENE	1.4E-03	6.9E-04	NC	NC
PYRENE	3.2E-02	1.9E-02	NC	NC
PESITICDES/PCBS				
4,4'-DDD	6.5E-03	1.3E-03	5.3E+00	5.3E-01
4,4'-DDE	1.3E-01	2.6E-02	1.7E+02	1.7E+01
4,4'-DDT	6.3E-02	1.3E-02	7.6E+01	7.6E+00
ALPHA-CHLORDANE	1.2E-03	6.1E-04	1.2E-02	2.3E-03
AROCLOR-1248	5.2E+00	5.2E-01		
AROCLOR-1254	1.3E+00	1.3E-01	1.3E+00	1.3E-01
AROCLOR-1260	7.7E-01	7.7E-02	7.3E-01	7.3E-02
DIELDRIN	1.1E-01	1.1E-02	1.2E-01	1.2E-02
ENDOSULFAN I	5.5E-06	5.5E-07	1.1E-07	1.1E-08
ENDOSULFAN II	7.8E-03	7.8E-04	4.9E-04	4.9E-05
ENDRIN	3.5E-02	3.5E-03	1.4E+00	1.4E-01
ENDRIN ALDEHYDE	3.9E-02	3.9E-03	1.5E+00	1.5E-01
GAMMA-CHLORDANE	3.4E-04	1.7E-04	3.2E-03	6.3E-04
HEPTACHLOR EPOXIDE	3.0E-03	3.0E-04		
INORGANICS				
ARSENIC	3.8E+00	3.8E-01	7.4E-01	2.5E-01
CADMIUM	1.0E-02	1.0E-03	2.5E-02	1.8E-03
CHROMIUM	3.4E-01	8.4E-02	4.3E+00	8.6E-01
COPPER	2.4E-01	1.9E-01	1.8E-01	1.3E-01
LEAD	4.8E-01	4.8E-02	1.3E+01	1.3E+00
MERCURY	1.1E+00	6.6E-01	8.1E+00	8.1E-01
NICKEL	2.9E-02	1.4E-02	5.3E-02	3.8E-02
ZINC	1.2E-01	6.1E-02	3.6E+00	4.0E-01

Notes:
- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- This table only presents the EEQs for contaminants that had EEQs greater than 1.0 using the maximum input parameters, and were detected above background concentrations

EEQ - Ecological Efects Quotient
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration
NC - PAHs were not included in the kingisher food chain model (see Section 7.3)

TABLE 7-13

NORTH BRANCH PETTIBONE CREEK
TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-AVERAGE CONCENTRATIONS
NTC GREAT LAKES, ILLINOIS

Parameter	Raccoon NOAEL	Raccoon LOAEL	Belted Kingfisher NOAEL	Belted Kingfisher LOAEL
SEMIVOLATILE ORGANICS				
2-METHYLNAPHTHALENE	1.7E-03	1.7E-04	NC	NC
ACENAPHTHYLENE	1.9E-02	1.9E-03	NC	NC
ANTHRACENE	1.7E-03	1.7E-04	NC	NC
BENZALDEHYDE				
BENZO(A)ANTHRACENE	4.9E-01	4.9E-02	NC	NC
BENZO(B)FLUORANTHENE	5.1E-01	5.1E-02	NC	NC
BENZO(G,H,I)PERYLENE	3.3E-01	3.3E-02	NC	NC
BENZO(K)FLUORANTHENE	2.8E-01	2.8E-02	NC	NC
BIS(2-ETHYLHEXYL)PHTHALATE	3.1E-02	3.1E-03	2.1E+00	2.1E-01
BUTYLBENZYL PHTHALATE	2.3E-04	7.9E-05		
CARBAZOLE	1.1E-01	1.1E-02	NC	NC
CHRYSENE	5.1E-01	5.1E-02	NC	NC
DIBENZOFURAN				
DI-N-BUTYL PHTHALATE	4.1E-07	1.2E-07	2.7E-03	2.7E-04
FLUORANTHENE	1.1E-01	5.6E-02	NC	NC
FLUORENE	8.1E-03	4.0E-03	NC	NC
INDENO(1,2,3-CD)PYRENE	2.5E-01	2.5E-02	NC	NC
PHENANTHRENE	9.3E-01	9.3E-02	NC	NC
PHENOL	1.6E-02	7.9E-03		
PYRENE	1.5E-01	8.9E-02	NC	NC
PESTICIDES/PCBS				
4,4'-DDD	2.9E-02	5.8E-03	2.7E+01	2.7E+00
4,4'-DDE	7.2E-01	1.4E-01	9.4E+02	9.4E+01
4,4'-DDT	3.5E-01	7.0E-02	4.3E+02	4.3E+01
ALDRIN	5.5E-02	1.1E-02		
ALPHA-CHLORDANE	2.3E-03	1.2E-03	2.3E-02	4.5E-03
AROCLOR-1254	4.8E+00	4.8E-01	5.1E+00	5.1E-01
AROCLOR-1260	1.9E+00	1.9E-01	2.0E+00	2.0E-01
DIELDRIN	6.0E-02	6.0E-03	6.7E-02	6.7E-03
ENDOSULFAN I	1.3E-02	1.3E-03	8.2E-04	8.2E-05
ENDOSULFAN II	3.7E-02	3.7E-03	2.4E-03	2.4E-04
ENDRIN	4.9E-02	4.9E-03	1.9E+00	1.9E-01
ENDRIN ALDEHYDE	6.2E-02	6.2E-03	2.5E+00	2.5E-01
GAMMA-CHLORDANE	7.9E-04	4.0E-04	7.4E-03	1.5E-03
HEPTACHLOR EPOXIDE	2.9E-03	2.9E-04		
INORGANICS				
ARSENIC	5.6E+00	5.6E-01	1.1E+00	3.7E-01
CADMIUM	9.7E-02	9.7E-03	2.3E-01	1.7E-02
CHROMIUM	6.0E-01	1.5E-01	7.6E+00	1.5E+00
COPPER	2.1E+00	1.6E+00	1.5E+00	1.2E+00
LEAD	1.7E+00	1.7E-01	4.8E+01	4.8E+00
MERCURY	3.9E+00	2.3E+00	2.8E+01	2.8E+00
NICKEL	4.8E-02	2.4E-02	8.8E-02	6.4E-02
SELENIUM	5.3E-01	3.2E-01	5.8E-01	2.9E-01
SILVER	7.3E-02	7.3E-03		
ZINC	8.0E-01	4.0E-01	2.4E+01	2.7E+00

Notes:
- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- This table only presents the EEQs for contaminants that had EEQs greater than 1.0 using the maximum input parameters, and were detected above background concentrations

EEQ - Ecological Efects Quotient
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration
NC - PAHs were not included in the kingisher food chain model (see Section 7.3)

TABLE 7-14

BOAT BASIN
TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL EEQS-AVERAGE CONCENTRATIONS
NTC GREAT LAKES, ILLINOIS

Parameter	Raccoon NOAEL	Raccoon LOAEL	Belted Kingfisher NOAEL	Belted Kingfisher LOAEL
SEMIVOLATILE ORGANICS				
ACENAPHTHYLENE	2.8E-02	2.8E-03	NC	NC
ANTHRACENE	1.4E-03	1.4E-04	NC	NC
BENZO(A)ANTHRACENE	3.4E-01	3.4E-02	NC	NC
BENZO(A)PYRENE	3.1E-01	3.1E-02	NC	NC
BENZO(B)FLUORANTHENE	3.1E-01	3.1E-02	NC	NC
BENZO(G,H,I)PERYLENE	1.7E-01	1.7E-02	NC	NC
BENZO(K)FLUORANTHENE	1.8E-01	1.8E-02	NC	NC
BIS(2-ETHYLHEXYL)PHTHALATE	2.2E-02	2.2E-03	1.4E+00	1.4E-01
CHRYSENE	3.4E-01	3.4E-02	NC	NC
DI-N-BUTYL PHTHALATE	4.1E-07	1.2E-07	2.7E-03	2.7E-04
FLUORANTHENE	7.8E-02	3.9E-02	NC	NC
FLUORENE	7.2E-03	3.6E-03	NC	NC
INDENO(1,2,3-CD)PYRENE	1.3E-01	1.3E-02	NC	NC
NAPHTHALENE	4.7E-03	4.7E-04	NC	NC
PHENANTHRENE	7.2E-01	7.2E-02	NC	NC
PYRENE	9.9E-02	5.9E-02	NC	NC
PESTICIDES/PCBS				
4,4'-DDD	3.9E-02	7.8E-03	3.0E+01	3.0E+00
4,4'-DDE	4.6E-01	9.3E-02	6.0E+02	6.0E+01
4,4'-DDT	8.1E-02	1.6E-02	9.6E+01	9.6E+00
ALDRIN	2.2E-02	4.5E-03		
ALPHA-BHC	5.1E-01	5.1E-02	5.3E-02	1.3E-02
ALPHA-CHLORDANE	2.1E-03	1.0E-03	2.0E-02	4.0E-03
AROCLOR-1254	3.5E+00	3.5E-01	3.0E+00	3.0E-01
AROCLOR-1260	1.7E+00	1.7E-01	1.5E+00	1.5E-01
BETA-BHC	2.1E-02	4.3E-03	6.4E-02	1.6E-02
DELTA-BHC	4.1E-03	2.1E-03	4.9E-02	1.2E-02
DIELDRIN	2.6E-01	2.6E-02	2.8E-01	2.8E-02
ENDOSULFAN I	2.4E-02	2.4E-03	1.5E-03	1.5E-04
ENDOSULFAN II	3.9E-02	3.9E-03	2.4E-03	2.4E-04
ENDOSULFAN SULFATE	5.3E-02	5.3E-03	3.3E-03	3.3E-04
ENDRIN	1.5E-02	1.5E-03	5.9E-01	5.9E-02
ENDRIN KETONE	5.6E-02	5.6E-03	2.1E+00	2.1E-01
GAMMA-BHC (LINDANE)	6.3E-04	6.3E-05	1.0E-02	1.0E-03
GAMMA-CHLORDANE	1.4E-03	6.9E-04	1.3E-02	2.5E-03
METHOXYCHLOR	8.7E-03	4.4E-03		
INORGANICS				
ARSENIC	5.1E+00	5.1E-01	1.0E+00	3.4E-01
CADMIUM	8.6E-02	8.6E-03	2.1E-01	1.5E-02
CHROMIUM	4.6E-01	1.1E-01	5.8E+00	1.2E+00
COPPER	1.6E+00	1.2E+00	1.1E+00	8.7E-01
LEAD	1.5E+00	1.5E-01	4.1E+01	4.1E+00
MERCURY	2.1E+00	1.3E+00	1.6E+01	1.6E+00
NICKEL	5.5E-02	2.7E-02	1.0E-01	7.3E-02
SELENIUM	4.6E-01	2.8E-01	5.0E-01	2.5E-01
SILVER	1.1E-01	1.1E-02		
ZINC	7.1E-01	3.5E-01	2.1E+01	2.3E+00

Notes:
- Cells are shaded if the EEQ is greater than 1.0
- Blank spaces indicates that an EEQ could not be calculated because a NOAEL or LOAEL was not available
- This table only presents the EEQs for contaminants that had EEQs greater than 1.0 using the maximum input parameters, and were detected above background concentrations

EEQ - Ecological Efects Quotient
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration
NC - PAHs were not included in the kingisher food chain model (see Section 7.3)

TABLE 7-15

SUMMARY OF CHEMICALS RETAINED AS COCs IN EACH AREA
NTC GREAT LAKES, ILLINOIS

Parameter	South Branch		North Branch		Boat Basin	
	Aquatic Receptors(1)	Piscivorous Birds(2)	Aquatic Receptors(1)	Piscivorous Birds(2)	Aquatic Receptors(1)	Piscivorous Birds(2)
PAHs(3)			X		X	
4,4'-DDD			X		X	
4,4'-DDE			X	X	X	X
4,4'-DDT			X	X	X	
Endosulfan I					X	
Endosulfan II			X		X	
Aroclor-1254					X	
Aroclor-1260					X	
Copper			X		X	
Lead			X		X	
Mercury			X			
Zinc			X		X	

1 - No chemicals in the surface water were retained as COCs for risks to aquatic receptors; All the chemicals listed in this tables were retained as COCs in the sediment only.
2 - No chemicals were retained a COCs for risks to mammals.
3 - Although a few individual PAHs may not be retained a COCs, PAHs as a group are retained as COCs where indicated on this table.

Navy Ecological Risk Assessment Tiered Approach

RPM Input and Risk Management Consideration[3]

Step 8: Risk Management

Tier 1. Screening Risk Assessment (SRA): Identify pathways and compare exposure point concentrations to benchmarks.

Step 1: Site visit; Pathway Identification/Problem Formulation; Toxicity Evaluation

Step 2: Exposure Estimate; Risk Calculation (SMDP)[1]

Proceed to Exit Criteria for SRA

Exit Criteria for the Screening Risk Assessment: Decision for exiting or continuing the ecological risk assessment.

1) Site passes screening risk assessment. A determination is made that the site poses acceptable risk and shall be closed out for ecological concerns.

2) Site fails screening risk assessment: The site must have both complete pathway and unacceptable risk. As a result, the site will either have an interim cleanup or move to the second tier.

Tier 2. Baseline Ecological Risk Assessment (BERA): Detailed assessment of exposure and hazard to "assessment endpoints" (ecological qualities to be protected). Develop site-specific values that are protective of the environment.

Step 3a: Refinement of Conservative Exposure Assumptions[2] (SRA)----**Proceed to Exit Criteria for Step 3a**

Step 3b: Problem Formulation - Toxicity Evaluation; Assessment Endpoints; Conceptual Model; Risk Hypothesis (SMDP)

Step 4: Study Design/DQO - Line of Evidence; Measurement Endpoints; Work Plan and Sampling & Analysis Plan (SMDP)

Step 5: Verification of Field Sampling Design (SMDP)

Step 6: Site Investigation and Data Analysis (SMDP)

Step 7: Risk Characterization

Proceed to Exit Criteria for BERA

Exit Criteria Step 3a Refinement

1) If re-evaluation of the conservative exposure assumptions (SRA) support an acceptable risk determination, the site exits the ecological risk assessment process.

2) If re-evaluation of the conservative exposure assumptions (SRA) do not support an acceptable risk determination, the site continues in the Baseline Ecological Risk Assessment process. **Proceed to Step 3b.**

Exit Criteria Baseline Risk Assessment

1) If the site poses acceptable risk, no further evaluation and no remediation from an ecological perspective is warranted.

2) If the site poses unacceptable ecological risk and additional evaluation in the form of remedy development and evaluation is appropriate, proceed to third tier.

Tier 3. Evaluation of Remedial Alternative (RAGs C)

a. Develop site-specific risk-based cleanup values.

B. Qualitatively evaluate risk posed to the environment by implementation of each alternative (short-term impacts) and estimate risk reduction provided by each (long-term impacts); provide quantitative evaluation where appropriate. Weigh alternative using the remaining CERCLA nine Evaluation Criteria. Plan for monitoring and site closeout.

Notes: 1) See USEPA's 8 Steps ERA Process for requirements for each Scientific Management Decision Point.

2) Refinement includes but is not limited to background, bioavailability, detection frequency, etc.

3) Risk Management is incorporated throughout the tiered approach.

FIGURE 7-1
NAVY TIERED APPROACH
SITE 17 – PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER, GREAT LAKES, ILLINOIS

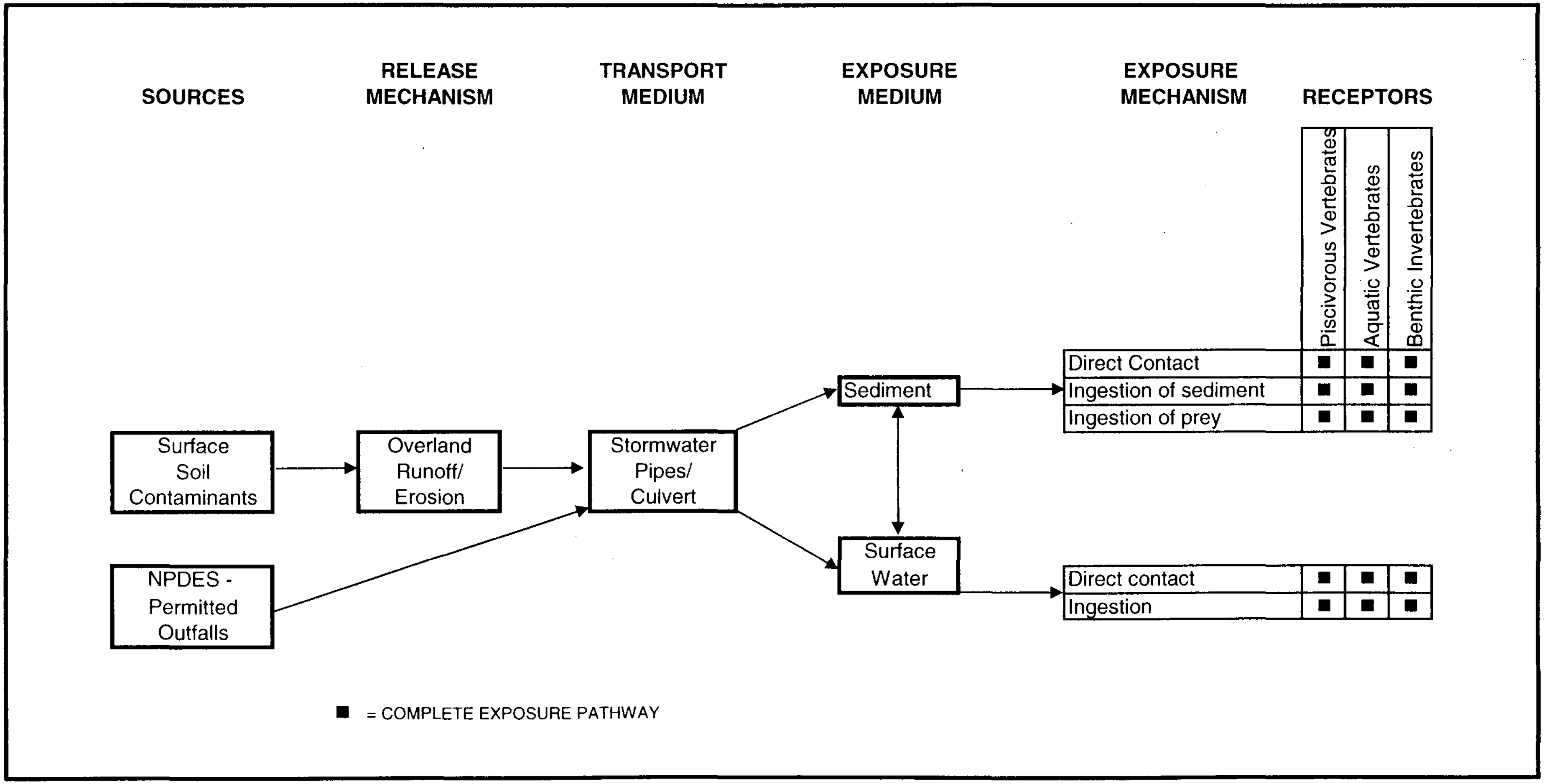


FIGURE 7-2

ECOLOGICAL CONCEPTUAL SITE MODEL
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

8.0 FISH TISSUE UNCERTAINTY ANALYSIS

This section provides additional evaluation of a fish tissue study (HHRA and ERA) using the Lake Michigan Fish Advisory to address the contamination and risk of fish ingestion from Site 17. This section uses existing fish tissue data obtained from the Illinois EPA and USEPA through the STORET (STOrage and RETrieval) database in the area of Lake Michigan near NTC Great Lakes to qualitatively evaluate the uncertainties in the HHRA and ERA.

8.1 INTRODUCTION

As discussed in the HHRA and ERA (Section 6.0 and 7.0, respectively), there are risks to humans and wildlife from the consumption of fish contaminated with organic chemicals and metals. There are uncertainties associated with these risks because they are based on sediment to fish and sediment to invertebrate BSAFs obtained from the literature. One uncertainty with using literature-based numbers to calculate fish tissue concentrations is that the BSAFs do not account for site-specific bioavailability of the chemicals. Also, this approach assumes that the fish in the site water body will not migrate from the site.

Because of the potential risks and the uncertainties in the fish tissue concentrations, it was initially proposed that fish tissue samples could be collected in the Boat Basin to reduce the uncertainties. However, the Navy and Illinois EPA determined that collecting fish tissue samples would not be appropriate for the following:

- The Boat Basin opens to Lake Michigan and it is likely that the fish that would be collected in the Boat Basin move between the Boat Basin and Lake Michigan. The fish would be exposed to sediment contaminant concentrations not only from the Boat Basin but also from Lake Michigan. Therefore, tissue concentrations in fish collected from the Boat Basin could not necessarily be tied to sediment concentrations in the Boat Basin.

- Fish advisories are already in effect for many species of fish in Lake Michigan. Based on the close proximity of the Boat Basin to Lake Michigan, the advisories for Lake Michigan would pertain to the Boat Basin.

For those reasons, it was determined that it would be more appropriate to obtain the available fish tissue data from the nearby stations and compare the actual fish tissue data with the predicted data to address some of the uncertainties in the HHRA and ERA. The remainder of this section of the report presents this evaluation.

8.2 HISTORIC DATA

Historic data, including fish tissue data from Lake Michigan and site-specific sediment data, were used in evaluating fish tissue modeling uncertainties. The data and their sources are described in more detail below.

