

**FIELD SAMPLING PLAN
PHASE I EDITION
REMEDIAL INVESTIGATION
AT THE
NIAGARA FALLS STORAGE SITE
NIAGARA COUNTY, NEW YORK**

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Prepared For:

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REFERENCES

LIST OF ACRONYMS/ABBREVIATIONS

AA	Atomic Absorption
AMSL	Above Mean Sea Level
AOI	Areas of Investigation
ARAR	Applicable or Relevant and Appropriate Requirements
AVS/SEM	Acid Volatile Sulfides/Simultaneously Extracted Metals
bgs	Below Ground Surface
BH	Borehole (location of existing wells)
BRA	Baseline Risk Assessment
CAS	Chemical Abstract System
CCC	Calibration Check Compound
CCV	Continuing Calibration Verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHMM	Certified Hazardous Materials Manager
CHP	Certified Health Physicist
CIH	Certified Industrial Hygienist
CLP	Contract Laboratory Program
cm	Centimeter
cm/s	Centimeters per Second
COR	Contracting Officer Representative
COPC	Constituents of Potential Concern
cpm	Counts per Minute
CRDL	Contract Required Detection Limit
CRL	Central Regional Laboratory
CSS	Chemical Solidification and Stabilization
DI	Deionized
DGPS	Differentially-Corrected Global Positioning System
DL	Detection Limit (Limit of Detection)
DO	Dissolved Oxygen
DOD	Department of Defense
DQO	Data Quality Objective
FSP	Field Sampling Plan
ft	Feet
ft/s	Feet per Second
ft/yr	Feet per Year
FUSRAP	Formerly Utilized Sites Remedial Action Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry

LIST OF ACRONYMS/ABBREVIATIONS (Continued)

GBR 21	Garmin Beacon Receiver 21
GEL	General Engineering Laboratory
gpm	Gallons per Minute
GPS	Global Positioning System
GW	Groundwater Sample
ha	Hectares
HPLC	High Performance Liquid Chromatography
HNO ₃	Nitric Acid
HTRW	Hazardous, Toxic, and Radioactive Waste
ICP	Inductively Coupled Plasma (Spectroscopy)
ICS	Interference Check Standard
ICVS	Initial Calibration Verification Standard
ID	Inner Diameter or Identification
IDL	Instrument Detection Limit
IDW	Investigation Derived Waste
ILM	Inorganic Laboratory Method
in	Inches
ITR	Internal Technical Review
IWCS	Interim Waste Containment Structure
KAPL	Knolls Atomic Power Laboratory
keV	One thousand electro volts
kg	Kilogram
km	Kilometer
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LEL	Lower Explosive Limit
LIMS	Laboratory Information Management System
LLR	Lowest Limit for Reporting
LOOW	Lake Ontario Ordnance Works
lpm	Liters per Minute
LRB	Lakes and Rivers Buffalo
LWD	Low Water Datum
m	Meter
m ³	Cubic Meter
m/s	Meters per Second
m/yr	Meters per Year
MB	Method Blank

LIST OF ACRONYMS/ABBREVIATIONS (Continued)

MCA	Multi-channel Analyzer
MCL	Maximum Contaminant Limit
MD	Matrix Duplicate
MDA	Minimum Detectable Activity
MDL	Method Detection Limit
mg/kg	Milligrams per Kilogram (ppm)
mg/L	Milligrams per Liter (ppm)
mi	Mile
mld	Million Liters per Day
mgd	Million Gallons per Day
MMI	Modern Mercalli Intensity
MS	Master of Science
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSA	Method of Standard Additions
NaI	Sodium Iodide
NBS	National Bureau of Standards
NFSS	Niagara Falls Storage Site
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
NTU	Nephelometric Turbidity Units
NYSDEC	New York State Department of Environmental Conservation
OC-PEST	Organochlorine Pesticides
OD	Outer Diameter
O/G	Oil and Grease
OLM	Organic Laboratory Method
ORP	Oxidation Reduction Potential
OVM	Organic Vapor Meter
OW	Observation Well (location of existing wells)
PAH	Polynuclear Aromatic Hydrocarbon
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethylene
pCi/L	Picocuries per Liter
pCi/g	Picocuries per Gram
PCOC	Potential Contaminant of Concern
P.G.	Professional Geologist
P.E.	Professional Engineer
ppb	Parts Per Billion
ppm	Parts Per Million
PQL	Practical Quantitation Limit

LIST OF ACRONYMS/ABBREVIATIONS (Continued)

PRG	Preliminary Remediation Goal
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QCP	Quality Control Plan
Ra	Radium
RBSL	Risk-Based Screening Level
RCRA	Resource Conservation and Recovery Act
RDL	Reporting Limit
REC	Recovery (% rec)
RF	Response Factor
RI	Remedial Investigation
RP	Replicate
RPD	Relative Percent Difference
RPP	Radiation Protection Plan
RRT	Relative Response and/or Retention Time
RSD	Relative Standard Deviation
RSO	Radiation Safety Officer
RT	Retention Time
SAIC	Science Applications International Corporation
SB	Subsurface Sample
SCA	Single Channel Analyzer
SD	Sediment Sample
SI	Site Investigation
SOP	Standard Operating Procedure
SOW	Scope of Work
SPCC	System Performance Check Compound
SRM	Standard Reference Material
SS	Surface Sample
SSHO	Site Safety and Health Officer
SSHP	Site-Specific Safety and Health Plan
SM	Site Manager
SRM	Standard Reference Material
SVOC	Semi-Volatile Organic Compound
SW	Surface Water Sample
SW-846	Test Methods for Evaluating Solid Waste
TAL	Target Analyte List (Inorganic-related)
TAGM	Technical and Administrative Guidance Manual

LIST OF ACRONYMS/ABBREVIATIONS (Continued)

TCE	Trichloroethene
TCL	Target Compound List (Organic-related)
TCLP	Toxicity Characteristic Leachate Procedure
Th	Thorium
TNT	Trinitrotoluene
TOC	Total Organic Carbon
TPP	Technical Planning Process
TSDF	Transportation, Storage, and Disposal Facility
U	Uranium
ug/kg	Micrograms per Kilogram (ppb)
ug/L	Micrograms per Liter (ppb)
UFPO	Underground Facility Protection Organization
UMTRA	Uranium Mill Tailings Remedial Action
UN	United Nations
uR	Micro-Roentgen
UST	Underground Storage Tank
USACE	U.S. Army Corps of Engineers
USAERDC	U.S. Army Engineering Research and Development Center
USDOE	U.S. Department of Energy
USCG	United States Coast Guard
USEPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey
UTM	Universal Trans Mercator
VOC	Volatile Organic Compound
yd ³	Cubic Yard

SECTION 1

1.0 PROJECT DESCRIPTION

This document describes a field sampling and analysis program to be implemented at the Niagara Falls Storage Site (NFSS) in the State of New York. The NFSS is a FUSRAP site, i.e., a site which was involved in the Manhattan Engineering District Project and which is being remediated under the Formerly Utilized Site Remedial Action Program. FUSRAP actions at the NFSS are being carried out under the direction of the Buffalo District, U.S. Army Corps of Engineers (USACE).

The NFSS is located at 1397 Pletcher Road, in the Township of Lewiston, Niagara County, New York. The site is shown on Figure 1.0-1. The coordinates of the site are at 43°12'45" north latitude and 78°59'10" west longitude as depicted on the United States Geological Survey (USGS) Ransomville 7.5-minute quadrangle, edited 1980.

The site is contaminated with low-level, high- and low-activity, radioactive waste. Known areas of radiological contamination include a waste containment structure enclosing high-activity residues and low activity radioactive waste, a building contaminated with low level radioactive material, and soil contaminated with low-level radioactive waste. Additional areas of the site may contain low-level radioactive contamination.

The NFSS is located on a portion of what was once the Lake Ontario Ordnance Works (LOOW), a former trinitrotoluene (TNT) manufacturing facility. Therefore, chemical contamination resulting from those manufacturing operations is also of concern at the NFSS.

The strategy at the NFSS is to remediate radiological and chemical contamination at the site such that the requirements of CERCLA (the Comprehensive Environmental Response, Compensation, and Liability Act of 1980) are met.

Maxim Technologies (Maxim) is under contract to the USACE to conduct a Remedial Investigation (RI) at the site. Maxim has extensive experience in performing contamination investigations at both Department of Defense (DOD) and U.S. Department of Energy (USDOE) sites. Maxim is being supported on the NFSS RI effort by Science Applications International Corporation (SAIC). SAIC has extensive experience with the FUSRAP program and site-specific experience gained through prior work at the NFSS.

The field sampling and analysis program, which is the subject of this document, is directed at supplementing and complementing previously-gathered information at the NFSS sufficiently to identify site contaminants, delineate their lateral and vertical extent, and, where cleanup was performed under USDOE management, to assess the success of that cleanup in attaining CERCLA objectives. None of the previous contamination-related studies performed at the site were CERCLA-based or comprehensive in nature. Thus, the field efforts described in this Field Sampling Plan (FSP) include the elements of a Site Investigation (SI) as well as those of a RI.

This FSP is one of a series of plans which together comprise the RI work plan for the NFSS. Other plans in this series include a Quality Assurance Project Plan (QAPP), a Site Safety and Health Plan (SSHP) (including the Radiation Protection Plan [RPP]), and a Quality Control Plan (QCP).

The approach to the RI is to develop and implement work plan(s) which respond to project-specific Data Quality Objectives (DQOs) in the context of the tasks below as defined in the Scope of Work (SOW). Those tasks which are supported by this FSP are shown with an asterisk (*).

- Records Review and Evaluation*;
- Visual Site Inspection*;
- Landfill Survey;
- Identify ARARs*;
- Data Summary and Data Needs Determination*;
- Field Sampling Plan and Quality Assurance Project Plan*;
- Specification and Acquisition of Field Data*;
- Interim Action Determination;
- Identify Remediation Areas and Volumes;
- Health, Safety, and Radiation Protection Plan*;
- Quality Control Plan and Independent Technical Review*;
- Community Relations and General Support; and
- Preparation of RI Report.

In June of 1999, the USACE NFSS team, (consisting of other District NFSS “virtual team” members [experts from other USACE Districts], representatives from the New York State Department of Environmental Conservation [NYSDEC], and the Maxim project team), convened a Technical Planning Process (TPP) meeting to discuss and define objectives for data collection at the NFSS. The primary objectives as developed in that meeting are shown on Figure 1.0-2.

Those primary objectives (numbered consistently with the TPP results) that govern the performance of the RI include:

1. Evaluate presence or absence of chemicals released from WCS (Waste Containment Structure) to 1st or 2nd groundwater aquifer (referred to in this document as the first (upper) and second (lower) water-bearing zones.);
2. Determine if chemical infiltration is occurring via groundwater into the WCS;
- 3a. Determine if hazardous substances and radiological activity at site are within limits established by ARARs;
- 3b. Determine Contaminants of Potential Concern;
4. Define site physical features and characteristics; and
11. Determine nature and extent of contamination posing unacceptable risk.

A series of DQOs for collection of analytical data to support those primary objectives was then developed. These DQOs are presented and discussed in Section 3.3. Using the SOW tasks and primary objectives described above and the DQOs derived from them, a field sampling strategy was developed through the following process:

- Examine site history and aerial photographs for evidence of and/or descriptions of prior site activities which could have led to site contamination;
- Examine and evaluate information from prior site investigations (evaluate data, assess data quality, and identify data gaps to be addressed in this RI);
- Perform site reconnaissance for direct visual evidence of prior site activities which could have led to site contamination;
- Based on a review of more than 450 documents and visual inspection, develop initial conceptualization of physical site characteristics which could affect fate and/or transport of any contaminants;
- Assess potential sampling concepts for adequacy for use in contamination evaluation and risk assessment, based on statistical distribution; and
- Optimize information yield for subsequent RI and FS use.

The field sampling and analysis strategy is further defined in the following subsections:

1.1—"Site History, Associated Contaminants, and Site Setting," where previous activities at the site, basic site characteristics, and their implications in terms of contamination are discussed;

1.2.—"Historical Investigations/Summary of Existing Site Data," where prior studies carried out at the site, data gathered during those studies, and the adequacy of that data in addressing DQOs is discussed;

1.3—"Site-Specific Sampling and Analysis Problems and Data Gaps," where characteristics of the site and of prior studies are described and the constraints they place on the current study are identified; and

1.4—"Sampling Approach and Strategy", where these elements are presented in the context of subsections 1.0 through 1.3.

1.1 Site History, Associated Contaminants, and Site Setting

This section provides information on historic site activities and site physical characteristics and their implications in terms of site setting. The section is strongly interrelated with section 1.2, which addresses previous studies carried out at the site, and section 1.3, which discusses site specific sampling and analysis problems and data gaps.

1.1.1 Site History

Following the December 7, 1941 attack on Pearl Harbor, the United States government officially entered into World War II. With this action, the War Department ordered the USACE to construct several facilities across the United States to manufacture components for the military effort. Under this directive in late December 1941, the USACE acquired 3,015 hectares (ha) (7,453 acres) of agricultural land in northwestern New York state from 149 individual land owners and initiated construction activities on a plant to produce TNT at the site designated as the LOOW (NFSS-284).

In September 1942, the United States Army opened the plant and started production with four process lines capable of producing a reported maximum of 108,900 kilograms (kg) (240,000 pounds) of TNT per day. Due to a perceived oversupply of TNT across the U.S., the War Department decided to stop production at the LOOW at the end of July 1943. An estimated 18,900,000 kg (41,656,000 pounds) of TNT were manufactured during this eight month period (NFSS-342). Piping and machinery at the facility were dismantled and sent to other war plants. Some pieces were classified as scrap metal and some were used as replacement parts at the other plants.

In February 1944, the USACE's Manhattan Engineering District, which was formed in 1942 with the responsibility of the construction aspects of the atomic energy program, requested and obtained usage of a portion of the LOOW for the storage of low-level radioactive residues generated through the processing of uranium ore (NFSS-306). Descriptions of the radioactive residue material placed on site are provided in Section 1.2.2.

The first residues to be shipped to the site were designated as L-50 and R-10 from the Linde Air Products facility in Tonawanda, New York. With this action, the NFSS was created. The L-50 residue was transported to the site in bulk and was stored in Buildings 413 and 414 of the water treatment plant near the southwest corner of the NFSS and the R-10 residue was placed on the site in a pile on open ground north of the water treatment plant (NFSS-011).

The War Assets Administration also transferred 612 ha (1,511 acres) of the LOOW, north of the current NFSS, to the Chemical Warfare Service for the storage of incendiary and napalm bombs and transferred 400 ha (989 acres) to the War Department for disposition to the U.S. Air Force (NFSS-306). Later in 1944, 1,400 drums of F-32 residues were shipped from Middlesex, New Jersey to the LOOW and stored in the recarbonation pit of the water treatment plant. In April 1945, L-30 residues from Linde Air Products were shipped to the LOOW and stored in Building 411, the cooling water reservoir (NFSS-187).

Figure 1.1.1-1 shows the building locations associated with potentially hazardous or radioactive materials at the NFSS.

After the end of World War II, the War Assets Administration sold 2,050 ha (5,066 acres) of the LOOW to the Federal Farm Mortgage Corporation for eventual sale back to private owners and transferred the Chemical Warfare Service acreage to the Atomic Energy Commission (AEC) by means of a Presidential Executive Order (NFSS-306). In 1946, the P-54, P-56, and P-58 processed uranium ore residues from Linde Air Products were shipped to the LOOW and stored in the thaw house adjacent to Building 434 and/or in Building 410.

The USACE Manhattan Engineering District transferred control of the radioactive residues at the NFSS to the AEC in 1948. In April 1949, the first K-65 residues (residue from refining of high purity uranium ore) were transferred to the LOOW from the Mallinckrodt Chemical Works in St. Louis, Missouri and were eventually stored in Building 434, the emergency process cooling water tower of the LOOW (NFSS-283). In 1950, the Middlesex sands, which consisted of sand and abraded material from sandblasting buildings and process equipment used in the uranium ore processing of the F-32 material, were shipped from Middlesex, New Jersey and were placed in Building 410. With the exceptions of the K-65 residues and miscellaneous radioactive residues, after 1950, all other radioactive residues were shipped to sites other than the NFSS.

The NFSS stored uranium and thorium ingots, billets, and rods in Building 421 and later in the constructed concrete vaults of Buildings 431 and 432. Radium bars and ingots were stored in a vault in Building 433. Animal carcasses from radiation tests at the University of Rochester were shipped to a graveyard located immediately north of the current NFSS property at the LOOW in 1951. In 1952, the water tower storing the K-65 residue was deemed to be full and the additional drummed K-65 residue already on the site was shipped to Fernald, Ohio. Also in 1952, combustible and non-combustible radioactive wastes, consisting of spent fuel rods and reactor waste, from the Knolls Atomic Power Laboratory (KAPL) was placed on the NFSS in Building 401 (NFSS-187).

In 1953, Building 401, the former boiler house for the TNT manufacturing process, was renovated into a boron-10 isotope separation plant. Prior to the renovation, the KAPL waste was moved to several buildings in the Baker-Smith portion of the NFSS. In 1955, the site contractor, Hooker Electrochemical Company, cleaned up 525 ha (1,297 acres) of the LOOW. Records explaining the rationale to undertake the cleanup activities or the specific remedial actions accomplished were not found. After the cleanup, the AEC transferred 354 ha (874 acres) to the Army, Navy, and the Air Force. When the AEC had stockpiled a sufficient supply of the boron isotope in 1958, the plant was deactivated and put on a stand-by status. In 1964, the AEC's boron supply was depleted and the plant was reactivated. The AEC sold 81 ha (200 acres) of land to a private landowner and 100 ha (246 acres) to a corporation in 1966 reducing the size of the NFSS site to its current size, 77 ha (191 acres). During this time frame, the "P" residues from Linde Air Products were transferred to West Valley, New York and Oak Ridge, Tennessee. The boron plant was deactivated for a final time in 1971 (NFSS-150).

In 1975, the AEC was dissolved and the responsibility of the site was transferred to the Energy Research and Development Administration (ERDA). The ERDA was abolished in 1977 and the responsibility of the site was then transferred to the U.S. Department of Energy (USDOE). In 1979, the Battelle Columbus Laboratory instituted and completed a comprehensive radiological characterization of the NFSS (NFSS-290). In 1980, the vent on Building 434 was sealed to reduce radon gas emissions from the tower and a geological investigation of the site was conducted. Beginning in 1981, a yearly monitoring program was initiated to assess the radon emissions from the NFSS and the potential for transport of the radiological contaminants to the groundwater. Radioactively-contaminated soil from a vicinity property was excavated and placed on the R-10 pile in 1981.

In 1982, Buildings 413 and 414 were sealed to reduce radon emissions from the L-50 residues, and a dike and cutoff wall were constructed around the R-10 area. Between 1983 and 1986, the transfer

of the K-65 residue from Building 434 to Building 411 was completed by hydraulically mining the residue from the tower, creating a slurry, and pumping the slurry through a pipeline to Building 411. In addition, the area around the R-10 pile became the Interim Waste Containment Structure (IWCS) after a clay dike was constructed surrounding the pile. Building 434 was demolished and the rubble was placed in the IWCS. Also in 1986, the impounded water generated through dewatering of the transferred residues was treated and discharged into the Central Ditch and the cap over the IWCS was completed.

In 1988, isolated areas of residual radioactivity from across the NFSS site were excavated and placed into temporary storage on the slab of former Building 430 and in 1990, a limited chemical characterization was performed at the NFSS. The materials placed in temporary storage were incorporated into the IWCS in 1991 (NFSS-054). With the exception of annual monitoring and maintenance, no other activities took place at the NFSS until 1997, when the USDOE transferred control of the site back to the USACE.

The only remaining structures at the site are Building 401, Building 403, an associated garage to Building 403, and Building 429. Buildings 401 and 403 are slated for decontamination and demolition in the near future. Details of the investigations and previous site characterizations are described in Section 1.2. Further information concerning the source and nature of radioactive waste streams disposed at the NFSS is presented in Section 1.2.2.

In summary, the NFSS is a FUSRAP site established on a portion of a TNT-manufacturing facility. As such, contaminants related to processes and activities from both of these types of programs might be expected. These contaminants, discussed in detail in subsequent sections of this FSP, include the uranium-thorium-radium series radionuclides and nitroaromatic and other explosive-derivative compounds as well as contaminants related to support activities related to these basic programs, such as solvents and semivolatile organic compounds. Additional contaminants (i.e., pesticides used to insect control, PCBs from transformers and hydraulic oils, and incineration by-products) could potentially be present at the site.

1.1.2 Physiography/Topography/Hydrology

The NFSS is located on the relatively flat to very gently rolling Ontario Plain approximately 5.6 kilometers (km) (3.5 miles [mi]) east of the Niagara River and 6.4 km (4.0 mi) south of Lake Ontario in the Central Lowland Physiographic Province. The Ontario Plain is generally level with a general north to northwestward slope with elevations of 109.7 meters (m) (360 feet [ft]) above mean sea level (AMSL) at the base of the Niagara Escarpment to an elevation of 82.3 m (270 ft) AMSL at the Lake Ontario shoreline.

Located approximately 4.0 km (2.5 mi) to the south of the NFSS, the Niagara Escarpment is the major topographic element of the region. With the exceptions of the IWCS and the previous R-10 residue pile, the site is relatively level with elevations ranging from 96.0 m (315 ft) AMSL to 97.8 m (321 ft) AMSL (NFSS-067, NFSS-087, and NFSS-267).

Surface water runoff is collected by several ditches located on site. The ditches on the NFSS property are shown on Figure 1.1.2-1. Surface water is primarily conveyed through east-west

trending ditches (South 16 Ditch and South 31 Ditch) which empty into the main north-south trending Central Ditch and is carried off the site to the north to Four Mile Creek. The confluence of the Central Ditch and Four Mile Creek occurs 2.4 km (1.5 mi) north of the NFSS. Four Mile Creek eventually empties into Lake Ontario.

Potential surface water run-off from the adjacent Modern Landfill, Inc. site onto the NFSS occurs from the east along Castle Garden Road and from the south along "O" Street. Potential surface water run-off from the adjacent CWM Chemical Services, Inc. site occurs from the north onto the NFSS property north of "N" Street. Potential surface water run-on to the NFSS also occurs from the properties to the south of the site that are connected to the site by the Central and West Ditches (NFSS-081).

Several areas on the NFSS property have the potential to collect and hold standing water at various times in the year. These areas are also shown as standing water or swamp on Figure 1.1.2-1. It should be noted that the 100-year flood elevation within the NFSS boundary is estimated to be 97 m (319 ft) AMSL, which is approximately 1.2 m (four ft) higher than the lowest topographic elevation at the NFSS (NFSS-145).

1.1.3 Regional Geology

The bedrock geology of northwestern New York state consists of essentially undeformed Paleozoic sedimentary rocks from the Ordovician and Silurian Periods which were deposited between 400 and 450 million years ago. The rocks have a regional dip of less than one degree toward the south and occupy a broad basin sloping southward from the neighboring crystalline terrains of the Canadian Shield and the Adirondack Dome. A metamorphic basement of gneiss underlies the sedimentary rocks. The area has been significantly modified by glaciation which left a series of east-west trending escarpments and low plains (NFSS-084, NFSS-193, and NFSS-257).

The region's sedimentary rocks consist predominantly of carbonates and fine clastic rocks. The uppermost bedrock in the area beneath the NFSS is the silty shale and mudstone laden Queenston Formation, which is of Ordovician age. Rocks from the Silurian Period Medina Group (consisting of sandstone, siltstone, and shale), Clinton Group (consisting of limestone, dolomite, and shale), and Lockport Group (consisting of dolomite and limestone) are exposed at the Niagara Escarpment to the south of the site. Near Buffalo, about 32 km (20 mi) south of the escarpment, the Lockport Group is overlain by the Silurian Period Salina Group (consisting of shale and gypsum). A stratigraphic column of the regional geology is shown on Figure 1.1.3-1 and a generalized regional cross-section is shown on Figure 1.1.3-2. According to NYSDEC, these units are not present in the immediate vicinity of the NFSS.

Surficial deposits of the Quaternary Period belong almost entirely to the late Pleistocene Series (12,500 years before present) and include glacial drift and associated glaciolacustrine deposits that cover most of Niagara County. The glacial deposits consist of till, principally from the most recent late-Wisconsin glaciation, and stratified drift in the form of kames, eskers, and sheets of outwash sands and gravel. The glaciolacustrine materials were deposited along the shorelines and at the bottom of glacial and post-glacial lakes.

The following six sections describe the geological units present at the NFSS. A generalized site specific stratigraphic column is shown on Figure 1.1.3-3. Figure 1.1.3-4 depicts the structural contours of the geologic units at the NFSS.

1.1.3.1 Surficial Soils and Fill - The surficial soil at the NFSS consists of a loose to medium dense brown to yellowish silt with organic matter usually present in the root zone, (upper 15 centimeters (cm) (six inches [in]) of the unit). Gravel and sands are generally encountered and are dispersed randomly throughout this unit. Thickness of surficial deposits vary from zero to 1.5 m (zero to five ft), with an average range of 0.3 to 0.6 m (one to two ft). The unit is described as fill where man-made materials (glass and bricks) or obvious signs of disturbance are found. The depth and lateral extent of fill was not documented.

1.1.3.2 Brown Clay Unit - The Brown Clay Unit is a brown or reddish brown clay, consisting of silty clayey glacial till, which underlies the surface soils. The clay was modified by lamination and deposition of sandy or gravelly zones when it was submerged beneath the glacial Lake Iroquois, which retreated and became Lake Ontario. These deposits are present in the unit as sand and silt seams, pockets, and lenses. Sandy gravel and gravelly sand and silt lenses are common within the basal portion of the unit. The brown clay varies in thickness from two to seven m (six to 23 ft). The consistency of the clay ranges from medium soft to hard with plasticity increasing with depth.

The sand, gravel, and silt lenses in the basal portion of this unit average 0.3 to 1.5 m (one to five ft) in thickness. Lateral extent and thickness of these lenses vary abruptly. The sediments in the lenses are usually moist to saturated and vary from loose to dense. Occasional extensive deposits of sand and gravel 5.3 to 6.1 m (17.5 to 20 ft) in thickness occur in this unit (NFSS-084 and NFSS-302).

The upper (first) water-bearing zone is located in the Brown Clay Unit.

1.1.3.3 Gray Clay Unit - Beneath the Brown Clay Unit is the Gray Clay Unit, which is of lacustrine origin from deeper portions of the glacial Lake Iroquois. Post depositional erosion of the unit is evident from channels along its upper surface which are filled with the coarser grained sediments of the Brown Clay Unit. The Gray Clay Unit is characterized by gray clay that occasionally grades vertically up to a silt and sand mixture. Gravel is dispersed throughout the unit as are lenses of fine to medium-grained sand. Sand and gravel become the primary constituents near the base of the unit. The overall consistency of the unit ranges from soft to medium soft, with clay portions being slightly to highly plastic. The clay is generally wet and sand lenses are wet to saturated.

Thickness of the Gray Clay Unit varies from less than 1.5 to nine m (five to 30 ft) and is the thickest unconsolidated unit on site. Lateral facies changes, characterized by increased sand and silt, occur within the upper 0.9 to 1.5 m (three to five ft) (NFSS-084 and NFSS-302).

1.1.3.4 Sand and Gravel Unit - The Sand and Gravel Unit consists of clean sand to mixtures of sand, gravel, and silt. The unit is thought to be glaciofluvial in origin; and is normally wet to saturated and exhibits loose to medium relative density. In general, the thickest portions of the unit are present where depressions occur in the bedrock. The Sand and Gravel Unit contains the lower (second) water-bearing zone and is considered to be a significant water-bearing zone.

The Sand and Gravel Unit is approximately 0.9 to 2.1 m (three to seven ft) in thickness and occurs 4.6 to 8.3 m (15 to 28 ft) below the ground surface (NFSS-084 and NFSS-302).

1.1.3.5 Red Silt Unit - The Red Silt Unit is also referred to as the Red Stony Till. This unit consists of angular fragments of bedrock in a sandy silt matrix that suggests that this till was locally derived and emplaced as a basal lodgement till. The Red Silt Unit is composed of clayey gravelly silt with lesser amounts of sand. Gravel is dispersed throughout the unit and consists of both rounded and angular fragments of bedrock. This unit is generally dry to moist, overconsolidated, and ranges from medium to very dense. The Red Silt Unit varies in thickness and is absent in some locations at the site (NFSS-084 and NFSS-302).

The Red Silt Unit is approximately zero to 2.1 m (zero to seven ft) in thickness and, where present, occurs 11.2 to 14.0 m (37 to 46 ft) below the ground surface (NFSS-084 and NFSS-302)

1.1.3.6 Queenston Formation - The bedrock at the site consists of brownish red shales, siltstone, and mudstone of the Queenston Formation. Occasional lenses of green siltstone and shale occur within this formation. The Queenston Formation is over 365 m (1,200 ft) thick and is slightly to moderately weathered in the upper region. Some fractures have been observed in the upper zone of the bedrock. Calcite replacement and clays have been noted in some of the wider fractures. A Pre-Cambrian gneiss underlies the Queenston Formation.

The Queenston Formation typically is encountered 9.8 to 14.9 m (32 to 49 ft) below the ground surface (NFSS-084 and NFSS-302). The bedrock aquifer is included in this unit.

1.1.3.7 Seismic Characteristics - The NFSS is situated in the Central Stable Seismic Region which extends from the eastern Appalachian Mountain chain to the western Rocky Mountains and from the Canadian Shield in the north to the Coastal Plain in the south. This region is considered to be generally tectonically stable with a few earthquakes of moderate magnitude (5.25 or less on the Richter Scale).

However, the earthquake record of adjacent portions of western New York is significant. The NFSS is approximately centered in the Niagara Seismic Source Zone, an oblong region that extends from west of Hamilton, Ontario, Canada to the east of Penn Yan, Yates County, New York. Figure 1.1.3.7-1 shows the Niagara Seismic Source Zone and locations of earthquakes in the NFSS area. There are no known major fault zones in the area, but the Clarendon-Linden fault traverses the Niagara Seismic Source Zone. In the Attica, New York area, located approximately 42 km (26 mi) southeast of the site, the Clarendon-Linden fault has been the chief regional source of earthquake activity. Table 1.1.3.7-1 shows a listing of earthquakes that have been recorded since 1857 above a Modern Mercalli Intensity (MMI) value of IV in the area of the NFSS (NFSS-054).

1.1.4 Regional Hydrogeology

Within 30 m (100 ft) of the ground surface, there are two general types of water-bearing formations that occur in northwestern New York state. These two formations are in the unconsolidated materials and in the sedimentary bedrock. The water-bearing unconsolidated formations are typically layers of sand and gravel or discontinuous lenses of sand and gravel containing perched water. The

bedrock aquifers occur in the Silurian or Ordovician sedimentary rocks and the deeper Pre-Cambrian gneiss. North of the Niagara Escarpment, the only sedimentary bedrock present is the Queenston Formation, which is up to 365 m (1,200 ft) thick. A regional groundwater divide exists near the Niagara escarpment. Regional groundwater flow north of the escarpment is toward the northwest, whereas groundwater flow south of the escarpment is toward the southwest (NFSS-191).

There are three zones of groundwater that have been identified to underlie the NFSS. The upper water-bearing zone (in the Brown Clay Unit), lower water-bearing zone (in the Sand and Gravel Unit), and a bedrock water-bearing zone in the upper fractured portion of the Queenston Formation (NFSS-084 and NFSS-302). None of these zones are considered significant sources of groundwater, due to low well yield and/or high degree of mineralization. The natural principal groundwater flow direction in all three of these water-bearing units is north-northwest toward Lake Ontario, mimicking the gently dipping underlying bedrock strata (NFSS-054).

Between 1990 and the Fall of 1998, groundwater extraction from wells in the lower water-bearing zone at the Modern Landfill, Inc. property reportedly reversed groundwater flow direction in both the upper and lower water-bearing zones beneath portions of the NFSS and the CWM Chemical Services, Inc. property (NFSS-054). The three groundwater zones and historical groundwater usage in Niagara County are presented in the following sections.

1.1.4.1 Upper Water-bearing Zone - The upper water-bearing zone is a water table unit (i.e., unconfined) characterized by discontinuous silt, sand, and gravel lenses that are contained within the Brown Clay Unit. Although not considered an aquifer, this zone has sand lenses capable of yielding a substantial flow rate for a short period of time (NFSS-054). Lenses in this zone vary abruptly in thickness and extent. However, it has been suggested that a northeasterly-trending sinuous channel deposit may exist just north of the IWCS (NFSS-084). The lenses range from dry to saturated conditions and therefore the occurrence of groundwater varies across the site.

This upper water-bearing zone has been reported to occur at depths from 0.03 to six m (0.1 to 20 ft) and has reportedly been contaminated during past facility activities (NFSS-084 and NFSS-302). Groundwater levels are generally highest in the early summer and lowest in the fall (NFSS-307). Seasonal fluctuations of up to 3 m (10 ft) have been reported (NFSS-220).

Groundwater flow direction was toward the northwest prior to 1990, at which time Modern Landfill, Inc. began extracting water from the lower water-bearing zone. The upper water-bearing zone reportedly discharges to the Central Ditch in some areas of the site and the Central Ditch has a pronounced affect on groundwater flow patterns when the water table is relatively high. Groundwater flow direction has been observed to be radial near the IWCS in the summer months when the overall NFSS water table is relatively low and the IWCS cap is actively irrigated (NFSS-307). Figure 1.1.4.1-1 shows the potentiometric surface of the upper water-bearing zone from February 25, 1998.

The upper water-bearing zone reportedly responds more rapidly than the lower-water bearing zone to seasonal fluctuations in groundwater recharge and the effects of watering the IWCS, indicating that the Gray Clay Unit acts as an aquitard by slowing recharge to the lower-water bearing zone. In other words, the vertical hydraulic gradient of the upper water-bearing zone is downward and

discharges to the underlying lower water-bearing zone by leakage through the Gray Clay Unit. The Gray Clay Unit reportedly has horizontal and vertical hydraulic conductivity values ranging from 1×10^{-4} to 1.4×10^{-8} centimeters/second (cm/s) (NFSS-193). The hydraulic gradient ranges from 0.003 to 0.008, but steepens to 0.07 at the Central Ditch near the IWCS (NFSS-054, NFSS-193, and NFSS-234). Recharge to the upper water-bearing zone is from surface infiltration (NFSS-054) and, according to water quality measurements, is relatively recent (NFSS-234).

The horizontal hydraulic conductivity of the upper water-bearing zone, estimated from both field (slug) tests and laboratory tests, ranges from 3×10^{-5} to 3×10^{-7} cm/s. Vertical hydraulic conductivity values for the clay within the Brown Clay Unit were reported to be 6×10^{-7} cm/s (NFSS-054). However, it should be noted that dessication fractures have been reported in the upper 0.6 to 0.9 m (two to three ft) of the Brown Clay Unit at the NFSS and 0.9 to 4.3 m (three to 14 ft) at both the CWM Chemical Services, Inc. and Modern Landfill, Inc. sites (NFSS-402 and NFSS-271). Groundwater flow velocities of 0.04 to 0.69 meters/year (m/yr) (0.12 to 2.26 feet/year [ft/yr]) have been reported for the upper water-bearing zone at the Modern Landfill, Inc. property (NFSS-402). Thirty-five wells have been completed in this water-bearing zone. With the exception of a few wells used to monitor the IWCS, no radiological or chemical sampling has been completed through these wells.

1.1.4.2 Lower Water-bearing Zone - The lower water-bearing zone is a partially confined aquifer (i.e., water level rises above the top of the unit when the unit is penetrated) in the Sand and Gravel Unit which is situated between the overlying Gray Clay Unit aquitard and the underlying Red Silt Unit or the bedrock. By USEPA definitions, this zone is the first regulatory-defined aquifer below the NFSS. Although the water is generally not potable, it is capable of providing minimal quantities of groundwater for domestic use (NFSS-054).

This zone is between 0.9 and two m (three to seven ft) thick and gravel quantities vary from zero to 40 percent. Water levels indicate this zone is confined with a potentiometric surface ranging from 7.6 to 9.1 m (25 to 30 ft) above the top of the Sand and Gravel Unit which typically ranges between 9.4 and 13.1 m (31 to 43 ft) below the ground surface. The potential for contamination of the lower water-bearing zone is reportedly limited due to the overlying Gray Clay Unit (NFSS-084 and NFSS-302). Groundwater levels are generally highest in the summer and lowest in the winter (NFSS-307). Groundwater seasonal fluctuations of up to 3 m (10 ft) have been reported (NFSS-220). Groundwater flow direction has been observed to be radial near the IWCS in the summer months when the overall NFSS water table is relatively low and the IWCS cap is actively irrigated.

Groundwater flow direction was toward the northwest prior to 1990, at which time Modern Landfill, Inc. began extracting water from the lower water-bearing zone. The groundwater extraction has reportedly caused a groundwater divide at the NFSS in the past. Groundwater flow in the northern part of the site was toward the north-northwest, while groundwater flow in the eastern part of the site was toward the east-southeast (NFSS-234). Review of the third quarterly (July 20, 1999) potentiometric map of groundwater levels at the CWM Chemical Services, Inc. and Modern Landfill, Inc. properties indicates that groundwater flow in the general area may be returning to its natural north-northwestwardly direction following the cessation of the groundwater extraction in 1998 at the Modern Landfill, Inc (NFSS-443). Figure 1.1.4.2-1 shows the potentiometric surface of the lower water-bearing zone from February 25, 1998.

The hydraulic gradient ranges from 0.001 to 0.004 (NFSS-054 and NFSS-193). The vertical hydraulic gradient of the lower water-bearing zone is reportedly downward except near the Central Ditch, where the gradient is upward at the rate of 0.12 (NFSS-054). Recharge to the lower water-bearing zone is from surface infiltration near the Niagara escarpment; leakage from the overlying Gray Clay Unit; and, where the Red Silt Unit is absent, from the underlying Queenston Formation (NFSS-054 and NFSS-307). Water quality measurements indicate the groundwater has a relatively longer residence time or distance traveled than in the upper water-bearing zone (i.e., the recharge is relatively old) (NFSS-234). This residence time is evident by the increased mineralization of the groundwater.

Horizontal hydraulic conductivity of the lower water-bearing zone, estimated from both field (slug) tests and laboratory tests, ranges from 1.3×10^{-3} to 9×10^{-6} cm/s (NFSS-193). Groundwater flow velocities of four to 23 ft/yr have been reported for the lower water-bearing zone at the Modern Landfill, Inc. property (NFSS-402). Fifty wells have been completed in this water-bearing zone. With the exception of the wells used to monitor the IWCS, no radiological and limited chemical information is available for the lower water-bearing zone.

1.1.4.3 Bedrock Aquifer - Groundwater movement within the bedrock aquifer is thought to be limited to weathered, fractured, and calcified sections of the upper 3.0 to 5.9 m (10 to 15 ft) of the Queenston Formation (NFSS-307). This aquifer is generally more productive than the glacial zones (NFSS-191). Well yields in this zone range from 3.8 liters per minute (one gallon per minute [gpm]) in the non-fractured portion to 26.4 lpm (seven gpm) in the fractured portion (NFSS-193).

Water levels indicate that this aquifer is confined with a potentiometric surface an average of 11.3 m (37 ft) above the top of the bedrock, which is generally encountered between 9.8 to 15.1 m (32 to 49 ft) bgs. The confining layer for this zone is the Red Silt Unit, where present. Where the Red Silt Unit is absent, the Queenston Formation is hydraulically connected to the lower water-bearing zone. The potential for contamination of this zone is limited due to the Gray Clay Unit and the Red Silt Unit, where present, the relatively low permeability of the shale, and the upward vertical gradient where the Red Silt Unit is absent (NFSS-084 and NFSS-302).

Groundwater flow direction is west or northwest, with some apparent anomalies observed near the former Building 434 area and the southwest corner of the NFSS property (NFSS-339). Recent monitoring events have not included water levels in the bedrock aquifer.

The in-situ hydraulic conductivity of the unweathered portion of this zone reportedly ranges from 2.31×10^{-4} to 2×10^{-7} cm/s (NFSS-084 and NFSS-193). The vertical hydraulic gradient of the upper bedrock water-bearing zone is reportedly upward to the lower water-bearing zone, where the Red Silt Unit is absent. The hydraulic gradient reportedly ranges from 0.001 to 0.0016 (NFSS-084 and NFSS-193). Recharge to the bedrock aquifer is from surface infiltration near the Niagara escarpment. Eight wells have been completed in this aquifer. No radiological or chemical sampling has been completed through these wells.

1.1.4.4 Groundwater Usage - According to the 1964 USGS report (NFSS-189), the development and usage of any groundwater supplies in the Niagara Falls area can be directed toward small domestic and farm applications in rural areas. A few moderate to large supply wells are installed in

the Lockport dolomite, which is reportedly the only important aquifer in the region. However, the Lockport dolomite is missing from the stratigraphic section north of the Niagara escarpment (i.e., missing at the NFSS property). Since the water requirements for a domestic supply well are generally about 132 liters per day (35 gallons per day) per person, a well yielding several hundred liters per day is adequate. A farm supply usually requires several hundred to several thousand liters per day depending on the type and number of stock and/or the acreage of agricultural land to be irrigated.

The 1964 USGS study reported that groundwater was the primary source of water for approximately 16 percent of the population in the Niagara Falls area. Water supplied to the rest of the population typically comes from surface water taken from Lake Ontario, Lake Erie, or the Niagara River. The study area for the report consisted of three-quarters of Niagara County and one-quarter of Orleans County. Approximately 38 million liters per day [mld] (10 million gallons per day [mgd]) of groundwater was used by the total population in the study area during 1961-62. Approximately 34 mld (nine mgd) was pumped from the Lockport dolomite and the remaining four mld (one mgd) was obtained from the unconsolidated deposits and Queenston Formation. The principal uses of the groundwater in the Niagara Falls area during 1961-62 are shown in Table 1.1.4.4-1.

The USGS report also indicated the quality of the Queenston Formation groundwater is poor. This is due to severe hardness of the water and a dissolved mineral content of 1,000 parts per million (ppm) or greater. Salty water can be found in a few wells in the Queenston Formation, particularly just north of the Niagara escarpment.

Bechtel National Incorporated's "Failure Analysis Report" (NFSS-054) contended that in 1968, 10 percent of the population of Niagara and Erie counties utilized groundwater. This report indicated that the wells in the NFSS vicinity generally have a low yield and supply water of poor quality. In 1991, requests were made from the towns of Lewiston and Porter to determine the approximate acreage of irrigated agricultural land in the vicinity of the NFSS. The town of Lewiston reported two properties with 5.3 irrigated ha (13 acres) and the town of Porter reported two properties with 85.0 irrigated ha (210 acres). All four of these properties fall within 4.8 km (three mi) of the NFSS boundaries.

Although the reports cited above are somewhat old, and are not specifically directed to the NFSS site, they suggest the potential exists that several residents in the area surrounding the NFSS may be using groundwater. Updated information for the groundwater usage is not available. This data gap will be addressed in an addendum for the Phase II activities.

1.1.5 Regional Meteorology

Niagara County and the NFSS has a humid, continental climate that is moderated by Lakes Erie and Ontario (NFSS-072, NFSS-136, and NFSS-145). The temperature extremes for the NFSS area range from -17°C to 35°C (2°F to 94°F). The average monthly temperature ranges from -3.3°C to 24°C (26°F to 76°F) with an average yearly temperature of 9.4°C (49°F). Average annual precipitation is 95.3 cm (37.5 in), which is relatively evenly distributed throughout the year. Average annual snowfall is 142 cm (56 in), which occurs primarily between November and March. The snowfall is included in the average precipitation values.

The wind in the area is predominantly from the west-southwest (14.2 percent of the time), with the west, west-southwest, and southwest components totaling 38.1 percent of the overall wind direction. Based on the 1982 wind speed data (NFSS-096), 69 percent of the wind was between 0 to five meters/second (m/s) (0 to 16.4 feet/second [ft/s]), 29 percent of the wind was between five to 10 m/s (16.4 to 32.8 ft/s), and two percent of the wind was greater than 10 m/s (32.8 ft/s). The wind rose from the NFSS onsite weather station from 1985 (NFSS-087) is included as Figure 1.1.5-1.

1.1.6 Surrounding Land Use

The NFSS is bordered on the north and northeast by the CWM Chemical Services, Inc. hazardous waste disposal facility; on the east and south by the Modern Landfill, Inc. solid waste disposal facility; on the west by the Niagara Mohawk Power Corporation owned transmission corridor property; and on the northwest by the village of Lewiston (the former LOOW wastewater treatment plant) (NFSS-054). All of the aforementioned properties were once part of the original LOOW. Land surrounding the bordering properties is primarily row-crop agricultural and orchards with abandoned agriculture fields, second-growth forests, recreational areas, the Lewiston public school property, and a recreational vehicle park with a campground. Additionally, several residences are located on Pletcher road approximately 800 m (0.5 mi) west-southwest of the site.

Figure 1.1.7-1 shows the current surrounding land use types and Figure 1.1.7-2 shows those projected for the year 2700 (NFSS-054).

1.2 Historical Investigations/Summary of Existing Site Data

More than 450 documents relating to the NFSS were reviewed. The following sections describe the investigations and remedial actions performed at the NFSS, provide a description of the radioactive residues and wastes that are/were on site, and presents data from the limited chemical investigations performed to date.

1.2.1 Investigations and Remedial Actions

The following sections summarize the results of previous radiological and chemical surveys at the NFSS site.

1.2.1.1 Radiological Surveys and Remediation - Cleanup of 525 ha (1,297 acres) of vicinity properties of the original LOOW site was completed by Hooker Electrochemical Company in 1955. No details of this offsite cleanup were reported (NFSS-054). In 1970, a radiological survey was performed by the AEC over the former LOOW site. Field screening was performed using hand-held survey meters. Soil samples were collected at locations where radioactivity was detected at higher than background concentrations and analyzed for "radiological parameters". Specific parameters and locations of samples were not discussed. Based on this survey, offsite (locations within the boundaries of the former LOOW but outside the boundaries of what is now the NFSS) removal actions pertaining to radiologically impacted soil began in 1972. These off-site removal actions included 548.6 m (1,800 ft) of the Central Ditch, 91.4 m (300 ft) of the bed of Six Mile Creek, and several other parcels of the LOOW other than the NFSS. A total of approximately 11,500 m³ (15,000 yd³) of contaminated soil/sediments were removed during these actions and were placed on the R-10

pile located north of the water treatment area (NFSS-267). Exact locations or depths of excavations of the remedial actions were not documented.