8.2.1 Historic Fish Tissue Data

Several people from Illinois EPA and USEPA were contacted to determine the availability of fish tissue data. The basic consensus was that the data were available from the STORET web site (http://www.epa.gov/storet/). STORET comprises of USEPA's largest computerized environmental data system and acts as a repository for water quality, biological, and physical data collected and used by state and federal agencies, universities, private citizens, and other organizations. The STORET web site contains data from the USEPA LDC (Legacy Data Center) and STORET database. The LDC contains historical water quality data from the early part of the 20th century to 1998. STORET contains data collected beginning in 1999 along with older data that has been properly documented and migrated from the LDC. Although the data presented in Tables 8-1 and 8-2 were compiled primarily from the LDC, for purposes of this report, the data will be referred to as being obtained from STORET.

STORET was searched for the closest fish tissue sample data along the shoreline upstream and downstream of NTC Great Lakes. Five locations were identified for use in this evaluation and have been included on Figure 8-1. These five locations are as follows:

- 21ILFISH/QZB15 located approximately 11,500 feet south of NTC Great Lakes in Lake Bluff (14 fish samples from 1984 to 1998).

- 21ILFISH/QZB03 located approximately 9,000 feet south of NTC Great Lakes in Lake Bluff (one fish sample from 1995).

- 21ILFISH/QZB12 located in the Outer Harbor at NTC Great Lakes (33 fish samples from 1984).

- 21ILFISH/QZO22 located approximately 19,500 feet north of NTC Great Lakes in Waukegan Harbor, Mid Harbor Central (13 fish samples from 1993).

- 21ILFISH/QZO01 located approximately 21,000 feet north of NTC Great Lakes in Waukegan Harbor, Upper Channel (58 fish samples from 1996 to 1998).

No known sources of contamination have been identified in the Lake Bluff area, so the chemical concentrations in the fish collected in that area are expected to represent "regional" levels. Waukegan Harbor, on the other hand, has been the source of PCBs (in the high percent levels) in sediment, and subsequently in fish tissue. Therefore, this area is expected to represent fish tissue levels that are impacted by PCBs. However, PCB concentrations in fish collected from Waukegan Harbor have decreased significantly in the last 10 years due to harbor cleanup activities. These harbor cleanup activities were initiated as part of a Consent Decree that required the remediation of sediments contaminated with PCBs in concentrations of 50 mg/kg and higher. Remedial efforts in Waukegan Harbor began in 1990 with dredging of contaminated sediments in 1992. Concentrations of PCBs in sediment in the most highly contaminated areas were as high as 500,000 mg/kg. Approximately 136,000 kg of PCBs were removed through the remedial action. As a result of this action, fish tissue concentrations analyzed for PCBs in 1993 were nearly five times lower than those tested in previous years through 1991 (Zarull et al., 1999). As a result of the remedial activities and the apparent decline of PCBs in fish tissue, the posted Waukegan Harbor fish advisories were removed, although fish advisories for carp and other bottom-feeding fish still exist in other areas of Lake Michigan and also apply to fish caught in Waukegan Harbor. The concentrations of PCBs and pesticides in the sediment in Pettibone Creek are presented in Section 4.3 of the report.

The fish tissue data from STORET for the above-mentioned stations were entered into a database to generate tables. Fish tissue results from 1984 to 1998 were compiled to provide historic information regarding actual fish tissue concentrations of pesticides and PCBs in Lake Michigan. In summary, results of the human health and ecological risk screening at Site 17, Pettibone Creek and Boat Basin, indicate that select metals, along with total PCBs, total DDT, aldrin, endrin (including aldehyde and ketone), alpha-BHC, beta-BHC, and delta-BHC presented unacceptable risks to human health and/or the environment (primarily piscivorous wildlife through food-chain modeling). With the exception of mercury in one sample, the fish data on STORET for the selected stations were not analyzed for metals. Therefore, only the organic chemicals listed above were included in the data tables.

Table 8-1 presents the analytical data from STORET for each fish sample collected at the five stations for the selected chemicals. Table 8-2 presents the frequency of detection results for the fish tissue data compiled at stations QZB15, QZB03, QZB12, QZO22, and QZO01.

8.2.2 Historic Sediment Data

Sediment data from Pettibone Creek has been collected over the years as part of other investigations, in addition to the sediment samples collected for this Site 17, Pettibone Creek and Boat Basin RI/RA report. The historic data from these previous investigations are described in more detail in Section 2.0 and briefly summarized here. Sediment samples were collected in Pettibone Creek, including the North and South Branches of Pettibone Creek and the Boat Basin as part of several historical investigations at NTC Great Lakes. Overall, more pesticides were detected in the North Branch and at greater concentrations than in samples from the South Branch or Boat Basin.

Historic Concentrations versus Maximum Concentrations
North Branch of Pettibone Creek

Pesticide	Maximum Historic Concentration (µg/mg)	Maximum Concentration from Site 17 RI/RA (µg/mg)
4,4'-DDD	3,300	170
4,4'-DDE	410	210
4,4'-DDT	1,000	1,800
alpha-BHC	6	ND
Aroclor-1016	1,600	ND
Aroclor-1254	3,300	440
Aroclor-1260	2,300	150
delta-BHC	130	ND
Endrin	210	2.6
Endrin Aldehyde	96	3.3

Historic Concentrations versus Maximum Concentrations
Boat Basin

Pesticide	Maximum Historic Concentration (µg/mg)	Maximum Concentration from Site 17 RI/RA (µg/mg)
4,4'-DDD	720	310
4,4'-DDE	350	230
4,4'-DDT	190	120
alpha-BHC	5.5	6.5
Aroclor-1254	1,500	660
Endrin	62	1.3

Historic Concentrations versus Maximum Concentrations
South Branch of Pettibone Creek

Pesticide	Maximum Historic Concentration (µg/mg)	Maximum Concentration from Site 17 RI/RA (µg/mg)
4,4'DDD	59	32
4,4'-DDE	41	31
4,4'-DDT	71	290
alpha-BHC	1.2	ND
Aroclor-1260	160	55
Endrin	9.7	1.3

As indicated by the above table comparisons, the maximum concentrations from the recently collected data are generally lower than the historic sediment sample concentrations. Noteworthy differences from the historic data are found primarily in the North Branch. 4,4'-DDD and PCB concentrations have significantly decreased from the historic data to the recent data.

8.3 COMPARISON OF FISH TISSUE DATA SAMPLES

As presented above, metals, PCBs, and select pesticides in fish tissue were causing unacceptable risks to humans and wildlife that consume fish. Because metals were not analyzed for in most of the STORET fish tissue samples, the discussion in this section will focus on PCBs and the selected pesticides.

Section 4.0 presents the nature and extent of PCB and pesticide contamination in Pettibone Creek and the Boat Basin. The HHRA evaluated potential risks to humans from eating fish in the Boat Basin, because there are inadequate numbers or sizes of fish in Pettibone Creek for human consumption. The ecological risk assessment however, evaluated potential risks to wildlife consuming fish from the Boat

Basin and the North and South Branches of Pettibone Creek. Therefore, the following discussions focus on the applicable chemicals in the areas that were causing risks to the human and/or ecological receptors.

8.3.1 Total DDT and Total PCB

The maximum predicted total DDT and total PCB fish concentrations at Site 17 were in the North Branch of Pettibone Creek. The maximum predicted concentrations of these chemicals in fish tissue were 42.6 mg/kg and 9.96 mg/kg, respectively, with average concentrations of 8.6 mg/kg and 2.8 mg/kg, respectively. The next highest predicted maximum fish concentrations of these chemicals at Site 17 were in the Boat Basin where total DDT was 11.4 mg/kg and total PCB was 9.54 mg/kg. Average concentrations of these chemicals were 4.46 mg/kg and 1.77 mg/kg, respectively. Predicted maximum concentrations in fish tissue in the South Branch were much lower at 4.93 mg/kg and 3.05 mg/kg, respectively. Average concentrations of total DDT and total PCBs were 1.53 mg/kg and 1.08 mg/kg, respectively.

These predicted fish concentrations at Site 17 were greater than the maximum historic fish tissue concentrations from STORET. The maximum total DDT and total PCB concentrations from STORET were found in samples from Waukegan Harbor at Station QZO22. The maximum total DDT was significantly lower at 2.8 mg/kg (see Table 8-2) than the predicted total DDT at Site 17. However, the maximum total PCB concentration in STORET samples of 9.2 mg/kg (see Table 8-2) was similar to the predicted total PCB in North Branch and the Boat Basin, but greater than the predicted total PCB concentration in fish tissue in the South Branch of Pettibone Creek.

STORET fish tissue concentrations at the Great Lakes Naval Training Station, QZB12, were significantly lower than those found in Waukegan Harbor samples. Historic concentrations for total DDT and total PCBs in this area were 0.69 mg/kg and 2.52 mg/kg, respectively in a 7- and 9-pound channel catfish sample (see Table 8-2). These concentrations are much lower than the total PCB predicted concentrations at Site 17. The STORET database also shows lower concentrations were found in the smaller fish samples.

STORET fish tissue concentrations in Lake Bluff were highest at Station QZB15 (see Table 8-2). Total DDT and total PCBs at this station had maximum concentrations of 1.5 mg/kg and 4.4 mg/kg, respectively in a 4- and 8-pound lake trout. These concentrations are lower than maximum concentrations in Waukegan Harbor samples and also most of the predicted fish tissue concentrations at Site 17. Only the predicted fish concentration for total PCBs in the South Branch were less than the maximum STORET samples from Station QZB15.

Overall, the predicted fish tissue concentrations for total DDT and total PCBs at Site 17 were higher than samples from STORET. It is likely that chemical concentrations in the fish tissue at Site 17 are overestimated for several reasons, including the following:

- Fish present in the South and North Branch (where the highest concentrations were estimated) are significantly smaller than those sampled in Lake Michigan, including Waukegan Harbor, and therefore would be expected to accumulate less organic chemicals than larger and older fish.

- Sediment concentrations of PCBs in North Branch samples were significantly less than those in Waukegan Harbor (see Section 8.2).

- Historic Boat Basin total DDT and total PCB sediment concentrations were much greater than the most recent samples (see the table on page 8-4). However, fish tissue concentrations (i.e., STORET fish tissue concentrations from Station QZB12 collected in 1984) that more closely correlate temporally with historic sediment concentrations, were actually significantly lower than the fish tissue concentrations (see Table 8-2) predicted using the most recent sediment sample data.

8.3.2 Aldrin and Endrin

Aldrin and endrin also had predicted maximum concentrations in the North Branch of Pettibone Creek. Aldrin was predicted at a maximum fish tissue concentration of 0.105 mg/kg, and endrin was predicted at a maximum fish tissue concentration of 0.04 mg/kg. The next highest concentrations of these pesticides were predicted in the Boat Basin at 0.04 mg/kg and 0.013 mg/kg. Aldrin was not predicted in fish tissue from the South Branch because aldrin was not detected in the South Branch sediment samples. However, endrin was detected in South Branch sediment and was predicted at a maximum fish tissue concentration of 0.016 mg/kg and an average concentration of 0.03 mg/kg. The average predicted concentration was greater than the maximum predicted concentration due to elevated detection limits in the non-detected sediment samples. These non-detected sediment samples were evaluated statistically utilizing one-half the reporting limit.

The maximum detected STORET fish tissue concentration for aldrin was found in Waukegan Harbor at 0.05 mg/kg (see Table 8-2), nearly half of what was predicted in the risk screening. Endrin was not found in the STORET data from Waukegan Harbor. In the STORET samples collected from the Great Lakes

Naval Training Station, aldrin was found at a maximum fish tissue concentration of 0.02 mg/kg, and endrin was detected at a maximum concentration of 0.02 mg/kg (see Table 8-2). Aldrin and endrin were each detected at concentrations of 0.01 mg/kg at both stations at Lake Bluff (QZB15 and QZB03).

Similar to the predicted concentrations of total DDT and total PCB, the predicted fish tissue concentrations at Site 17 appear to be overestimated for the following reasons:

- Fish present in the North Branch (where the highest concentrations were estimated) are significantly smaller than those sampled in Lake Michigan, including Waukegan Harbor.
- Aldrin and endrin were less frequently detected in fish tissue samples from the STORET database than other pesticides (i.e., total DDT) and PCBs.
- Aldrin and endrin were detected relatively infrequently compared to other pesticides (i.e., total DDT) and PCBs in sediment samples at Site 17.

8.3.3 Dieldrin, alpha-BHC, beta-BHC, and delta-BHC

The maximum predicted fish tissue concentrations of dieldrin and alpha-BHC were in the Boat Basin at Site 17. Dieldrin and alpha-BHC were predicted at maximum fish tissue concentrations of 0.13 mg/kg and 0.065 mg/kg, respectively. The average predicted concentration for dieldrin in the Boat Basin was 0.047 mg/kg. The average predicted fish tissue concentration for alpha-BHC was the same as the maximum predicted concentration in the Boat Basin. The next highest concentration of dieldrin predicted in fish tissue was in the South Branch of Pettibone Creek at 0.035 mg/kg, with an average concentration of 0.02 mg/kg. Dieldrin was predicted at a concentration of 0.028 mg/kg in the North Branch with an average of 0.014 mg/kg. alpha-BHC was not predicted in fish tissue from the South and North Branches of Pettibone Creek because alpha-BHC was not detected in the sediment of these areas.

beta-BHC and delta-BHC were detected in sediment samples in the Boat Basin, and fish tissue concentrations were predicted for these pesticides in the Boat Basin. However, STORET data for these pesticides are not available and comparisons cannot be made. For these reasons, beta-BHC and delta-BHC will not be discussed further.

The maximum STORET fish tissue concentration for dieldrin (0.25 mg/kg) in samples from Waukegan Harbor (see Table 8-2) was higher, nearly double the predicted fish tissue concentration in the Boat Basin and much higher than predicted concentrations in the North and South Branches. The maximum

STORET fish tissue concentration for alpha-BHC (0.01 mg/kg) was also in samples from Waukegan Harbor (see Table 8-2). This concentration is nearly six times less than what was predicted in fish tissue at the Boat Basin.

The maximum concentration of 0.18 mg/kg for dieldrin from samples collected from the Great Lakes Naval Training Station (see Table 8-2) and Lake Bluff (see Table 8-2) was similar to, although slightly greater than that predicted in the Boat Basin. STORET fish tissue concentrations for alpha-BHC of 0.01 mg/kg (at all stations) were less than the predicted maximum concentration in the Boat Basin. The predicted fish tissue concentrations for dieldrin and alpha-BHC in Pettibone Creek appear to be closer in concentration to historical STORET data than for other chemicals.

8.4 UNCERTAINTIES IN THE HHRA

In the HHRA for the Boat Basin, the primary risk drivers were PCBs and several pesticides (i.e., DDT and dieldrin) in fish eaten by recreational fishermen. Several uncertainties were associated with estimated risks for fish ingestion. The fish tissue concentrations were estimated from sediment concentrations and sediment bioaccumulation factors. Therefore, the calculated risks were not based on actual measured fish tissue concentrations. To more fully characterize the effects of using the estimated fish tissue concentrations in the quantitative risk assessment, risks for the recreational fisherman were recalculated using concentrations from STORET as discussed in Section 8.3. The results of the reanalysis were as follows: the total RME HI for the fisherman increased from 6.6 to 15 and the ILCR increased from $1.8x10^{-4}$ to $3.1x10^{-4}$ when using the STORET data. These differences were mainly due to the increase in the total PCB concentration. Although there is a slight increase in the calculated risks, the risks from the estimated fish tissue concentrations and the STORET data are in close agreement with one another, differing by about a factor of two.

Another uncertainty associated with the fish ingestion scenarios is the assumption that the fish are continually exposed to contaminants in the sediment in the Boat Basin. This assumption would apply only to bottom feeding fish such as carp and catfish that spend most of their time in the study area, and would not apply to game fish such as trout that are not bottom feeders and whose range would not be confined to the Boat Basin. It should be noted that sediment concentrations in the Boat Basin have been decreasing over time (see page 8-4), and as a result contaminant concentrations in fish tissue are also expected to decrease. Evidence of the relationship between decreasing fish tissue and sediment concentrations is provided by the STORET data for Waukegan Harbor described in Section 8.2.1.

The State of Illinois has issued fish consumption advisories for Lake Michigan and Waukegan Harbor (http://www.idph.state.il.us/public/press97/fish97.htm) for salmon, trout, whitefish, perch and bottom feeding fish such as catfish and carp. Although the fish advisories indicate that some fish such as trout can be eaten on a restricted basis (e.g., one meal a month), they state that carp and catfish should not be eaten at all. The fish advisories are based on the assumption that one meal consists of one-half pound of fish. In the HHRA for Site 17, recreational fishermen were assumed to eat 20 grams of fish for 365 days per year and that 10 percent of the fish consumed by the recreational fisherman were caught in the Boat Basin. This is equivalent to eating approximately 1.5 pounds per year of fish caught in the Boat Basin and corresponds to three meals per year according to the State (i.e., one meal equals one-half pound of fish).

The risk assessment estimated that the carcinogenic risk from ingestion of fish was 1.8×10^{-4} and the noncarcinogenic hazard index (HI) was 6.6. Because these risks are based on the equivalent of three meals per year, a person would have to eat less than one full meal per year for risks to be acceptable (i.e., less than USEPA benchmarks and a HI less than 1, for example). The conclusions of the HHRA, therefore, indicate that a person could eat very small amounts of fish from the Boat Basin per year. The findings of the risk assessment agree well with the fish advisory restrictions that fish caught in Lake Michigan should be eaten infrequently or not at all, thereby reducing the uncertainty in the exposure assumptions for recreational fish ingestion.

8.5 UNCERTAINTIES IN THE ERA

During the ERA, it was found that potential risks to piscivorous species existed for certain pesticides and metals at Site 17. These chemicals include total DDT, chromium, lead, mercury, and zinc in the Boat Basin; DDE, DDT, and lead in the South Branch; and total DDT, chromium, copper, lead, mercury, and zinc in the North Branch. These conclusions were based primarily on the $LOAEL_{avg}$ scenario and predicted fish tissue concentrations. Because the fish tissue concentrations were predicted and not measured in fish tissue samples, uncertainties in the ecological risk conclusions exist. Some of those uncertainties have been reduced with the comparison of the historic data in Section 8.3 above.

When comparing predicted fish tissue concentrations to measured fish tissue data from STORET, it was found that in almost all cases, the average predicted concentrations were closer to those found in the STORET data. Therefore, risk decisions based on the average scenario provide a better basis for conclusions. Although in some scenarios, such as for total DDT, PCBs, and alpha-BHC, the average predicted tissue concentrations are still greater than those found in STORET samples. Risk conclusions for these chemicals, even though they are based on the average scenario, are likely to still be over-predicted for the reason discussed below.

Concentrations of bioaccumulative chemicals are expected to be greatest in larger, older fish. Older fish typically have higher percentages of lipid/fat, and this is where bioaccumulative chemicals such as pesticides and PCBs bioconcentrate. This is evidenced by the STORET fish data (see Table 8-1) where the larger fish samples had higher concentrations as compared to smaller fish samples. Therefore, risks to piscivorous wildlife consuming fish from the North Branch and Boat Basin, where risks were predicted to be the greatest, are overestimated than other areas in Pettibone Creek because the fish are significantly smaller there compared to the fish that were collected and included in STORET. In summary, it is likely that risks would be lower to piscivorous wildlife consuming fish from Site 17 if actual fish data were available, but the actual decrease in risks cannot be quantified at this time.