In 1979, Battelle Columbus Laboratory, under the direction of the USDOE, performed a "radiological characterization" of the NFSS (NFSS-290). Several remedial actions took place as a result of this survey. Exact locations or depths of excavations of the remedial actions were not documented. In 1981, 344 m³ (450 yd³) of radiologically impacted material was excavated from an adjacent offsite property located to the east of the NFSS. This material was brought to the NFSS and placed on the R-10 pile. In 1982, the roofs of Buildings 413 and 414 were sealed with an asphalt emulsion to reduce radon emissions. The dike and cutoff wall around the R-10 pile was completed and the pile was covered with a ethylene propylene diene monomer (EPDM) liner.

In 1983, interim remedial actions included cleanup of 1,463 m (4,800 ft) of the West Ditch and cleanup of 2,103 m (6,900 ft) of the Central Ditch, generating 41,288 m³ (54,000 yd³) of material that was placed north of Building 411. The offsite portion of the Central Ditch was decontaminated during 1984 and 22,466 m³ (29,385 yd³) of radiologically-impacted material was generated. All but 2,753 m³ (3,600 yd³) of material was placed north of Building 411 in 1984, and the remaining volume was placed north of Building 411 in 1985.

The dike and cutoff wall forming the IWCS was completed around Building 410 in 1986. Radioactive residues (i.e., the K-65 and F-32) were moved from their original onsite storage locations and placed in Building 411 in specific bays so storage location could be documented (NFSS-054).

In 1985, all remaining residues from the NFSS were placed in Building 411 within the structure that was called the IWCS. Specifically, 516 m³ (675 yd³) of rubble from Building 434 was transferred to the IWCS, onsite and offsite areas were decontaminated and 1,453 m³ (1,900 yd³) of materials were placed in the IWCS, 10 vicinity properties were decontaminated and generated 4,817 m³ (6,300 yd³) of material that was placed in the IWCS, and 8,411 m³ (11,000 yd³) of onsite materials were placed in the IWCS (NFSS-054).

Concentrations of radionuclides over background data ("hot spots"), identified during Oak Ridge Associated Universities' off-site verification studies for the 1983 to 1986 interim remedial actions were remediated in 1988. These actions included the excavation of 2,450 m³ (3,200 yd³) of contaminated material and placement of the material on the foundation of the former Building 430. The material was encapsulated with an impermeable membrane (NFSS-306). No details of the type of membrane or how the encapsulation occurred were reported. In 1991, this material was consolidated into the IWCS.

Based on the conclusions or lack thereof, in summary, no evidence or verification of the cleanup activities (i.e., definitive analytical data for parameters regulated by potential ARARs) was discussed in the site documents. This omission of data and the possibility of soils on site being disturbed due to movement during the reported remedial activities necessitates performance of the RI

1.2.1.2 Chemical Characterization Efforts - The following two sections describe chemical characterization studies that were performed at the NFSS under the direction of the USDOE. The

results discussed in the following sections are summaries and conclusions from the reports. Where applicable, the authors of the previous reports compared the concentrations of chemicals found to TAGM cleanup criteria or to various background values.

1.2.1.2.1 Limited Chemical Characterization: In an effort to ready the NFSS for eventual land disposition, a limited chemical characterization of the site was performed by Bechtel National Incorporated in 1990 (NFSS-179). The locations of sampling from this investigation are shown on Figure 1.2.1.2.1-1. This characterization included soil, sediment, surface water, and groundwater sampling and a soil gas survey. The following paragraphs discuss the results of that investigation.

Soil was collected from 14 sampling locations on the NFSS property at depths ranging from 0.3 to 1.8 m (one to six ft) below the ground surface. The soil samples were analyzed for TAL metals plus boron and molybdenum, mobile ions (i.e., sulfate, sulfite, nitrate, nitrite, chloride, fluoride, carbonate, and phosphate), and volatile and base/neutral/acid extractable (BNA) organics, pesticides, and polychlorinated biphenyls (PCBs).

As discussed in the document, concentrations of boron, lead, and thallium detected in the samples exceeded the mean background levels for metallic constituents in soil across the United States in all 14 samples. Concentrations of magnesium and zinc detected in the samples exceeded the mean background levels for metallic constituents in soil across the United States in 13 and eight of the 14 samples, respectively. Carbon disulfide, toluene, flouranthene, and pyrene were also detected at concentrations above the reporting limits in some of the soil samples. Two of the 14 samples were analyzed for the Toxicity Characteristic Leachate Procedure (TCLP) volatile and BNA organics, TCLP metals, TCLP pesticides and herbicides, and Resource Conservation and Recovery Act (RCRA) hazardous waste characteristics (reactivity, ignitability, and corrosivity). With the exception of barium being detected in one of the two TCLP samples at a concentration of 2.990 micrograms per liter (ug/L) or parts per billion (ppb), all other TCLP constituents were not detected above the detection limits.

Nine sediment samples were collected and analyzed for metals, mobile ions, and volatile and BNA organics, pesticides, and PCBs. Some samples exhibited concentrations of magnesium, manganese, and zinc above background. Fluoride was detected in one sample above background concentrations. PCBs were detected at concentrations above the reporting limits in one sediment sample.

Twelve surface water samples were collected and analyzed for metals, mobile ions, and volatile and BNA organics. Concentrations of boron, magnesium, manganese, and thallium detected in the surface water samples exceeded reported background levels. Bis(2-ethylhexyl)phthalate was detected at concentrations above the reporting limits in a sample taken from the West Ditch.

Groundwater samples from 16 existing wells completed in the upper and lower water-bearing zones were collected and analyzed for metals, mobile ions, volatile and BNA organics, and general groundwater parameters (i.e., pH, temperature, and conductivity). Analytical results indicated that all groundwater zones sampled were of poor quality (due to mineralization). Calcium and magnesium concentrations were elevated in the wells surrounding the IWCS.

As part of the limited chemical characterization, a soil gas survey (NFSS-179 and NFSS-218) consisting of 167 sampling locations was performed by Target Environmental Services, Inc. The survey was performed using an approximate 61 m (200 ft) grid spacing over most of the NFSS. No soil gas samples were collected in the IWCS area. During the survey, only a limited number of target constituents (methylene chloride, trans-1,2-dichloroethene, cis-1,2-dichloroethene, trichloroethene [TCE], tetrachloroethene [PCE], benzene, and toluene) from the soil gas samples were analyzed by gas chromatography using modified Methods 601 and 602. Direct injection was used instead of the normal purge and trap method during the gas chromatography. All samples were collected at depths less than 1.2 m (four ft) below the ground surface. TCE was detected in seven sampling locations surrounding Building 401 with a maximum concentration of 44.5 micrograms/liter ($\mu\text{g/l}$) approximately 46 m (150 ft) north of the building. The constituent concentrations from the soil gas results (i.e., $\mu\text{g/l}$) are not a direct measurement of the concentration of the contaminant in the soil due to the difference in the mass of equal volumes of water and gas matrices. PCE was detected at minimal concentrations ($< 2.0 \mu\text{g/l}$) in five sampling locations surrounding Building 401, in one location 61 m (200 ft) north of "O" Street and 198 m (650 ft) east of Campbell. Cis-1,2-dichloroethene was detected in two sampling locations just north and south of Building 401 with a maximum concentration of $9.0 \mu\text{g/l}$. No other constituents were reported above detection limits.

Confirmatory soil samples were collected in 0.3 m (one ft) increments to 1.2 m (four ft) below the ground surface at the four locations which had exhibited TCE or 1,2-dichloroethene in the soil gas samples. All four soil samples exhibited TCE concentrations ranging from seven to 440 ppb. One soil sample exhibited 1,2-dichloroethene with concentrations ranging from 18 to 59 ppb.

1.2.1.2.2 Data Gap Characterization: As a further confirmation of the results of the soil gas survey, a limited data gap characterization of the NFSS was initiated in 1995 by Bechtel National Incorporated (NFSS-406). Sample locations from the investigation are shown on Figure 1.2.1.2.1-1. Four sediment and surface water sample locations, five soil sampling locations, and seven groundwater sampling locations were sampled during this investigation.

The sediment and surface water samples were analyzed for total 1,2-dichloroethene, TCE, PCE, and total metals. The surface water samples were also measured for field parameters of pH, temperature, and specific conductivity. Iron was detected in one sample from the West Ditch above the applicable water quality criteria regulatory concentration.

Three soil samples were collected from each of the soil boring locations. These samples were analyzed for total 1,2-dichloroethene, TCE, PCE, and thallium. A background soil sample was collected from the Lewiston public school property, which is located approximately 2.4 km (1.5 mi) west of the site. No contaminants were reported above analytical detection levels in the soil samples.

Groundwater samples collected from the upper water-bearing zone at the site were analyzed for total 1,2-dichloroethene, TCE, PCE, pH, temperature, specific conductivity, Eh, dissolved oxygen, and turbidity. No hazardous substances were reported above the detection levels in the groundwater samples.

1.2.1.3 Previous Remedial Investigations - As part of the Defense Environmental Restoration Program (DERP), EA Engineering, Science, and Technology, on behalf of the USACF Baltimore

District, conducted a Phase I Remedial Investigation of the entire former LOOW in 1998 (NFSS-442). Sample locations that pertain to the NFSS are shown on Figure 1.2.1.2.1-1. Included in the RI was a discussion of results of collection and analyses of three “site-specific” background soil and groundwater samples. Investigatory samples were compared to these site-specific background levels and the New York State Department of Environmental Conservation (NYSDEC) Technical and Administrative Guidance Manual (TAGM) levels. The following five sections (which correspond to the areas shown in Figure 1.3.1-1) provide a general discussion of the analytical results from that RI.

1.2.1.3.1 Former Acidification Area: Soil samples were collected from 27 locations using a 61 m (200 ft) grid system over the former acidification area and 11 biased locations within the former acidification area. Most soil samples were field screened for PCBs (by Method E4020), polynuclear aromatic hydrocarbons (PAHs) (by Method 4035), volatile organics (by gas chromatography), and nitroaromatics (by Method E4050). Screened samples indicated the presence of PAHs, 1,1-dichloroethene, trans-1,2-dichloroethene, PCE, and TCE. Two samples were sent to an offsite laboratory to be analyzed for the full target compound list/target analyte list (TCL/TAL) parameters, including volatile organics, semi-volatile organics, pesticides and PCBs, inorganic parameters, and nitroaromatics. Levels of beryllium, calcium, copper, iron, magnesium, nickel, sodium, and zinc were detected in the soil samples above the site-specific background concentrations or NYSDEC TAGM cleanup criteria. Other metals, heptachlor, acenaphthene, acenaphthylene anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene were also reported above the detection limits.

One groundwater sample was collected from a temporary wellpoint in the upper water-bearing zone in the former acidification area and was sent to an offsite laboratory to be analyzed for the full TCL/TAL parameters, including volatile organics, semi-volatile organics, pesticides and PCBs, inorganic parameters, and nitroaromatics. Concentrations of aluminum, calcium, iron, lead, magnesium, manganese, sodium, and heptachlor epoxide were detected above site-specific background concentrations or NYSDEC TAGM cleanup criteria. Other metals, acetone, carbon disulfide, acenaphthene, anthracene, fluoranthene, fluorene, phenanthrene, and pyrene were also reported above the detection limits.

1.2.1.3.2 Former Shop Area: Soil samples were collected from 23 locations on a 61 m (200 ft) grid system over the former shop area and five biased locations within the shop area. Most soil samples were field screened for PCBs (by Method E4020), PAHs (by Method 4035), volatile organics (by gas chromatography), and nitroaromatics (by Method E4050). Screened samples indicated the presence of PCBs, PAHs, benzene, 1,1-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, PCE, and TCE. Three samples were sent to an offsite laboratory to be analyzed for the above noted TCL/TAL parameters. Levels of aluminum, beryllium, calcium, copper, magnesium, nickel, sodium, zinc, mercury, heptachlor epoxide, and acetone were detected above site-specific background concentrations or NYSDEC TAGM cleanup criteria. Other metals, aldrin, heptachlor, heptachlor epoxide, arochlor 1260, bis(2-ethylhexyl)phthalate, acenaphthene, acenaphthylene anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene,

fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene were also reported above the detection limits.

One groundwater sample was collected from a temporary wellpoint in the upper water-bearing zone in the former shop area and was sent to an offsite laboratory to be analyzed for the above noted TCL/TAL parameters. Concentrations of aluminum, antimony, iron, lithium, lead, magnesium, manganese, sodium, alpha-BHC, 1,1,1-trichloroethane and TCE were detected above site-specific background concentrations or NYSDEC TAGM levels. Other metals, 1,1-dichloroethylene, total-1,2-dichloroethylene, 2-butanone, phenanthrene, and 1,3,5-trinitrobenzene were also reported above the detection limits.

1.2.1.3.3 Baker Smith Area: Soil samples were collected from 20 locations using a 25 m (75 ft) grid system over the Baker Smith area and four biased locations within the area. Most soil samples were field screened for PCBs (by Method E4020), PAHs (by Method 4035), volatile organics (by gas chromatography), and nitroaromatics (by Method E4050). Screened samples indicated the presence of PAHs, benzene, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, PCE, toluene, TCE, and (m and p-isomer) xylenes. Two samples were sent to an offsite laboratory to be analyzed for the above noted TCL/TAL parameters. Levels of aluminum, beryllium, calcium, copper, iron, and nickel were detected above site-specific background concentrations or NYSDEC TAGM cleanup criteria. Mercury, heptachlor, bis(2-ethylhexyl)phthalate, di-n-octyl phthalate, benzo(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene were also reported above the detection limits.

One groundwater sample was collected from a temporary wellpoint in the upper water-bearing zone on the adjacent property immediately north of the Baker Smith area and was sent to an offsite laboratory to be analyzed for the above noted TCL/TAL parameters. Concentrations of aluminum, antimony, iron, lithium, magnesium, and sodium were detected above site-specific background concentrations or NYSDEC TAGM cleanup criteria. Other metals, 1,3,5-trinitrobenzene and HMX were also reported above the detection limits.

1.2.1.3.4 Sanitary, Acid Waste, and Storm Sewer Lines: Two samples of sludge were collected from the manholes of the former LOOW process, sanitary, and storm sewer utilities located in the former acidification area. The sludge samples were field screened for PCBs (by Method E4020), PAHs (by Method 4035), volatile organics (by gas chromatography), and nitroaromatics (by Method E4050). Screened samples indicated the presence of PCBs, PAHs, and PCE. Eight samples were sent to an offsite laboratory to be analyzed for the above noted TCL/TAL parameters. Levels of arsenic, cadmium, chromium, copper, iron, lead, magnesium, nickel, silver, zinc, mercury, and 4,4'-DDT were detected above site-specific background concentrations or NYSDEC TAGM cleanup criteria. Other metals, endrin aldehyde, alpha BHC, gamma BHC, delta BHC, alpha chlordane, 4,4'-DDD, 4,4'-DDE, dieldrin, endrin endosulfan I, endosulfan sulfate, heptachlor, heptachlor epoxide, acetone, phenol, arochlor 1248, arochlor 1260, 4-methylphenol, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene were also reported above the detection limits.

Six samples of wastewater were collected from the manholes of the former LOOW utilities and were sent to an offsite laboratory to be analyzed for the above noted TCL/TAL parameters. Concentrations of aluminum, iron, selenium, silver, and bis(2-ethylhexyl)phthalate were detected above site-specific background concentrations or NYSDEC TAGM cleanup criteria. Other metals, acetone, PCE, 4-methylphenol, and phenanthrene were also reported above the detection limits.

1.2.1.3.5 Sediments and Surface Water: Six sediment samples were collected from the Central, South 16, and South 31 Ditches on the NFSS property. Samples were field screened for PCBs (by Method E4020), PAHs (by Method 4035), TCE (by gas chromatography), and nitroaromatics (by Method E4050). Screened samples indicated the presence of PAH levels above NYSDEC TAGM cleanup criteria. Three samples were sent to an offsite laboratory to be analyzed for boron, lithium, 4-amino-2,6-dinitrotoluene, and total organic carbon. Boron and lithium were reported above the detection limits.

Three surface water samples were collected on the NFSS property. These samples were sent to an offsite laboratory to be analyzed for general wastewater properties, boron, lithium, and nitroaromatics. Water quality parameters, chloride, fluoride, sulfate, nitrogen as nitrate, nitrogen as ammonia, total Kjeldahl nitrogen, total phosphorus, biological oxygen demand, chemical oxygen demand, boron, and lithium were reported for the surface water samples.

1.2.1.4 Environmental Surveillance Data - Environmental surveillance data for the NFSS has been prepared yearly since 1981. The yearly environmental surveillance includes air monitoring at the perimeter of the NFSS for radon; groundwater monitoring for radiological constituents, select metals, and water quality parameters; and sediment samples for radiological constituents.

1.2.2 Descriptions of Radiological Residues

The following seven sections provide a description of each major radiological residue that was stored at the NFSS.

1.2.2.1 L-50 Residues - The L-50 residues are low-level, high-activity radioactive residues from the refinement of low-grade uranium pitchblende ores from the Belgian Congo. These residues were generated from the processing of ores containing seven percent uranium oxides. The residues were transferred to the NFSS from Linde Air Products in Tonawanda, New York. A history of the L-50 residue is summarized in Table 1.2.2.1-1.

1.2.2.2 R-10 Residues - R-10 residues are low-level, low-activity radioactive residues from the refinement of low-grade uranium pitchblende ores from the Belgian Congo. These residues were generated from the processing of ores containing 2.6 to 3.5 percent uranium oxides. The residues were transferred to the NFSS from Linde Air Products in Tonawanda, New York. A history of the R-10 residue is summarized in Table 1.2.2.2-1.

1.2.2.3 F-32 Residues - F-32 residues are low-level, high-activity radioactive residues from the refinement of high-grade uranium pitchblende ores owned by the U.S. Government. These residues were generated from the processing of ores containing 20 to 50 percent uranium oxides. The

residues were transferred to the NFSS from the Middlesex Metal Refinement Plant, Middlesex, New Jersey. A history of the F-32 residues is summarized in Table 1.2.2.3-1.

1.2.2.4 L-30 Residues - L-30 residues are low-level, high-activity radioactive residues from the refinement of low-grade uranium pitchblende ores from the Belgian Congo. These residues were generated from the processing of ores containing 10 percent uranium oxides. The residues were transferred to the NFSS from Linde Air Products in Tonawanda, New York. A history of the L-30 residues is summarized in Table 1.2.2.4-1.

1.2.2.5 K-65 Residues - K-65 residues are low-level, high-activity radioactive residues from the refinement of high-grade uranium pitchblende ores from the Belgian Congo. These residues were generated from the processing of ores containing 35 to 60 percent uranium oxides. The residues were transferred to the NFSS from Mallinckrodt Chemical Works in St. Louis, Missouri. A history of the K-65 residues is summarized in Table 1.2.2.5-1.

1.2.2.6 Middlesex Sands - The Middlesex sands are residues from the sandblasting decontamination of the Middlesex Metal Refinement Plant in Middlesex, New Jersey, where the F-32 residues were generated. The Middlesex sands were transferred to the NFSS around 1950 and were placed in Building 410 until 1986 when it was incorporated into the IWCS.

1.2.2.7 Miscellaneous Residues and Wastes - The P-54 residue is lead sulfide cake generated from processing L-30 and L-50 ore. The P-56 residue is regenerated lead sulfate cake generated from processing L-30 and L-50 ores. The P-58 residue is lead vanadate generated by adding lead sulfate to uranium-bearing carbonate liquors in order to remove vanadium during the processing of L-19 ore. The "P" residues were transferred to the NFSS from Linde Air Products in Tonawanda, New York in 1946. The P-54 residues were stored in Building 410. The P-56 residues were stored in the thaw house adjacent to Building 434 and/or in Building 410. The P-58 residues were stored in an open pit in the southeastern corner of the second floor of Building 410. The "P" residues were ultimately transferred to West Valley, New York and Oak Ridge, Tennessee in 1966 for final storage.

Wastes from the KAPL consisting of combustible materials and spent fuel rods were transferred to the NFSS for storage near Building 401. During the boron separation startup activities, the KAPL waste was moved from the Building 401 area to the Baker Smith area. The combustible materials having low levels of radioactivity were burned on site at an unknown location and in the off-site incinerator. The remaining KAPL materials were ultimately transferred to Oak Ridge, Tennessee for storage. Animal carcasses from the University of Rochester radiation safety tests were transferred to the LOOW and buried in a graveyard north of the existing NFSS boundaries. During a remedial action, the carcasses were exhumed and transferred to the IWCS.

1.3 Site-Specific Sampling and Analysis Problems and Data Gaps

Sampling and analysis problems at the site are of two primary types. These include physical access problems and problems in verifying the reliability of previously collected data.

1.3.1 Physical Access Problems

Aerial photos show that portions of the site may have limited accessibility due to the presence of first and second growth forest. Aerial photos also show other portions of the site having standing water (i.e., east-west ditches south of "N" street and north of "O" street) limiting the access to various areas. These conditions were verified during the detailed walkover survey.

Foundations of previously demolished buildings may limit the initial locations of the planned borings. Roads will need to be constructed to access some areas of the site.

1.3.2 Problems with Verification and Validation of Previously-Collected Data

As documented in Section 1.2, data has been collected at various portions of the site under several previous programs. Much of this data is usable as basic information on the site. However, data sets have not yet been made available for inspection to verify the accuracy of much of this data or to establish that the data was produced under a level of QA/QC which would render it suitable for use in a USACE CERCLA-based RI.

1.3.3 Data Gaps

The activities addressed in this FSP were chosen to eliminate the current data gaps identified during the review of the former studies and investigations. Additional data gaps may be exposed as a result of the Phase I investigation process. The following sections describe the current data gaps for the NFSS.

1.3.3.1 Existing Data - The following four sections detail the specific deficiencies and data gaps for the previous investigations.

Where data was available, USEPA usability screening procedures defined in *Guidance for Data Usability in Risk Assessment (Part A)*, USEPA Publication 9285.7-09A, April 1992, were applied to determine the usability of this data as definitive data (usable for risk assessment purposes). As the data exists currently, it is unusable for those purposes without further exploration of the QA/QC information that was potentially generated for the data and an independent validation of the data. Attempts to discover the information for this data gap will continue after the initiation of Phase I activities. If the information is found, it will be incorporated in the addendum FSP for the Phase II sampling event.

1.3.3.1.1 Previous Radiological Surveys and Remediation Data: With the exception of the three reports detailed in Sections 1.2.1.2.1, 1.2.1.2.2, and 1.2.1.3, this Section describes problems and data gaps from an analysis of the reports of the Previous Radiological Surveys and Remediation (presented in Section 1.2.1.1). These reports include the following specific problems:

- Details of radiological background data and levels of cleanup (i.e., the USDOE 5/15 cleanup standard - a maximum of 5 pCi/g of residual radioactivity in the first 15 cm of the soil and a maximum of 15 pCi/g below 15 cm) were not discussed.

- Confirmatory soil sampling results subsequent to the remedial actions to evaluate the remedial effectiveness was not presented.
- Documentation of the location of the specific areas of cleanup was not included or defined through civil survey.

Data gaps evident from the review of these reports include:

- No soil, groundwater, sediment, or surface water samples for radiological parameters were collected or analyzed.

1.3.3.1.2 Limited Chemical Characterization Data: The Limited Chemical Characterization investigation of the NFSS (NFSS-179) was extremely limited. Although several media was sampled, the quantity of sampling locations characterized by definitive analytical results is not sufficient for a complete characterization of the site. The analysis of the report of the Limited Chemical Characterization investigation (presented in Section 1.2.1.2.1) includes the following specific problems:

- Locations of the samples collected (with the exception of the monitoring well sampling) were not well defined or surveyed. Repeatability of this data is impossible.
- Screening techniques (i.e., the soil gas survey) were used to determine if VOC constituents were present across the site (with exception of the IWCS area where no samples were collected). The data generated by the soil gas survey is not definitive data.
- Limited analytes (i.e., methylene chloride, TCE, PCE, 1,2-dichloroethene [cis and trans], benzene, toluene) were investigated over the site using the soil gas survey. Samples for additional VOC constituents were not analyzed.
- Data for radiological and chemical background (other than the U.S. inorganic chemical background data for soils) was not reported, although it was used to make comparisons. The comparison of results with the U.S. background data for soils may not satisfy the potential Applicable, Relevant and Appropriate Requirements (ARARs) and Data Quality Objectives (DQOs) for the site.
- For samples that were analyzed by an analytical laboratory, the analytical methods, detection limits, reporting limits, and QA/QC documentation were either not completed or not reported.
- No indication of independent validation of the data was presented.

Data gaps at the completion of the Limited Chemical Characterization include:

- No soil samples for radiological parameters were collected or analyzed.

- Radiological investigation of the site-wide groundwater was not completed. Results for radiological parameters are provided only for the few wells surrounding the IWCS that are routinely sampled in the annual site monitoring report.
- The chemical analyses of samples from the 16 sampled wells for groundwater is not adequate to provide a complete discussion of the groundwater over the entire NFSS. None of the 16 monitoring wells were not located within the areas of the site where previous processes related to the TNT or boron manufacturing occurred.
- Information related to the chemical constituency of the soil was limited. Depths of samples ranged from 0.3 to 1.8 m (one to six ft) bgs. No surficial soil samples were collected
- Investigation of the ditches (a potential receptor or transport pathway) was limited. Three sampling locations are not adequate to provide a complete discussion of the sediments and surface water over the entire NFSS.
- No sampling was conducted in areas indicated on historical site documents as potential fuel oil and other UST locations. These include potential locations in the acidification area of the TNT manufacturing facility, the associated shop and support area, and the Building 401 area.
- Numerous sumps shown on historical site documents in the acidification area were not investigated.
- Not all areas of the NFSS have been addressed by radiological or chemical investigations.

1.3.3.1.3 Data Gap Investigation Data: The Data Gap investigation (NFSS-406) followed the Limited Chemical Characterization (NFSS-179) and was based on Bechtel National Incorporated's evaluation of that investigation. The Data Gap Investigation primarily investigated the VOCs identified in the Limited Chemical Characterization with a few additional soil, groundwater, sediment, and surface water samples for spacial distribution. An analysis of the report of the Data Gap Investigation (presented in Section 1.2.1.2.2) includes the following specific problems:

- Locations of the samples collected (with the exception of the monitoring wells) were not specifically defined or surveyed. Repeatability of this data is impossible.
- Limited analytes (i.e., TCE, PCE, 1,2-dichloroethene [cis and trans], and thallium) were investigated in the areas identified by the soil sampling from the limited chemical characterization (NFSS-179) (locations identified during the site using the soil gas survey). Soil samples for additional constituents (i.e., VOC, SVOC, metals, pesticides/PCBs, radiological parameters, or nitroaromatics) were not analyzed.
- For samples that were analyzed, QA documentation was either not completed or not reported.
- No indication of independent third party validation of the data was presented.

Data gaps at the completion of this investigation include:

- No soil, groundwater, sediment, or surface water samples for radiological parameters were collected or analyzed.
- The limited analyses in the soil samples did not definitively address the potential of additional volatile organic or metal contamination.

The data gaps identified for the Limited Chemical Characterization were not completely addressed by the Data Gap Investigation.

1.3.3.1.4 Lake Ontario Ordnance Works Remedial Investigation Data: The LOOW Remedial Investigation (which contained portions of the NFSS) was significantly more detailed than the previous investigations. Although several media was sampled, the number of sampling locations characterized by definitive laboratory analytical results is insufficient to make a complete characterization of the site using a risk assessment. An analysis of the report of the LOOW Remedial Investigation (presented in Section 1.2.1.3) includes the following specific problems:

- Locations of the samples collected were not well reported. Repeatability of this data is impossible.
- Screening techniques (i.e., the immunoassay for nitroaromatics, PAHs, and PCBs and the field gas chromatography for the VOCs) did not generate definitive data.
- Limited analytes (nitroaromatics, PAHs, PCBs, and VOCs) were investigated over the three major areas by screening techniques. Off site analytical laboratory (confirmatory) analysis was only performed on a few samples. The laboratory analyses for the constituents were not identical to those that were field screened (i.e., PAHs were not analyzed in the laboratory).
- Data for background was generated using three off-site area borings. And insufficient number of samples and depths were collected to be statistically valid.
- No indication of independent validation of the data was presented.

Data gaps at the completion of this investigation include:

- No soil, groundwater, sediment, or surface water samples for radiological parameters were collected or analyzed.
- The chemical analyses of the investigation is not adequate to provide a complete discussion of the characteristics over the entire NFSS.
- No sampling was conducted in areas indicated on historical site documents as potential fuel oil and other USTs. These include potential locations in the Building 401 area.

- A few of the numerous sumps shown on historical site documents in the acidification area were investigated. Additional investigation of this area is warranted due to the constituents found.
- Not all areas of the NFSS have been addressed by radiological or chemical investigations.

1.3.3.2 Background Data - Background data will be assessed and integrated in an addendum to the FSP during the Phase II activities. Data gaps requiring additional sampling during Phase II will be identified.

1.3.3.3 Soil Characterization - No radiological data comparable to potential ARARs was discovered for the soils at the site. Additionally, limited chemical information exists for soils over the majority of the site. Extremely limited amounts of data is known to be definitive. Due to the non-existent radiological and limited chemical information, data gaps exist for both surface and subsurface soil. Planned Phase I activities will address this data gap.

1.3.3.4 Groundwater Characterization - Limited radiological and chemical information exists for the groundwater. Extremely limited amounts of data is known to be definitive. Due to the limited radiological and chemical information, data gaps exist for the upper and lower water-bearing zones as well as the bedrock aquifer. Well locations require civil survey information. Planned Phase I activities will address this data gap.

1.3.3.5 Sediment Characterization - Limited radiological and chemical information exists for the sediments at the NFSS. Three locations currently undergo annual environmental monitoring. Due to the limited locations and limited available radiological and chemical, data gaps exist along the length of each of the ditches. Planned Phase I activities will address this data gap.

1.3.3.6 Surface Water Characterization - Limited radiological and chemical information exists for the surface water at the NFSS. Three locations currently undergo annual environmental monitoring. Due to the limited locations and limited available radiological and chemical, data gaps exist along the length of each of the ditches. Planned Phase I activities will address this data gap.

1.3.3.7 Well Search - Due to the lack of information contained in the Bechtel National Incorporated well canvasses (NFSS-054) a well search data gap has been identified. This well search should be conducted within a two-mile radius from the center of the site to identify potential receptors. This search should include: analyses of any New York State databases, a possible Department of Health assisted letter of information/reply strategy, and possibly a field follow-up “door-to-door” search. This data gap was identified due to the older information indicating several wells in the vicinity of the NFSS, and the follow-up door to door canvasses “missing” many of these wells. Wells near the NFSS should be properly closed or restricted to agricultural irrigation use only.

1.4 Sampling Approach and Strategy

No comprehensive, CERCLA-based characterization of chemical contamination has been performed at the NFSS. The approach must, therefore, combine the features of a Site Investigation (SI) and

a Remedial Investigation (RI) and must include both radiological and chemical analytes. (DQOs were introduced in Section 1.0 and are discussed in more detail in Section 3.2 and 3.3.)

Key elements of the strategy for development of a Plan to achieve project objectives through collection and analysis of samples at NFSS include:

- Use of a phased approach, with Phase I sampling and analysis scheduled to begin Nov 1, 1999 and completion of Phase II by August, 2000;
- Identification of eight Areas of Investigation, and the types of waste suspected at each.
- Preparation of a Preliminary Conceptual Model of the Site (See Figure 1.4-1.);
- Identification of potentially contaminated media:
 - Soils, including surficial soils and subsurface soils;
 - Groundwater, including upper (first) water-bearing zone; lower (second) water-bearing zone; and Bedrock Aquifer;
 - Sediments, in the on-site network of ditches, and;
 - Surface water, in the on-site network of ditches.
- Compilation of Preliminary ARARs.
- Evaluation of data from previous studies, integration of useful information, and identification of data gaps;
- Selection of analytes and corresponding test methods, to determine the presence or absence of CERCLA-regulated hazardous substances, including:
 - radiological parameters, consisting of total uranium, thorium, and radium, selected isotopes, and gross alpha and beta activity,
 - chemical parameters, including TCL organics, TAL and other metals, pesticides/PCBs, and/or nitroaromatics, and;
 - geotechnical parameters, used to characterize the site, classify soils, and assess contaminant mobility.
- Identification of sampling locations, including:
 - 69 exploratory boreholes, with collection of one surficial soil sample, a minimum of one subsurface soil sample, and one groundwater sample from the upper (first) water-bearing zone, at each borehole;

- Collection of one set of groundwater samples from each of 4 existing monitoring wells, already installed in the upper (first) water-bearing zone at representative locations surrounding the IWCS;
- Collection of one set of groundwater samples from each of 28 existing monitoring wells, already installed in the lower (second) water-bearing zone at representative locations within Areas of Investigation throughout NFSS;
- Collection of one set of groundwater samples from each of 5 monitoring wells, previously installed in the Bedrock Aquifer at representative locations at NFSS, and;
- Collection of one set of sediment samples and one set of surface water samples at each of 39 locations within the ditch network at NFSS.
- Specification of analytes for each sampling location, including:
 - Analysis of **all** soil, sediment, groundwater, and surface water samples for **all** radiological analytes cited above;
 - Analysis of 26 sets of surficial soil samples, 26 sets of subsurface soil samples, and 26 sets of upper (first) water-bearing zone groundwater samples for the “full suite” of analytes (briefly defined as TCL organics, TAL, and other metals, pesticides, PCBs, and nitroaromatics. The full suite is defined in detail in Tables 3-4 through 3-8 of the QAPP.) Remaining samples will be analyzed for selected analytes based on previous sampling results and/or the likelihood of their presence;
 - Analysis of 4 sets of upper (first) water-bearing zone groundwater samples for the full suite of chemical analytes.
 - Analysis of 10 sets of lower (second) water-bearing zone groundwater samples for the full suite of chemical analytes. Analytes for remaining sets have been selectively specified, based on the likelihood of their presence, and results of previous sampling events;
 - Analysis of two sets of Bedrock aquifer samples for the full suite of chemical analytes. The analytes for the other three sets have been specified based on the likelihood of their presence, and;
 - Analysis of 20 sets of sediment samples and 20 sets of surface water samples, collected from ditches, for the full suite of chemical analytes. Analytes for remaining sets have been selected based on the likelihood of their presence.
- Selection and application of analytical Methods to achieve comparison of analytical results to potential ARARS;

- Preparation of a data base in Microstation GIS format to tabulate data, map contaminant concentrations, and compare results with potential ARARs, and;
- Use of Phase I results to design the Phase II activities, as an Addendum to this FSP.

In the following Sections, an explanation of the rationale supporting development of the FSP for the NFSS is provided.

1.4.1 Rationale for Phased Approach

A two-phased approach to development of a data base which will support a CERCLA-based remedial investigation and risk assessment at the NFSS has been developed. In Phase I, to be implemented during the Fall of 1999, sampling and analysis in accordance with SW-846, ASTM, and other definitive methods to develop data in support of project objectives specified in the TPP meeting conducted in June 1999 will be performed. Phase I is designed to further characterize the geology and hydrogeology of the site, and assess the presence or absence of radiological and chemical contaminants considered potentially present at NFSS. Approximately one-half of the resources planned for the remedial investigation field activities will be expended through the implementation of Phase I.

Phase I results will be used in conjunction with further evaluation of data generated during previous studies at the site, statistical analysis of background levels defined in previous studies at neighboring properties, and refinement of proposed ARARs, to identify supplementary sampling and analysis requirements for Phase II. Phase II will be designed and defined (in an Addendum to this FSP) to fill data gaps, further characterize background levels (as necessary), assess areal and vertical extent of contamination (if found), further evaluate additional radiological contaminants potentially present, and ensure proper spatial distribution of sampling locations to satisfy risk assessment requirements. This second phase of the RI is scheduled for completion in August, 2000.

1.4.2 Preliminary Conceptual Model of the NFSS

A preliminary conceptual model of the site is presented in Figure 1.4-1. The model illustrates the interrelationships between potentially contaminated environmental media, migration pathways, and potential receptors at NFSS and its surroundings. It provides a basis for determination of media to be characterized, sampling locations and depths, and the relationships of sampling locations to migration pathways and potential receptors.

1.4.3 Selection of Areas of Investigation, and Types of Wastes Potentially Present

Based on a detailed records review, evaluation of the history of industrial processes and waste generation, storage, treatment and disposal practices at NFSS, results of TPP meetings sponsored by USACE, analysis of aerial photography and historical site drawings, walk-over site surveys, results of previous sampling and analysis, and available documentation of previous site cleanup activities, eight Areas of Investigation at the NFSS have been delineated. The Areas of Investigation are identified in Table 1.4-1. They are described in detail in Section 4.1 of this FSP. Sampling and

analysis will be performed in order to evaluate potential presence or absence of chemical and radiological contamination within each of these eight areas.

The types of waste suspected to be present at each Area of Investigation are also identified in Section 4.1 of this FSP. Residual radioactive wastes are considered to be potentially present within all eight of the Areas of Investigation. Chemical wastes potentially present at individual Areas of Investigation may include solid and liquid fuels such as coal and diesel fuel, heating and lubricating oils, solvents, degreasing agents, transformer fluids, boiler additives, pesticides, acids and residues related to production of explosives, residues related to incineration of products, by-products, or wastes streams, metal processing wastes, wastes disposed in an on-site scrap yard, and wastes which may have migrated from off-site sources such as neighboring landfills.

The sampling strategy is based in part on the premise that wastes previously stored, treated, or disposed on NFSS property could be present at any of the Areas of Investigation on the property. Previous remediation involving earthmoving, re-grading, and burial has occurred, and remaining waste residues may have been relocated. In addition, contaminant migration, (e.g., transport of contaminated soils into ditches through stormwater runoff) may have resulted in movement of wastes from their point of origin to other locations.

1.4.4 Sample Media, Locations, and Depths

The rationale for collection of samples in various media, at various depths and locations, is described in the following sections.

1.4.4.1 Surficial Soils - Comprehensive radiological characterization and evaluation of selected chemical and geotechnical parameters will be performed. Surficial soils will be the focus of assessment of risks associated with potential exposures routes such as inhalation and skin contact by site workers, visitors, and ecological receptors, potential migration of contaminants potentially present to surface waters, sediments, subsurface soils, and groundwater, and uptake of contaminants by on-site vegetation.

The surficial sample will be collected from the interval 0 to 6 inches (0 to 15 cm) below the surface. Detritus, vegetative matter, and debris will be removed from the sample.

Surficial soils, (as well as subsurface soils, and upper-water bearing zone groundwater, as explained below) will be sampled at 69 locations. Approximately 60 of these samples are “purposeful” or “biased” locations, selected because they are located within or adjacent to known or suspected sources of contamination, “hot-spots” identified through previous sampling, and/or areas where soil removal/remediation has occurred. The remaining borehole locations have been chosen at random, in order to ensure spatial representation throughout the site.

The specific location of each borehole will be chosen based on its location with respect to potential sources such as tanks, piping, sewers, and/or ditches. In absence of these site features, locations will be chosen based on the results of a gamma survey of a 100 square meter area surrounding each borehole location.

1.4.4.2 Subsurface Soils - Each of the 69 boreholes will be advanced from the surface to the interface of the soil with the first water-bearing zone encountered. Each borehole will be logged continuously, and potential evidence of contamination, (e.g olfactory, staining, elevated organic vapors, discoloration, elevated gamma readings, or presence of wastes) will be noted. Each borehole will be terminated after the water-bearing zone is explored and presence of the confining layer immediately below is verified, in order to avoid cross-contamination with lower aquifers. Subsurface soil samples will be collected at the soil/groundwater interface. At the discretion of the Site Manager, additional samples will be collected at one or more depths which exhibit evidence of contamination such as the criteria listed earlier in this paragraph. Subsurface soil samples will be collected in order to evaluate health risks associated with exposure routes such as site construction worker inhalation or skin absorption, and contamination of groundwater supplies.

1.4.4.3 Groundwater - Three distinct water-bearing zones will be sampled during Phase I, as described below.

1.4.4.3.1 Upper (First) Water-bearing Zone: In each of the 69 exploratory boreholes, a temporary well point will be installed. Sampling for radiological and selected chemical contaminants will be performed in order to evaluate presence or absence of contamination in the Brown Clay Unit, which contains the first water-bearing zone. With the exception of the IWCS Area of Investigation, no sampling and analysis from monitoring wells installed in this aquifer has previously been performed at the NFSS. The upper water-bearing zone reportedly contains contaminants transferred from soil to groundwater through infiltration of precipitation. In turn, this water-bearing zone may seep into on-site drainage ditches. Water within the upper water-bearing zone may also migrate to (or from) neighboring properties, and this will be evaluated.

Additionally, one set of groundwater samples for radiological and selected chemical contaminants in each of 4 existing groundwater monitoring wells present in the vicinity of the IWCS. No known full-suite chemical characterization has been performed on these wells.

1.4.4.3.2 Lower (Second) Water-bearing Zone: Potential presence or absence of radiological and selected chemical contaminants in the lower (second) water-bearing zone (sand and gravel layer) will be evaluated. One set of groundwater samples for radiological and selected chemical contaminants in each of 28 existing groundwater monitoring wells present throughout the NFSS will be collected. One or more groundwater wells is present in each of the eight Areas of Investigation (except the ditches). No known radiological characterization of groundwater in these wells has been performed. Chemical characterization of groundwater in six of these wells occurred in 1990. (Results are discussed in Section 1.2.) No known chemical characterization has been performed on the remaining 22 wells.

As is described in Section 1.1, a layer of gray clay separates the upper and lower water-bearing zones. Based on its characteristics, this layer acts as an aquitard. Whether it separates the two units hydrologically under all conditions is not known and must be investigated in the RI. The initial assumption is that the lower water-bearing zone may be interconnected with the first, upper water-bearing zone. If contamination is present in the upper water bearing zone, cross-contamination may occur. The lower water-bearing zone may also be subject to migration of surficial or sub-surface soil contaminants through infiltration of precipitation, and may potentially discharge to surface ditches

on the property. Conversely, contaminants in surface water or sediment may migrate into the first or second water bearing zones. Contaminants in this medium may migrate off-site and result in exposures to humans or other biological receptors.

Groundwater elevations will be measured in all existing monitoring wells to assess the direction of groundwater movement.

1.4.4.3.3 Groundwater (Bedrock Aquifer): Migration of contaminants potentially present in soil and groundwater in the Brown Clay Unit, Gray Clay Unit, Sand and Gravel Layer, and/or Red Silt Layer to the Bedrock Aquifer (Queenston Formation) is considered unlikely, but will be evaluated. The Gray Clay Unit is considered to be a continuous and confining layer, based on previous documentation. The Red Silt Unit is considered to be a discontinuous, confining layer. Groundwater contamination (including radiological and selected chemical contaminants) will be evaluated through collection of one sample in each of five existing groundwater monitoring wells in the Bedrock Aquifer. These are the only wells presently installed in this formation. They will be further used to assess the direction of groundwater flow within this aquifer through measurement of groundwater elevations.

Presence of groundwater contamination in the Bedrock Aquifer will be evaluated due to its potential to migrate off-site and contaminate off-site groundwater resources.

1.4.4.4 Surface Water and Sediments. - Potential presence or absence of radiological and selected chemical contaminants will be evaluated through collection of co-located surface water and sediment samples at 39 locations throughout the existing network of ditches on the NFSS. Limited radiological and extremely limited chemical sampling has previously been conducted at three ditch locations at the NFSS.

Phase I sampling locations have been strategically selected to evaluate potential presence or absence of radiological and selected chemical contaminants related to a variety of potential contaminant sources on site, such as former waste storage, burial, and incineration locations. Sampling locations have also been selected to assess on-site and off-site migration of contaminants in surface water and sediments.

1.4.5 Selection of Analytes

The analytes chosen for inclusion in the Phase I evaluation are a wide variety of CERCLA-regulated hazardous substances. They have been selected for inclusion in Phase I based on results of previous sampling/analysis, because it is considered likely that they have been and/or may still be present at the site, or to confirm their absence at representative locations.

Analytical results will be evaluated in terms of potential ARARs. At the TPP meeting, NYSDEC Technical and Administrative Guidance Memoranda (TAGMs) and USEPA Region IX Risk-Based Screening Levels (RBSLs) were specifically identified as the basis for potential ARARs recommended for evaluation in the project. USEPA Drinking Water Standards, USEPA Ecological Surface Water Screening Values, and USDOE Ecological Preliminary Remediation Goals (PRGs) are also believed to be of primary importance in selection and evaluation of analytical results. A

preliminary compilation of potential ARARs is presented in Appendix D of the QAPP. At this stage of the project, ARARs are considered to be potentially applicable, and will be further evaluated and negotiated before they are finalized.

1.4.5.1 Radiological Parameters - Due to the historical and current use of NFSS as a radioactive waste repository, radiological parameters require thorough site-wide evaluation. Results will be used to identify presence of radiological contamination which may require remediation, or to verify that previous cleanups have achieved on-site compliance with CERCLA requirements. Total uranium, U-235, U-238, radium-226, and thorium-230 were present in high-grade uranium ores and residues sent to the NFSS for disposal. Uranium, thorium, and radium are responsible for most of the radioactivity currently present in the IWCS, and potentially present at other portions of the NFSS if cleanup was not complete. Gross alpha and beta radiation are specifically included in potential groundwater ARARs, and are considered “indicator parameters” in soil. Combined with results of downhole gamma monitoring, gamma walkover survey results in the 100 square meter area surrounding each prospective borehole, and results of analysis for uranium, thorium, and radium, these indicator parameters may provide evidence of the presence of other radioactive isotopes not currently included in the Phase I FSP.

All samples collected in Phase I activities will undergo all the radiological analyses identified above. Whether or not radiological analyses providing for further direct speciation is warranted will be evaluated based on Phase I results.

1.4.5.2. Chemical Parameters - Several analytical groups have been included in the Phase I Remedial Investigation, in order to comprehensively evaluate the presence or absence of specific chemical contaminants. These analytical groups have been specified to identify contaminants potentially present in waste streams known to be present at the site in the past, to further evaluate chemicals previously identified as present through sampling programs, or to confirm absence of chemicals not identified through previous site screening analyses.

Analytical groups to be included in Phase I include TCL organics (including volatile and semi-volatile organics, potentially present in solvents, degreasing agents, oils, fuels, and incineration residues); TAL metals, plus boron and lithium (potentially present in metal processing wastes, uranium ore residues, boiler additives, and products or by-products previously generated at the site); nitroaromatics (related to former production of trinitrotoluene while the site was part of the former Lake Ontario Ordnance Works); PCBs (potentially present in transformer fluids, hydraulic fluids, and other wastes shipped to the site for disposal); and pesticides (formerly used and/or disposed at NFSS).