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TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Station ID	QZB03	QZB12	QZB12	QZB12	QZB12	QZB12
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WESTERN SHORE	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS
Sample Date	06/14/95	10/09/84	10/11/84	10/11/84	10/11/84	10/11/84
Anatomy code/no. individuals per sample	86/10	86/5	86/5	86/2	86/5	86/5
Species code/FWS numeric code	YP/63	CHN/83	BT/11	RBT/39	RBT/39	CHN/83
Length (inches)/Weight(lbs)	9.7/0.35	/4.16	/3.55	/9.1	/6.2	/10.97
Inorganics (mg/kg)						
MERCURY						
Miscellaneous Parameters (%)						
LIPIDS	0.58 %	3.15 %	1.28 %	3.79 %	2.96 %	0.7 %
Pesticides/PCBs (ug/kg)						
ALDRIN	10 J	14	17	17	10 J	10
ALPHA-BHC	10 J	10 J	10 J	10 J	10 J	10 J
DIELDRIN	10 J	17	24	32	21	10 J
ENDRIN	10 J	10 J	17	10 J	10 J	10 J
TOTAL DDT	20	60	76	127	40	38
TOTAL PCB CONGENERS	120	410	380	260	130	270

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Station ID	QZB12	QZB12	QZB12	QZB12	QZB12	QZB12
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS
Sample Date	10/11/84	12/14/84	12/14/84	12/14/84	12/14/84	12/14/84
Anatomy code/no. individuals per sample	86/5	86/1	86/1	86/1	86/1	86/1
Species code/FWS numeric code	CHN/83	BT/11	BT/11	BT/11	BT/11	BT/11
Length (inches)/Weight(lbs)	/7.88	/1.1	/7.27	/4.41	/1.5	/8.1
Inorganics (mg/kg)						
MERCURY						
Miscellaneous Parameters (%)						
LIPIDS	1.42 %					
Pesticides/PCBs (ug/kg)						
ALDRIN	12	10 J	10 J	10 J	10 J	10 J
ALPHA-BHC	10 J	10 J	10 J	10 J	10 J	10 J
DIELDRIN	47	39	29	184	62	51
ENDRIN	10 J	10 J	10 J	10 J	10 J	10 J
TOTAL DDT	24	135	282	360	213	240
TOTAL PCB CONGENERS	540	260	813	920	280	580

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 3 OF 16

Station ID	QZB12	QZB12	QZB12	QZB12	QZB12	QZB12
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS
Sample Date	12/14/84	12/14/84	12/14/84	12/14/84	12/14/84	12/14/84
Anatomy code/no. individuals per sample	86/1	86/1	86/1	86/1	86/1	86/1
Species code/FWS numeric code	BT/11	BT/11	BT/11	BT/11	CHN/83	CHN/83
Length (inches)/Weight(lbs)	/1.082	/5.4	/4.85	/1.1	/8.59	/20.9
Inorganics (mg/kg)						
MERCURY						
Miscellaneous Parameters (%)						
LIPIDS					1.1 %	3.48 %
Pesticides/PCBs (ug/kg)						
ALDRIN	10 J	10 J	10 J	10 J	10 J	10 J
ALPHA-BHC	10 J	10 J	10 J	10 J	10 J	10 J
DIELDRIN	79	34	36	30	2	82
ENDRIN	10 J	10 J	10 J	10 J	10 J	10 J
TOTAL DDT	613	319	170	300	336	445
TOTAL PCB CONGENERS	1082	1028	366	718	802	1740

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Station ID	QZB12	QZB12	QZB12	QZB12	QZB12	QZB12
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS
Sample Date	12/14/84	12/14/84	12/14/84	12/14/84	12/14/84	12/14/84
Anatomy code/no. individuals per sample	86/1	86/1	86/1	86/1	86/1	86/1
Species code/FWS numeric code	CHN/83	CHN/83	CHN/83	CHN/83	CHN/83	CHN/83
Length (inches)/Weight(lbs)	/14.3	/18.7	/18.7	/16.3	/9.3	/6.06
Inorganics (mg/kg)						
MERCURY						
Miscellaneous Parameters (%)						
LIPIDS	1.45 %	3.6 %	6 %	1.48 %	0.3 %	1.1 %
Pesticides/PCBs (ug/kg)						
ALDRIN	10 J	10 J	10 J	10 J	10 J	10 J
ALPHA-BHC	10 J	10 J	10 J	10 J	10 J	10 J
DIELDRIN	64	104	26	47	10 J	12
ENDRIN	10 J	10 J	10 J	10 J	10 J	10 J
TOTAL DDT	552	293	241	235	307	199
TOTAL PCB CONGENERS	1199	951	1268	1043	748	490

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 5 OF 16

Station ID	QZB12	QZB12	QZB12	QZB12	QZB12	QZB12
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS
Sample Date	12/14/84	12/14/84	12/15/84	12/15/84	12/15/84	12/15/84
Anatomy code/no. individuals per sample	86/1	86/1	86/1	86/1	86/1	86/1
Species code/FWS numeric code	CHN/83	CHN/83	CHN/83	CHN/83	CHN/83	CHN/83
Length (inches)/Weight(lbs)	/8.25	/7.27	/12.3	/11.7	/11	/9.9
Inorganics (mg/kg)						
MERCURY						
Miscellaneous Parameters (%)						
LIPIDS	1.4 %	2.88 %	0.7 %	0.2 %	0.8 %	0.4 %
Pesticides/PCBs (ug/kg)						
ALDRIN	10 J	10 J	10 J	10 J	10 J	10 J
ALPHA-BHC	10 J	10 J	10 J	10 J	10 J	10 J
DIELDRIN	5	17	10 J	3	10 J	10 J
ENDRIN	10 J	10 J	10 J	10 J	10 J	10 J
TOTAL DDT	439	686	86	252	354	605
TOTAL PCB CONGENERS	230	2276	117	263	1045	2518

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Station ID	QZB12	QZB12	QZB12	QZB15	QZB15	QZB15
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/GLNTS	WESTERN SHORE/LB	WESTERN SHORE/LB	WESTERN SHORE/LB
Sample Date	12/15/84	12/15/84	09/20/88	06/12/84	06/06/85	06/10/88
Anatomy code/no. individuals per sample	86/1	86/5	86/5	86/10	86/10	86/10
Species code/FWS numeric code	CHN/83	CHN/83	BT/11	YP/63	YP/63	YP/63
Length (inches)/Weight(lbs)	/9.9	/4.16	/7.2	/0.37	/0.45	/0.39
Inorganics (mg/kg)						
MERCURY						
Miscellaneous Parameters (%)						
LIPIDS	0.7 %	3.2 %	6.6 %	0.5 %	0.4 %	0.5 %
Pesticides/PCBs (ug/kg)						
ALDRIN	10 J	10 J	10 U	10 J	10 J	10 U
ALPHA-BHC	10 J	10 J	10 U	10 J	10 J	10 U
DIELDRIN	10 J	19	50	10 J	10 J	10 J
ENDRIN	10 J	10 J	10 U	10 J	10 J	10 U
TOTAL DDT	397	407	500	5	8	20
TOTAL PCB CONGENERS	427	151	1200	10 J	10 J	100 J

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Station ID	QZB15	QZB15	QZB15	QZB15	QZB15	QZB15	QZB15
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WESTERN SHORE/LB	WESTERN SHORE/LB	WESTERN SHORE/LB	WESTERN SHORE/LB	WESTERN SHORE/LB	WESTERN SHORE/LB	WESTERN SHORE/LB
Sample Date	06/08/89	04/18/90	08/01/90	08/01/90	08/01/90	10/30/90	06/06/91
Anatomy code/no. individuals per sample	86/10	59/25	86/5	86/5	86/5	86/10	86/10
Species code/FWS numeric code	YP/63	AW/75	LT/29	LT/29	LT/29	YP/63	YP/63
Length (inches)/Weight(lbs)	/0.31	NA	23.3/4.82	27.3/7.93	17.6/1.95	10.1/	9.6/0.3
Inorganics (mg/kg)							
MERCURY				0.17			
Miscellaneous Parameters (%)							
LIPIDS	0.5 %	9.8 %	12.3 %	16.8 %	5.4 %	0.3 %	0.27 %
Pesticides/PCBs (ug/kg)							
ALDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10 J
ALPHA-BHC	10 J	10 J	10 J	10	10 J	10 J	10 J
DIELDRIN	10 J	90	80	180	10	10 J	10 J
ENDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10 J
TOTAL DDT	20	350	1500	1300	220	20	10 J
TOTAL PCB CONGENERS	110	590	4400	1800	620	100 J	100 J

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Station ID	QZB15	QZB15	QZB15	QZB15	QZO01	QZO01	QZO01
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WESTERN SHORE/LB	WESTERN SHORE/LB	WESTERN SHORE/LB	WESTERN SHORE/LB	WH/UC	WH/UC	WH/UC
Sample Date	06/05/92	06/06/96	06/06/97	06/04/98	05/15/96	05/15/96	05/15/96
Anatomy code/no. individuals per sample	86/10	86/10	86/10	86/10	59/5	86/1	86/1
Species code/FWS numeric code	YP/63	YP/63	YP/63	YP/63	WSU/61	BKB/4	NP/36
Length (inches)/Weight(lbs)	9.1/0.3	9.4/0.32	9.7/0.32	9.78/0.34	5.6/	7.8/0.28	24/2.69
Inorganics (mg/kg)							
MERCURY							
Miscellaneous Parameters (%)							
LIPIDS	0.3 %	0.45 %	0.71 %	0.59 %	1.9 %	0.64 %	0.45 %
Pesticides/PCBs (ug/kg)							
ALDRIN	10 U	10 J	10 J	10 J	10 J	10 J	10 J
ALPHA-BHC	10 U	10 J	10 J	10 J	10 J	10 J	10 J
DIELDRIN	10 U	10 J	10 J	10 J	10 J	10 J	10 J
ENDRIN	20 U	10 J	10 J	10 J	10 J	10 J	10 J
TOTAL DDT	5 J	10	20	50	60	110	30
TOTAL PCB CONGENERS	100 U	100 J	100 J	170	900	1400	170

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Station ID	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC
Sample Date	06/19/96	06/19/96	06/19/96	06/19/96	06/19/96	07/16/96	07/16/96	07/16/96	07/16/96
Anatomy code/no. individuals per sample	59/4	59/8	59/1	59/1	59/11	59/3	59/1	59/1	59/8
Species code/FWS numeric code	BKS/5	GSH/21	GSH/21	WSU/61	AW/75	GSN/22	GF/24	WSU/61	AW/75
Length (inches)/Weight(lbs)	6.2/0.12	5.4/0.06	11.4/0.51	13.2/0.87	7.9/0.11	4.4/0.02	6.6/0.21	10.8/0.48	6.6/0.04
Inorganics (mg/kg)									
MERCURY									
Miscellaneous Parameters (%)									
LIPIDS	1.7 %	3.2 %	3.1 %	4.8 %	4.3 %	2.5 %	3.8 %	4.5 %	2.9 %
Pesticides/PCBs (ug/kg)									
ALDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
ALPHA-BHC	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
DIELDRIN	10 J	10	20	10	40	10	10 J	20	20
ENDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
TOTAL DDT	90	70	160	100	200	120	140	120	170
TOTAL PCB CONGENERS	360	1600	310	770	390	590	380	860	400

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Station ID	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC
Sample Date	07/16/96	07/16/96	07/16/96	07/16/96	07/16/96	07/30/96	08/14/96	08/14/96	08/14/96
Anatomy code/no. individuals per sample	86/1	86/3	86/1	86/5	86/5	86/4	86/1	86/5	86/5
Species code/FWS numeric code	C/12	LMB/31	SMB/47	YP/63	YP/63	C/12	C/12	YP/63	YP/63
Length (inches)/Weight(lbs)	34.2/19.6	10.3/0.65	17.8/3	8/0.21	6.7/0.11	27.3/10.4	15.4/1.74	8.3/0.24	6.4/0.11
Inorganics (mg/kg)									
MERCURY									
Miscellaneous Parameters (%)									
LIPIDS	12 %	1.5 %	0.86 %	0.54 %	0.26 %	12 %	0.31 %	0.4 %	0.4 %
Pesticides/PCBs (ug/kg)									
ALDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
ALPHA-BHC	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
DIELDRIN	30	10 J	10 J	10 J	10 J	30	10 J	10 J	10 J
ENDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
TOTAL DDT	820	50	100	10 J	10 J	700	20	10 J	10 J
TOTAL PCB CONGENERS	8000	300	390	160	100 J	4400	100 J	100 J	100 J

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
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Station ID	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC
Sample Date	10/01/96	10/01/96	10/01/96	10/01/96	10/01/96	10/01/96	10/01/96	10/06/96	10/08/96
Anatomy code/no. individuals per sample	86/1	86/2	86/2	86/5	86/2	86/5	86/5	86/2	59/7
Species code/FWS numeric code	BKS/5	BT/11	BT/11	CHO/81	CHO/81	CHN/83	CHN/83	CHN/83	WSU/61
Length (inches)/Weight(lbs)	8.2/0.31	17.2/2.86	22.9/5.4	23.8/5.37	25.5/6.5	34/13.7	39.5/21.8	27.9/8.81	9.1/0.29
Inorganics (mg/kg)									
MERCURY									
Miscellaneous Parameters (%)									
LIPIDS	0.67 %	3.3 %	6.4 %	1.9 %	1.5 %	1.2 %	1.9 %	1.2 %	1.8 %
Pesticides/PCBs (ug/kg)									
ALDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
ALPHA-BHC	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
DIELDRIN	10 J	20	40	10 J	10 J	10	20	10	10 J
ENDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
TOTAL DDT	30	200	250	210	200	260	460	210	50
TOTAL PCB CONGENERS	170	430	1000	620	700	650	1300	770	300

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 12 OF 16

Station ID	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC
Sample Date	10/08/96	10/11/96	10/14/96	10/17/96	10/17/96	10/17/96	10/17/96	10/17/96
Anatomy code/no. individuals per sample	86/3	86/3	86/4	59/1	59/4	59/4	86/1	86/3
Species code/FWS numeric code	WSU/61	CHN/83	CHO/81	BGS/8	GSN/22	FHM/382	NP/36	WSU/61
Length (inches)/Weight(lbs)	15.9/1.6	23.4/4.96	12.9/0.94	4.4/	4.3/	2.8/	36/12.1	10.5/0.44
Inorganics (mg/kg)								
MERCURY								
Miscellaneous Parameters (%)								
LIPIDS	1.7 %	1.6 %	3.1 %	2.7 %	5 %	2.1 %	2.4 %	1.2 %
Pesticides/PCBs (ug/kg)								
ALDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
ALPHA-BHC	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
DIELDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10	10 J
ENDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
TOTAL DDT	40	160	190	80	60	130	130	20
TOTAL PCB CONGENERS	360	600	330	950	1200	1200	1300	170

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 13 OF 16

Station ID	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC
Sample Date	10/17/96	10/17/96	10/17/96	07/01/97	07/01/97	07/16/97	07/16/97	07/16/97	07/16/97
Anatomy code/no. individuals per sample	86/5	86/5	86/5	86/3	86/2	59/5	59/5	59/6	86/5
Species code/FWS numeric code	YP/63	YP/63	YP/63	C/12	C/12	GSH/21	GSH/21	GSH/21	C/12
Length (inches)/Weight(lbs)	7.4/0.18	6.5/0.11	9.1/0.3	28.8/12.6	33.3/20.8	8.6/	9.2/	9.5/	18.6/3.57
Inorganics (mg/kg)									
MERCURY									
Miscellaneous Parameters (%)									
LIPIDS	0.36 %	0.66 %	0.46 %	14 %	24 %	6 %	8.1 %	10 %	15 %
Pesticides/PCBs (ug/kg)									
ALDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
ALPHA-BHC	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
DIELDRIN	10 J	10 J	10 J	110	100	10	20	20	30
ENDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
TOTAL DDT	10 J	20	10 J	680	1400	160	170	110	990
TOTAL PCB CONGENERS	140	240	180	9200	7800	530	710	800	3700

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 14 OF 16

Station ID	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01	QZO01
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC	WH/UC
Sample Date	07/16/97	09/19/97	09/19/97	09/19/97	06/01/98	06/01/98	07/08/98	07/08/98	07/28/98
Anatomy code/no. individuals per sample	86/4	86/1	59/1	86/3	86/5	86/5	86/5	86/5	59/5
Species code/FWS numeric code	C/12	C/12	GSH/21	WSU/61	C/12	C/12	C/12	LMB/31	BGS/8
Length (inches)/Weight(lbs)	31.1/14.6	19.6/3.85	17.4/2.1	14.1/0.95	28.9/13	21/4.96	18.3/3.17	13.2/1.29	5.04/
Inorganics (mg/kg)									
MERCURY								0.3	
Miscellaneous Parameters (%)									
LIPIDS	13 %	9.3 %	5.8 %	3 %	22 %	13 %	8 %	2 %	2.4 %
Pesticides/PCBs (ug/kg)									
ALDRIN	10 J	10 J	10 J	10 J	10 J	50	50	10 J	10 J
ALPHA-BHC	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
DIELDRIN	40	20	30	10 J	90	20	20	10 J	10 J
ENDRIN	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J	10 J
TOTAL DDT	530	220	40	60	1700	500	260	110	90
TOTAL PCB CONGENERS	2800	1700	6300	510	8100	7300	4900	1200	1500

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 15 OF 16

Station ID	QZO01	QZO01	QZO22	QZO22	QZO22	QZO22	QZO22	QZO22	QZO22
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WH/UC	WH/UC	WH/MHC	WH/MHC	WH/MHC	WH/MHC	WH/MHC	WH/MHC	WH/MHC
Sample Date	07/28/98	07/28/98	08/16/93	08/16/93	08/16/93	08/16/93	08/16/93	08/16/93	08/16/93
Anatomy code/no. individuals per sample	59/4	59/20	59/6	59/1	59/5	59/15	59/1	59/1	59/8
Species code/FWS numeric code	GSF/25	SHI/497	BGS/8	GSH/21	GSN/22	GSN/22	WSU/61	WSU/61	AW/75
Length (inches)/Weight(lbs)	5.9/		5.1/	16.6/1.76	5.2/	3/	14.6/1.32	11/0.66	5.9/
Inorganics (mg/kg)									
MERCURY									
Miscellaneous Parameters (%)									
LIPIDS	2 %	2.3 %	2.63 %	3.56 %	1.96 %	3 %	4.07 %	3.03 %	3.8 %
Pesticides/PCBs (ug/kg)									
ALDRIN	10 J	10 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ALPHA-BHC	10 J	10 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIELDRIN	10 J	10 J	26 C	10 U	10 U	12 C	12 C	14 C	10 U
ENDRIN	10 J	10 J	20 U	20 U	20 U	20 U	20 U	20 U	20 U
TOTAL DDT	110	170	75 C	59 C	58 C	103 C	103 C	80 C	66 C
TOTAL PCB CONGENERS	3500	1000	1070 C	410 C	460 C	1060 C	1060 C	620 C	170 C

TABLE 8-1

STORET HISTORIC FISH TISSUE RESULTS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS
PAGE 16 OF 16

Station ID	QZO22	QZO22	QZO22	QZO22	QZO22	QZO22
Site	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN	LAKE MICHIGAN
Area of Concern	WH/MHC	WH/MHC	WH/MHC	WH/MHC	WH/MHC	WH/MHC
Sample Date	08/16/93	08/16/93	08/16/93	08/16/93	08/16/93	08/16/93
Anatomy code/no. individuals per sample	86/1	86/1	86/1	86/1	86/1	86/1
Species code/FWS numeric code	C/12	C/12	C/12	C/12	C/12	C/12
Length (inches)/Weight(lbs)	27.4/8.7	26.8/10.6	31.8/23.2	28/12.6	26.2/10.1	25/8.59
Inorganics (mg/kg)						
MERCURY						
Miscellaneous Parameters (%)						
LIPIDS	5.12 %	5.53 %	40.1 %	20.3 %	16.2 %	5.3 %
Pesticides/PCBs (ug/kg)						
ALDRIN	10 U	10 U	50 U	10 U	10 U	10 U
ALPHA-BHC	10 U	10 U	50 U	2 M	10 U	10 U
DIELDRIN	70 C	43 C	250 C	10 U	56 C	18 C
ENDRIN	20 U	20 U	100 U	20 U	20 U	20 U
TOTAL DDT	270 C	217 C	2800 C	690 C	890 C	706 C
TOTAL PCB CONGENERS	3000 C	8590 C	2660 C	2140 C	1660 C	630 C

Species Code/Fish & Wildlife Service Code:
AW/75 = Alewife
BGS/08 = Blue Gill
BKB/04 = Black Bullhead
BKS/05 = Black Crappie
BT/11 = Brown Trout
C/12 = Carp
CHN/83 = Chinook Salmon
CHO/81 = Coho Salmon
FHM/382 = Fathead Minnow
GF/24 = Goldfish
GSF/25 = Green Sunfish
GSH/21 = Gizzard Shad
GSN/22 = Golden Shiner
LMB/31 = Large Mouth Bass
LT/29 = Lake Trout
NP/36 = Northern Pike
RBT/39 = Rainbow Trout
SHI/497 = Shiner
SMB/47 = Small Mouth Bass
WSU/61 = white Sucker
YP/63 = Yellow Perch

Anatomy Code:
86 = fillet
59 = whole body

TABLE 8-2

FREQUENCY OF DETECTION AT STORET STATIONS VERSUS PREDICTED CONCENTRATIONS
SITE 17 - PETTIBONE CREEK AND BOAT BASIN
NAVAL TRAINING CENTER
GREAT LAKES, ILLINOIS

Station and Parameter[(1)]	Frequency of Detection	Minimum Concentration	Maximum Concentration	Average of Positive Results	Average of All Results	Predicted Maximum/Average Fish Concentration (Boat Basin)	Predicted Maximum/Average Fish Concentration (North Branch)	Predicted Maximum/Average Fish Concentration (South Branch)
QZB15 - LAKE BLUFF								
Aldrin	12/14	0.01	0.01	0.01	0.01	0.041 / 0.041	0.11 / 0.11	--
Endrin	12/14	0.01	0.01	0.01	0.01	0.013 / 0.013	0.043 / 0.043	0.018 / 0.03
Total DDT	14/14	0.01	1.5	0.25	0.25	11.4 / 4.46	42.6 / 8.64	4.93 / 1.53
Total PCB Congeners	13/14	0.01	4.4	0.63	0.59	9.54 / 1.77	9.96 / 2.84	3.05 / 1.08
Mercury	1/1	0.17	0.17	0.17	0.17	0.95 / 0.22	4.7 / 0.39	0.23 / 0.11
Lipids	14/14	0.27	16.8	3.49	3.49	0.036	0.036	0.036
QZB03 - LAKE BLUFF								
Aldrin	1/1	0.01	0.01	0.01	0.01	0.041 / 0.041	0.11 / 0.11	--
Endrin	1/1	0.01	0.01	0.01	0.01	0.013 / 0.013	0.043 / 0.043	0.018 / 0.03
Total DDT	1/1	0.02	0.02	0.02	0.02	11.4 / 4.46	42.6 / 8.64	4.93 / 1.53
Total PCB Congeners	1/1	0.12	0.12	0.12	0.12	9.54 / 1.77	9.96 / 2.84	3.05 / 1.08
alpha-BHC	1/1	0.01	0.01	0.01	0.01	0.065 / 0.065	--	--
Lipids	1/1	0.58	0.58	0.58	0.58	0.036	0.036	0.036
QZB12 - GREAT LAKES NAVAL TRAINING CENTER								
Aldrin	32/33	0.01	0.02	0.011	0.011	0.041 / 0.041	0.11 / 0.11	--
Dieldrin	33/33	0	0.18	0.038	0.038	0.13 / 0.05	0.03 / 0.01	0.035 / 0.02
Endrin	32/33	0.01	0.02	0.01	0.01	0.013 / 0.013	0.043 / 0.043	0.018 / 0.03
Total DDT	33/33	0.02	0.69	0.29	0.29	11.4 / 4.46	42.6 / 8.64	4.93 / 1.53
Total PCB Congeners	33/33	0.12	2.52	0.77	0.77	9.54 / 1.77	9.96 / 2.84	3.05 / 1.08
alpha-BHC	32/33	0.01	0.01	0.01	0.01	0.065 / 0.065	--	--
Lipids	23/23	0.2	6.6	2.12	2.12	0.036	0.036	0.036
QZO22 - WAUKEGAN HARBOR/MID HARBOR CENTRAL								
Dieldrin	9/13	0.01	0.25	0.06	0.04	0.13 / 0.05	0.03 / 0.01	0.035 / 0.02
Total DDT	13/13	0.06	2.8	0.47	0.47	11.4 / 4.46	42.6 / 8.64	4.93 / 1.53
Total PCB Congeners	13/13	0.17	8.59	1.81	1.81	9.54 / 1.77	9.96 / 2.84	3.05 / 1.08
alpha-BHC	1/13	0	0	0	0.011	0.065 / 0.065	--	--
Lipids	13/13	1.96	40.1	8.82	8.82	0.036	0.036	0.036
QZO01 - WAUKEGAN HARBOR/UPPER CHANNEL								
Aldrin	58/58	0.01	0.05	0.011	0.011	0.041 / 0.041	0.11 / 0.11	--
Dieldrin	58/58	0.01	0.11	0.019	0.019	0.13 / 0.05	0.03 / 0.01	0.035 / 0.02
Endrin	58/58	0.01	0.01	0.01	0.01	0.013 / 0.013	0.043 / 0.043	0.018 / 0.03
Total DDT	58/58	0.01	1.7	0.23	0.23	11.4 / 4.46	42.6 / 8.64	4.93 / 1.53
Total PCB Congeners	58/58	0.1	9.2	1.65	1.65	9.54 / 1.77	9.96 / 2.84	3.05 / 1.08
alpha-BHC	58/58	0.01	0.01	0.01	0.01	0.065 / 0.065	--	--
Lipids	58/58	0.26	24	4.54	4.54	0.036	0.036	0.036