Cation exchange capacity and Total Organic Carbon (TOC) will be evaluated in soil to assess contaminant mobility. TOC is integral to calculation of levels supplied in the NYSDEC TAGM.

Dissolved metal contaminants will be evaluated in addition to total metals in groundwater and surface water to distinguish between total and dissolved metals, and to provide supplementary information for risk assessment.

1.4.5.3 Geotechnical Parameters - Particle size analyses, Unified Soil Classification analyses, moisture content, Atterberg Limits, and soil density will be included in analysis of soils and sediments to assess contaminant mobility, aid in classification of soils, and provide information potentially useful to assess remedial alternatives.

Not all chemical and geotechnical parameters will be evaluated in all soil samples. Not all chemical parameters will be evaluated in all surface water and groundwater samples. The selection of chemical and geotechnical analytes is further described below and is specified for each sample in Section 4. A technical memorandum will be prepared and submitted separately and will provide the rationale for selection of each analytical parameter in each sample.

1.4.6. Rationale for Selection of Sampling Locations and Analytes at Each Location

Within each Area of Investigation, sampling of surficial and subsurface soils, groundwater, surface water, and sediments has been planned in order to achieve, to the extent practical, detection of contaminants potentially present, or to verify absence of contamination. Sample locations have been selected to evaluate potential hot spots, further investigate contamination detected in previous studies, verify that CERCLA-required cleanup levels have been achieved, evaluate migration at Area of Investigation or property boundaries, assess vertical extent of contamination, ensure a statistically defensible number of samples per Area of Investigation, and assess potential exposures through a variety of exposure routes.

Health risks associated with radiological contaminants present in the IWCS and potentially present at other locations at the NFSS are a primary focus of this Phase I RI. For this reason, radiological characterization in all soil, surface water, groundwater, and sediment sampling locations will be included.

Chemical characterization will be performed to complete a comprehensive “full suite” list of analytes at several selectively-chosen, representative locations within each Area of Investigation. At the remaining locations, analytes considered unlikely to be present have been eliminated. For example, pesticides, PCBs, and nitroaromatics are not included for analysis in all samples in Areas of Investigation where they were not known to be used, stored, or disposed. Conversely, metals and semivolatile organics are considered likely to be present in most Areas of Investigations and have been included in the majority of soil and groundwater samples scheduled for collection.

At each sampling location, the Site Manager, with the concurrence of the USACE oversight representative, will specify additional chemical analytes not previously planned, if in his professional judgment they are warranted through site history and observation of potential evidence of contamination, such as odors, stains, elevated gamma or organic vapor measurements, or observation of contamination.

1.4.6.1 Exploratory Boreholes/Temporary Well Points - Full suite analyses have been recommended for surficial soil, subsurface soil, and upper water-bearing zone groundwater sample sets to be collected at approximately 25 of 69 exploratory borehole locations and 4 sets of samples to be collected from existing upper water-bearing zone monitoring wells surrounding the IWCS. The remaining samples will be analyzed for a sub-set of the full suite.

1.4.6.2 Lower (Second) Water-bearing Zone - Full suite analyses are recommended for 10 of the 28 sets of samples to be collected from existing lower water-bearing zone monitoring wells. At the majority of the remaining wells, samples for nitroaromatics and PCBs/pesticides have been excluded because these contaminants are considered unlikely to have migrated from the surface through a confining layer to this depth.

1.4.6.3 Bedrock Aquifer - Full suite analyses are recommended for two of the five existing monitoring wells in the Bedrock Aquifer. Nitroaromatics and PCBs/pesticides have been excluded from inclusion for analysis in the other three sample sets, because of the unlikelihood they have migrated to this depth.

1.4.6.4 Surface Water and Sediments - Full suite analyses are included in approximately 20 surface water samples and 20 sediment samples. Locations chosen for full suite analysis were chosen to evaluate off-site or on-site migration, because of their proximity to known sources of contamination, to evaluate presence of contamination within each Area of Investigation or at Area of Investigation boundaries, or to ensure spatial distribution throughout the NFSS.

1.4.6.5 Summary of Rationale - For each of the eight Areas of Investigation, the relationships between the media to be sampled, sampling locations, and TPP objectives are summarized in Table 1.4-1.

1.4.7. Selection of Analytical Methods

Analytical methods have been selected in order to achieve the following objectives:

1.4.7.1. Definitive Data - Where possible, use of SW-846 or equivalent methods have been specified. Radiological analyses of Isotopic Uranium (U234,235,238) by HASL 300/Alpha Spectroscopy; Isotopic thorium (Th228,230,232) by HASL 300/Alpha spectroscopy; Radium 226 by HASL 300/Gamma spectroscopy; Total Uranium by ASTM D5174; Gross Alpha/Beta by EPA 900 for soil samples and Isotopic Uranium (U234,235,238) by HASL 300/Alpha Spectroscopy; Isotopic Thorium (Th228,230,232) by HASL 300/Alpha Spectroscopy; Radium 226 by 903.1 Mod., Radon Emanation; Total Uranium by ASTM D5174; and Gross Alpha/Beta by EPA 900 for water samples have been specified. Wherever applicable, all analyses will be performed by a laboratory validated by the USACE to perform the applicable method. These methods will provide definitive data, to be validated by an independent third party, and will be suitable for use in a CERCLA-based risk assessment.

1.4.7.2. Comparability to ARARs - Potential ARARs have been compiled and corresponding method detection limits and reporting limits for analytes have been tabulated in Appendix D of the QAPP. Methods have been selected which provide, to the extent practical, the ability to compare site data with potential ARARs.

1.4.7.3 Evaluation of Spatial Representativeness of Data - Using the definitions in SW846, the proposed sampling strategy for Phase I is a combination of Authoritative Sampling (i.e., locating samples in areas where we suspect contamination) and Random Sampling (i.e., random sample locations within the site boundary to fill spatial distributions). In accordance with SW846 Chapter

9, the concentrations of the analytes and spacial distribution of sampling points are needed to estimate a potential grid spacing.

The NFSS site is not represented by a single “population” of constituents. From Section 4.1, eight Areas of Investigation have been identified and each could be assumed to its own “population”. Each area may require different numbers of samples to achieve estimates at similar levels of confidence.

Preliminary estimates of the analyte sample mean and variation will be derived from the data generated from the samples to be collected in Phase I of the RI and will be augmented by the existing data. These estimates will be used to back-calculate the appropriate number of samples to be collected from each area of concern using SW846 methodology. These estimates will be used to guide the subsequent phases of the remedial investigation.

1.4.7.4 Risk Assessment Considerations - In general, many sites are assessed by source area. The NFSS was assessed by source area while also considering risk assessment issues. The site is expected to be classified as industrial land use only, as is the surrounding area. The site was divided into eight Areas of Investigation, or exposure areas. Sample locations selected within those areas are based on potential sources, migration pathways, and sinks for contaminants. Based on existing information, approximately 69 soil/groundwater and 39 sediment/surface water sample locations are proposed as an initial Phase I assessment. After collection, the data will be screened using potential ARARs to identify data gaps. In areas where more information is needed, additional samples will be collected to fill data gaps. This screening of Phase I data and the resulting data tables, maps, technical memoranda, or presentations will facilitate the Phase II investigation, risk assessment, and better management decisions. Without this screening step between the sampling phases, data gaps would not be identified until after the risk assessment is complete.

SECTION 2

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Maxim has overall responsibility for all phases of the RI at the NFSS. Maxim will prepare project work plans, direct field investigations and provide project management and quality assurance functions. Maxim's qualifications include performance of site investigations, remedial investigations, feasibility studies and/or risk assessments at more than 100 DOD sites and/or USDOE sites. Maxim also assisted USEPA's Office of Radiation Programs in development of standards for radioactive waste disposal for the USEPA.

Science Applications International Corporation (SAIC), a subcontractor to Maxim, has previously performed work at the NFSS and will support the Maxim team by providing knowledge gained through that work and work conducted at similar FUSRAP sites. SAIC will also provide health physics, field radiation safety support, and other radiation-related technical support to Maxim. Resumes of key Maxim and SAIC personnel are included in Appendix A of the QAPP.

General Engineering Laboratories (GEL) will provide analytical services for this project. GEL has performed analyses for chemical and radioactive parameters for samples collected at numerous DOD, USDOE and FUSRAP sites investigated by Buffalo District USACE. GEL is currently certified by the USACE for all parameters under Routine Analytical Services (RAS) anticipated for this project. In addition they are currently undergoing certification for nitroaromatics. They are also licensed to accept and analyze radioactive materials. Copies of personnel summaries, including resumes for key laboratory personnel have been provided by GEL and are presented in Appendix B of the QAPP. Copies of the Laboratory Quality Assurance Plan for GEL are presented in Appendix C of the QAPP.

The quality control and management responsibilities of key personnel for this project are defined in subsequent paragraphs of this section. A QA/QC Organizational Chart is shown on Figure 2-1. Key project personnel are identified below. A summary of qualifications of key personnel is presented in Table 2-1.

2.1 U.S. Army Corps of Engineers Project Representatives

Dr. Judith Leithner, Ph.D. is the USACE Project Manager for this project. She has responsibility for technical project direction, review and approval of contractor work plans and reports, allocation of overall project resources, tracking and management of the overall project schedule and budget, and management of contractor oversight by other USACE staff. In case of any problems, Dr. Leithner can be contacted at 716-879-4234 (e-mail address: Judith.S.Leithner@USACE.army.mil). Requests from any third parties for project information should be addressed to Dr. Leithner at the following address:

Dr. Judith Leithner, CELRB-PE-EE
U. S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207-3199

Mr. Dennis Rimer will be the USACE Site Superintendent. The USACE Site Superintendent will oversee field activities for the USACE, and will have the authority to approve all field decisions exclusive of those that require a scope change or commitment of additional resources. In those instances, the decision must be approved by Dr. Leithner and the Lakes and Rivers Buffalo (LRB) Contracting Officer, Mrs. Mary Price.

2.2 Project Principal

Mr. Max Gricevich, M.S., is Maxim's Project Principal. He is Manager of Maxim's St. Louis office. Mr. Gricevich possesses over 26 years of environmental experience with scientific and engineering projects ranging from initial site planning and contamination surveys through remedial investigations (RIs), feasibility studies, and hazardous waste clean-up supervision. Past investigative, engineering and management experience has been obtained at numerous active and inactive DOD and USDOE sites.

The responsibilities of the Project Principal will include:

- Signatory authority and power to commit company resources to the overall execution of the contract;
- Allocate manpower and other resources to the project;
- Review subcontract agreements;
- Interface with subcontractors on the administrative level;
- Communicate directly with the USACE Manager for both routine support and for problem solving if problems cannot be resolved through normal channels;
- Develop solutions to problems of particular difficulty;
- Provide senior-level technical, administrative and logistical support to Maxim's Project Manager as needed;
- Provide quality assurance audits of all aspects of the project; and
- Review and approve project plans and reports prior to submittal.

2.3 Contractor Program Manager/Project Manager

Mr. Thomas Lachajczyk, M.S., is Maxim's USACE Buffalo District Program Manager. Mr. Lachajczyk has over 25 years experience in environmental science, project management and program management. He has extensive experience with CERCLA and Resource Conservation and Recovery Act (RCRA) processes and regulatory agencies. His experience includes Program/Project Management involving more than 100 DOD sites, development of sampling plans for USDOE sites, and radioactive waste characterization, pollutant migration modeling, and cost/risk assessment in

support of USEPA's Office of Radiation Program's development of standards for disposal of radioactive waste.

Mr. Lachajczyk has overall responsibility for ensuring that the project meets USACE's project objectives and Maxim's quality standards. In addition, as Project Manager for this Delivery Order, he is responsible for technical quality control and project oversight, and will provide the Site Manager with access to corporate management.

Mr. Lachajczyk is responsible for implementing the project and has the authority to commit the resources necessary to meet project objectives and requirements. The Project Manager's primary function is to ensure that technical, financial, and scheduling objectives are achieved successfully. The Project Manager will report directly to the USACE Project Manager and will provide the major point of contact and control for matters concerning the project. The Project Manager will:

- Define project objectives and develop a detailed work plan schedule;
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;
- Acquire and apply technical and corporate resources as needed to ensure performance within budget and schedule constraints;
- Orient all field leaders and support staff concerning the project's special considerations;
- Monitor and direct the field leaders;
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;
- Review the work performed on each task to ensure quality, responsiveness, and timeliness;
- Review and analyze overall task performance with respect to planned requirements and authorizations;
- Approve all external reports (deliverables) before their submission;
- Ultimately responsible for the preparation and quality of interim and final reports;
- Represent the project team at progress meetings;
- Develop solutions to problems of particular difficulty;
- Communicate with the USACE's Project Manager;
- Coordinate with federal and state agencies, following approval from the USACE Project Manager, concerning scheduled activities and regulatory criteria;

- Maintain daily contact with Site Manager during field operations;
- Notify USACE concerning the status of the project schedule;
- Resolve problems, interpret the Scope of Work, submit monthly schedule changes, progress reports, and pertinent written and telephonic communications;
- Develop subcontract agreements;
- Communicate with USACE concerning modifications to the delivery order; and
- Supervise preparation of the engineering report of results and the presentation of results to the USACE.

2.4 Independent Technical Review (ITR) Committee

Independent reviews of all plans, designs, reports, analytical data, surveys and assessments has been completed by the following personnel, based on their areas of expertise:

- **Mr. Dennis Herzing, M.S., Professional Engineer (P.E.)** - Mr. Herzing is a civil/environmental engineer and has more than 25 years of experience in RI/FS, records of decision, landfill design, industrial and municipal wastewater treatment systems and closure of RCRA hazardous waste storage facilities. He is responsible for reviewing all plans, designs, reports, surveys, and assessments.
- **Mr. Clyde Yancey, M.S., Professional Geologist (P.G.)** - Mr. Yancey has more than 20 years of environmental experience of the CERCLA process at Uranium Mill Tailings Remedial Action (UMTRA) and USDOE sites. He is responsible for reviewing all plans, designs, reports, surveys, and assessments.
- **Dr. Robert Tucker (SAIC), Ph.D., P.G., Senior Geologist** - Dr. Tucker has over 25 years of experience in hydrogeologic investigations and the CERCLA/RCRA process at DOD, USDOE and FUSRAP sites. His experience varies from development of project work plans and reports for hydrogeologic investigations to performing cost evaluations for proposed remedial actions. He is responsible for reviewing all health and safety and field-related documents.
- **Mr. Steve L. McBride, B.S. (SAIC), Chemistry** - Mr. McBride possesses over 13 years of experience in the analytical QA/QC. He is experienced in laboratory operations, data validation, method development and development of Quality Assurance Project Plans at FUSRAP and other USDOE sites. He is responsible for reviewing all documents related to analytical and radiological quality control such as the QAPP, data reports, RI report, and all chemical and radiological surveys.

- **Mr. Steve Passig (SAIC), Certified Health Physicist (CHP)** - Mr. Passig possesses 13 years of experience in all aspects of radiation health and safety for a number of radiological industries. He is experienced in radiation surveys and worker protection, development of Radiation Safety Plans and evaluation of radio-chemical data for the protection of human health and the environment. Mr. Passig is responsible for reviewing all documents associated with on-site radiation health and safety and assessments of human and ecological exposure to radiological contamination at the NFSS.
- **Mr. William Borden (CH2M Hill), Certified Health Physicist (CHP)** - Mr. Borden has more than 30 years professional experience including two years of experience involving management of radioactive wastes at the NFSS. Mr. Borden has provided independent technical review comments related to the FSP.

Each ITR committee member's responsibilities include:

- Review documents pertinent to their expertise as described above;
- Provide written comments and required actions to Maxim concerning technical adequacy, accuracy, feasibility, as well as omissions, inconsistencies, typographical and grammatical errors and other corrections requiring revisions;
- Review responses to comments and all action taken in response to comments;
- Resolve any outstanding differences; and
- Document independent review and resolution of all comments using a Review Certification Sheet (shown at the front of this document).

Each Independent Technical Reviewer will have no participation in the preparation of documents prior to his review.

2.5 Principal Engineer

Mr. David Germeroth, P.E., is the Principal Engineer. He will provide engineering expertise and review, approve and apply his Professional Engineer's seal to pertinent design documents as necessary. Mr. Germeroth possesses over ten years experience performing geotechnical testing, construction oversight, health and safety evaluation, remedial investigations, remedial design and site investigations. Mr. Germeroth has extensive experience at FUSRAP and former USDOE sites.

2.6 SAIC Senior Technical Consultant

Mr. Michael Giordano, P.E., Certified Hazardous Materials Manager (CHMM), is Senior Technical Consultant for SAIC participation in this project. The Alternate Senior Technical Consultant is Mr. George Butterworth, M.S. Mr. Giordano and Mr. Butterworth each have more than 20 years of experience in remedial investigations, feasibility studies and remedial design at USDOE and FUSRAP sites. For nine years, Mr. Giordano has provided technical and program oversight and

management for USDOE, FUSRAP and DOD projects. Mr. Butterworth has extensive expertise in environmental management, engineering oversight and health and safety at FUSRAP sites in New York State and active USDOE sites throughout the U.S. Each of these individuals is familiar with the NFSS and SAIC's previous work at the site. Their responsibilities include:

- Coordinate with Maxim's Project Principal and Program Manager to administer SAICs efforts;
- Attend Technical Planning Process Meetings;
- Ensure that all required resources to be provided by SAIC are available on an as needed basis;
- Participate in preparation and technical review of plans and reports;
- Participate in development of strategy and approach to achieve project objectives;
- Provide site-specific continuity based on previous and programmatic experience at NFSS and other FUSRAP projects;
- Coordinate the development of the Radiation Protection Plan by SAIC personnel;
- Communicate problems anticipated and/or encountered during activities performed by SAIC to the Maxim Project Manager.

2.7 Risk Assessor

Brian Mulhearn is the Risk Assessor for this project. The Risk Assessor will be supported by the Project Manager, Program Manager, Principal Engineer, Site Manager, SAIC, and other involved parties. Mr. Mulhearn has a B.S. in Toxicology and more than nine years of experience in the field, with experience ranging from human to ecological and aquatic toxicology. He developed and performed marine and freshwater bioaccumulation assays, including radioisotopic analysis at the U.S. Army Corps of Engineers Waterways Experiment Station. Mr. Mulhearn's experience includes developing CERCLA and non-CERCLA risk assessments at federal and private facilities.

Mr. Mulhearn will:

- Participate in compilation of site data, Applicable or Relevant and Appropriate Requirements (ARARs), toxicological data, and cleanup-goals;
- Compare the potential ARARs to analytical reporting limits for each parameter.
- Aid in the evaluation of the usability of old and recently generated data for use in a risk assessment;
- Coordinate SAIC's assessment and review of risks estimated for radioisotopes.

- Develop the baseline human health and ecological risk assessment for the site;
- Review documents from a risk assessment perspective;
- Identify data gaps and assist in the preparation of sampling strategies for Phase II and
- Provide input during scoping and planning sessions.

2.8 Project Industrial Hygienist

Ms. Yvonne Freix, Certified Industrial Hygienist (CIH), will review and approve the Site Safety and Health Plan and supervise its implementation. She will determine the need for any upgrades or downgrades in levels of protection required for non-radiological contaminants and will perform an on-site audit of compliance with Health and Safety Plan requirements and an evaluation of their adequacy. Ms. Freix possesses over 12 years of professional experience as a CIH. She has strong knowledge of current industrial hygiene and safety regulations and extensive knowledge in interpreting sampling data, results and compliance with regulatory and advisory standards. Ms. Freix has supervised the development of Site Safety and Health Plans for numerous DOD sites.

2.9 Radiation Safety Officer(s)

Mr. Paul Smith, CHMM, is Maxim's Radiation Safety Officer (RSO) and will administer Maxim's in-house radiation safety and monitoring programs and will interface with the radiation safety officers at USACE. Mr. Smith possesses 12 years of experience in chemical and radiological analysis, documentation, validation and analytical project management. For the past seven years, Mr. Smith has been a representative of Maxim's Radiation Safety Committee and is currently Maxim-St. Louis's RSO. Mr. Smith will be supported by subcontractor personnel as described below.

RSOs will monitor all locations and field activities for the presence of radioactive contamination. Mr. Douglas Haas of SAIC will be the RSO for field investigations. (The Radiation Safety Plan is presented in the SSHP.) Others may assist Mr. Haas when more than one field radiation safety officer is required. Mr. Haas is a Registered Radiological Protection Technologist with experience in radiation safety, radiation control and sampling at numerous USDOE and FUSRAP sites. The following tasks are the responsibility of the field RSO:

- Interface with the radiation safety officers at USACE;
- Coordinate all activities with Maxim's RSO, Mr. Paul Smith;
- Conduct on-site training in radiation safety and radiation protection;
- Perform radiation level surveys of work areas;

- Monitor field activities and equipment related to field activities for the presence of radioactive contamination;
- Evaluate potential radioactive hazards and establish restricted areas if necessary;
- Coordinate with the Site Manager and Health and Safety Officer for implementation of the Site Safety and Health Plan (SSHP); and
- Direct the preparation and shipment of radioactive materials as required.

2.10 Site Safety and Health Officer

Mr. Gregory Dawdy is the Site Safety and Health Officer (SSHO). Mr. Dawdy has over 15 years of experience in all aspects of health and safety associated with the performance of site investigations, RIs, compliance monitoring, and installation of groundwater remediation systems at CERCLA and RCRA sites. Mr. Dawdy has extensive experience in sampling and reconnaissance activities at USDOE and FUSRAP sites.

Depending on the task requirements, an alternate SSHO may be designated SSHO for a given task. The responsibilities of the SSHO include:

- Interface with the Site Safety and Health Officer at the USACE;
- Preparation and implementation of the SSHP;
- Assurance that all required safety equipment is available on-site;
- Coordination with both Maxim and SAIC Radiation Safety Officers and the project Industrial Hygienist for implementation of the SSHP and the Radiation Safety Plan;
- Enforcement of use of proper safety equipment and implementation of other plan requirements on-site by employees and subcontractors and assurance that personal protective equipment is available for authorized government or other authorized official visitors;
- Review of equipment requirements and procedures based on new information gathered during site inspection;
- Modification (upgrading or downgrading) of levels of personnel protection based on site observations after consultation with the CIH and/or RSO;
- Determination and posting of locations of medical facilities, telephone numbers of emergency resources (police, fire, ambulance), and arranging emergency transportation to medical facilities (as required);
- Observation of work-party members for symptoms of exposure or stress;

- Arrangement for availability of on-site emergency medical care and first aid (as necessary);
- Preparation of accident or incident reports and submittal to the USACE;
- Coordination of specialized training, pre-investigation health and safety briefing, daily morning safety meetings, and post-investigation health and safety briefing;
- Implementation of on-site continuous monitoring for exposure to airborne contaminants. This also includes continuous monitoring of sampling activities for hazardous conditions;
- Collection of personal monitoring air samples, if necessary;
- Reference of all questions from the news media to the USACE Project Manager, Mr. Judith Leithner at telephone number (716) 879-4234, U.S. Corps of Engineers, Buffalo, New York;
- Assistance to the Site Manager for preparation and shipment of samples in accordance with shipping regulations;
- Supervision of safety aspects of subsurface exploration;
- Designation of Site Manager as SSHO to administer duties identified above in case of unavoidable absence from site;
- Preparation and shipment of equipment including preservatives in accordance with Department of Transportation regulations; and
- Implementation of a utility check and metal detector search prior to the initiation of sampling activities to clear subsurface exploration sites prior to initiation of drilling.