1 All units are in mg/kg except lipids, which are in percent (%).

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P:\GIS\GREATLAKES_NTC\APR\PHOTO_LOCATIONS.APR STORET FISH DATA LOCATIONS LAYOUT 5/14/03 AJ

DRAWN BY	DATE	Tetra Tech NUS, Inc.	CONTRACT NUMBER	OWNER NUMBER
A. JANOCHA	5/09/03		N1333	CTO 295
CHECKED BY	DATE	STORET FISH DATA STATIONS NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS	APPROVED BY	DATE
R. HAYNIE	5/09/03		RFD	5/14/03
COST/SCHEDULE-AREA			APPROVED BY	DATE
			—	—
SCALE			DRAWING NO.	REV
AS NOTED			FIGURE 8 - 1	0

9.0 SUMMARY AND CONCLUSIONS

The following items summarize the environmental conditions at Site 17, Pettibone Creek and the Boat Basin:

- Pettibone Creek flows through a ravine (named Pettibone Creek Ravine) that ranges from approximately 50 to 100 feet in height with 30- to 70-degree slopes and defines the boundary between different areas of the Main Installation of NTC Great Lakes. The Pettibone Creek system consists of north and south branches that merge and flow east into Lake Michigan via the Boat Basin. The North Branch of Pettibone Creek begins outside of NTC Great Lakes in an urbanized area zoned for industry and is the discharge point for storm sewers within the City of North Chicago and NTC Great Lakes. The South Branch originates in a residential area southwest of NTC Great Lakes then flows through a private golf course before entering NTC Great Lakes. The Pettibone Creek study area ranges from the culvert at the northern end of North Branch Pettibone Creek and the golf course/NTC Great Lakes property limit of the South Branch Pettibone Creek downstream to the west end of the bridge upstream of the Boat Basin.

- The Boat Basin was constructed in 1906, and extensive erosion of Pettibone Creek contributes to the silting-in of the Boat Basin. The Boat Basin is approximately 2.6 acres in area and is the most protected portion of the NTC Great Lakes harbor system. It served as an area for boat slips when the water was deeper. The eastern portion of the Boat Basin provided access to the boat repair building, but accumulated sediment now prevents access for most vessels. Public Works Center Great Lakes has estimated that some 30,000 cubic yards of sediment would have to be dredged from the Boat Basin to reestablish a desired water depth of 8 feet. The harbor was dredged in the early 1950s and again in the early 1970s.

- Early investigations of Pettibone Creek and Boat Basin resulted from studies of the abandoned industrial facilities located in North Chicago in the 1970s. Several of the facilities (Fansteel, NCRS, and the Vacant Lot) were turn of the century manufacturing facilities that produced tantalum mill products, non-ferrous metals, and zinc oxide. USEPA Region 5 investigated these facilities for organic, pesticide, PCB, and inorganic contamination. These industries, in combination with several storm sewers collecting water/runoff from a large section of the City of North Chicago (Illinois EPA, December 1995) and NTC Great Lakes, have contributed to elevated concentrations of contaminants based on the historical information.

- NTC Great Lakes has been used to support naval training since 1911 with some commercial activities such as gas stations, dry cleaners, printers, transformer and drum storage, underground storage tanks, etc. Industrial-type activities have not been conducted at this facility. The Navy has identified potential areas where hazardous materials may have been released to the environment. The sites that have sources of contamination that may be discharged into Site 17 through storm water runoff include transformer storage areas (PCBs), a silk screen shop (VOCs and metals), demolition debris disposal areas (metals), and service stations and drum storage areas (VOCs).

The following summarizes the analytical findings at Site 17:

- VOCs are not significant site-related contaminants in sediment for Site 17.

- PAHs are the predominant SVOCs detected in the sediment samples collected at Site 17. Many of the analytical results reported exceed the referenced human health or ecological screening criteria. However, the interpretation of the PAH data must consider the fact that PAHs are common, anthropogenic contaminants frequently detected in soils and sediments as a result of the wide-spread use of petroleum products in our modern, industrialized society. Pettibone Creek receives surface water run-off and storm water from roadways and areas that have been paved with asphalt. The PAH concentrations reported for Pettibone Creek and the Boat Basin are within the range of concentrations reported as anthropogenic background for soils. The maximum concentrations for many PAHs detected in Pettibone Creek were reported for the sample collected at the upstream boundary of Site 17.

- Pesticides were detected in the sediment samples collected at Site 17 at concentrations that reflect the widespread and historic use of the chemicals for pest control. With the exception of a few results reported for sediment samples collected from the Boat Basin, the pesticide concentrations reported for the Site 17 sediment samples do not exceed TACO screening levels for human health. In contrast, the pesticide results frequently exceed referenced screening levels for ecological receptors. There is no evidence or records that pesticides were ever stored, mixed or used in the general area of Pettibone Creek and the Boat Basin. Historically, banned pesticides were applied when it was legal to do so at NTC Great Lakes by operation and maintenance personnel or contractors who are licensed to apply these products. There is no evidence of a release of such products in excess of the reportable quantities under 40 CFR Part 373, and *there are no analytical data available that indicate pesticide applications are a source of the contamination at Pettibone Creek and the Boat Basin.*

- PCBs were detected in less than 50 percent of the sediment samples analyzed. The concentrations for the at-depth sediment samples from the Boat Basin exceed the TACO screening criteria for human health, and numerous samples in the North Branch of Pettibone Creek and the Boat Basin exceed the referenced ecological screening criteria. PCBs were detected in the off-site, upstream samples collected during previous environmental investigations as well as at the transformer storage areas. PCB- and lead-contaminated soil was excavated from one of the industrial facilities in 1998 and disposed in a permitted Subtitle D disposal facility. Clean-up documentation for the transformer storage areas is not available, but the reported PCB-contaminated soil was limited. The transformer storage areas are no longer used at NTC Great Lakes.

- Several metals (e.g., copper, lead, mercury, selenium, silver, zinc) were detected in the sediments of the Boat Basin and the North Branch of Pettibone Creek at average concentrations an order of magnitude greater than background sediment and/or soil concentrations reported in TACO. In contrast, most analytical results reported for the South Branch of Pettibone Creek are similar to background sediment and/or soil concentrations reported in TACO. These metals were also detected in the off-site, upstream samples collected during previous environmental investigations. The concentrations that were reported for the off-site, upstream samples were often 2 to 3 times the concentrations noted in the Site 17 sediment samples. The analytical data suggest that the primary source of contamination is historical discharge and storm water discharge within the Pettibone Creek Watershed.

- Several VOCs were detected in the surface water samples. Maximum detected concentrations reported for bromodichloromethane, chloroform, and trichloroethene exceed TACO GRO criteria. However, the trihalomethanes noted are often produced as a result of the chlorination process (e.g., chlorination of drinking water supply or a wastewater discharge such as the industrial discharges upstream of NTC Great Lakes). Maximum concentrations of the chlorinated solvents and toluene were reported for the sample collected at the upstream boundary of Site 17.

- PAHs were not detected in the Site 17 surface water samples. Four pesticides were detected in the surface water samples collected from Site 17. The concentrations reported for these compounds are less than the method reporting limits and do not exceed TACO screening levels for human health. The infrequent low-level detections suggest that the contamination is most likely the result of historic use of pesticides in the Pettibone Creek Watershed.

- Six inorganic constituents were detected in the surface water samples at concentrations exceeding one or more of the screening criteria. Analytical results reported for iron, lead, and manganese exceed the Illinois TACO Tier I GRO screening criteria and the ecological surface water screening criteria. The concentrations detected may be elevated due to sample turbidity. Previous studies of properties located upstream of the base property indicated several metals in the up-stream surface water samples were at concentrations three times greater than background concentrations. According to Illinois EPA documents, the R. Lavin facility has violated its NPDES permit limits and has contributed to contaminated sediments in Pettibone Creek. When sample turbidity is considered, the metal concentrations at the NTC Great Lakes sampling locations are similar, suggesting no obvious primary point source of contamination located on the NTC Great Lakes property. The metal concentrations detected in the NTC Great Lakes surface water samples are likely the result of natural occurrence in combination with releases from sources that originate upstream of Site 17 (industrial point sources, urban runoff, erosional processes, flooding events, and storm water outfalls) and storm water outfalls that originate within NTC Great Lakes.

- Upstream industrial sources are a primary source of the environmental contaminants detected in the surface water and sediments of Site 17. Predominant inorganic contaminants in the Site 17 sediments (e.g., copper, lead, and zinc) were also identified as significant environmental contaminants in sediment samples collected upstream and off-site of Site 17 during past environmental investigations. Overland run-off and storm water discharges from NTC Great Lakes may contribute pollutants to the watershed but the analytical results do not suggest that a significant point source(s) from NTC Great Lakes is (are) impacting the surface water/sediment quality of Pettibone Creek or the Boat Basin.

- Chemical concentrations detected in the sediments of the South Branch of Pettibone Creek are less than those reported for samples collected from the North Branch of Pettibone Creek and the Boat Basin by a factor of 2 or more. The differences are attributable to the fact that significant industrial sources of contamination exist(ed) upstream of the North Branch of Pettibone Creek (which drains to the Boat Basin); similar industrial sources do not exist on the South Branch of Pettibone Creek.

- Average concentrations of pesticides, PCBs, and metals in the deeper (at-depth) samples of the Boat Basin often exceed the average concentrations reported in the surface (0 to 4 centimeters) sediment samples of the Boat Basin by a factor of 2 or more. The differences with depth may reflect decreases in contaminant loading over time; sediments have built up, undisturbed in the Boat Basin over an extended period. Average concentrations of most metals, pesticides, and PCBs in the at-depth samples of the Boat Basin also exceed those reported for surface or at-depth sediments collected along Pettibone Creek.

The following items summarize the HHRA at Site 17:

- Adult and adolescent recreational users were evaluated as potential receptors for exposure to surface water and sediment. Adult recreational users were also evaluated for exposure to fish assumed to be caught in the Boat Basin.

- Potential risks associated with inhalation exposures are considered to be minimal and were not evaluated in the quantitative risk assessment. Inhalation of volatile emissions and fugitive dust from sediment were not considered to be appropriate for sediment because of high moisture content associated with sediment matrices.

- No significant potential health hazards are associated with exposure to chemicals of potential concern (COPCs) in surface water and surface sediment under the recreational land use scenarios. The quantitative risk evaluation indicates that noncarcinogenic hazard indices (HIs) were less than unity (1.0) for adult and adolescent recreational users. Carcinogenic risks were less than or within the USEPA's risk management range, $1x10^{-6}$ to $1x10^{-4}$.

- The HIs and carcinogenic risks (ILCRs) estimated for recreational fisherman consuming fish contaminated with PCBs and pesticides exceeded USEPA benchmarks. However, these elevated risks were not based on actual measured fish tissue samples but rather on concentrations estimated by a model. The primary sources of the COPCs at the site are probably the contaminant releases that occurred upstream of NTC Great Lakes and runoff/storm water outfalls. Overland runoff and storm water discharges from NTC Great Lakes may contribute pollutants to the watershed, but the analytical results do not suggest that a significant point source(s) is (are) impacting the surface water/sediment quality of Pettibone Creek or the Boat Basin.

An evaluation of the uncertainties associated with the predicted fish tissue concentrations was conducted with the data used to prepare the Lake Michigan Fish Advisory. This evaluation used existing fish tissue data obtained from the Illinois EPA and USEPA through the STORET database in the area of Lake Michigan near NTC Great Lakes to qualitatively evaluate the uncertainties in the estimated risks. The following items summarize the fish tissue uncertainty in the human health evaluation for Site 17:

- The Lake Michigan Fish Advisory is issued to recommend restriction of fish consumption depending on the species. Sport fish such as trout and salmon are advised to be limited to one meal per month, whereas bottom feeding fish such as carp and catfish should not be eaten at all.

- The risks calculated in the HHRA from the predicted fish tissue concentrations and the STORET data are in close agreement with one another, differing by about a factor of two. Note that risks calculated using the STORET data were slightly greater than the risks calculated in the HHRA (See Section 8.4).

- The conclusion of the HHRA is that a person could eat only very small amounts of fish from the Boat Basin per year. The findings of the risk assessment agree well with the fish advisory restrictions, thereby reducing the uncertainty in the exposure assumptions for recreational fish ingestion.

The following items summarize the ERA at Site 17:

- Two primary ecological endpoints evaluated in this ERA were aquatic organisms (i.e., fish and invertebrates) and mammals and birds that consume invertebrates and/or fish. These ecological receptors were used to assess which chemicals have the greatest potential for causing risks.

- No chemicals detected in the surface water were retained as COCs for risks to aquatic organisms. A few of the chemicals detected in the surface water were included in the food chain model, however, the drinking portion of the food chain models is insignificant for exposure because the chemical concentrations in surface water are much lower than they are in sediment.

- No chemicals were retained as COCs for surface water/sediments in the South Branch of Pettibone Creek for aquatic receptors or mammals/birds. With the exception of a few sporadic elevated detections, the chemical concentrations in this branch are relatively low, and may represent a good reference location for comparison to data collected in the North Branch and Boat Basin.

- Several chemicals were retained as COCs in the North Branch of Pettibone Creek and the Boat Basin because they were detected at concentrations that exceeded many of the alternate benchmarks in several sediment samples. This indicates that there may be potential risks to aquatic receptors from these chemicals. There is uncertainty in this conclusion because they are based on literature values and because of the large amount of soil erosion in the creek that is a potential physical as well as chemical stressor that may be adding to the risks to aquatic organisms.

- Pesticides (DDT and DDE) were selected as COCs in the North Branch of Pettibone Creek and the Boat Basin because they may cause a risk to piscivorous birds that consume fish from the area. There is uncertainty in this conclusion because the risks are based on predicted fish tissue concentrations and because the samples were biased toward depositional areas that are expected to have greater chemical concentrations that the rest of the creek.

Similar to the HHRA, an evaluation of the uncertainties associated with the predicted fish tissue concentrations for the ERA was conducted with the data used to prepare the Lake Michigan Fish Advisory. This evaluation used the same fish tissue data obtained from the Illinois EPA and USEPA through the STORET database as in the HHRA uncertainty evaluation. A qualitative assessment was conducted to evaluate the uncertainties in the ERA. The following items summarize the fish tissue uncertainty evaluation with respect to the ERA at Site 17:

- In general, the maximum predicted fish concentrations at Site 17 in the ERA were greater than the maximum historic fish tissue concentrations from STORET. The predicted fish tissue concentrations at Site 17 are overestimated because the fish present in the South and North Branches of Pettibone Creek are significantly smaller than those sampled in Lake Michigan (they would be expected to accumulate less organic chemicals than larger and older fish in Lake Michigan), and sediment concentrations of PCBs and pesticides in samples collected for this report are significantly less than the historical data.

- For the ERA, it was found that comparing average predicted fish tissue concentrations to measured fish tissue data from STORET were in close agreement. Therefore, risk decisions based on the average scenario provide a better basis for conclusions. Although in some scenarios, risk conclusions are likely to still be overpredicted because concentrations of bioaccumulative chemicals are expected to be greatest in larger, older fish, and the risks to piscivorous wildlife consuming fish from the North Branch and Boat Basin should be based on fish that are smaller. In general, it is likely that risks would be lower to piscivorous wildlife, but the actual decrease in risks cannot be quantified at this time.

Based on the results of this RI/RA, the data indicate the upstream industrial sources (historical discharges and contamination) and storm water discharges within the Pettibone Creek Watershed are the primary sources of the environmental contaminants (PAHs, pesticides, PCBs, and metals) detected in the sediments of Site 17. Predominant inorganic contaminants in the Site 17 sediments (e.g., copper, lead, and zinc) were also identified as significant environmental contaminants in sediment samples collected upstream and off site of Site 17 during past environmental investigations. Overland runoff and storm water discharges from NTC Great Lakes to Site 17 may contribute pollutants to the watershed, but analytical results do not suggest that a significant point source(s) is(are) impacting the sediment quality of Pettibone Creek or the Boat Basin.

The PAH concentrations in the sediment samples have increased, and this is believed to be caused by widespread use of petroleum products in our modern, industrialized society (more roads, more traffic). The pesticide, PCB, and metals concentrations in sediment samples have decreased compared to the concentrations reported for historical samples. There is a general trend that the sediment at the surface is "cleaner" than sediment at depth.

Many of the potential sources of contamination still remain especially the storm water sewer systems and the surface water runoff from the industrial facilities into Pettibone Creek. However, a few of the industrial facilities (R. Lavin & Sons and Fansteel) that have contributed to the historical contamination in Pettibone Creek have filed petitions for bankruptcy and have ceased operations. Pettibone Creek may continue to receive a variety of wastes from the upstream industries, road runoff, storm sewers, and runoff/discharges from local residential properties. Many of the potential sources (industrial sites) have been cleaned up, and it is thought that additional releases to the Creek should not be as significant as they were in the past. Nevertheless, there could be residual runoff into Pettibone Creek because the upstream outfalls are still permitted under the NPDES. The Navy should maintain documentation of the spills resulting from both Navy and non-Navy (upstream) sources.

The human health risks from exposure to surface water and surface sediment under the recreational land use scenarios were less than the USEPA and Illinois EPA acceptable risk management range. However, the results of the HHRA indicated that there are risks from fish ingestion. The ERA indicated that several chemicals in the surface sediment may present risks to aquatic receptors and piscivorous birds in the North Branch of Pettibone Creek and the Boat Basin. Based on the overall conclusions from this RI/RA, it is recommended that a Feasibility Study be prepared to identify possible remedial alternatives to address the risks at Site 17 from the North Branch of Pettibone Creek and the Boat Basin sediment to be compliant with CERCLA requirements. Possible remedial action alternatives that should be reviewed in the Feasibility Study include:

- the no-action remedial alternative,

- an institutional control (land use control) to restrict fishing or fish consumption from the North Branch of Pettibone Creek and the Boat Basin areas at NTC Great Lakes and land use controls to make sure the current recreational use does not change in the future, and

- an engineering control response action combined with institutional controls.

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APPENDIX A.1

TASK MODIFICATION FORMS

TETRA TECH NUS, INC.
TASK MODIFICATION REQUEST FORM

NTC Great Lakes	3939 CTO 0154	04
Project/Installation Name	Project Number	Task Mod. Number
Bob Davis	Site 17	9/25/01
To	Site/Sample Location	Date

Description: Collected Surface water samples next to sediment sample locations. Moved NTC17BBSW05 inward from the opening of the boat basin to its present location near NTC17BBSD45

Reason for Change: To make it easier for Surveying purposes and Database purposes.

Recommended Disposition: Associate surface water sample locations with Sediment locations.

Robert Balkovec
Field Operations Leader (Signature)

October 29, 2001
Date

Disposition:

Robert [signature]
Site Coordinator (Signature)

10/29/01
Date

Distribution:
Program Coordinator-
Quality Assurance Officer -
Task Order Manager -
Field Operations Leader -

Others:
Robert Balkovec
Bob Davis
Robert Balkovec

APPENDIX A.2

SURFACE WATER SAMPLE LOG SHEETS

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: 3939 CTO 0154

Sample ID No.: NTC17PCSW01 01
Sample Location: NTC17PCSW01
Sampled By: B. Balkovic
C.O.C. No.:

- [x] Stream
- [ ] Spring
- [ ] Pond
- [ ] Lake
- [ ] Other: ~~BOAT BASIN~~ PETTIBONE CREEK
- [ ] QA Sample Type:

Type of Sample:
- [ ] Low Concentration
- [ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	OPR (mV)
Date: 9/24/01 Time: 1418 Depth: 2" Method: GRAB	HAZY	7.42	1.37	16.46	300	8.76	0.1	+121

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCl / 4°C	12 (3) 40 mL Vials	✓
TCL SVOCs	4°C	6 (2) 1 L Amber	✓
TAL Metals	HNO_3 / 4°C	3 (1) 500 mL Poly	✓
Filtered TAL Metals	HNO_3 / 4°C	3 (1) 500 mL Poly	✓
TCL PEST / PCBS	4°C	6 (2) 1 L Amber	✓

OBSERVATIONS / NOTES:

ASSOCIATED W/ NTC17PCSD0101

MAP:

SEE FIG B-2 + B-3

Circle if Applicable:

MS/MSD (circled)

Duplicate ID No.:

Signature(s):

Robert Balkovic

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17R SW03 01
Project No.:	3939 CTO 0154	Sample Location:	NTC17R SW03
		Sampled By:	B Balkovec
		C.O.C. No.:	

- [X] Stream
- [ ] Spring
- [ ] Pond
- [ ] Lake
- [ ] Other: ~~BOAT BASIN~~ Pettibone Creek
- [ ] QA Sample Type:

Type of Sample:
- [ ] Low Concentration
- [ ] High Concentration

SAMPLING DATA:

Date: 4/23/01 Time: 1240 Depth: 4" Method: GRAB	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	OPR (mV)
	Light	8.22	0.34	17.4	476	10.18	0.0	+118

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCl / 4°C	4 ~~(3)~~ 40 mL Vials	✓
TCL SVOCs	4°C	(2) 1 L Amber	✓
TAL Metals	HNO_3 / 4°C	(1) 500 mL Poly	✓
Filtered TAL Metals	HNO_3 / 4°C	(1) 500 mL Poly	✓
TCL PEST / PCBS	4°C	(2) 1 L Amber	✓

OBSERVATIONS / NOTES:

ASSOCIATED W/ SD33

MAP:

SEE FIG B-2 + B-3

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Page 1 of 1

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17R SW 04 01
Project No.:	3939 CTO 0154	Sample Location:	NTC17R SW04
		Sampled By:	B BALKOVEC
[X] Stream		C.O.C. No.:	
[ ] Spring			
[ ] Pond		Type of Sample:	
[ ] Lake		[ ] Low Concentration	
[ ] Other:	~~BOAT BASIN~~ PETTIBONE CREEK	[ ] High Concentration	
[ ] QA Sample Type:			

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	OPR (mV)
Date: 9/24/01 Time: 0915 Depth: 3" Method: GRAB	cloudy	7.41	0.638	14.5	600	9.11	0.0	190

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCl / 4°C	2x (4) ~~(6)~~ 40 mL Vials	✓
TCL SVOCs	4°C	2x (2) 1 L Amber	✓
TAL Metals	HNO_3 / 4°C	2x (1) 500 mL Poly	✓
Filtered TAL Metals	HNO_3 / 4°C	2x (1) 500 mL Poly	✓
TCL PEST / PCBS	4°C	2x (2) 1 L Amber	✓

OBSERVATIONS / NOTES:

ASSOCIATED W/ SD34

MAP:

SEE FIG. B-3

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	NTCFD04240102	Robert Balkovec

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES

Project No.: 3939 CTO 0154

Sample ID No.: NTC1788SW0601

Sample Location: NTC1788SW06

Sampled By: L. DOBSON/B. BALTROWE

C.O.C. No.:

- [ ] Stream
- [ ] Spring
- [ ] Pond
- [ ] Lake
- [x] Other: BOAT BASIN
- [ ] QA Sample Type:

Type of Sample:

- [ ] Low Concentration
- [ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	OPR (mV)
Date: 9/5/01 Time: 0900 Depth: 6" Method: GRAB	CLOUDY	6.02	0.346	21.30	21.1	8.51	0.0	+145

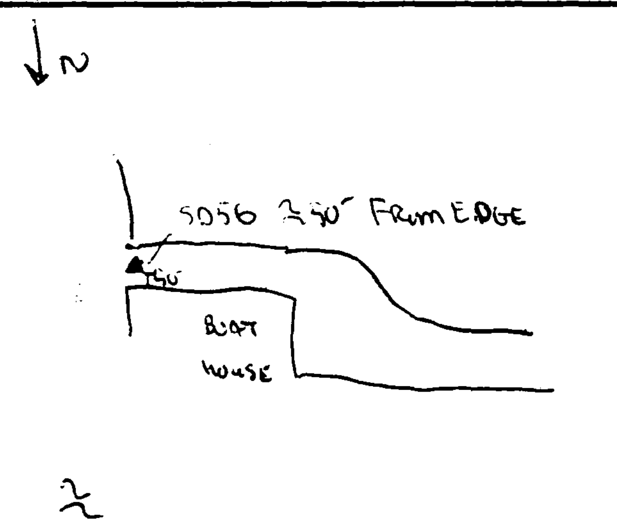
SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL VOCs	HCl / 4°C	(3) 40 mL Vials	✓
TCL SVOCs	4°C	(2) 1 L Amber	✓
TAL Metals	HNO_3 / 4°C	(1) 500 mL Poly	✓
Filtered TAL Metals	HNO_3 / 4°C	(1) 500 mL Poly	✓
TCL PEST / PCBS	4°C	(2) 1 L Amber	✓

OBSERVATIONS / NOTES:

ASSOCIATED W/ SD56

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Robert Baltrowe

APPENDIX A.3

SEDIMENT SAMPLE LOG SHEETS

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PCSD01 02
Sample Location: NTC17PCSD01
Sampled By: R.BALKOVIS/L.DURSON
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5/24/01 Time: 1432 Method: D?? TROWEL Monitor Reading (ppm): ND	AT 1'	BROWN	FINE-COARSE SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	|	
TCL PEST / PCBs & PAHs	8 oz. Jar	|	
TOC & pH	4 oz. Jar	|	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	(1)	

OBSERVATIONS / NOTES:

* OBTAINED AN AT 1' SAMPLE TO MAKE UP FOR PCSD0202 THAT WAS UNABLE TO COLLECT.

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Robert Balkovis

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PLSD0201
Sample Location: NTC17PLSD 02
Sampled By: R BALKOVIC / L DOBSON
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/24/01 Time: 1358 Method: DIP TROWEL Monitor Reading (ppm): —	0 - 4cm	LT. GRAY	F-SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	2	
TCL PEST / PCBs & PAHs	8 oz. Jar	2	
TOC & pH	4 oz. Jar	2	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

UNABLE TO OBTAIN 1' SAMPLE DUE TO GRAVEL.

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	NTCFD092401 04

Signature(s): Robert Balkovic

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[ ] Other:
[ ] QA Sample Type:

Sample ID No.: NTC17PC SD0401
Sample Location: NTC17PC SD04
Sampled By: B. BALKWILL/ L. DOBSON
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/24/01 Time: 1253 Method: DISP. TROWEL Monitor Reading (ppm): –	0 - 4cm	OLIVE GRAY	FINE SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	–	
TCL VOCs + ETHYL ALCOHOL/ACETATE	(2) 4 oz. Jar	1	
TCL SVOCs	4 oz. Jar	1	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s):

Robert Balkwill

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PCSD04 02
Sample Location: NTC17RCSD04
Sampled By: B.Baltrowe/L.Dobson
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/24/01 Time: 1306 Method: Disposable Trowel Monitor Reading (ppm): —	AT 1'	Olive Gray	Fine Sand w/some Silt

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

See Page 1

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Robert Baltrowe

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17R_SD06 01
Sample Location: NTC17R_SD06
Sampled By: B.Murray/L.Dobson
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/24/01 Time: 1652 Method: D-SP. TROWEL Monitor Reading (ppm): —	0-4cm ~~AT 1'~~	BROWN	FINE-MED SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

See F26 B-2

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Robert Balhorn

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17PCSD07 02
Project No.:	N3939	Sample Location:	NTC17PCSD 07
		Sampled By:	LOWSON
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/24/01 Time: 1645 Method: DISP. TROWEL Monitor Reading (ppm): —	0–4cm ~~AT 1'~~	BROWN	FINE-MED SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Robert Baltkure

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES

Project No.: N3939

Sample ID No.: NTC17RCSD0302

Sample Location: NTC17RCSD08

Sampled By: D.Buckman/L.Dobson

C.O.C. No.:

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/24/01 Time: 1620 Method: Disp. Trowel Monitor Reading (ppm): 00	AT 1'	Ol. Gray	Silt + F-Sand

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

See Page 1

Circle if Applicable:

MS/MSD: –

Duplicate ID No.:

Signature(s): Robert Belknap

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17RC SD04 01
Sample Location: NTC17RC SD 04
Sampled By: BB/LD
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/24/01 Time: 1555 Method: DISP. TROWEL Monitor Reading (ppm): 0.0	0-4cm ~~ATH~~	DL. GRAY	F-SAND + SILT

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	-	
TCL VOCs	(2) 4 oz. Jar	-	
TCL SVOCs	4 oz. Jar	-	
Grain Size	Quart Ziplock Bag	-	

OBSERVATIONS / NOTES:

MAP:
SEE FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Robert Balkever

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other: ______
[] QA Sample Type: ______

Sample ID No.: NTC17PCSD10 01
Sample Location: NTC17PCSD10
Sampled By: B-BALFOUR / L. DOBSON
C.O.C. No.: ______

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/24/01 Time: 1537 Method: DISP. TROWEL Monitor Reading (ppm): —	0-4cm ~~AT 1~~	OL GRAY	SILT w/ F-SAND + T- CLAY

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s):

Robert Balfour

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17C SD10 02
Project No.:	N3939	Sample Location:	NTC17C SD10
		Sampled By:	B.Balkovic/L. Dobson
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/24/01 Time: 1543 Method: Disp. Trowel Monitor Reading (ppm): 0.0	AT 1'	VL Gray/ DK Gray	Silt w/ F-Sand & Some Clay

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

Strong Fuel Odor

MAP:

See Page 1

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Robert Balkovic

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PCSD11 01
Sample Location: NTC17PCSD11
Sampled By: R Balkonyi / L Dobson
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 9/23/01	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 0900 Method: Disp. Trowel Monitor Reading (ppm): 0.0	0 - 4cm	Brown	Fine - Med Sand

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	\	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

See Fig B-2

Circle if Applicable:

MS/MSD —

Duplicate ID No.:

Signature(s): Robert Balkonyi

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17PCSD11 02
Project No.:	N3939	Sample Location:	NTC17PCSD11
		Sampled By:	B.BALKOVIC/LARSON
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/23/01 Time: 0910 Method: DSP-TROWEL Monitor Reading (ppm): 0.0	AT 1'	BROWN	FINE-MED SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Robert Balkovic

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PC_SD12 01
Sample Location: NTC17PC_SD12
Sampled By: R. Belkowe / D. [illegible]
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/23/01 Time: 08:30 Method: [illegible] TROWEL Monitor Reading (ppm): 0.0	0 - 4cm	BROWN	COARSE - MED SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	3	
TCL PEST / PCBs & PAHs	8 oz. Jar	3	
TOC & pH	4 oz. Jar	3	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD

Duplicate ID No.: —

Signature(s):

Robert Belkowe

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17R SD12 02
Project No.:	N3939	Sample Location:	NTC17R SD12
		Sampled By:	B Baker/L Dason
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/23/01 Time: 0845 Method: Dredge Trowel Monitor Reading (ppm): 0.0	AT 1'	Brown	Coarse- Gravelly Sand

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Robert Balker

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17RC SD13 01
Project No.:	N3939	Sample Location:	NTC17RC SD13
		Sampled By:	B.Baltrusaitis/L.Dobson
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/23/01 Time: 0815 Method: [illegible] Trowel Monitor Reading (ppm): [illegible]	0 - 4cm	BROWN	MED to FINE SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE FIG. B-2

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Robert Baltrusaitis

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PC SD 1401
Sample Location: NTC17PC SD14
Sampled By: B Balkovec
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 4/23/01 Time: 0755 Method: DISP. TROWEL Monitor Reading (ppm): 0.0	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	0 - 4cm	BROWN	FINE - MED SAND

COMPOSITE SAMPLE DATA:

Date: / Method: / Monitor Readings (Range in ppm):	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	2	
TCL PEST / PCBs & PAHs	8 oz. Jar	2	
TOC & pH	4 oz. Jar	2	
AVS / SEM	8 oz. Jar	—	
TCL VOCs + ETHYL ALCOHOL/ACETATE	(2) 4 oz. Jar	1	
TCL SVOCs	4 oz. Jar	1	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	NTCFD0423010I

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17PCSD14 02
Project No.:	N3939	Sample Location:	NTC17PCSD14
		Sampled By:	BALKOVETZ
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 9/23/01	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 0800 Method: D-FR-TROWEL Monitor Reading (ppm): 0.0	AT 1'	BROWN + GRAY	COARSE-MED SANDY W/ GRAVEL + CLAY

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Robert Balkovetz

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17PC SD15 01
Project No.:	N3939	Sample Location:	NTC17PC SD15
		Sampled By:	B Balkovec
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/23/09 Time: 0715 Method: Dash-Trowel Monitor Reading (ppm): 0.0	0 - 4cm	Brown	F-MED SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	✓	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17 PC SD 1601
Sample Location: NTC17 PC SD 16
Sampled By: LD
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 9-23-01 / Time: 0710 / Method: Disposable Trowel / Monitor Reading (ppm): 0.0	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	0 - 4cm	Brown	F-Sand + Silt

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	✓	
TCL VOCs + Ethyl Alcohol/Acetate	(2) 4 oz. Jar	✓	
TCL SVOCs	4 oz. Jar	✓	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

See Fig B.2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Robert Balkever

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC170C SD17 01
Sample Location: NTC17PC SD17
Sampled By: L. DODSON
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 6/22/01 Time: 1755 Method: DISPOSABLE TROWEL Monitor Reading (ppm): 0.0	0 - 4cm	BROWN	MED-COARSE SAND + GRAVEL

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	✓	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Robert Baltierz

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PCSD17 02
Sample Location: NTC17PCSD17
Sampled By: L DURSON
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/22/01 Time: 1810 Method: DISPOSABLE TROWEL Monitor Reading (ppm): —	AT 1'	BROWN	FINE - GRAVELLY SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle If Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PC SD1901
Sample Location: NTC17PC SD19
Sampled By: L.DOBSON
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/22/01 Time: 1657 Method: DISP. TROWEL Monitor Reading (ppm): 0.0	0 - 4cm	BROWN	MEDIUM COARSE SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	~~✓~~	
TCL VOCs + ETHYL ALUMINUM / ACETATE	(2) 4 oz. Jar	✓	
TCL SVOCs	4 oz. Jar	✓	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Robert Baldwin

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17PCSD18 02
Project No.:	N3939	Sample Location:	NTC17PCSD18
		Sampled By:	L.OLSON
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/22/01 Time: 1700 Method: DISPOSABLE TROWEL Monitor Reading (ppm): 0.0	AT 1'	BROWN	MED-COARSE SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Robert Balkove

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PC SD19 01
Sample Location: NTC17PC SD19
Sampled By: BBALKOVEC
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/22/01 Time: 1515 Method: DISPOSABLE TROWEL Monitor Reading (ppm): 0.0	0 - 4cm	OL. GRAY	SILT + F. SAND, T- MED SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	2	
TCL PEST / PCBs & PAHs	8 oz. Jar	2	
TOC & pH	4 oz. Jar	2	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	✓	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	NTCFD092201 02

Signature(s):

Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17PC SD20 01
Project No.:	N3939	Sample Location:	NTC17PC SD20
		Sampled By:	B[illegible]
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other: ______
[] QA Sample Type: ______

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/22/01 Time: 1451 Method: DISPOSABLE TROWEL Monitor Reading (ppm): 0.0	0 - 4cm	OL GRAY	F-SAND w/ T-SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
–	

Signature(s): Robert Balkwe[illegible]

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17RCSD2002
Sample Location: NTC17RCSD20
Sampled By: B.Balkovec
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/22/01 Time: 1458 Method: Disposable Trowel Monitor Reading (ppm): 0.0	AT 1'	Brown	Med-Coarse Sand,

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD —

Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17RC SD21 01
Sample Location: NTC17RC SD21
Sampled By: B Bauknecht
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/22/01 Time: 1421 Method: Disposable Trowel Monitor Reading (ppm): —	0 - 4cm	Brown	Fine - coarse sand

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	✓	
TCL VOCs + Ethyl Methyl/Acetate	(2) 4 oz. Jar	✓	
TCL SVOCs	4 oz. Jar	✓	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE FIG. B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): Robert Bauknecht

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17RSD2201
Sample Location: NTC17RSD22
Sampled By: B Balkovec
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9-22-01	0-4cm ~~ATT~~	Brown	Fine-Med Sand
Time: 1340			
Method: Disposable Trowel			
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	4	
TCL PEST / PCBs & PAHs	8 oz. Jar	4	
TOC & pH	4 oz. Jar	4	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

See Fig B-2

Circle if Applicable:

MS/MSD

Duplicate ID No.: NTCFD09220101

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17RC SD2301
Sample Location: NTC17RC SD23
Sampled By: BB
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 9-22-01 / Time: 1305 / Method: Disposable Trowel / Monitor Reading (ppm): 0.0	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	0 - 4cm	Brown	Fine Sand + Silt

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	—	
TCL VOCs + Ethyl Acetate/Acetate	(2) 4 oz. Jar	✓	
TCL SVOCs	4 oz. Jar	✓	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

See Fig B-2

Circle if Applicable:

MS/MSD — Duplicate ID No.:

Signature(s): Robert Balkovic

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17PLSD2302
Project No.:	N3939	Sample Location:	NTC17PLSD23
		Sampled By:	B. Balkover
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/22/01	~~0-4cm~~ 6"	BROWN	FINE TO GRAVELLY SAND
Time: 1325			
Method: Disposable Trowel			
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD —

Duplicate ID No.:

Signature(s):

Robert Balkover

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PC SD24 01
Sample Location: NTC17PCSD24
Sampled By: BBALKOVEC
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/22/01 Time: 1240 Method: DISPOSABLE TROWEL Monitor Reading (ppm): —	0 - 4cm	BROWN	FINE SAND, T-SILT

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE FIG. B-2

Circle if Applicable:

MS/MSD —
Duplicate ID No.: —

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES

Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PCSD25 01

Sample Location: NTC17PCSD25

Sampled By: B BALKOVEC / L DOBSON

C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 4/23/01 Time: 1458 Method: DISP TROWEL Monitor Reading (ppm): 0.0	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	0 - 4cm	DARK BROWN	FINE SAND - COARSE SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
–	

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17RC SD2601
Project No.:	N3939	Sample Location:	NTC17RC SD20
		Sampled By:	D Bawkins / L Dobson
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/23/01 Time: 1452 Method: Steel Trowel Monitor Reading (ppm): 0.0	0 - 4cm	DARK BROWN	FINE SAND + SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	✓	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Robert Belknap

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PLSD2701
Sample Location: NTC17PLSD27
Sampled By: B.Balkovec/L.Dobson
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 4/23/01 Time: 1446 Method: DSS. Trowel Monitor Reading (ppm): 0.0	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	0 - 4cm	Brown	Fine-Coarse Sand

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	\	
TCL VOCs	(2) 4 oz. Jar	-	
TCL SVOCs	4 oz. Jar	-	
Grain Size	Quart Ziplock Bag	-	

OBSERVATIONS / NOTES:

MAP:

See Fig B-2

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PC SD2801
Sample Location: NTC17PC SD28
Sampled By: B Balkovec / L Dobson
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/23/01 Time: 1430 Method: Disp. Trowel Monitor Reading (ppm): 0.0	0 - 4cm	Dark Brown	Fine Sand - Silt

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

See Fig. B-2

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PC SD79 01
Sample Location: NTC17PC SD79
Sampled By: B.BALKOVEC, DUDSON
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/29/01 Time: 1410 Method: DISP. TROWELS Monitor Reading (ppm): 0.0	0 - 4cm	OLIVE GRAY	FINE SAND w/SOME ORGANICS

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	1	
TCL VOCs + ETHYL ALCOHOL/ACETATE	(2) 4 oz. Jar	1	
TCL SVOCs	4 oz. Jar	1	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PCSD2402
Sample Location: NTC17PCSD24
Sampled By: B BALKOVEC / L PUASON
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/23/01 Time: 1415 Method: DISP. TROWEL Monitor Reading (ppm): 0.0	AT 1'	DL GRAY	FINE SAND + SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	|	
TCL PEST / PCBs & PAHs	8 oz. Jar	|	
TOC & pH	4 oz. Jar	|	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PCSD3001
Sample Location: NTC17PCSD30
Sampled By: R. Balkovic / L. Dotson
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/23/01 Time: 1315 Method: Dist. Trowel Monitor Reading (ppm): 0.0	0 - 4cm	Olive Gray	Fine Sand + Silt

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:
See Fig B-2

Circle if Applicable:
MS/MSD
Duplicate ID No.:

Signature(s): Robert Balkovic

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PCSD3101
Sample Location: NTC17PCSD31
Sampled By: B Bauknecht / L Dobson
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/23/01 Time: 1300 Method: Dip Trowel Monitor Reading (ppm): 0.0	0 - 4cm	Olive Gray	Fine Sand + Silt, Some Clay

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	-	
TCL VOCs	(2) 4 oz. Jar	-	
TCL SVOCs	4 oz. Jar	-	
Grain Size	Quart Ziplock Bag	-	

OBSERVATIONS / NOTES:

MAP:

See FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): Robert Bauknecht

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17DC SD3201
Project No.:	N3939	Sample Location:	NTC17DC SD32
		Sampled By:	J. BALKOVEC/L. DOBSON
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 4/23/01	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1230 Method: DISP. TROWEL Monitor Reading (ppm): ND	0 - 4cm	BROWN	FINE-MED SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s):

Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17PCSD3202
Project No.:	N3939	Sample Location:	NTC17PCSD32
		Sampled By:	B BALKOVER
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/23/01 Time: 1235 Method: DISP. TROWEL Monitor Reading (ppm): ND	AT 1'	GRAY	FINE TO COARSE SAND W/CLAY