The SSHO has ultimate responsibility to cease any operations not in compliance with the approved policy or which could otherwise threaten the health or safety of on-site personnel or the general public, or which may cause significant adverse impact on the environment.

2.11 Site Manager

The Project Manager will be supported by the field team managers (Site Manager and SSHO). The Site Manager is responsible for leading and coordinating the day-to-day activities of the various resource specialists under his supervision. The Site Manager is an experienced environmental professional and will report directly to the Project Manager. Mr. Timothy Biggs, M.S., P.G., will be Maxim's Site Manager. Mr. Biggs has managed and participated in numerous groundwater investigations, biofeasibility studies, remedial investigations and feasibility studies at sites with chemical and radioactive contamination. He has previous experience as site hydrogeologist for a USEPA Superfund site involving burial of radioactive waste from uranium enrichment processes.

Depending on the task requirements, an Alternate Site Manager may be assigned for a given task. Alternate Site Managers will report to the Site Manager. Alternate Site Managers will have prior

experience at the site and will not supervise activities without prior experience on-site. Alternate Site Managers will be selected based on their areas of expertise such as survey work, geology/hydrogeology, engineering, or disposal of investigation derived waste (IDW). The Site Manager may be assisted by additional field personnel when warranted.

Specific Site Manager responsibilities include:

- Coordination on a daily basis with the Project Manager on technical issues in specific areas of expertise;
- Development and implementation of field-related work plans, assurance of schedule compliance, and adherence to management-developed study requirements;
- Submit a site mobilization plan to the USACE representatives and implement the plan in accordance with USACE requirements;
- Coordination and management of field staff;
- Implementation of QC for technical data provided by the field staff including field measurement data;
- Adherence to work schedules provided by the Project Manager;
- Authorship, review, and/or approval of text and graphics required for field team efforts;
- Coordination and oversight of technical efforts of subcontractors assisting the field team;
- Identification of problems at the field team level, discussion of resolutions with the USACE Site Superintendent, and provision of communication between team and upper management;
- Participation in the preparation of the final report;
- Communication with USACE representatives concerning scheduled activities;
- Identification of sampling locations as specified in the FSP;
- Coordination with the USACE, locator services, and utility companies to ensure subsurface exploration sites are cleared for possible presence of underground utilities;
- Submission of requests to the laboratory to supply sample containers for soil, sediment, and water samples;
- Supervision of the collection, labeling, preservation, packing, chain of custody, documentation, and proper shipment and transportation of sediment samples, equipment blanks, and duplicates from the site to the project analytical laboratories;

- Coordination of efforts of field team managers;
- Assurance that field team managers stake all borehole and sampling locations and boundaries of surface gamma surveys;
- Supervision of all aspects of drilling, sampling and field testing activities;
- Maintenance of a daily written log and photo documentation of all field activities
- Coordination with USACE and Argonne National Laboratory to facilitate collection of split QA samples;
- Assistance to the SSHO and the Radiation Safety Officer in implementation of the SSHP and the Radiation Safety Plan; and
- Notification of Maxim's Project Manager and the USACE (Dr. Judith Leithner, 716/879-4234) concerning problems encountered during field activities.

2.12 Analytical Services Coordinator

Mr. Paul Smith is Maxim's Analytical Services Coordinator. Mr. Smith possesses 12 years of experience in chemical and radiological analysis, documentation and data validation, and analytical project management. For the past seven years, Mr. Smith has provided analytical expertise to DOD and USDOE clients associated with Superfund, CERCLA, RCRA, and FUSRAP sites. Mr. Smith has been a representative of Maxim's Radiation Safety Committee and is currently Maxim-St. Louis's RSO. His responsibilities as Analytical Services Coordinator for the NFSS project include:

- Ensures all resources of the subcontractor laboratory are available on an as-required basis;
- Conducts on-site audit of subcontractor laboratory operations;
- Participates in preparation, review and approval of the QAPP and preparation of the I SP;
- Coordinates client sample submissions to GEL, establishes quality control requirements, and project completion dates;
- Reviews laboratory work orders (i.e., chain-of-custody forms, cooler receipt forms and other documentation) to ensure compliance with project plans;
- Communicates problems encountered during analyses to the Project Manager and the USACE Project Chemist, and provides guidance for their resolution;
- Provides technical guidance to the Maxim Project Manager, USACE and laboratory regarding all aspects of environmental analytical methodologies;
- Communicates project changes to GEL;

- Oversees report preparation and reviews project data submitted by GEL for completeness, accuracy, and compliance to project requirements; and
- Submits the analytical results to the Program Manager and the USACE.

2.13 Chemical Radiological, and Geotechnical Analysis

GEL will perform the chemical and radiological analyses for this project, and Maxim's geotechnical laboratory will perform the geotechnical analysis for this project. GEL has more than 15 years of experience analyzing all types of sample matrices from DOD, USDOE and FUSRAP sites. Maxim's laboratory has performed geotechnical testing on low-level radioactive samples for USDOE Superfund sites and active USDOE sites throughout the United States. The laboratories possess the required certifications and licenses for receipt and analysis of chemical and radiological samples.

Maxim's field team will interface with GEL's Project Manager, Edith Kent, prior to initiation of field work to ensure appropriate sample containers are provided and to inform GEL of the projected sampling schedule. Prior to shipment of samples, the field team will communicate and coordinate with the GEL and Maxim's Sample Custodians, Dionne Francis and James Shetley, respectively, to alert them to the receipt of samples.

SECTION 3

3.0 SCOPE AND OBJECTIVES

This section describes the methodology of preparation for the field sampling-related activities outlined in the USACE Statement of Work (SOW), as shown in Appendix A, and summarizes the project objectives stated in the SOW that were further defined in the TPP meeting held in Amherst, New York on June 8 and 9, 1999.

3.1 Scope of Work Activities

The following sections summarize project tasks included in the SOW which have supported the preparation of the Phase I RI Work Plan.

3.1.1 Task 1 - Records Review and Evaluation

The records review and evaluation task was initiated by reviewing approximately 450 available pertinent documents regarding: site and adjacent properties history; regional and local geology/hydrogeology; former surface and subsurface investigations and remedial actions conducted at the NFSS and adjacent properties; and, stakeholder opinions and preferences. The records were catalogued and their contents were summarized and used in the preparation of the FSP.

A draft summary report of potentially applicable treatment/stabilization technologies and/or disposal options for the K-65 residues at the Fernald, Ohio facility was prepared. This report was submitted to the USACE on June 1, 1999. Treatment/stabilization technologies and/or disposal options utilized at the Fernald site may be applicable to the K-65 wastes present in the IWCS at the NFSS.

3.1.2 Task 2 - Visual Site Inspection

Maxim personnel, accompanied by USACE representatives, conducted a brief visual survey of the NFSS and inspection of Building 401 on April 20, 1999. Maxim personnel also conducted a site reconnaissance of the NFSS property on July 13-16, 1999. The reconnaissance consisted of a site walkover while mapping, photo documenting, and video-recording potentially significant site features. These features, depicted on Figure 4.1-1, include former/current buildings, the IWCS, former process areas, surface water/ditches, manholes, wells, debris piles, potential underground storage tank systems, former rail lines, etc. Visual observations of wildlife at the NFSS were recorded. Information gathered during the site reconnaissance was utilized in the preparation of the project work plans and will be summarized in the RI report.

3.1.3 Task 4 - Identify Applicable or Relevant and Appropriate Requirements

A list of potential ARARs for the NFSS has been prepared, based on a review of pertinent regulations and communications with the NYSDEC. The list is presented in Appendix D of the QAPP. The list includes a justification of potential ARARs for this CERCLA action. The potential ARARs were used to develop Phase I RI sampling and analytical strategies. The ARARs selected later in the project will eventually be used to propose remedial action levels and preliminary

identification of remedial alternatives for radiological constituents, considering partial or complete removal of residues from the IWCS, or allowing the residues to remain under a long-term cap. The task will also include preparing preliminary guidance pertaining to the establishment of chemical contamination cleanup criteria for the NFSS.

3.1.4 Task 5 - Data Summary and Needs Determination

The purpose of this task is to summarize the existing chemical and radiological characterization data and determine the chemical and radiological data requirements needed to complete the RI and risk assessment. This FSP documents a portion of the data needs to determine potential remedial alternatives and groundwater flow parameters and will supplement this information in an addendum to the FSP for the proposed Phase II activities of the RI. The documentation from past investigations/remedial actions at the NFSS supplied by the USACE was reviewed. No relevant documentation was found to exist that confirms that sampling/analysis was conducted to verify that soils/sediments in drainage ditches and other potential transport pathways were remediated to applicable standards. A discussion of recommended path forward is included in Section 4.0 of the FSP.

3.1.5 Task 6 - Preparation of Field Sampling Plan/Quality Assurance Project Plan

A draft FSP and QAPP were submitted to the USACE on September 27, 1999. These documents were revisions of the preliminary drafts submitted in July 1999 and incorporate responses to internal, ITR, and/or USACE commentators. Prior to the performance of any investigatory field work, the FSP and QAPP has been further reviewed by the USACE virtual team reviewers and the NYSDEC. Their comments and responses are included in Appendix D. This FSP has been submitted to the USACE prior to initiation of intrusive site investigation and verbal approval to proceed has been provided. Any further changes to this FSP will be documented through Addenda. The FSP, which provides documentation of the data collection program, includes chemical and radiological sampling. The FSP was prepared utilizing "Requirements for Preparation of Sampling and Analysis Plans", USACE EM-200-1-3, September 1, 1994, and "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA", EPA/540/G-89/004, October 1988 as guidance.

The QAPP details project organization and responsibility, describes the sampling procedures which will be employed, and details project specific QA/QC requirements for the collection and analysis of the samples. The QAPP was prepared utilizing the above-noted USACE guidance for the FSP and "Chemical Data Quality Management for Hazardous, Toxic, Radioactive Waste Remedial Activities", USACE ER 1110-1-263, April 30, 1998, as guidance.

3.1.6 Task 7 - Specification and Acquisition of Field Data

The RI activities will involve the collection of environmental data as specified in the FSP, which includes the data/analytes of concern and proposed number and placement of the field samples. The data of concern are the: usual or frequently measured parameters (both chemical and radiological) presented in the yearly NFSS technical memorandum; potential chemical contaminants of concern identified in the site history review; extent of soil contamination outside of the Building 401; direction of groundwater flow when local landfills are/are not pumping water; concentration of

TCL/TAL materials in selected samples for surface soil, subsurface soil, sediment, surface water, and groundwater; and the chemical nature of the radionuclide constituents of concern. Overall guidance for data collection activities are included in USACE ER 1110-1-263. Based upon the SOW, biased sampling will be conducted with approximately one-third of all sampled media analyzed for full TCL/TAL parameters. A detailed description of Phase I RI field activities and analytical parameters is included in Sections 1 and 4 of this FSP.

3.1.7 Task 10 - Preparation of Site Safety and Health Plan

A Draft SSHP and Radiation Protection Plan (RPP) for sampling, shipment, and analysis was prepared and submitted to the USACE in September 1999. The Draft included revisions to the preliminary SSHP submitted in July 1999. Prior to the performance of any field work, the SSHP and RPP will be approved by the USACE virtual team reviewers. The SSHP meets the requirements of the USACE EM 385-1-1 and ER 385-1-80 and complies with 29 CFR 1910.120, Hazardous Waste and Emergency Response; 10 CFR 20, Standards for Protection Against Radiation; and, 49 CFR 171, Hazardous Materials. The SSHP also addresses radiation protection as shown in Appendix B of ER 385-1-92.

3.1.8 Task 11 - Preparation of the Quality Control Plan and Independent Technical Review

A draft QCP was prepared and submitted it to the USACE in September 1999. The QCP details the management plan for execution of all aspects of the RI project and describes the way deliverables are produced and steps that will be taken to control product quality. A preliminary draft of the FSP was reviewed by the ITR team and the FSP was modified accordingly. The ITR is described in the QCP and was performed on each element of the work plan, and all design and engineering drawings based on the proposed plan. The ITR focuses primarily on the conformance to the proposed design and appropriate technical criteria for function, reliability, and safety. A Certificate of Completion for the ITR is submitted to the USACE with this plan.

3.2 Goals/Objectives

Environmental data from the Phase I and II investigations will be used to complete an RI under the CERCLA program. This goal will be accomplished by characterizing the radiological and chemical concentrations in the surface soil, subsurface soil, surface water, groundwater and sediments present at the NFSS to a degree that a feasibility study can be completed to recommend a mode of remedial action for the site. The following goals and objectives for the NFSS RI were determined at the TTP workshop:

- (1) **Evaluate absence or presence of chemicals released from the interim waste containment structure to the first or second groundwater aquifer;**
- (2) **Determine if chemical infiltration is occurring via groundwater into the interim waste containment structure;**
- (3a) **Determine if hazardous substances and radiological activity at the site comply with ARARs;**

- (3b) **Determine Constituents of Potential Concern;**
- (4) **Define site physical features and characteristics;**
- (5) Chemically characterize Building 401 to dispose of the building materials;
- (6) Chemically characterize soils outside of Building 401;
- (7) Radiologically characterize subsurface soils;
- (8) Radiologically characterize surface soils to complete delineation;
- (9) Radiologically characterize “high-bay” portion of Building 401;
- (10) Evaluate potential remedies for the interim waste containment structure; and
- (11) **Determine nature and extent of contamination posing unacceptable risk.**

Those objectives denoted by bold text are supported in the SOW currently authorized.

3.3 ARARs and DQOs

The following three sections discuss ARARs and DQOs that are potentially applicable to the NFSS RI.

3.3.1 ARARs

All suggested ARARs are, at this point, potential. They will be more fully defined during the RI and feasibility study phases of this project. Potential ARARs were compiled based on discussions during the TPP meeting. At the TPP meeting, the NYSDEC’s criteria identified in the TAGM 4046 were cited as the starting point for evaluating risks to human health and for developing detection limits. TAGM criteria include soil cleanup objectives to protect groundwater, allowable soil concentrations, and groundwater standards. TAGM criteria for soil are based on the presence of one percent total organic carbon. Based on a formula presented in the guidance document, the TAGM soil criteria varies in direct proportion to the percentage of organic material in the soil.

Additional ARARs applicable for use in assessing human health risks include: USEPA secondary and primary Maximum Contaminant Levels (MCLs) for drinking water, USEPA Region 9 Preliminary Remediation Goals (PRGs) for soil and groundwater, and TAGM 4003. Potential ARARs identified for assessing ecological risks include USEPA Region 4 screening values for sediment and surface water and DOE PRGs for soil, sediment and surface water.

The potential ARARs are presented in Appendix D of the QAPP. TAGM criteria and USEPA Region 9 PRGs presented in Appendix D of the QAPP are based on residential land use. At this time, the applicability of residential criteria to the NFSS has not been determined. Since land use

at the NFSS has not been determined, the TAGM ARARs may be overly conservative. This list is an interim summary of ARARs and will be updated with input from the USACE and NYSDEC.

Since ARARs are the primary means for evaluating data in the risk assessment, reporting limits for each analytical parameter should be below the potential ARAR. Most ARARs are mathematically derived and, in some instances, laboratory technology cannot achieve a reporting limit below the ARAR. Two values for reporting results were obtained from GEL: the method detection limit (MDL) and the practical quantitation limit (PQL). The PQL is specified by SW-846 and applicable analytical methods and reflects the concentration the laboratory should be able to identify and quantify with some degree of certainty. The PQL represents the actual Reporting Detection Limit (RDL) that will be used to report data for this project. The MDL is the lowest concentration the laboratory can detect to verify the presence of the compound. MDLs are determined at the laboratory on an annual basis. There is some level of uncertainty associated with concentrations reported below the PQL, but above the MDL. These concentrations are considered to be estimated and are generally qualified with a "J" qualifier. MDLs and ARARs are presented in Appendix D of the QAPP. MDLs that are higher than the potential ARAR are noted in Appendix D of the QAPP.

3.3.2 Analytical Data Quality Objectives (DQOs)

DQOs are qualitative and quantitative statements which specify the quality of the data required to identify the presence or absence of contaminants and support decisions concerning the NFSS. They are based on the end uses of the data to be collected. As such, different data uses may require different levels of data quality. The USEPA has defined two analytical levels which address various data uses and the QA/QC effort and methods required to achieve the desired level of quality. These levels include:

- **Screening** (DQO Level I): Screening data is described as "data generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data provides analyte identification and quantification, although the quantification may be relatively imprecise. At least 10% of the screening data are confirmed using analytical methods and QA/QC procedures and criteria associated with definitive data. Screening data without associated confirmation data are not considered to be data of known quality".

Screening data generated during the field sampling activities at the NFSS will include use of a HNU 101 or OVM 580B PID equipped with a 10.2eV Lamp for organic vapor meter observations, use of NE Technology Radiation Meter for gamma monitoring, use of a 4-Gas Combustible Gas Meter (TMX-412) for monitoring LEL, hydrogen sulfide, carbon monoxide, oxygen, and use of a Scout II Hydrolab or YSI water quality meter for monitoring temperature, conductivity, dissolved oxygen, pH and oxidation/reduction potential. This data may be confirmed, if required, through the collection of the actual field samples.

- **Definitive** (DQO Level II): Definitive data is described as "generated using rigorous analytical methods, such as approved EPA reference methods." Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce tangible raw data

(e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files. All data generated at Level II, and having chain-of-custody documentation, is legally defensible. Data may be generated at the site or at an off-site location, as long as the QA/QC requirements are satisfied. For the data to be definitive either analytical or total measurement error must be determined. Level II protocols all have built-in QA/QC including external QA in the form of trip blanks, replicate samples, and blind samples. Level II analytical methods and protocols for this project are identified in Test Methods For Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition and subsequent updates, including Update III, or other methods designated by U.S. Army Corps of Engineers. Level II data is used for site characterization, confirmation of Level I field data, risk assessments, establishing cleanup objectives, and environmental monitoring to demonstrate attainment of cleanup objectives or compliance with applicable standards. Level II data must provide sufficient documentation to allow qualified personnel to review, evaluate, and validate data quality in accordance with acknowledged standards and protocols. Data used for risk assessment must use definitive data.

All soil, sediment and water samples analyzed in the laboratory for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), target analyte list (TAL) metals, cation exchange capacity, Total Organic Carbon, nitroaromatic compounds, radiological parameters will be performed in accordance with Level II definitive data criteria and specifications.

3.3.3 Additional DQOs

The following DQOs concern additional data needs required to achieve the basic DQOs or needed to ensure the quality of the data collected:

- Obtain information of sufficient quantity and quality to meet the requirement of a site inspection as described in the directives entitled "Guidance for Performing Site Inspections Under CERCLA: USEPA Directives 93.151-05, September 1992";
- Obtain information of sufficient quantity and quality to meet the requirement for use in a risk assessment as described in the USEPA document, Guidance for Data Usability in Risk Assessment, April 1992;
- Obtain information of sufficient quantity and quality to meet the requirements for development of a Baseline Risk Assessment (BRA) based on USEPA Risk Assessment Guidance for Superfund (RAGS), 1989 and subsequent guidance documents;
- Obtain information of sufficient quantity and quality to identify sources of contamination and migration pathways to adequately characterize potential contamination at areas included in this investigation; and
- Install temporary well points, monitoring wells, and use the existing monitoring well network to collect groundwater samples and collect soil, sediment and surface water samples to obtain

information of sufficient quantity and quality to determine if contaminants are migrating off-site or migrating on-site from off-site sources.

SECTION 4

4.0 FIELD ACTIVITIES

As presented in Section 1.4.1, this FSP proposes to use a two-phased approach for the remedial investigation at the NFSS. During Phase I, 69 soil borings will be completed, 39 sediment and surface water locations will be sampled, and 37 of the approximately 90 existing site monitoring wells will be sampled. Surface soil, subsurface soil, groundwater, sediment and surface water samples will be collected/analyzed during the Phase I investigation. No monitoring wells or piezometers are scheduled to be installed during Phase I. These activities will be related to the Areas of Investigation described in Section 4.1.

Tables 4.3-1, 4.4-1, and 4.5-1 summarize the laboratory parameters for which each sampled medium will be analyzed. General Engineering Laboratories of Charleston, South Carolina will serve as the contract laboratory. Argonne National Laboratory in Argonne, Illinois will serve as the quality assurance (QA) laboratory.

If chemical impact, above ARARs and/or the background levels as specified by the NYSDEC, is determined to be present in any of the sampled media, further investigation/sampling activities be performed to determine the vertical and horizontal extent of contamination. This delineation will be proposed for Phase II. If radiological impact, above the background levels as defined by the NYSDEC, is determined to be present in any of the sampled media, further evaluation of the need for a gamma radiation walkover survey utilizing global positioning system (GPS) be conducted to identify the surface and near-surface lateral extent of contamination is recommended. If additional investigation activities are warranted, an addendum to this FSP will be prepared and the work will be performed in Phase II of the RI.

4.1 Areas of Investigation

The following eight sections detail each of the Areas of Investigation that will be examined during the implementation of this field sampling plan. These areas were selected based on a review of site history, aerial photo interpretation, plant diagrams and as-built drawings, chemical process evaluations, raw material usage, and waste disposal records. These areas were further investigated during a detailed site walkover survey performed during July 13-16, 1999. Features found during the walkover survey are shown in Figure 4.1-1. Biased Phase I sampling locations were identified during this survey.

4.1.1 Interim Waste Containment Structure

The IWCS contains the radioactive residues, radioactive wastes from prior decontamination and remediation efforts of both the NFSS and vicinity properties, building rubble, drummed radioactive tar-like waste, foundations from Buildings 411, 412, 413, and 414, and other road construction debris. Most of the material in the IWCS was classified by its radiological characteristics, but not by its chemical characteristics. The cap covering the IWCS was initially completed in 1986. Sixty drums of radioactive and other materials were placed atop the original cap of the IWCS and in 1991,

a new cap was constructed over the drums and previous cap. A network of groundwater monitoring wells, completed in the upper and lower water-bearing zones, surrounds the IWCS. The Scope of Work excludes intrusive sampling/analyses within the boundaries of the IWCS.

The area surrounding the IWCS is currently enclosed with a fence. USACE contractors keep all the grass covering and surrounding the IWCS mowed and watered. Buildings 411, 412, 413, and 414 (the water treatment plant) are no longer present and have been incorporated into the IWCS.

No intrusive investigations are authorized in the Scope of Work for this area. However, groundwater samples will be collected from existing wells located in the upper and lower water-bearing zones and the bedrock aquifer surrounding the IWCS. The purpose for collection of the samples from these locations is to determine the presence/absence of contamination due to the radioactive residue, radioactive waste, and other material stored in the IWCS.

4.1.2 Building 401 Area

Building 401 was initially a coal-fired boiler house used to supply steam to the TNT production facility located to the north of the NFSS. Subsequent renovations of the building in 1953 converted the building into a boron-10 isotope separation plant. The building was used for the boron separation process from 1953 to 1958 and 1964 to 1971. Building 401 has or has had several supporting buildings adjacent to it, where potentially hazardous materials (i.e., waste oil, solvents, or paints) were stored. Several underground storage tanks are depicted on the facility plans near Building 401. Radioactive residues were also stored in the building and in outdoor areas adjacent to this building.