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	-	
TCL VOCs	(2) 4 oz. Jar	-	
TCL SVOCs	4 oz. Jar	-	
Grain Size	Quart Ziplock Bag	\	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Robert Baltaver

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PCSD33 01
Sample Location: NTC17PCSD33
Sampled By: B Brennan
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/23/01 Time: 1215 Method: Disp. Trowel Monitor Reading (ppm): 0.0	0 - 4cm	Gray	F-Sand + Silt, Some Clay

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

See Fig B-2

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Robert Brennan

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PCSD34 01
Sample Location: NTC17PCSD34
Sampled By: B.Balkum/R.Dobson
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/24/01 Time: 0918 Method: DISP-TROWEL Monitor Reading (ppm): 0.0	0 - 4cm	Gray	F-Sand Silt

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	-	
TCL VOCs	(2) 4 oz. Jar	-	
TCL SVOCs	4 oz. Jar	-	
Grain Size	Quart Ziplock Bag	-	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Robert Balkum

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PCSD3501
Sample Location: NTC17PCSD35
Sampled By: B.Balkovec/L.Dobson
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/24/01 Time: 0912 Method: Dredge Tr... Monitor Reading (ppm): 0.7	0 - 4cm	Gray	F-SAND + SILT

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	-	
TCL VOCs	(2) 4 oz. Jar	-	
TCL SVOCs	4 oz. Jar	-	
Grain Size	Quart Ziplock Bag	-	

OBSERVATIONS / NOTES:

MAP:

See Fig B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17PC SD36 01
Project No.:	N3939	Sample Location:	NTC17PC SD36
		Sampled By:	B.Balkovec/L.Dobson
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 5/24/01 Time: 0832 Method: DISP TROWEL Monitor Reading (ppm):	0 - 4cm	DARK BROWN/ OLIVE GRAY	FINE SAND W/ SOME SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	1	
TCL VOCs + ETHYL ALCOHOL/ACETATE	(2) 4 oz. Jar	1	
TCL SVOCs	4 oz. Jar	1	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17RCSD36 02
Sample Location: NTC17RCSD36
Sampled By: B Balkovec / L. Dubsen
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 4/24/01	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 0840 Method: Disp. Trowel Monitor Reading (ppm): 0.0	AT 1'	DARK BROWN / OL. GRAY	FINE - GRAVELLY SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	|	
TCL PEST / PCBs & PAHs	8 oz. Jar	|	
TOC & pH	4 oz. Jar	|	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17PC SD37 01
Project No.:	N3939	Sample Location:	NTC17PC SD37
		Sampled By:	B.Malkovec / L.Dobson
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/24/01 Time: 0808 Method: Disp. Trowel Monitor Reading (ppm): 0.0	0 - 4cm	Ol. Gray	F-Sand & Silt

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	1	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE F2-5B-2

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Robert Belhewe

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name: NTC GREAT LAKES

Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17PC SD38 01

Sample Location: NTC17 PC SD38

Sampled By: B Baker / A. Dobson

C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/24/01 Time: 0750 Method: Dip. Trowel Monitor Reading (ppm):	0 - 4cm	DL. GRAY	F-SAND+SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	2	
TCL PEST / PCBs & PAHs	8 oz. Jar	2	
TOC & pH	4 oz. Jar	2	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	1	

OBSERVATIONS / NOTES:

MAP:

SEE FIG B-2

Circle if Applicable:

MS/MSD: —

Duplicate ID No.: NTCFD09240101

Signature(s):

Robert Baker

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC1786 SD4501
Sample Location: NTC1786 SD45
Sampled By: B Bawolek
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/7/01 Time: 0810 Method: Piston Sampler Monitor Reading (ppm): 0.0	0 - 4cm	Brown	F-MED SAND W/ ORGANICS

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

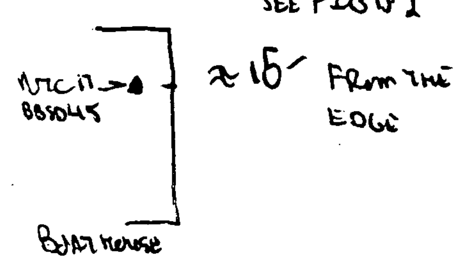
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PG 02



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Robert Bawolek

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17~~8~~ SD45 03
Sample Location: NTC17~~8~~ SD45
Sampled By: B. Balkovic
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/7/01 Time: 0815 Method: Piston Sampler Monitor Reading (ppm): 0.0	4cm - 3'	Gray	Silt + Clay w/ organics

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Robert Balkovic

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC1788SD45T04
Sample Location: NTC1788SD45
Sampled By: B Balkovec
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/7/01 Time: 0835 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	3' - 6'	DARK GRAY	CLAY w/ F-SAND + SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	✓	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17BSD4505
Sample Location: NTC17BSD45
Sampled By: B. BALKOVEC
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/7/01 Time: 0845 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	6' - 10'	DARK GRAY	MOST COARSE SAND W/ SILT & CLAY

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	✓	
TCL VOCs	(2) 4 oz. Jar	✓	
TCL SVOCs	4 oz. Jar	✓	
Grain Size	Quart Ziplock Bag	✓	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17BB SD46 01
Project No.:	N3939	Sample Location:	NTC17BB SD46
		Sampled By:	B. Balkovec
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/6/01 Time: 1620 Method: Disposable Trowel Monitor Reading (ppm): 0.0	0 - 4cm	Gray	F.-Coarse Sand w/ Gravel

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

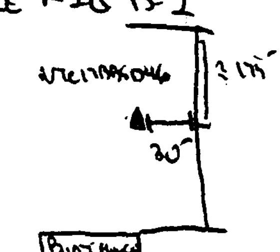
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	|	
TCL PEST / PCBs & PAHs	8 oz. Jar	|	
TOC & pH	4 oz. Jar	|	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

See Fig B-2



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17BSD46 03
Project No.:	N3939	Sample Location:	NTC17BSD46
		Sampled By:	B. Balkovec
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/6/01 Time: 1630 Method: Piston Sampler Monitor Reading (ppm): 0.0	4cm - 3'	Dark Gray	Silt w/ clay + organics

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	-	
TCL VOCs	(2) 4 oz. Jar	-	
TCL SVOCs	4 oz. Jar	-	
Grain Size	Quart Ziplock Bag	-	

OBSERVATIONS / NOTES:

MAP:

See Page 1

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17BBSD4604
Project No.:	N3939	Sample Location:	NTC17BBSD46
		Sampled By:	B. BALKOVEC
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/6/01 Time: 1640 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	3' - 6'	DARK GRAY	CLAY + SILT, W/ F-SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	2	
TCL PEST / PCBs & PAHs	8 oz. Jar	2	
TOC & pH	4 oz. Jar	2	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	NTCFD04060102

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17BSD4605
Sample Location: NTC17BSD46
Sampled By: B. Baltkowiz
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/6/01			
Time: 1650	6' - 10'	LT/DK GRAY	SILTY CLAY W/ ORGANICS
Method: PISTON SAMPLER			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	-	
TCL VOCs	(2) 4 oz. Jar	-	
TCL SVOCs	4 oz. Jar	-	
Grain Size	Quart Ziplock Bag	-	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Robert Baltkowiz

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC178SD47 03
Project No.:	N3939	Sample Location:	NTC178SD47
		Sampled By:	L.Dobson / B. Balkovec
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 9/6/01 Time: 0925 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	4cm - 3'	DARK GRAY	F-SANDY SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17SD47 04
Sample Location: NTC17SD47
Sampled By: L. DOBSON / B. BALKOWE
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/6/01 Time: 0840 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	3' - 6'	DARK GRAY	STICKY CLAY

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Robert Balkowe

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES

Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17BBSD4801

Sample Location: NTC17BBSD48

Sampled By: L. Dobson/B. Balkovec

C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 4/5/01	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1330 Method: Piston Sampler Monitor Reading (ppm): 0.0	0 - 4cm	Dark Gray	Silt w/ v.f. sand some organics

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

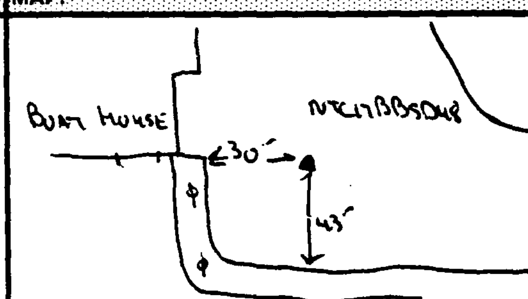
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	-	
TCL VOCs	(2) 4 oz. Jar	-	
TCL SVOCs	4 oz. Jar	-	
Grain Size	Quart Ziplock Bag	-	

OBSERVATIONS / NOTES:

.7' to water

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17BSD48 03
Project No.:	N3939	Sample Location:	NTC17BSD48
		Sampled By:	L.DOBSEN/B.BALKOVEC
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other: ____
[] QA Sample Type: ____

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/5/01 Time: 1335 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	4cm - 3'	DARK GRAY	SILTY CLAY, SOFT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	2	
TCL PEST / PCBs & PAHs	8 oz. Jar	2	
TOC & pH	4 oz. Jar	2	
AVS / SEM	8 oz. Jar	-	
TCL VOCs	(2) 4 oz. Jar	-	
TCL SVOCs	4 oz. Jar	-	
Grain Size	Quart Ziplock Bag	-	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	NTC FD09050101

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC178SD4805
Sample Location: NTC178SD48
Sampled By: R. BALKAVEY / L. DOBSON
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 4/5/01 Time: 1415 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	6' - 10'	DARK GRAY	CLAY, W/ ORGANICS

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Robert Balkavey

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17BB SD49 01
Sample Location: NTC17BB SD49
Sampled By: B. BALKOVEC
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 4/7/01	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 0950 Method: DISPOSABLE TROWEL Monitor Reading (ppm): 0-0	0 - 4cm	BROWN + GRAY	F-COARSE SAND, GRAVELLY W/ ORGANICS SOME SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

~ 8' FROM EDGE

MAP:

SEE FIG B2

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17BBSD4904
Project No.:	N3939	Sample Location:	NTC17BBSD49
		Sampled By:	B BALKOVEC
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/7/01 Time: 1010 Method: PISTON SAMPLER Monitor Reading (ppm): 0-0	3' - 6'	GRAY	F- MED SAND T- PEBBLES

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17 SD44 05
Sample Location: NTC17 SD44
Sampled By: B.Balkovec/L.Dobson
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/7/01 Time: 1040 Method: Dixon Sampler Monitor Reading (ppm): 0.0	6' - 10'	Dark Gray	F- Coarse Sand, Some Clay

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

See Page 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC1788SD50 03
Project No.:	N3939	Sample Location:	NTC1788SD50
		Sampled By:	L Dobson / B Baltrusaitis
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 9/6/01 / Time: 1455 / Method: Piston Sampler / Monitor Reading (ppm): 0.0	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	4cm - 3'	Dark Gray	F-Sand w/ Silt

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	1	
TCL PEST / PCBs & PAHs	8 oz. Jar	1	
TOC & pH	4 oz. Jar	1	
AVS / SEM	8 oz. Jar	-	
TCL VOCs	(2) 4 oz. Jar	-	
TCL SVOCs	4 oz. Jar	-	
Grain Size	Quart Ziplock Bag	-	

OBSERVATIONS / NOTES:

MAP:

See Page 1

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Robert Baltrusaitis

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC170SD50 04
Sample Location: NTC170SD50
Sampled By: L. Dobson/B. Balkovic
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/6/01 Time: 1505 Method: Piston Sampler Monitor Reading (ppm): 0.0	3' - 6'	Dark Gray	F. Sand w/ Silt

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

See Page 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): Robert Balkovic

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17BB SD5101
Project No.:	N3939	Sample Location:	NTC17BB SD51
		Sampled By:	L. DOBSON/B BALKOVEC
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/6/01	0 - 4cm	DARK GRAY	BAR SILT + F-SAND, HIGH ORGANICS
Time: 0940			
Method: DISPOSABLE TROWEL			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

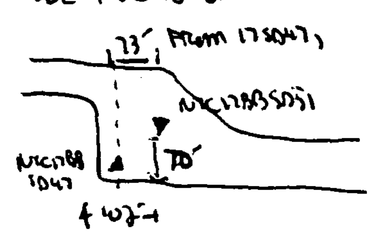
≈70' OFF OF THE EDGE OF THE BOAT BASIN

49' AWAY FROM SD47.

SED LOCATION ON LAND ≈ 20' FROM WATER

MAP:

SEE FIG B-2



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17SD51 03
Sample Location: NTC17SD51
Sampled By: L. Dason / B Balkovec
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 9/6/01 / Time: 0945 / Method: Piston Sampler / Monitor Reading (ppm): 0.0	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	4cm - 3'	Olive Gray	F. Sand w/ some Silt

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC178SD51 05
Sample Location: NTC178SD 51
Sampled By: L.Olson/B.Balkovec
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/6/01 Time: 1015 Method: Piston Sampler Monitor Reading (ppm): 0.0	6' - 10'	Dark Gray	Silty Clay

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	✓	

OBSERVATIONS / NOTES:

MAP:

See Page 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17BBSD5201
Project No.:	N3939	Sample Location:	NTC17BBSD52
		Sampled By:	L. DOBSEN / B. BALKOVEC
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/5/01 Time: 1500 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	0 - 4cm	DARK GRAY	F-SAND T- COARSE GRAINS

COMPOSITE SAMPLE DATA:

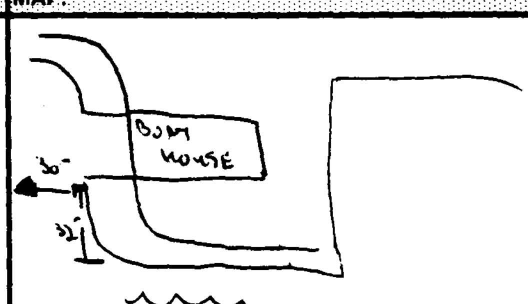
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17SD52 04
Sample Location: NTC17SD52
Sampled By: L. Dussen / B Balkovetz
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/5/01 Time: 1520 Method: Piston Sampler Monitor Reading (ppm): 0.0	3' - 6'	Dark Gray	Silty Clay, V-Soft Some F-Sand

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

See Page 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Robert Balkovetz

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC1788SD5205
Sample Location: NTC1788SD
Sampled By: L. DOBSEN/B. BALKOVEC
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/5/01 Time: 1530 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	6' - 10'	DARK GRAY	SILTY CLAY W/ ORGANICS

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17BSD5303
Sample Location: NTC17BSD53
Sampled By: L Dobson / B Balkovec
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/6/01 Time: 1325 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	4cm - 3'	DARK GRAY	F. SAND + SILT

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	✓	
TCL SVOCs	4 oz. Jar	✓	
Grain Size	Quart Ziplock Bag	✓	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17BBSD53 04
Sample Location: NTC17BBSD53
Sampled By: L. DOBSON / B BALKOVEZ
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/6/01 Time: 1345 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	3' - 6'	DARK GRAY	SILT + CLAY

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): Robert Balkovez

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17BB SD5401
Project No.:	N3939	Sample Location:	NTC17BB SD54
		Sampled By:	L. DURSON / B. BAUKOVIC
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 05/01 Time: 1615 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	0 - 4cm	DARK GRAY	FINE-MED SAND W/ T PEBBLES

COMPOSITE SAMPLE DATA:

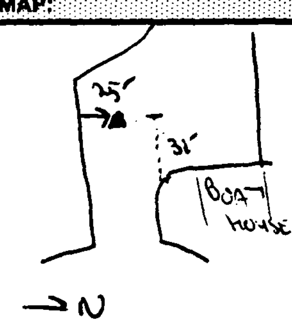
	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	3	
TCL PEST / PCBs & PAHs	8 oz. Jar	3	
TOC & pH	4 oz. Jar	3	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:



Circle if Applicable:

MS/MSD (circled)

Duplicate ID No.:

Signature(s): Robert Baukovic

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17BSD54 03
Project No.:	N3939	Sample Location:	NTC17BSD54
		Sampled By:	L. DOBSON/B. BALKOVEC
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/5/01 Time: 1620 Method: PISTON SAMPLER Monitor Reading (ppm): 0-0	4cm - 3'	DARK GRAY	SILTY F-SAND w/ ORGANICS

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17SD5405
Project No.:	N3939	Sample Location:	NTC17SD54
		Sampled By:	L. Dobson / B. Balkovec
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/5/01 Time: 1645 Method: Piston Sampler Monitor Reading (ppm): 0.0	6' - 10'	Dark Gray	Silt w/ V.F. Sand

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

MAP:

See Page 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
–	–

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17BBSD55 01
Project No.:	N3939	Sample Location:	NTC17BBSD55
		Sampled By:	L.Bason / B. Balkovec
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/5/01 Time: 1045 Method: Piston Sampler Monitor Reading (ppm): 0.0	0 - 4cm	DARK GRAY	FINE-COARSE SAND

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	✓	

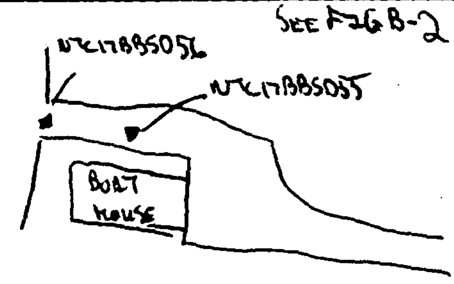
OBSERVATIONS / NOTES:

1.9' TO WATER

SAMPLE LOCATION ≈ 37' AWAY FROM BOAT BASIN EDGE PERPENDICULAR TO THE #23 CONCRETE BLOCK

MAP:

SEE FIG B-2



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC178SD55 04
Sample Location: NTC178SD55
Sampled By: L.DOBSON/B.BALKOVETZ
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/5/01 Time: 1115 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	3' - 6'	DARK GRAY	FINE TO COARSE SAND, T-CLAY

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	\	
TCL PEST / PCBs & PAHs	8 oz. Jar	\	
TOC & pH	4 oz. Jar	\	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Robert Balkovetz

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17SD5505
Sample Location: NTC17SD55
Sampled By: L DOBSON / B BALKOVEC
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/5/01 Time: 1130 Method: PISTON SAMPLER Monitor Reading (ppm): 0.0	6' - 10'	DARK GRAY	CLAY W/ SOME FINE-COARSE SAND

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	|	
TCL PEST / PCBs & PAHs	8 oz. Jar	|	
TOC & pH	4 oz. Jar	|	
AVS / SEM	8 oz. Jar	-	
TCL VOCs	(2) 4 oz. Jar	-	
TCL SVOCs	4 oz. Jar	-	
Grain Size	Quart Ziplock Bag	-	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Robert Baltzer

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17[illegible] SD5601
Project No.:	N3939	Sample Location:	NTC17[illegible]SD56
		Sampled By:	[illegible]
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 4/5/01 Time: 0915 Method: POWER DREDGE Monitor Reading (ppm): 0.0	0 - 4cm	DARK GRAY	V-FINE SAND

COMPOSITE SAMPLE DATA: (section struck through)

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar (circled)	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar (circled)	✓	
TOC & pH	4 oz. Jar (circled)	✓	
AVS / SEM	8 oz. Jar	–	
TCL VOCs	(2) 4 oz. Jar	–	
TCL SVOCs	4 oz. Jar	–	
Grain Size	Quart Ziplock Bag	–	

OBSERVATIONS / NOTES:

SAMPLE LOCATION ≈ 50' FROM THE BOAT BASIN EDGE.

MAP:

DEPTH TO SED 4.8'

SEE FIG B-2

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Robert Baltrusaitis

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC1758SD5603
Project No.:	N3939	Sample Location:	NTC178SD56
		Sampled By:	L.DOBSON/B.BALKOVEC
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/5/01 Time: 0930 Method: PISTON SAMPLER Monitor Reading (ppm):	4cm - 3'	DARK GRAY	V.FINE SAND & SILT T-ORGANICS

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	/	
TCL PEST / PCBs & PAHs	8 oz. Jar	/	
TOC & pH	4 oz. Jar	/	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NTC GREAT LAKES
Project No.: N3939

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: NTC17BSD56 04
Sample Location: NTC17BSD56
Sampled By: L. DOBSON / B. BALKOVEC
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/5/01 Time: 0955 Method: PISTON SAMPLER Monitor Reading (ppm): 0-0	3' - 6'	DARK GRAY	CLAYEY SILT

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar		
TCL VOCs	(2) 4 oz. Jar		
TCL SVOCs	4 oz. Jar		
Grain Size	Quart Ziplock Bag		

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name:	NTC GREAT LAKES	Sample ID No.:	NTC17SD56 05
Project No.:	N3939	Sample Location:	NTC17SD 56
		Sampled By:	L.DOBSON/B BALKOVEC
		C.O.C. No.:	

[] Surface Soil
[] Subsurface Soil
[X] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 9/5/01 Time: 1020 Method: PISTON SAMPLER Monitor Reading (ppm): —	6' - 10'	DARK GRAY	SILTY, V.F SAND. T-ORGANICS

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TAL Metals	4 oz. Jar	✓	
TCL PEST / PCBs & PAHs	8 oz. Jar	✓	
TOC & pH	4 oz. Jar	✓	
AVS / SEM	8 oz. Jar	—	
TCL VOCs	(2) 4 oz. Jar	—	
TCL SVOCs	4 oz. Jar	—	
Grain Size	Quart Ziplock Bag	—	

OBSERVATIONS / NOTES:

MAP:

SEE PAGE 1

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Robert Baltzer

APPENDIX A.4

BORING LOGS

REMEDIAL INVESTIGATION AND RISK ASSESSMENT

SITE 17 PETTIBONE CREEK AND BOAT BASIN

NAVAL TRAINING CENTER GREAT LAKES
GREAT LAKES, ILLINOIS

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS, Inc.
661 Andersen Drive
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0154

May 2002

BORING LOGS APPROVED BY:

Carol Nissen

CAROL NISSEN, P.G.
ILLINOIS LICENSED GEOLOGIST 196-000346

Tetra Tech NUS, Inc.