Building 401 is present at the site. The fenced area surrounding the building is currently maintained by mowing the grass. Several containers of radioactive waste and roped-off areas containing radioactively contaminated soil were noted directly adjacent to Building 401 during the site visit. No support buildings are present. Several concrete slabs, debris piles, potential underground storage tank fill pipes, and a concrete block wall were also noted inside the fence line around Building 401. The underground storage tank fill pipes have been filled with concrete. Outside the fence, areas to the north and east of Building 401 were overgrown with scrub brush and trees. Building 401 is slated to be decontaminated and demolished in the near future. Building 403 (the fire house) and Building 429 (the garage/office) still remain to the west of Building 401. Building 403 is also slated to be decontaminated and demolished in the near future.

Surface soil, subsurface soil, and groundwater samples will be collected in the Building 401 Area. The purpose for collection of the samples from these locations is to determine the presence/absence of contamination due to the former radioactive residue storage, former waste oil/solvent storage area, former/existing diesel and fuel oil underground storage tanks (USTs), former sludge beds, former paint shop, former railroad beds, potential outside coal storage, possible contamination from offsite sources, and known samples in the area containing TCE, 1,1-dichloroethene, and elevated levels of radioactivity.

4.1.3 Former Shop Area

The central portion of the NFSS was known as the shop area. This area contained a parking garage, an equipment maintenance garage and repair shop, material shed, general storehouse, combined shops, millwright shop, and riggers shop. A fuel oil pipeline and storage tank are depicted on the facility drawings. Radioactive residues were stored in several of the former buildings in this area. Corroded uranium billets were cut into smaller sections in the riggers shop. Other potentially hazardous materials may have been used in the shops (i.e., solvents and/or thinners).

The former shop area is presently overgrown with scrub brush and trees. Slabs, building foundations, and small tank cradles were identified during the walkover survey. The partially buried pipeline was observed and the location of a potential underground storage tank was noted.

Surface soil, subsurface soil, and groundwater samples will be collected in the former shop area. Samples from these locations will be selected to determine the presence/absence of contamination due to the former radioactive residue storage, former/existing diesel and fuel oil underground storage tanks and pipelines, former railroad beds, and former shop operations.

4.1.4 Former Acidification Area

The northern central portion of the NFSS was initially used as the acidification and acid storage location for the TNT production plant. Several aboveground tanks storing various acids (nitric and sulfuric) and other potentially hazardous materials are depicted on the historical facility drawings of this area. Tank cradles and concrete slabs are still at the site. Possible fuel oil storage and TNT mixed acid storage may have occurred in this area. Temporary storage locations and constructed vaults for storage of pure uranium, thorium, and radium billets, ingots, bars, and rods reportedly existed in the former acidification area.

Most of the former acidification area is presently overgrown with scrub brush and trees. No former buildings are present. Slabs, tank cradles, debris piles, and building foundations were identified during the site visit.

Surface soil, subsurface soil, and groundwater samples will be collected in the former acidification area in the north central portion of the NFSS. The purpose for collection of the samples from these locations is to determine the presence/absence of contamination due to the former uranium storage, former radium storage, former thorium storage, former fuel oil storage tanks, former process sewers, former scrap and waste dump, former sulfuric acid storage, former mixed acid storage, former nitric acid storage, and the former ammonia manufacturing plant.

4.1.5 Baker Smith Area

The Baker Smith area, in the northwestern corner of the NFSS, consisted of a storehouse, pipe shop, welding shop, and machine shop where potentially hazardous materials may have been used. Large loading and unloading platforms are depicted on the facility drawings directly north of this area which could have been an unloading platform for radioactive residue. Radioactive residue was stored in these buildings prior to their demolition.

Portions of the Baker Smith area are presently overgrown with scrub brush and trees. Some open areas were noted during the site visit around the former shop locations. No former buildings are present. Slabs and building foundations were identified during the site visit.

Surface soil, subsurface soil, and groundwater samples will be collected in the Baker Smith area. Samples from these locations will be collected to determine the presence/absence of contamination due to the former radioactive residue storage, former machine shop, former welding shop, and former pipe shop.

4.1.6 Former Radioactive Residue Storage Areas

Radioactive residues were previously stored in and/or around Buildings 401, and former Buildings 420, 421, 422, 430, 431, 432, 433, 434, 443, 444, 445, and 722-1. This listing does not include those buildings that were associated with the former water treatment plant or are currently contained within the boundaries of the IWCS.

With the exception of Building 401, none of the other listed buildings remain at the site. The area near former Building 434 (the process cooling water tower) is currently open with a stand of trees ringing its perimeter. Slabs and building foundations are present at many of the former radioactive material storage building locations.

Surface soil, subsurface soil, and groundwater samples will be collected in the former residue storage areas which are not associated with the other sampling locations located in this plan. Samples from these locations will be collected to determine the presence/absence of contamination due to the former radioactive residue storage, absence of radioactive remedial verification data and former undocumented AEC/USDOE activities at the site.

4.1.7 Onsite Ditches

Two major north-south trending ditches, the Central Ditch and the West Ditch, traverse the NFSS. The Central Ditch is located near the center of the NFSS and flows from south to north. It collects water from the property to the south and east. The West Ditch enters the NFSS property near the Baker Smith area and also collects water from the properties to the south and west. The South 16 Ditch and South 31 Ditch are two major east-west trending ditches that have their confluence with the north-south trending Central Ditch. These ditches potentially receive run-on from the Modern Landfill, Inc. which is directly east of the site. Aerial photos from 1987 also depict two east-west ditches south of "N" street and north of "O" street that have had standing water at certain times of the year. Several smaller ditches are located around the site and can potentially be impacted by runoff from other Areas of Investigation.

Most ditches have cattails and other wetland type foliage growing in them. Most of the ditches were dry with the exception of the Central Ditch, West Ditch, South 16 Ditch, and South 31 Ditch, and localized spots of the other ditches.

Central Ditch: Sediment and surface water samples will be collected to determine the presence/absence of contamination due to potential runoff from the mixed acid storage area,

possible contamination from offsite sources, concentrations of constituents in sediments (known samples from the ditch contain levels of magnesium and thallium above background) as the ditch enters the site and leaves the site, if leachate is seeping from/to the IWCS, discharge of impacted groundwater from the upper water-bearing zone and impacted sediments transported from other site ditches that empty into the Central Ditch.

West Ditch: Sediment and surface water samples collected from these locations will determine the presence/absence of contamination due to possible runoff from the Baker Smith area, possible contamination from offsite sources, concentrations of constituents in sediments as the ditch enters the site and leaves the site, if leachate is seeping from/to the IWCS, discharge of impacted groundwater from the upper water-bearing zone and impacted sediments transported from other site ditches that empty into the West Ditch.

South 31 Ditch: Sediment and surface water samples will be collected to determine the presence/absence of contamination due to possible runoff from the Building 401 area, possible contamination from offsite sources, and concentrations of constituents in sediments (samples from the ditch were reported to contain levels of copper, magnesium and zinc above background).

South 16 Ditch: Sediment and surface water samples collected will determine the presence/absence of contamination due to possible runoff from the Building 401 area, possible contamination due to runoff from the former shop area, and possible contamination from offsite sources.

“N” Street Ditches: Sediment and surface water samples collected will determine the presence/absence of contamination due to possible runoff from the former radioactive residue storage area, runoff from the former acidification area, and possible contamination from offsite sources.

“O” Street Ditches: Sediment and surface water samples will be collected to determine the presence/absence of contamination due to possible runoff from the former radioactive residue storage area, runoff from the former acidification area, and possible contamination from offsite sources.

MacArthur Street West Ditch: Sediment and surface water samples collected from these locations will determine the presence/absence of contamination due to possible offsite sources and concentrations of constituents in sediments (samples from the ditch were reported to contain PCBs and levels of thallium and zinc above background).

Other Ditches and Depressions: Sediment and surface water samples will be collected from each of the following locations: from the large depressed area located north of the location of former Building 434, from the CWM Ditch, from the Modern Ditch, from the Building 401 Ditch, from the West Patrol Road Ditch, and from the Castle Garden Road West Ditch. One sample will be collected from each of the three small ditches (north, central, and south) located west of the IWCS. Sediment samples will be collected from these locations to determine the presence/absence of contamination due to possible offsite sources, possible contamination due to former waste oil and solvent storage, former radioactive material storage areas, current radioactive material storage areas, and shop areas.

4.1.8 Previously Uninvestigated Areas

Subsurface conditions at several areas of the site, not described in the Section 4.1.1 to 4.1.7, have not been radiologically or chemically characterized. Several groundwater wells were installed in 1981, but no radiological or chemical samples have been collected. Potential contamination due to undocumented past site practices/activities may be present in these areas.

In general, the previously uninvestigated areas not included in the previous sections are not associated with facility buildings or process equipment. These areas are located across the site and most are open grass. However, in the northern areas and the southeastern corner of the site, these areas are covered with scrub brush and trees.

Surface soil, subsurface soil, and groundwater samples will be collected in the previously uninvestigated areas. The purpose for collection of samples from these locations is to determine the presence/absence of contamination due to potential run-on from offsite properties and former undocumented AEC/USDOE activities at the site.

Nine of these twelve sampling locations (803, 804, 805, 806, 807, 808, 809, 810, and 812) were randomly selected to provide spacial distribution.

4.2 General Field Procedures

All sampling, custody, transportation and analytical procedures will be consistent with guidelines published in USEPA's "Test Methods for Evaluating Solid Wastes (SW-846), Third Edition, Update I, July 1992" and USACE's "Engineering and Design, Chemical Data Quality Management for Hazardous, Toxic, and Radioactive Waste Remedial Activities" April 30, 1998, (ER 1110-1-263). Collection, preservation, and storage requirements are summarized for each analytical parameter in Table 4.2-1 of this FSP and in Section 5.0 of the Quality Assurance Project Plan (QAPP)

Duplicate [quality control (QC)] samples will be analyzed at the rate of one per every 10 or fewer samples collected. The duplicate samples will be numbered such that they are indistinguishable ("blind") from other samples and will be submitted to GEL for analysis. Split (QA) samples will be analyzed at the rate of one per every 20 or fewer samples collected. Matrix spike/matrix spike duplicate (MS/MSD) samples, with the exception of samples for cation exchange capacity and total organic carbon analysis, will be analyzed by the Argonne National and GEL Laboratories at the rate of one per batch of 20 or fewer samples analyzed. Only the primary analytes (i.e., VOC, SVOC, Metals, Pesticides/PCBs, and radiological parameters) will undergo QA laboratory testing. The cation exchange capacity and total organic carbon samples will undergo internal laboratory QA procedures. The pre-designated QA/QC and MS/MSD samples are also identified in Tables 4.3-1, 4.4-1, and 4.5-1. These samples will be collected in the quantities specified. The locations where these samples will be collected are subject to change, if determined to be necessary by the Site Manager.

The analytical groups specified for each sample are presented in Tables 4.3-1, 4.4-1, and 4.5-1. These Tables will serve as checklists in the field, and will be used by the Site Manager to ensure all samples scheduled for collection are completed, to the extent practical.

Field instrumentation used will be inspected on a daily basis and calibrated according to the instrument manufacturer's specifications. A description of the field screening instrumentation and the frequency of calibration is summarized in Table 4.2-2.

4.3 Soil Boring Procedures

During the TPP workshop held in Amherst, New York on June 8-9, 1999, Maxim and the USACE agreed that one surface soil, a minimum of one subsurface soil, and one groundwater sample would be collected from each proposed boring location. Proposed boring locations are based upon: results of previous NFSS investigations; locations of former buildings/ slabs; knowledge of former site activities/processes; facility maps; topography; and, findings during the site reconnaissance. Boring in or disturbing areas designated as local, state, or federal wetlands will be avoided.

Boring numbers, sample identification numbers, sample depths, and parameters to be analyzed from the eight areas identified in Section 4.1 are described in Table 4.3-1. Boring locations are depicted on Figure 4.3-1.

Borehole logging will comply with "Borehole Logging" established in USACE EM 1110-1-400, November 1, 1998. Drilling activities will be directed by a Maxim Geologist or Geotechnical Engineer. Details of drilling activities will be recorded on Maxim Field Boring Log Forms as depicted in Exhibit 4-1. All soil samples will be visually classified using the Unified Soil Classification System (ASTM D-2488). Information provided in the logs shall include, but not be limited to, the following:

- Depth of each change of stratum;
- Thickness of each stratum, including thin lenses and layers;
- Depth interval from which each sample was taken;
- Depth at which groundwater is encountered;
- Type of drilling equipment;
- Type and size of samplers used;
- Borehole diameter;
- Any sealing off of water-bearing strata;
- Date(s) borehole was drilled;
- Evidence of contamination, i.e., odors, PID measurements, staining, etc.;
- Reason for borehole termination; and
- The manufacturer and quantities of all materials used in the borehole.

Where possible, disposable field sampling equipment will be used. However, where this type of equipment is unusable, all sampling equipment will be decontaminated prior to collection of samples as described in Section 4.0 of Maxim's General Sampling Procedures Manual (Appendix E of the QAPP). The drill rig, drill tools, samplers, and associated equipment will be steam cleaned prior to commencement of drilling at each boring location. Sampling equipment will be thoroughly washed with Liquinox or Alconox and tap water, rinsed with tap water, and rinsed with deionized (DI) water between sample intervals. All water generated from decontamination activities will be managed according to Section 7 of the FSP. Decontamination equipment includes plastic sheeting, buckets, brushes, DI and tap water sprayers, Liquinox or Alconox, tap water, and DI water.

All unique sampling locations will be staked and coordinates established through survey.

4.3.1 Surface Soil Sampling Procedures

A 10 m by 10 m (32.8 ft by 32.8 ft) area, surrounding the proposed boring locations, will be gamma scanned prior to sample collection. The surface location exhibiting the highest readings will be sampled for the radioactive components. If no site feature (i.e., probable location of a UST, process lines, or etc.) exists in close proximity to the collected radiological sample location, the boring location will be moved to the point of radiological sample collection. Otherwise, the surface radiological collection location and the boring may be uncoupled.

Surface soil samples will be collected from land surface to approximately 15 cm (six in) below ground surface (bgs) with a stainless steel shovel, stainless steel bucket auger, or stainless steel spoon. Vegetation matter, rock, and other debris will be removed from the sample. This depth interval for surface soil collection was agreed to by the NYSDEC. Sufficient sample volume will be collected at each location to provide for the analysis of laboratory-designated MS/MSD samples. Field duplicate and split samples will be collected as replicates of the prime sample.

Collection of surface soil samples for VOC analysis will occur first and will be conducted by SW 846 Method 5035. This method will be utilized to minimize the volatilization and biodegradation of the volatile organic compounds. Various techniques can be used to accomplish Method 5035 sample collection, depending upon the cohesiveness of the soils (e.g., clay versus gravel) and the anticipated VOC concentration (low versus high) of the sample collected. A thorough description of the techniques to be used is presented in Appendix B.

The remaining sample material will be placed in a stainless steel bowl and homogenized by mixing the material with a stainless steel spoon. For boring locations at which QA/QC or MS/MSD samples are designated, the prime sample will be mixed and divided into three relatively equal fractions. For boring locations at which only QC samples are designated, the prime sample will be mixed and divided into two relatively equal fractions. All samples will be placed in properly-labeled containers and put in iced coolers for overnight shipment. Excess soil will be placed in a properly labeled 55-gallon drum and stored in the designated IDW storage area as described in Section 7.0. The actual boring from which the QA/QC and MS/MSD samples are designated to be collected from will change if sufficient sample volume cannot be recovered.

4.3.1.1 Surface Soil Field Measurement Procedures

Organic vapor and radiological concentrations in and immediately around each surface sample location will be monitored with a photoionization detector (PID) and radiological survey meters, respectively. Organic vapor concentrations and radiological activity will be measured at the land surface prior to sample collection, near the surface soil sample upon collection, and at the bottom of the sample hole after sample collection. The resulting readings will be recorded on a Maxim Field Boring Log Form for each sample location.

4.3.2 Subsurface Soil Sampling Procedures

Subsurface soil samples will be continuously collected from approximately 15 cm (six in) bgs to termination depth with a hollow-stem auger drill rig. Maxim's drilling services will complete all drilling activities using truck-mounted or all-terrain vehicle (ATV) drill rigs. Drilling procedures will be conducted in accordance with USACE EM 1110-1-4000, November 1, 1998.

Each boring location will be inspected and approved as safe prior to commencement of drilling activities by the Maxim Site Manager and SSHO. New York's Underground Facility Protection Organization (UFPO) underground utility locate service has been contacted at least seven days prior to commencing drilling activities. A site meeting with the utility locating services of concern has been accomplished to identify proposed boring locations and adjust the boring locations. In addition, each boring location will be screened for underground utilities with a magnetometer prior to drilling. Drilling will be performed using 8.3, 10.8, or 15.9 cm inner diameter (ID) (3.25, 4.25, or 6.25 in ID) hollow stem augers.

Following borehole termination, a five cm (two in) diameter polyvinyl chloride (PVC) pipe with no bottom cap or plug will be placed through the augers to the bottom of the boring. The PVC pipe will consist of a five or 10 foot section of threaded 0.010 machine-slotted screen placed at the boring bottom. The remainder of the pipe will be completed with threaded sections of riser. The top of the PVC pipe will be covered and the augers will be removed from the ground. A downhole gamma scan, as described in Section 4.3.2.3, will be performed and a groundwater sample, as described in Section 4.4.1, will be collected. Each borehole will then be sealed with a bentonite-Portland cement grout to ground surface, via the tremmie method, through the slotted PVC pipe as it is gradually removed from the borehole. The bentonite-Portland cement grout will consist of approximately three percent by weight of bentonite powder and five to six gallons of water per 94 pound sack of Portland cement.

4.3.2.1 Subsurface Soil Sampling Procedures for Chemical and Radiological Analyses

Subsurface soil samples for radiological and chemical analyses will be collected with 7.6 cm (three in) outer diameter (OD) / 6.4 cm (2.5 in) ID / 1.5 meter (m) [five foot (ft)] stainless steel continuous samplers placed at the base of the lead auger. The continuous sampler will be retrieved from the augers at each five-foot interval and soils will be classified by the Maxim Engineer/Geologist. If difficulties are encountered while using the continuous samplers (e.g., poor sample recovery in coarse-grained soils), 5.1 cm (two in) OD / 3.8 cm (1.5 in) ID / 0.6 m (two ft) stainless steel split spoons will be employed. The split spoons will be driven with a mechanical hammer and the number of blows per 15 cm (0.5 ft) of advancement will be recorded on the soil boring log. Drilling fluid additives (bentonite, foams, gels, barite, etc.) will not be used. If drilling difficulties are encountered (e.g., sand/gravel heaving in augers), it may be necessary to add tap water to the boring in order to extract the augers.

Soil samples will be collected from the Brown Clay and Brown and Gray Clay Unit interface. All soil samples collected will be temporarily sealed in properly labeled plastic bags and immediately placed in an iced cooler. Soil samples to be submitted for laboratory analysis will be removed from the plastic bags and placed in properly labeled containers. A soil sample collected from near the top

of the saturated zone (if encountered) in each borehole will be submitted for laboratory analysis. If field observations (i.e., monitoring instruments, odors, staining, etc.) indicate that other sampled intervals within a boring may be impacted by radiological or chemical contaminants, a sample will be collected and submitted for laboratory analysis at the discretion of the Maxim Engineer/Geologist with concurrence of the USACE site representative. Each borehole will be terminated after penetrating the upper few inches of the underlying Gray Clay Unit. This unit typically occurs at a depth of three to six m (10 to 20 ft) bgs, depending upon its location at the NFSS. If no saturated zone is encountered, a sample will be collected from the base of the Brown Clay Unit. Samples collected for radiological parameters will be taken from a maximum interval of 15 cm (six in) in order to minimize dilution of any contaminated material.

Sample containerization, packaging, and shipment will be conducted as described in Section 6.

4.3.2.2 Subsurface Soil Sampling Procedures for Geotechnical Analyses

Approximately 69 subsurface samples will be collected and submitted to Maxim's St. Louis geotechnical laboratory for physical testing in order to verify the Maxim Engineer's/Geologist's field classifications. Maxim's laboratory is licensed by the Nuclear Regulatory Commission (NRC) to accept low-level radioactive samples. Spatial distribution of these samples will be adequate to obtain a better understanding of the subsurface geology of the NFSS Brown Clay Unit and the upper part of the Gray Clay Unit.

The following ASTM procedures will be performed:

- Grain size distribution by sieve analysis (ASTM D-422);
- Atterberg limits (ASTM D-4318);
- Moisture content (ASTM D-2216); and
- Bulk density (ASTM D-2937)

Samples will be collected from each distinct strata present in a maximum of five boreholes and analyzed for grain-size distribution, Atterberg limits, and moisture content. The remainder of the samples to be collected for these three tests will be spatially distributed at the discretion of the Maxim Engineer/Geologist with concurrence from the USACE site representative. Samples will be collected in properly labeled plastic bottles.

One undisturbed representative sample per distinct subsurface strata present at the NFSS will be collected in thin-walled Shelby tubes (ASTM D-1587) and submitted for bulk density testing. It is anticipated that no more than five samples will be analyzed for bulk density.

It is anticipated that geotechnical samples will be collected from both impacted and non-impacted soils.

4.3.2.3 Subsurface Soil Field Measurement Procedures

Field screening of oxygen, carbon monoxide, hydrogen sulfide, radiological, and organic vapor concentrations and lower explosive limits will be performed to monitor potentially hazardous

conditions during drilling activities. Small portions of each soil sample will be placed in a separate sealable plastic bag and field screened for organic vapors with a PID and radiological impact with radiological survey meters.

Samples for VOC analysis will be collected from each potentially contaminated zone and will promptly be placed in sample containers. Representative samples for laboratory analysis will be specified by the on-site geologist.

Downhole radiological logging will be performed in each soil boring. This survey will be performed to determine the vertical distribution of radiological contaminants and identify subsurface soil samples to be submitted for radiological laboratory analysis. Logging will be performed using a one cm by one cm (3/8 in by 3/8 in) sodium iodide (NaI) gamma detector with a portable single channel or multi-channel analyzer. The detector will be equipped with a collimeter to ensure that the photons detected originate from the nearest boring wall.

Testing will be performed through the PVC casing which will be placed along one side of the boring. The NaI detector is attached to a cable and initially lowered to the bottom of the casing. The instrument is then withdrawn to the surface and measurements are recorded at 15 cm (6 in) increments. The scaler to be used is a Ludlum Measurements Inc. Model 2200 or 2350 which can be operated in either the scaler or count rate mode. The analyzer will be set up with an energy threshold of approximately 100keV and an open energy window. The detector is calibrated semi-annually with a cesium-137 source to verify the relationship between counts per minute (cpm) and the exposure rate (about 30 cpm/micro-Roentgen/hour).

4.4 Groundwater Sampling Procedures

During the TPP workshop, Maxim and the USACE agreed that groundwater samples will be collected from temporary wells placed in the first water-bearing zone (Brown Clay Unit) at each proposed boring location. After the workshop, it was further recommended and approved by the USACE that the upper water-bearing zone, lower water-bearing zone (Sand and Gravel Unit) and bedrock aquifer (Queenston Formation) would be sampled via the existing monitoring well network. Existing monitoring well sample location numbers, sample identification numbers, and parameters to be analyzed are described in Table 4.4-1 and well locations are depicted on Figure 4.4-1. QA/QC and MS/MSD samples, with the exception of VOCs, will be collected by alternately pumping approximately equal aliquots into each sample container. The actual boring from which the QA/QC and MS/MSD samples are designated to be collected from will change if sufficient sample volume cannot be recovered.