BORING LOG

Page 1 of 1

PROJECT NAME: NTC GREAT LAKES
BORING NUMBER: NTC17BBSD45
PROJECT NUMBER: N3939 CTO 0154
DATE: 9/7/01
DRILLING COMPANY: PATRICK DRILLING
GEOLOGIST: BOB BALKOVEC
DRILLING RIG: EIJKELKAMP PISTON SAMPLER
DRILLER: KEVIN SHAMWAY

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth /Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
1	1					BR	TOP 4cm F-M SAND	SP	W/ ORGANICS	0.0	0.0		
	2				WET +	GRAY	SILT + CLAY	CL		↓	↓		
S-1	3		2.5 / 3		SOFT	↓	W/ ORGANICS	/ML					0.0
	4				↓	DK	CLAY W/ F-SAND +	CL					
	5					GRAY	SILT	↓					
S-2	6		3 / 3		↓	↓	↓	↓					
	7				WET +	DK	MED- COARSE SAND	SM					
	8				LOOSE	GRAY	W/ SILT + CLAY	/SC					
	9				↓	↓	↓	↓					
S-3	10		4 / 4							↓	↓		
				T.D. 10'									

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: —

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NTC GREAT LAKES | BORING NUMBER: NTC17BBS046
PROJECT NUMBER: N3939 CTO 0154 | DATE: 9/6/01
DRILLING COMPANY: PATRICK DRILLING | GEOLOGIST: BOB BALKOVEC
DRILLING RIG: EIJKELKAMP PISTON SAMPLER | DRILLER: KEVIN SHAMWAY

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth /Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1					GRAY	TOP 4cm F-C SAND w/ GRAVEL	GP		0.0	0.0		
	2					DK	SILT w/ CLAY + ORGANICS	CL					
S-1	3		3' / 3'			GRAY	↓	/ML					
	4						CLAY + SILT, w/ F-SAND	CL					
	5							/ML					
S-2	6		3.5' / 3'			↓	↓	L					0.0
	7					LT/	SILTY CLAY w/	CL					
	8					DK	ORGANICS						
	9					GRAY							
S-3	10		3' / 4'	T.D. 10'		↓	↓	↓		↓	↓		

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks:

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NTC GREAT LAKES
PROJECT NUMBER: N3939 CTO 0154
DRILLING COMPANY: PATRICK DRILLING
DRILLING RIG: EIJKELKAMP PISTON SAMPLER

BORING NUMBER: NTC17BBSD47
DATE: 4/6/01
GEOLOGIST: BOB BALKOVEC
DRILLER: KEVIN SHAMWAY

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth /Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	PID/FID Reading (ppm): Sampler BZ	PID/FID Reading (ppm): Borehole**	PID/FID Reading (ppm): Driller BZ**
	1				WET & LOOSE	GRAY & BLK	TOP 4cm F-C SAND, SOME GRAVEL	GP		0.0	0.0	-	
	2				WET &	DK	FINE SANDY SILT	ML		↓	↓	-	
S-1	3		3'/3'		M. STIFF	GRAY	↓	↓				-	
	4				↓	↓	SILTY CLAY	CL				-	
	5						↓	↓				-	
S-2	6		30"/3'		↓	↓	↓	↓				-	0.0
	7				WET &	DK	SILTY CLAY	CL				-	
	8				M. STIFF	GRAY	↓	↓				-	
	9				↓	↓						-	
S-3	10		42"/4'	T.D. 10'	↓	↓	↓	↓		↓	↓	-	

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks:

Converted to Well: Yes ____ No X

Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NTC GREAT LAKES
BORING NUMBER: NTC17BBSD48
PROJECT NUMBER: N3939 CTO 0154
DATE: 4/5/01
DRILLING COMPANY: PATRICK DRILLING
GEOLOGIST: BOB BALKOVEC
DRILLING RIG: EIJKELKAMP PISTON SAMPLER
DRILLER: KEVIN SHAMWAY

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth /Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1				WET + LOOSE	DK GRAY	TOP 4cm SILT W/ V.F. SAND	ML	SOME ORGANICS	0.0	0.0	-	
	2				WET +	↓	SILTY CLAY	CL		↓	↓	-	
S-1	3		28"/3'		SOFT	↓	↓	↓				-	
	4				WET +	DK	CLAY W/ SOME SILT	CL				-	
	5				M. STIFF	GRAY	↓	↓				-	
S-2	6		3'/3'		↓	↓	↓	↓				-	0.0
	7				WET +	DK	CLAY W/ ORGANICS	CL				-	
	8				M. STIFF	GRAY	↓	↓				-	
	9				↓	↓	↓	↓				-	
S-3	10		42"/4'		↓	↓	↓	↓		↓	↓	-	
				T.D. 10'									

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks:

Converted to Well: Yes ____ No X Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NTC GREAT LAKES
BORING NUMBER: NTC17BBS049
PROJECT NUMBER: N3939 CTO 0154
DATE: 9/7/01
DRILLING COMPANY: PATRICK DRILLING
GEOLOGIST: BOB BALKOVEC
DRILLING RIG: EIJKELKAMP PISTON SAMPLER
DRILLER: KEVIN SHAMWAY

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth /Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1				LOOSE	BR + GRAY	TOP 4cm GRAVELLY F-C SAND, SOME SILT	GP	W/ORGANICS	0.0	0.0	-	
	2				WET +	DK	FINE SAND, SOME MED. SAND	SP				-	
S-1	3		3'/3'		LOOSE	GRAY	T-SILT	↓				-	
	4					GRAY	F-M SAND	SP				-	
	5						T-PEBBLES					-	
S-2	6		2'/3'			↓	↓	↓				-	0.0
	7					DK	F-C SAND SOME CLAY	SP/SC				-	
	8					GRAY						-	
	9											-	
S-3	10		3.5'/4'			↓	↓	↓		↓	↓	-	
				T.D. 10									

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X

Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME:	NTC GREAT LAKES	BORING NUMBER:	NTC17BBSD50
PROJECT NUMBER:	N3939 CTO 0154	DATE:	9/6/01
DRILLING COMPANY:	PATRICK DRILLING	GEOLOGIST:	BOB BALKOVEC
DRILLING RIG:	EIJKELKAMP PISTON SAMPLER	DRILLER:	KEVIN SHAMWAY

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth /Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	Sample	Sampler BZ	Borehole**	Driller BZ**
	1				LOOSE	BR	F-C SAND Top 4cm	SP		0.0	0.0	0.0	
	2				WET +	DK	FINE SAND W/SILT	SP/		↓	↓	-	
S-1	3		29"/3'		LOOSE	GRAY	↓	SM				-	
	4				↓	↓	FINE SAND W/SILT	↓				-	
	5						↓					-	
S-2	6		2.5'/3'		↓	↓	↓	↓				-	0.0
	7					DK	SILTY CLAY	ML/				-	
	8					GRAY	SOME F-SAND	CL				-	
	9					↓	↓	↓				-	
S-3	10		42"/4'			↓	↓	↓		↓	↓	-	
				T.D. 10'									

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks:

Converted to Well: Yes ____ No X Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NTC GREAT LAKES
BORING NUMBER: NTC17BBS051
PROJECT NUMBER: N3939 CTO 0154
DATE: 9/6/01
DRILLING COMPANY: PATRICK DRILLING
GEOLOGIST: BOB BALKOVEC
DRILLING RIG: EIJKELKAMP PISTON SAMPLER
DRILLER: KEVIN SHAMWAY

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth /Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1				M. STIFF	DK GRAY	TOP 4cm SILT + F. SAND	ML	HIGH ORGANICS	0.0	0.0	0.0	
	2				WET +	OL	FINE SAND W/ SOME SILT	SP		↓	↓	-	
S-1	3		24"/3'		LOOSE	GRAY	↓	SM				-	0.0
	4				WET +	DK	SILT + CLAY W/ TRACE	ML				-	
	5				M. STIFF	GRAY	FINE SAND	CL				-	
S-2	6		3'/3'		↓	↓	↓	↓				-	0.0
	7				WET +	DK	SILTY CLAY	CL				-	
	8				M. STIFF	GRAY						-	
	9				↓	↓	↓	↓				-	
S-3	10		46"/4'		↓	↓	↓	↓		↓	↓	-	
				T.D. 10'									

When rock coring, enter rock brokeness.
Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm):

Converted to Well: Yes ____ No ____ Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NTC GREAT LAKES
BORING NUMBER: NTC17BBS052
PROJECT NUMBER: N3939 CTO 0154
DATE: 9/5/01
DRILLING COMPANY: PATRICK DRILLING
GEOLOGIST: BOB BALKOVEC
DRILLING RIG: EIJKELKAMP PISTON SAMPLER
DRILLER: KEVIN SHAMWAY

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth /Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
	1				WET+LOOSE	DK GRAY	TOP 4cm F-SAND	SP	T-COARSE GRAINS	0.0	0.0	–	
	2				WET +	↓	SILTY F-SAND W/	SM		↓	↓	–	
S-1	3		34"/3'		M. DENSE	↓	ORGANICS	↓				–	
	4				WET +	DK	SILTY CLAY, SOME FINE	CL				–	
	5				SOFT	GRAY	SAND	↓				–	
S-2	6		3'/3'		↓	↓	↓	↓				–	0.0
	7				WET +	DK	SILTY CLAY W/ ORGANICS	CL				–	
	8				M. STIFF	GRAY						–	
	9				↓	↓						–	
S-3	10		45"/4'	T.D. 10'	↓	↓	↓	↓		↓	↓	–	

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks:

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NTC GREAT LAKES
PROJECT NUMBER: N3939 CTO 0154
DRILLING COMPANY: PATRICK DRILLING
DRILLING RIG: EIJKELKAMP PISTON SAMPLER
BORING NUMBER: NTC17BBSD53
DATE: 9/6/01
GEOLOGIST: BOB BALKOVEC
DRILLER: KEVIN SHAMWAY

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth /Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1				WET + LOOSE	DK GRAY	TOP 4cm FINE SAND	SP	Some COARSE GRAINS	0.0	0.0	–	0.0
	2				WET +	↓	FINE SAND + SILT	SP/SM		↓	↓	–	
S-1	3		3'/3'		M. DENSE	↓	↓					–	
	4				WET +	DK	SILT + CLAY	ML/LL				–	
	5				M. STIFF	GRAY	↓					–	
S-2	6		34"/3'		↓	↓	↓	↓				–	
	7				WET +	DK	SILTY CLAY	LL				–	
	8				M. STIFF	GRAY						–	
	9											–	
S-3	10		3'/4'	T.D. 10'	↓	↓	↓	↓		↓	↓	–	

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks:

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NTC GREAT LAKES
BORING NUMBER: NTC17BBSD54
PROJECT NUMBER: N3939 CTO 0154
DATE: 9/5/01
DRILLING COMPANY: PATRICK DRILLING
GEOLOGIST: BOB BALKOVEC
DRILLING RIG: EIJKELKAMP PISTON SAMPLER
DRILLER: KEVIN SHAMWAY

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth /Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1				LOOSE	DK GRAY	TOP 4cm F-M SAND, T-PEBBLES	SP		0.0	0.0	0.0	0.0
	2				WET & M.	↓	SILTY F-SAND W/ORGANICS	SM		↓	↓	-	
S-1	3		2.5'/3'		STIFF	↓	↓	↓				-	
	4				WET & V.	DK	SILTY CLAY W/ORGANICS	CL				-	
	5				SOFT	GRAY						-	
S-2	6		34"/3'		↓	↓	↓	↓				-	
	7					DK	SILT W/ V.F. SAND	ML				-	
	8					GRAY						-	
	9											-	
S-3	10		42"/4'			↓	↓	↓		↓	↓	-	
				T.D. 10'									

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks:

Converted to Well: Yes ____ No X

Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NTC GREAT LAKES
PROJECT NUMBER: N3939 CTO 0154
DRILLING COMPANY: PATRICK DRILLING
DRILLING RIG: EIJKELKAMP PISTON SAMPLER
BORING NUMBER: NTC17BBS055
DATE: 9/5/01
GEOLOGIST: BOB BALKOVEC
DRILLER: KEVIN SHAMWAY

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth /Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Sample	PID/FID Sampler BZ	PID/FID Borehole**	PID/FID Driller BZ**
	1				WET + LOOSE	DK GRAY	TOP 4cm F-C SAND	SP		0.0	0.0	-	0.0
	2				WET +	↓	SILTY F-C SAND	SM		↓	↓	-	
S-1	3		29"/3'		M. STIFF	↓	↓	↓				-	
	4				↓	DK	F-C SAND, T-CLAY	SP				-	
	5					GRAY						-	
S-2	6		2'/3'		↓	↓	↓	↓				-	
	7				WET +	DK	CLAY W/ SOME F-C SAND	CL				-	
	8				M. STIFF	GRAY	↓	↓				-	
	9				↓	↓						-	
S-3	10		3.5'/4'	T.D. 10'	↓	↓	↓	↓		↓	↓	-	

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NTC GREAT LAKES
BORING NUMBER: NTC17BBS056
PROJECT NUMBER: N3939 CTO 0154
DATE: 9/5/01
DRILLING COMPANY: PATRICK DRILLING
GEOLOGIST: BOB BALKOVEC
DRILLING RIG: EIJKELKAMP PISTON SAMPLER
DRILLER: KEVIN SHAMWAY

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth /Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1				WET, LOOSE	DK GRAY	TOP 4cm V.F. SAND	SP		0.0	0.0	-	0.0
	2				WET,	↓	V.F. SAND + SILT	ML		↓	↓	-	
S-1	3		3.4" / 3'		M. STIFF	↓	TRACE ORGANICS	↓				-	
	4				WET,	DK GRAY	CLAYEY SILT	ML				-	
	5				M. STIFF	↓	↓	↓				-	
S-2	6		2' / 3'		↓	↓	↓	↓				-	
	7				WET,	DK	SILTY, V.F. SAND	SM				-	
	8				M. DENSE	GRAY	T- ORGANICS	↓				-	
	9				↓	↓	↓					-	
S-3	10		3.5' / 4'		↓	↓	↓	↓		↓	↓	.	
				T.D 10'									

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks:

Converted to Well: Yes ____ No X Well I.D. #: ____

APPENDIX A.5

CHAIN OF CUSTODY SHEETS

STL Pittsburgh

01314

CHAIN OF CUSTODY RECORD

PROJECT NO.: N3939 CTO 0154	SITE NAME: NTC GREAT LAKES
SAMPLERS (SIGNATURE): Robert Balkovec / Lori L. Dobson	

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	TCL VOC's + E. Alcohol E. Acetate	TAL Metals	TCL Pest/PCB's/PAH	TOC/pH	TCL SVOC's	TAL Metals	TAL Filtered Metals	TCL Pest/PCB's	REMARKS
—	9/5/01	0800	WATER		NTCTB09050101	2	2								
SW06		0900	SW		NTC17BBSW0601	9	3				2	1	1	2	
SD56		0915	SED		NTC17BBSD5601	3		1	1	1					
↓		0930			NTC17BBSD5603	3		1	1	1					
		0955			NTC17BBSD5604	3		1	1	1					
↓		1020			NTC17BBSD5605	3		1	1	1					
SD55		1045			NTC17BBSD5501	3		1	1	1					
↓		1100			NTC17BBSD5503	3		1	1	1					
		1115			NTC17BBSD5504	3		1	1	1					
↓		1130			NTC17BBSD5505	3		1	1	1					
SD48		1330			NTC17BBSD4801	3		1	1	1					
↓		1335			NTC17BBSD4803	3		1	1	1					
		1355			NTC17BBSD4804	3		1	1	1					
↓		1415			NTC17BBSD4805	3		1	1	1					

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
Robert Balkovec	9/5/01 1500				
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY: (SIGNATURE):	DATE / TIME:	REMARKS:	
		[signature]	9-6-01 1015		

Order No. 70440 (0693)

8

STL Pittsburgh

CHAIN OF CUSTODY RECORD

01315

PROJECT NO.: N3439 CTO 0154

SITE NAME: NTC GREAT LAKES

SAMPLERS (SIGNATURE): Robert Balkowec / Lori L Dolezal

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	TAL METALS	TCL PEST/PCB's/PAH	TOC + pH	Unnamed 1	Unnamed 2	Unnamed 3	REMARKS
SD52	9/5/01	1500	SED	✓	NTC17BBSD5201	3	1	1	1				
↓		1505	↓	✓	NTC17BBSD5203	3	1	1	1				
		1520		✓	NTC17BBSD5204	3	1	1	1				
↓		1530		✓	NTC17BBSD5205	3	1	1	1				
—		0000	↓	✓	NTCFD09050101	3	1	1	1				
		1600	DI	✓	NTCRB09050101	5	1	2	*2				* RUN FOR TOC ONLY
SED54		1615	SED	✓	NTC17BBSD5401	9	3	3	3				RUN MS/MSD
↓		1620	↓	✓	NTC17BBSD5403	3	1	1	1				
		1635		✓	NTC17BBSD5404	3	1	1	1				
↓		1645		✓	NTC17BBSD5405	3	1	1	1				
—		0000	↓	✓	NTCFD09050102	3	1	1	1				

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):
Robert Balkowec	9/5/01 1800				

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS:
		[illegible]	9-6-01 1005	

Order No. 70440 (0693)

9

01316

CHAIN OF CUSTODY RECORD

PROJECT NO.:	SITE NAME:
N3939 CTO 0154	NTC GREAT LAKES

SAMPLERS (SIGNATURE): Robert Balkovec

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	TCL VOC's + E. Alcohol E. Acetate	TAL METALS	TCL PEST/PCBs/PAHs	TOC + pH	AVS/SEM	TCLP VOC's	GRAIN SIZE	REMARKS
—	4/6/01	0930	WATER	✓	NTCTB04060101	2	2							
SD47	↓	0815	SED	✓	NTC17BBSD4701	6	2	1	1	1		1		
↓		0825	↓	✓	NTC17BBSD4703	3		1	1	1				
↓		0840		✓	NTC17BBSD4704	3		1	1	1				
↓		0850		✓	NTC17BBSD4705	3		1	1	1				
SD51		0940		✓	NTC17BBSD5101	3		1	1	1				
↓		0945		✓	NTC17BBSD5103	3		1	1	1				
↓		1000		✓	NTC17BBSD5104	4		1	1	1	1			
↓		1015		✓	NTC17BBSD5105	3		1	1	1				
SD53		1315		✓	NTC17BBSD5301	4		1	1	1	1			
↓		1325		✓	NTC17BBSD5303	7	2	1	1	1		1	1	
↓		1345		✓	NTC17BBSD5304	3		1	1	1				
↓		1350		✓	NTC17BBSD5305	3		1	1	1				
—	↓	0000	↓	✓	~~NTC17~~ NTCFD04060101	3		1	1	1				

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
Robert Balkovec	4/6/01 1830				

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RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS:
		[signature]	4-7-01 / 200	

Order No. 70440 (0693)

CHAIN OF CUSTODY RECORD

PROJECT NO.: N3939 CTO 0154

SITE NAME: NTC GREAT LAKES

SAMPLERS (SIGNATURE): Robert Balkwe

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	TCL VOC's + Ethyl Alcohol/Acetate	TAL METALS	TCL PEST/PCB's/PAHs	TOC/pH	TCL SVOC's		REMARKS
SD50	9/6/01	1445	SED	✓	NTC17BBSD5001	9		3	3	3			RUN MS/MSD
↓	↓	1455	↓	✓	NTC17BBSD5003	3		1	1	1			
		1505		✓	NTC17BBSD5004	3		1	1	1			
↓		1515		✓	NTC17BBSD5005	3		1	1	1			
SD46		1620		✓	NTC17BBSD4601	3		1	1	1			
↓		1630		✓	NTC17BBSD4603	3		1	1	1			
		1640		✓	NTC17BBSD4604	3		1	1	1			
↓		1650		✓	NTC17BBSD4605	3		1	1	1			
—		0000	↓	✓	NTCFD09060102	3		1	1	1			
—	↓	1800	DI	✓	NTCRB09060101	11	4	1	2	*2	2		RUN ON PISTON SAMPLER
													* RUN TOC ONLY.

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
Robert Balkwe	9/6/01 1830				
RELINQUISHED BY (SIGNATURE):	**DATE / TIME:**	**RECEIVED BY (SIGNATURE):**	**RELINQUISHED BY (SIGNATURE):**	**DATE / TIME:**	**RECEIVED BY (SIGNATURE):**

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS:
		[signature]	9-7-01 200	

Orde[illegible] 440 (0693)

CHAIN OF CUSTODY RECORD

01318

PROJECT NO.: N3939 CTO 0154

SITE NAME: NTC GREAT LAKES

SAMPLERS (SIGNATURE): Robert Balkovec

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	TCL VOCs + Ethyl Alcohol/Acetate	TAL METALS	TCL PEST/PCBs/PAHs	TOC + pH	AVS/SEM	TCL SVOCs	FILTERED TAL METALS	REMARKS
—	4/7/01	0730	WATER	✓	NTCTB04070101	2	2							
SW05	↓	0805	SW	✓	NTC17BBSW0501	10	4	1	*2	—	—	2	1	* NO PAHs
SD45	↓	0810	SED	✓	NTC17BBSD4501	3		1	1	1				
↓	↓	0815	↓	✓	NTC17BBSD4503	3		1	1	1				
↓	↓	0835	↓	✓	NTC17BBSD4504	4		1	1	1	1			
↓	↓	0845	↓	✓	NTC17BBSD4505	3		1	1	1				
SD49	↓	0950	↓	✓	NTC17BBSD4901	3		1	1	1				
↓	↓	0955	↓	✓	NTC17BBSD4903	3		1	1	1				
↓	↓	1010	↓	✓	NTC17BBSD4904	3		1	1	1				
↓	↓	1040	↓	✓	NTC17BBSD4905	3		1	1	1				

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):
Robert Balkovec	4/7/01 1300				
RELINQUISHED BY (SIGNATURE):	**DATE / TIME:**	**RECEIVED BY (SIGNATURE):**	**RELINQUISHED BY (SIGNATURE):**	**DATE / TIME:**	**RECEIVED BY(SIGNATURE):**
RELINQUISHED BY (SIGNATURE):	**DATE / TIME:**	**RECEIVED FOR LABORATORY BY (SIGNATURE):**	**DATE / TIME:**	**REMARKS:**	
		[signature]	4-8-01 0950	AB# 829367981887	

Order No. 70440 (0693)

SED

CHAIN OF CUSTODY RECORD

01325

PROJECT NO.: N3839 CTO 0154

SITE NAME: NTC GREAT LAKES

SAMPLERS (SIGNATURE): Robert Balhorn

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	TCL VOCs 8260	TAL METALS	TCL PEST/PCBs/PAHs	WC-pH	AVS/SEM	TCL VOCs 5035	TCL SVOCs	GRAIN SIZE	REMARKS
—	9/22/01	0000	SED		NTCFD09220101	3		1	1	1					
—	↓	0000	↓		NTCFD09220102	3		1	1	1					
—	9/23/01	0700	DI		NTCTB09230101	2	2								
SD16		0710	SED		NTC17PCSD1601	5	1	1	1	1		1	1		
SD15		0715			NTC17PCSD1501	4		1	1	1				1	
SD14		0755			NTC17PCSD1401	6	1	1	1	1		1	1		
↓		0800			NTC17PCSD1402	3		1	1	1					
SD13		0815			NTC17PCSD1301	3		1	1	1					
SD12		0830			NTC17PCSD1201	9		3	3	3					MS/MSD
↓		0845			NTC17PCSD1202	3		1	1	1					
SD11		0900			NTC17PCSD1101	4		1	1	1	1				
↓		0910			NTC17PCSD1102	3		1	1	1					
SD33		1215			NTC17PCSD3301	3		1	1	1					
SD32	↓	1230	↓		NTC17PCSD3201	3		1	1	1					

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
Robert Balhorn	9/24/01 2030				
RELINQUISHED BY (SIGNATURE):	**DATE / TIME:**	**RECEIVED BY (SIGNATURE):**	**RELINQUISHED BY (SIGNATURE):**	**DATE / TIME:**	**RECEIVED BY (SIGNATURE):**
RELINQUISHED BY (SIGNATURE):	**DATE / TIME:**	**RECEIVED FOR LABORATORY BY (SIGNATURE):**	**DATE / TIME:**	**REMARKS:**	
		[signature]	9-25-01 0930		

Order No. 704[illegible]93)

CHAIN OF CUSTODY RECORD

01326

PROJECT NO.:	SITE NAME:
N3939 CTO 0154	NTC Great Lakes

SAMPLERS (SIGNATURE): [signature]

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CON-TAINERS	TCL VOC's 8260	TAL Metals	TCL Pest/PCB's PAHs	TOC + pH	AVS/SEM	TCL VOC's 8015	TCL SVOC's	Grain Size	REMARKS
SD32	9/23/01	1235	SED		NTC17PCSD3202	3		1	1	1					
SD31	↓	1300	↓		NTC17PCSD3101	3		1	1	1					
SD30		1315			NTC17PCSD3001	3		1	1	1					
SD29		1410			NTC17PCSD2901	6	1	1	1	1		1	1		
↓		1415			NTC17PCSD2902	3		1	1	1					
SD28		1430			NTC17PCSD2801	3		1	1	1					
SD27		1446			NTC17PCSD2701	4		1	1	1	1				
SD26		1452			NTC17PCSD2601	3		1	1	1					
SD25		1458			NTC17PCSD2501	3		1	1	1					
—	↓	1200	↓		NTCFD09230101	3		1	1	1					
—	9/24/01	0730	DI		NTCTB09240101	2	2								
SD38	↓	0750	SED		NTC17PCSD3801	4		1	1	1				1	
SD37		0805	↓		NTC17PCSD3701	4		1	1	1	1				
—	↓	1000	↓		NTCFD09240101	3		1	1	1					

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):
[signature]	9/24/01 2030				

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RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS:
		[signature]	9-25-01 0950	

Order No. 70440 (0693)

CHAIN OF CUSTODY RECORD

01327

PROJECT NO.: N3939 CTO 0154

SITE NAME: NTC GREAT LAKES

SAMPLERS (SIGNATURE): Robert [illegible]

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	TCL VOC'S 8260	TCL VOC'S 8015	TCL SVOC'S	TAL METALS	TOC	FILTERED METALS	TCLP VOC'S	TCLP METALS	TCLP SVOAS, PEST/HERBS	TCL PEST/PCBS	REMARKS
—	9/22/01	0720	DI		NTCTB09220101	2	2										
GW05	↓	0745	GW		NTC07GW0501	10	2	2	2	1	2	1					
GW06		0817	↓		NTC07GW0601	27	6	6	6	3	6						MS/MSD
GW07		1010	↓		NTC07GW0701	9	2	2	2	1	2						
—		1050	IDW		NTC IDW WATER	5							2	1	2		
—		1615	DI		NTCRB09220101	11	2	2	2	1	2					2	
SW02	↓	1650	SW		NTC17PCSW0201	10	2	2	2	1		1				2	
SW03	9/23/01	1210	SW		NTC17PCSW0301	10	2	2	2	1		1				2	
SW04	9/24/01	0915	SW		NTC17PCSW0401	10	2	2	2	1	~~2~~	1				2	
SW01	↓	1418	SW		NTC17PCSW0101	30	6	6	6	3		3				6	MS/MSD
—	↓	0000	SW		NTCFD09240102	10	2	2	2	1		1				2	

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RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS:
		[signature]	9-25-01 0930	

Order No. 70

SOIL/.

01328

CHAIN OF CUSTODY RECORD

PROJECT NO.:	SITE NAME:
N3939 CTO 0154	NTC GREAT LAKES

SAMPLERS (SIGNATURE): Robert Balkwer

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	TCL VOC'S 8260	TAL METALS	TCL PEST/PCB'S + PAHS	TOC + pH	AVS/SEM	TCL SVOC'S	TCL VOC'S 8015	GRAIN SIZE	TCLP VOC'S	TCLP PEST/HERB/METALS + SVOAS	REMARKS
—	4/23/01	1000	DI	/	NTCTB04220102	2	2										
—	↓	1005	IDW		~~[illegible]~~ NTCIDW SOIL	2									2	1	
SD24	↓	1240	SED		NTC17PCSD2401	3		1	1	1							
SD23	↓	1315	SED		NTC17PCSD2301	6	1	1	1	1		1	1				
↓	↓	1325	SED		NTC17PCSD2302	3		1	1	1							
SD22	↓	1340	SED		NTC17PCSD2201	9		3	3	3							MS/MSD
SD21	↓	1431	SED		NTC17PCSD2101	7	1	1	1	1	1	1	1				
SD20	↓	1451	SED		NTC17PCSD2001	3		1	1	1							
↓	↓	1458	SED		NTC17PCSD2002	3		1	1	1							
SD19	↓	1515	SED		NTC17PCSD1901	3		1	1	1				1			
SD18	↓	1655	SED		NTC17PCSD1801	6	1	1	1	1		1	1				
↓	↓	1700	SED		NTC17PCSD1802	3		1	1	1							
SD17	↓	1755	SED		NTC17PCSD1701	4		1	1	1	1						
↓	↓	1810	SED		NTC17PCSD1702	3		1	1	1							

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
Robert Balkwer	4/24/01 2030				
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS:	
		[signature]	4-25-01 0950		

Order No. 70440 (0693)

CHAIN OF CUSTODY RECORD

01330

PROJECT NO.:	SITE NAME:
N3939 CTO 0154	NTC GREAT LAKES

SAMPLERS (SIGNATURE): Robert Balkever

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CON-TAINERS	TCL VOC'S 8260	TAL METALS	TCL PEST/PCB/DIOX	TOC/pH	AVS/SEM	TCL VOC'S 6015	TCL SVOC'S	GRAIN SIZE	REMARKS
SD36	9/24/01	0832	SED		NTC17PCSD03601	7	1	1	1	1	1	1	1		
✓		0840	↓		NTC17PCSD03602	3		1	1	1					
SD35		0912			NTC17PCSD03501	3		1	1	1					
SD34		0918			NTC17PCSD03401	3		1	1	1					
SD05		1230			NTC17PCSD00501	9		3	3	3					MS/MSD
SD04		1253			NTC17PCSD00401	6	1	1	1	1		1	1		
✓		1306			NTC17PCSD00402	3		1	1	1					
SD03		1325			NTC17PCSD00301	4		1	1	1				1	
—		0000			NTCFD09240103	3		1	1	1					
SD02		1358			NTC17PCSD00201	3		1	1	1					
—		0000			NTCFD09240104	3		1	1	1					
SD01		1422			NTC17PCSD00101	3		1	1	1					
✓		1432			NTC17PCSD00102	4		1	1	1				1	
SD10		1537	↓		NTC17PCSD01001	3		1	1	1					

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):
Robert Balkever	9/24/01 2030				
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY(SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE): [signature]	DATE / TIME: 9-25-01 0830	REMARKS:	

Order No. 7(

CHAIN OF CUSTODY RECORD

01331

PROJECT NO.: N3939 CTO0154	SITE NAME: NTC GREAT LAKES

SAMPLERS (SIGNATURE): Robert Balkwe

STATION NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	TAL METALS	TCL PEST/PCBS/PAHs	TOC + pH				REMARKS
SD10	9/24/01	1543	SED		NTC17PCSD1002	3	1	1	1				
SD09		1535			NTC17PCSD0901	3	1	1	1				
SD08		1615			NTC17PCSD0801	3	1	1	1				
↓		1620			NTC17PCSD0802	3	1	1	1				
SD07		1645			NTC17PCSD0701	3	1	1	1				
SD06		1652			NTC17PCSD0601	3	1	1	1				

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
Robert Balkwe	9/24/01 2020				

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS:
		[signature]	9-25-01 0950	

Order No. 70440 (0693)

APPENDIX A.6

SAMPLE LOG SHEETS FOR IDW

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page 1 of 1

Project Site Name: NTC GREAT LAKES
Project No.: N3939 CTO 0154

[ ] Domestic Well Data
[X] Monitoring Well Data
[X] Other Well Type: IDW
[ ] QA Sample Type:

Sample ID No.: NTC~~07GW-01~~ IDW WATER
Sample Location: NTC~~07MW~~ 07 +17
Sampled By: BRAUKNER
C.O.C. No.:
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	ODOR
Date: 9/27/01	Visual	Standard	mS/cm	°C	NTU	mg/l		
Time: 1050								
Method: Peristaltic Pump	—	—	—	—	—	—	—	—

PURGE DATA:

Date: —	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Flow Rate
Method: Peristaltic Pump								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD):				See Low Flow Purge Data Sheet				
Static Water Level (WL):								
One Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL Volatiles	HCl / 4°C	(3) 40 ML VIALS	
TCL Semivolatiles	4°C	(2) 1 L AMBER	
TAL Metals	HNO_3 / 4°C	(1) 1 L POLY	
Filtered Metals	HNO_3 / 4°C	(1) 1 L POLY	
TOC	H_2SO_4 / 4°C	(2) 40 mL Vial	
TCLP VOC's	4°C/HCl	(2) 40ml VIAL	✓
TCLP METALS	4°C	(1) 500ml POLY	✓
TCLP BNAs, PESTS + HERBS	4°C	(2) 1L AMBERS	✓

OBSERVATIONS / NOTES:

COMPOSITE OF DECON, PURGE, + DEVELOPMENT WATER

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Robert Bolhever

APPENDIX A.7

SAMPLE LOG SHEETS FOR QUALITY ASSURANCE/QUALITY CONTROL

Tetra Tech NUS, Inc.

QA SAMPLE LOG SHEET

Project Site Name: NTC Great Lakes
Sample ID Number: NTCRB091001
Project Number: N3939
Sampled By: B. BALKOVEC
Sample Location: SITE 7
C.O.C. Number:
QA Sample Type:

[] Trip Blank
[X] Rinsate Blank
[] Source Water Blank
[] Other Blank

SAMPLING DATA:

Date: 9/10/01
Time: 1500
Method: DIRECT POUR

WATER SOURCE:

[] Laboratory Prepared
[] Tap
[X] Purchased
[] Fire Hydrant
[] Other

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name: NERL REAGENT GRADE WATER
Supplier: VWR INTERNATIONAL
Manufacturer: NERL DIAGNOSTICS
Order Number: PO # P1646
Lot Number: 0510011
Expiration Date: 05/2002

RINSATE INFORMATION (If Applicable):

Media Type: SOIL
Equipment Used: DPT CUTTING SHOE
Equipment Type:

[] Dedicated
[X] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL Volatiles	Cool 4°C / HCl	4 ~~(3)~~ 40 mL Vial	(YES) / NO
TCL Semivolatiles, TCL PSVOCs, PCBs, METALS	Cool 4°C	(2) 1 L Amber	(YES) / NO
TCL PEST / PCBs	Cool 4°C	(2) 1 L Amber	YES / (NO)
TAL Metals	Cool 4°C / HNO_3	(1) 500 mL Poly	(YES) / NO
TOC	Cool 4°C / H_2SO_4	(2) 40 mL Vial	(YES) / NO

OBSERVATIONS / NOTES:

Signature(s):

Robert Balkovec

Tetra Tech NUS, Inc.

QA SAMPLE LOG SHEET

Project Site Name: NTC Great Lakes
Project Number: N3939
Sample Location: —
QA Sample Type:

Sample ID Number: NTC RB041801
Sampled By: B. Brunner / L. Dobson
C.O.C. Number:

[] Trip Blank
[] Source Water Blank
[X] Rinsate Blank – 'BATCH BLANK'
[] Other Blank

SAMPLING DATA:

Date: 4/18/01
Time: 1500
Method: DIRECT POUR

WATER SOURCE:

[] Laboratory Prepared
[X] Purchased
[] Other
[] Tap
[] Fire Hydrant

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name: NERL REAGENT GRADE WATER
Supplier: VWR INTERNATIONAL
Manufacturer: NERL DIAGNOSTICS
Order Number: PO # P1646
Lot Number: 051001
Expiration Date: 05/2002

RINSATE INFORMATION (If Applicable):

Media Type: SOIL
Equipment Used: ACETATE LINER
Equipment Type:
[X] Dedicated
[] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL Volatiles	Cool 4°C / HCl	4 (3) 40 mL Vial	(YES) / NO
TCL Semivolatiles + TCL SVOCs PEST/HERBS	Cool 4°C	(2) 1 L Amber	(YES) / NO
TCL PEST / PCBs	Cool 4°C	(2) 1 L Amber	YES / NO
TAL Metals	Cool 4°C / HNO_3	(1) 500 mL Poly	(YES) / NO
TOC	Cool 4°C / H_2SO_4	(2) 40 mL Vial	(YES) / NO

OBSERVATIONS / NOTES:

Signature(s):

Robert Balthaser

Tetra Tech NUS, Inc.

QA SAMPLE LOG SHEET

Project Site Name: NTC Great Lakes
Project Number: N3939
Sample Location: —
QA Sample Type:

Sample ID Number: NTCBB042401
Sampled By: L. DOBSON
C.O.C. Number:

[] Trip Blank
[] Source Water Blank
[] Rinsate Blank
[X] Other Blank BATCH BLANK

SAMPLING DATA:

Date: 4/24/01
Time: 1630
Method: DIRECT POUR

WATER SOURCE:

[] Laboratory Prepared
[X] Purchased
[] Other
[] Tap
[] Fire Hydrant

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name: NERL REAGENT GRADE WATER
Supplier: VWR INTERNATIONAL
Manufacturer: NERL DIAGNOSTICS
Order Number: PO # P1646
Lot Number: 051001
Expiration Date: 05/2002

RINSATE INFORMATION (If Applicable):

Media Type: GROUNDWATER
Equipment Used: SILICON TUBING
Equipment Type:
[X] Dedicated
[] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL Volatiles	Cool 4°C / HCl	4 ~~(2)~~ 40 mL Vial	(YES) / NO
TCL Semivolatiles	Cool 4°C	(2) 1 L Amber	(YES) / NO
TCL PEST / PCBs	Cool 4°C	(2) 1 L Amber	YES / NO
TAL Metals	Cool 4°C / HNO_3	(1) 500 mL Poly	(YES) / NO
TOC	Cool 4°C / H_2SO_4	(2) 40 mL Vial	(YES) / NO

OBSERVATIONS / NOTES:

* DISPOSABLE TUBING

Signature(s):

Robert Baltrave

Tetra Tech NUS, Inc.

QA SAMPLE LOG SHEET

Project Site Name: NTC Great Lakes
Project Number: N3939
Sample Location: Pettibone Creek
QA Sample Type:

[] Trip Blank
[] Source Water Blank
[] Rinsate Blank
[X] Other Blank Batch Blank

Sample ID Number: NTCRA0922U101
Sampled By: L. Dobson
C.O.C. Number:

SAMPLING DATA:

Date: 9/22/01
Time: 1615
Method: Direct Pour

WATER SOURCE:

[] Laboratory Prepared
[X] Purchased
[] Other
[] Tap
[] Fire Hydrant

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name: Nerl Reagent Grade Water
Supplier: VWR International
Manufacturer: Nerl Diagnostics
Order Number: PO # 01646
Lot Number: 0510011
Expiration Date: 05/2002

RINSATE INFORMATION (If Applicable):

Media Type: Sediment
Equipment Used: Disposable Trowel
Equipment Type:

[X] Dedicated
[] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL Volatiles	Cool 4°C / HCl	4 ~~(2)~~ 40 mL Vial	(YES) / NO
TCL Semivolatiles	Cool 4°C	(2) 1 L Amber	(YES) / NO
TCL PEST / PCBs	Cool 4°C	(2) 1 L Amber	(YES) / NO
TAL Metals	Cool 4°C / HNO_3	(1) 500 mL Poly	(YES) / NO
TOC	Cool 4°C / H_2SO_4	(2) 40 mL Vial	(YES) / NO

OBSERVATIONS / NOTES:

Signature(s): Robert Balkovec

Tetra Tech NUS, Inc.

QA SAMPLE LOG SHEET

Page 1 of 1

Project Site Name: NTC Great Lakes
Project Number: N3939
Sample Location: ←
QA Sample Type:

Sample ID Number: NTCRB04050101
Sampled By: B. BALKOVEC
C.O.C. Number:

[] Trip Blank
[] Source Water Blank
[X] Rinsate Blank
[] Other Blank

SAMPLING DATA:

Date: 9/5/01
Time: 1600
Method: DIRECT POUR

WATER SOURCE:

[] Laboratory Prepared
[X] Purchased
[] Other
[] Tap
[] Fire Hydrant

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name: NERL REAGENT GRADE WATER
Supplier: VWR INTERNATIONAL
Manufacturer: NERL DIAGNOSTICS
Order Number: PO# P1646
Lot Number: 0510011
Expiration Date: 05/2002

RINSATE INFORMATION (If Applicable):

Media Type: SEDIMENT
Equipment Used: PISTON SAMPLER
Equipment Type:
[] Dedicated
[X] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL Volatiles	Cool 4°C / HCl	(3) 40 mL Vial	YES / NO (circled: NO)
TCL Semivolatiles	Cool 4°C	(2) 1 L Amber	YES / NO (circled: NO)
TCL PEST / PCBs/PAHs	Cool 4°C	(2) 1 L Amber	YES / NO (circled: YES)
TAL Metals	Cool 4°C / HNO_3	(1) 500 mL Poly	YES / NO (circled: YES)
TOC	Cool 4°C / H_2SO_4	(2) 40 mL Vial	YES / NO (circled: YES)

OBSERVATIONS / NOTES:

Signature(s):
Robert Balkovec

Tetra Tech NUS, Inc.

QA SAMPLE LOG SHEET

Project Site Name: NTC Great Lakes
Sample ID Number: NTCRS040601 01
Project Number: N3939
Sampled By: B. BALKOVEC
Sample Location: —
C.O.C. Number:
QA Sample Type:

[] Trip Blank
[X] Rinsate Blank
[] Source Water Blank
[] Other Blank

SAMPLING DATA:

Date: 9/6/01
Time: 1800
Method: DIRECT POUR

WATER SOURCE:

[] Laboratory Prepared
[] Tap
[X] Purchased
[] Fire Hydrant
[] Other

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name: NERL REAGENT GRADE WATER
Supplier: VWR INTERNATIONAL
Manufacturer: NERL DIAGNOSTICS
Order Number: PO # P1646
Lot Number: 0510011
Expiration Date: 05/2002

RINSATE INFORMATION (If Applicable):

Media Type: SEDIMENT
Equipment Used: PISTON SAMPLER
Equipment Type:

[] Dedicated
[X] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL Volatiles	Cool 4°C / HCl	(4) ~~(3)~~ 40 mL Vial	(YES) / NO
TCL Semivolatiles	Cool 4°C	(2) 1 L Amber	(YES) / NO
TCL PEST / PCBs	Cool 4°C	(2) 1 L Amber	(YES) / NO
TAL Metals	Cool 4°C / HNO_3	(1) 500 mL Poly	(YES) / NO
TOC	Cool 4°C / H_2SO_4	(2) 40 mL Vial	(YES) / NO

OBSERVATIONS / NOTES:

Signature(s): Robert Balkovec