4.4.1 Groundwater Sampling Procedures for Temporary Wells

Grab groundwater samples will be collected from each temporary well after the downhole gamma logging is completed. No development or purging will be conducted. Water level and total boring depths will be measured from ground surface prior to sample collection. If sufficient volume is available, a portable water quality meter will be used to monitor pH, conductivity, temperature, DO, ORP, and turbidity of the groundwater immediately preceding sampling. These measurements will be collected in situ with a YSI 600XL water quality meter.

The VOC samples will be collected first with a disposable Teflon® bailer or micro-bailer to minimize the loss of volatile organics. The remainder of the samples will be collected with one or more low-flow peristaltic pumps connected to lengths of dedicated disposable silicon tubing. The sample rate, to the extent possible, will be adjusted to match the well recharge rate. It may be necessary to sample the wells with a bailer if water levels are below approximately 25 feet bgs (maximum depth of water extraction for a ground surface pump). But this situation is not anticipated for the upper (first) water-bearing zone at the NFSS. Based on information provided by the NYSDEC, recharge rates may be relatively slow and it may take up to 48 hours to accumulate sufficient volume of water for all proposed laboratory analyses. Groundwater sampling will cease in each borehole after the boring has been open for a period of 48 hours regardless of the volume collected. If sufficient volume of groundwater cannot be collected the USACE Project Chemist will be contacted and will define a hierarchy of sample collection at that time.

The hierarchy of analytes to be collected in wells that produce significant volumes of water is as follows: VOC, semi-volatile organics (SVOCs), nitroaromatics, pesticides/PCBs, and inorganic compounds (metals, radiological parameters). Samples collected for analysis of dissolved metals will be filtered using a Masterflex peristaltic pump and dedicated disposable 0.45 micron filter prior to sample preservation. Groundwater samples will be placed into the appropriate containers and samples will be immediately placed in an iced cooler for overnight shipment.

4.4.2 Groundwater Sampling Procedures for Existing Monitoring Wells

Groundwater samples be collected from 37 existing monitoring wells, including four wells completed in the upper water-bearing zone, 28 wells completed in the lower water-bearing zone, and five wells completed in the bedrock aquifer. Prior to collecting groundwater samples, each well will be developed and purged in accordance with the USACE's "Requirements for the Preparation of Sampling and Analysis Plans", EM 200-1-3, September 1, 1994, and "Monitor Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites", EM 1110-1-4000, November 1, 1998.

Development and sampling procedures will be determined in the field and will be attached to this plan as an addendum.

Maxim plans to open all wells on the site and measure groundwater elevations to get a complete groundwater picture. If current pumps are installed in the wells, as designated on Figure 4.4-1, these pumps will be removed and be placed as solid investigation derived waste.

The water level and the total depth of each well will be measured from the top of the well casing and recorded. Each well will be developed by removing a minimum of three times the standing volume of water present in the well casing and annulus. A portable water quality meter will be used to measure in-situ parameters of turbidity, pH, conductivity, temperature, DO, and ORP of the well water initially, after removing each well volume, and after development has been completed.

Development will cease when either: (1) the turbidity is less than or equal to 20 Nephelometric Turbidity Units (NTU); (2) there is less than 0.1 feet of sediment in the well; (3) temperature, pH, and conductivity stabilize to within ± 0.5 °C, ± 0.2 pH units, and less than 10% variation in

conductivity for three successive well volumes; or, (4) five times the standing volume of water present in the well casing and annulus has been removed. The length of time developed, volume of water removed, odor, color, turbidity, and PID readings will be recorded on Maxim's Well Development Log (Exhibit 4-2). After development is completed, approximately one liter of water from each well will be collected in a clear glass jar, and will be labeled and photographed.

Existing monitoring wells will be sampled a minimum of two weeks after development is completed. Prior to collection of samples each well will be purged. The water level and total depth of the well will be measured and recorded and each well will be purged of a minimum of three and a maximum of five standing volumes of water present in the well casing and annulus. Water quality parameters of pH, temperature, conductivity, ORP, and DO will be measured in-situ prior to purging, after purging each well volume and when purging is complete. These measurements will be collected in situ with a YSI 600XL water quality meter while simultaneously purging the wells.

Groundwater elevations will be measured and recorded after each well volume is removed and after purging is complete. Purging will cease when either: (1) the turbidity is less than or equal to 20 NTU; (2) temperature, pH, and conductivity stabilize to within ± 0.5 °C, ± 0.2 pH units, and less than 10% variation in conductivity for three successive well volumes; or, (3) five times the standing volume of water present in the well casing and annulus has been removed. The length of time purged, volume of water removed, odors, color, turbidity, and PID readings will also be noted on a Maxim Well Monitoring Data Log (Exhibit 4-3). All purge water will be placed in a 5,800 liter (1,500 gallon) storage tank or other appropriate container, labeled, and managed according to the procedures described in Section 7.

If a well becomes dry before purging is complete, well purging will cease and the well will be sampled after sufficient recharge permits ample volume for sample collection.

Groundwater sampling will cease in each well after a period of 48 hours or longer, regardless of the volume collected. If sufficient volume of groundwater cannot be collected the USACE Project Chemist will be contacted for a hierarchy of samples to be collected.

The hierarchy of analytes to be collected if sufficient water is present is as follows: VOC, semi-volatile organics (SVOCs), nitroaromatics, pesticides/PCBs, and inorganic compounds (metals, radiological parameters). Samples collected for analysis of dissolved metals will be filtered using a dedicated disposable 0.45 micron filter prior to sample preservation. Groundwater samples will be placed into the appropriate containers and samples will be immediately placed in an iced cooler for overnight shipment.

In order to determine groundwater flow direction of the three water-bearing zones at the NFSS, static water level measurements of all existing monitoring wells will be collected within a 24-hour period. Measurements will be collected at least 72 hours after well development, purging, or sampling has been completed.

4.5 Sediment and Surface Water Sampling

During the TPP workshop, Maxim and the USACE agreed that sediment and surface water samples should be collected from site ditches and other topographically low-lying areas which may transmit surface water at the NFSS. Proposed sample locations are based upon: results of previous NFSS investigations; locations of former buildings/slabs; knowledge of former site activities/processes; facility maps; topography; and, findings during the site reconnaissance.

Sample location numbers, sample identification numbers, and parameters to be analyzed from the eight areas identified in Section 4.1 are described in Table 4.5-1. Sample locations are depicted on Figure 4.5-1.

A walkover gamma survey, consisting of approximately 15.2 linear m (50 linear feet) along the upstream and downstream sides of the proposed sampling location and 3 m (10 ft) past the top of the bank, will be conducted prior to sampling. If water is present in the ditch, the survey will be conducted along the waterline to 3 m (10 ft) past the top of the bank. The radiological sediment sample will be collected within the ditch at the highest reading. If no site feature (i.e., probable inflow or outflow of surface water) exists in close proximity to the collected radiological sample location, the sediment location will be moved to the point of radiological sample collection. Otherwise, the sediment radiological collection location and the sediment chemical collection location may be uncoupled.

If insufficient water volume occurs, surface water sampling activities will be conducted during/after a significant rainfall event or significant snow melt event. Sampling activities will be directed by a Maxim Geologist or Geotechnical Engineer. Details of sampling activities will be recorded on a Maxim Field Boring Log Form. All soil samples will be visually classified using the Unified Soil Classification System. Information provided in the logs shall include, but not limited to, the following:

- Depth interval from which each sample was taken;
- Depth, flow direction, and flow rate of surface water;
- Type/size of sampling equipment used;
- Date(s) sample was collected;
- Evidence of contamination, i.e., odors, PID measurements, gamma measurements, staining, etc.;

All sampling equipment will be decontaminated as described in Section 4.3 of the FSP.

4.5.1 Sediment and Surface Water Sampling Procedures

To minimize turbidity, all surface water samples will be collected prior to the collection of on-located sediment samples. If it is necessary for field personnel to stand in the surface water to collect samples, that person will stand downstream of the sample location. Surface water samples will be collected by submerging a pre-cleaned sample container or dedicated disposable bailer into the water. If the bailer method is used, the water will be immediately transferred into the sample container. If the water level is not sufficient for submersion, a Masterflex peristaltic pump and disposable

Teflon® tubing will be used to collect the samples. Samples collected for analysis of dissolved metals will be filtered using a Masterflex peristaltic pump and disposable 0.45 micron filters prior to sample preservation.

Sediment samples will be collected to a maximum depth of 15 cm (6 in) bgs with a stainless steel shovel, stainless steel Ekman dredge, stainless steel bucket auger, or stainless steel spoon. Vegetation matter, rock, and other debris will be removed from the sample and placed in a properly marked 55-gallon drum. The sediment will be placed in a stainless steel bowl and free water will be drained from the sample.

QA/QC and MS/MSD samples will be collected as replicates of the prime sample. The actual boring from which the QA/QC and MS/MSD surface water samples are designated to be collected from will change if sufficient sample volume cannot be recovered. Sample containerization, packaging, and shipment will be conducted as described in Section 6.

4.5.2 Sediment and Surface Water Field Measurement Procedures

A portable water quality meter will be used to measure the pH, ORP, DO, electrical conductivity, turbidity, and temperature of the surface water samples.

Organic vapor and radiological concentrations immediately around each sediment sample location and above the sediment in the bowl will be monitored with a PID and radiological survey meters, respectively. The resulting concentrations will be recorded on a Maxim Field Boring Log Form for each sample location.

4.6 Surveying

Coordinates and elevations will be surveyed at each soil boring, sediment/surface water sampling location, and existing monitoring well in accordance with USACE EM 1110-1-4000, November 1, 1998. The geologist/geotechnical engineer in charge of each sampling crew is responsible for staking all sampling locations. These locations will be sketched in the field and measured in relation to permanent features at the site.

The surveyor will establish a site benchmark and will survey all locations with reference to the benchmark. Soil boring and sediment/surface water sampling locations will be surveyed at the ground surface immediately adjacent to the location. Existing monitoring wells will be surveyed at the ground surface immediately adjacent to the well and at the top of the well casing.

Horizontal coordinates will be measured to the nearest 1.0 foot and elevations will be measured to the nearest 0.01 foot. Coordinates will be referenced to either a local coordinate system or State Plane Coordinate System. Elevations will be referenced to the National Geodetic Vertical Datum of 1929.

SECTION 5

5.0 SAMPLE CHAIN-OF-CUSTODY/DOCUMENTATION

The following sections describe the sample chain-of-custody documentation and other site documentation that will be generated during the field activities performed at the NFSS.

5.1 Field Log Book

The field sampling log will enable the Site Manager to reconstruct the sampling events. Information recorded on other documents, such as core sample logs, air monitoring calibration, or monitoring forms, will not be repeated in the log books except in summary form to avoid transcription errors. Logbooks will be maintained in the possession of the Site Manager and the Site Safety and Health Officer, or in a secure place during the field work. Following site activities, the logbooks will become a part of the final project file.

The following are some suggested generic topics which may be included in the logbook; as appropriate.

- Name and title of author, date, and time of entry.
- Purpose of sample activity.
- Name and address of field contact.
- Names and responsibilities of field crew members.
- Names and titles of any site visitors.
- Type of waste, suspected waste concentration if known, and sample matrix.
- Sample collection method.
- Number and volume of sample(s) taken.
- Location, description, and log of photographs (if taken) of the sampling points.
- References for all maps and photographs of the sampling site(s).
- Information concerning sampling changes, scheduling modifications, and change orders.
- Information concerning drilling decisions, not shown on the drill log.
- Information concerning access agreements.

- Locations of stakes and pinflags which define location of all samples and survey boundaries.
- Details of the sampling location (dimensioned sketches of sampling locations may be appropriate).
- Date and time of sample collection.
- Field observations.
- Any field measurements made (e.g., pH, specific conductance, temperature coordinates, or water level depth) and calibration results of field instruments.
- Sample identification number(s).
- Information from containers, labels of reagents used, de-ionized water used for blanks, etc.
- Sampling methodology, including distinction between grab and composite samples
- Sample preservation.
- Sample distribution and transportation (i.e., name of the laboratory and courier).
- Sample documentation such as:
 - Bottle lot numbers as received from repository
 - Chain-of-custody records numbers
- Decontamination procedures.
- Documentation for investigation-derived wastes such as:
 - Contents and approximate volume of waste
 - Disposal method
 - Type and predicted level of contamination
- Summary of daily tasks and documentation on any cost or Scope of Work changes required by field conditions.
- Signature and date (entered by personnel responsible for observations).

5.2 Photographs

A photographic documentation log will be maintained. Information will be entered in the log for each photo taken. The information will include:

1. Date/time
2. Direction of photo
3. Subject/description
4. Notes
5. Photographer name
6. Sketch of location
7. Sequential number of photograph and roll number

Where possible, objects of known size will be included in each photo for scale. Unless otherwise specified, all photos will be in color and will be mounted on photo documentation log sheets. The location of each photo will be cross referenced to a view location grid plan.

Subjects to be photographed will include:

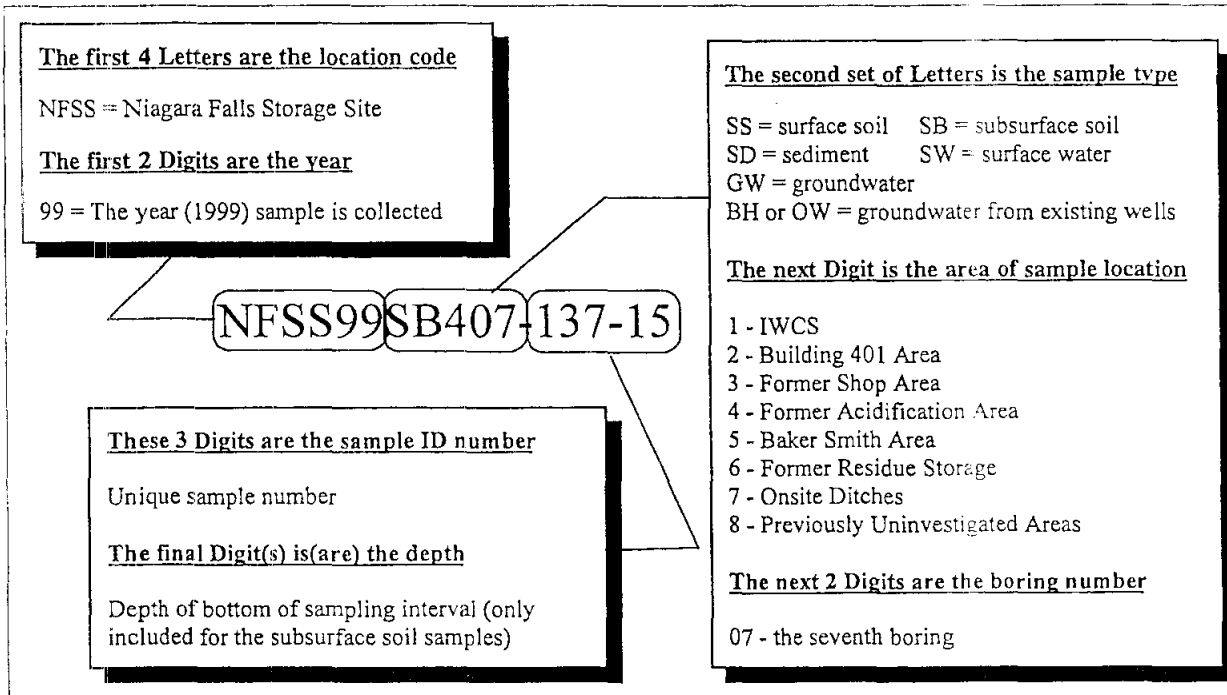
1. Each borehole, surface soil, and sediment/surface water sampling location, showing the location in reference to known landmarks
2. Any evidence of contamination or free product found in samples
3. Photos exhibiting personal protective equipment used
4. IDW storage location after completion of waste generation
5. Any damage to property which may be present before, during, or after on-site activities
6. Equipment used on site
7. Any other noteworthy objects

5.3 Sample Numbering System

A unique sample number will be assigned to each sample which is collected during this study. The sample ID will incorporate the site where the sample was collected, sample year, sample type, location of the sample and a designator (only for subsurface soil) which indicates the depth at which the sample was collected.

The following sample numbering system will be used to identify each sample for chemical and radiological analysis. The purpose of this numbering system will be to provide a tracking system for retrieval of data on each sample. Sample identification numbers will be used on sample labels, field sheets, sample tracking matrix forms, chain-of-custody records, and all other applicable

documentation used during the sampling activity. A listing of all sample identification numbers will be maintained in the field logbook.



The sample identification number begins with the location code (NFSS = Niagara Falls Storage Site), followed by the year, the sample type (SS = surface soil sample, SB = subsurface soil sample, SD = sediment sample, SW = surface water sample, GW = groundwater sample, BH (or OW) = existing well groundwater sample), sample location (1 - IWCS, 2 - Building 401 Area, 3 - Former Shop Area, 4 - Former Acidification Area, 5 - Baker Smith Area, 6 - Former Radioactive Residue Storage, 7 - Onsite Ditches, and 8 - Previously Uninvestigated Areas), boring or sample number, unique sample number, and (for the subsurface soil sampling only) the depth of the bottom of the interval sample d.

The above example, NFSS99SB407-137-15, shows the seventh boring in the former acidification area (unique sample number 137) collected at 15 feet below the ground surface.

Unique sample numbers will be assigned to the blind field duplicates so that these samples will not be identified to the laboratory as duplicates. All other information in the sample ID for the blind filed duplicates will be the same as the original sample. Duplicate samples corresponding to the original sample will be recorded. Quality assurance samples will have the same sample identification number as the prime sample with "QA" appended as a suffix to the sample identification number. Laboratory MS and MSD samples will bear the same number as the prime sample but will be identified with "MS" or "MSD" succeeding the sample ID.

Sample ID, type, and required analysis are provided in Tables 4.3-1, 4.4-1, and 4.5-1.

5.4 Sample Documentation

The following sections provide information concerning the documentation necessary for labeling, recording, entering samples on the chain-of-custody, and receipt of samples

5.4.1 Sample Labels

A pressure sensitive gummed label will be affixed to each sample container. The following information will be recorded on the label in indelible ink: sample identification number, the sample collection technique (grab or composite), source of sample, preservative used, the collector(s) signature, date and time of collection, and analyses required. The label will be covered with clear waterproof tape. Examples of sample identification labels to be used are illustrated in Exhibit 5-1

5.4.2 Sample Field Sheets and/or Log Book

A listing of all sample identification numbers will be maintained in the field logbook.

5.4.3 Chain-of-Custody Records

An example of a chain-of-custody transfer form is presented in Exhibit 5-2. The sample containers will be placed in a shipping container (cooler) along with the chain-of-custody record form, pertinent field records, analysis requests, and the name of the shipper. The USACE tracking number that is used in conjunction with the government QA sample shipment will be written on the QA sample chain-of-custody record. A copy of these forms will be retained by the field crew and transferred to the project files upon completion of the sampling. The shipping bill will be maintained in the project file with the chain-of-custody .

When transferring the custody of the samples, the custodian will sign and record the date and time on the chain-of-custody record. Custody transfers will account for each individual sample, although samples may be transferred as a group. Every person who takes custody will fill in the appropriate section of a chain-of-custody record. The Site Manager will be insure that the chain-of-custody is properly documented.

As is discussed in Section 6.2 below, custody seals will be placed on each cooler.

5.5 Documentation Procedures

Stringent sample custody procedures are maintained for all samples received for analysis. The analytical laboratory's sample log-in and documentation procedures are described in Section 5.2 of the QAPP.

SECTION 6

6.0 SAMPLE PACKAGING AND SHIPPING

The following sections describe the sample packaging and shipping requirements from samples that will be generated during the field activities performed at the NFSS.

6.1 Destinations for Sample Shipment

Samples will be shipped directly to the analytical laboratories by an overnight carrier such as Federal Express (800-463-3339) or Airborne Express (800-426-2323).

6.1.1 Samples for Chemical and Radiological Analysis

Samples to be analyzed for volatile organics (by USEPA SW846 Methods 5035/8260B); semi-volatile organics (by USEPA SW846 Methods 3550B/8270C); pesticides and PCBs (by USEPA SW846 Methods 3550B/8081A/8082); TAL metals plus boron and lithium (by USEPA SW846 Methods 3050B/6010B/6020); Mercury (by USEPA SW846 Method 7470A/7471A); Total Organic Carbon (TOC) (by USEPA SW846 Method 9060); cation exchange capacity (by USEPA SW846 Method 9081); radiological speciation: uranium-235, uranium-238, thorium-230, and radium-226 (by HASL 300/903.1); gross alpha and beta radiation (by Method 900); total uranium (by ASTM D5174); and nitroaromatics (by USEPA SW846 Method 8330) will be shipped to General Engineering Laboratories' laboratory at the following address:

**General Engineering Laboratories
Attn: Sample Custodian
3040 Savage Road
Charleston, SC 29407
Telephone: (843) 556-8171
Fax: (843) 766-1178**

Maxim will notify GEL's project manager when samples are shipped.

All aqueous samples collected for organic analysis will be shipped on the day of sample collection. All other samples may be stored on site for up to 48 hours before shipment. Any samples stored on site overnight will be placed in a locked and secured building or trailer.

6.1.2 Geotechnical Samples

Samples for geotechnical testing will be sent to Maxim's St. Louis Laboratory at the following address:

**Maxim Technologies Inc.
Attn: Jim Shetley, Sample Custodian
1908 Innerbelt Business Center Drive**

St. Louis, MO 63114-5700
Telephone: (314) 426-0880
Fax: (314) 426-4212

The number and type of geotechnical samples are summarized in Section 4 of this Field Sampling Plan.

6.1.3 Quality Assurance (QA) Split Samples

A systems audit for this project will consist of collection and shipment of split samples for each analytical parameter to Argonne National Laboratory. Unless otherwise instructed, split samples will be shipped to:

Argonne National Laboratory
Building 205
Room L176
9700 S. Cass Avenue
Attn: Alice Birmingham
Phone: 630-252-4473
630-252-4379
Fax: 630-252-5655

Ms. Birmingham will be notified by telephone at least 48 hours in advance of shipment of split samples. Ms. Birmingham will provide a QA tracking number and this number will be recorded on the chain-of-custody form which accompanies the shipment of QA samples.

6.2 Sample Packaging

The following two sections detail the packaging requirements for general environmental and hazardous samples.

Before samples are shipped, the Field Radiation Safety Officer will estimate the specific activity of each sample using a Bicon Microrem Meter and an Eberline R02 meter and calculating an activity. If the field tests indicate that the specific activity of a sample may be greater than 2 nCi/g, a "radioactive" label will be affixed to the sample container and the sample will be shipped as a radioactive material using the procedures described in the Radiation Protection Plan.

Environmental samples will be packaged for shipment as follows:

1. Sample container is adequately identified with sample labels. Sample labels are placed on samples at this time if required.
2. All bottles, except the volatile organic analysis (VOA) vials, are taped shut with electrical tape (or other tape as appropriate).

3. Each sample bottle is wrapped in bubble wrap and then placed into a resealable plastic bag. For VOA water samples, each vial is wrapped in a paper towel, and the two vials are placed in one bag. If a trip blank is submitted, it will also be wrapped and placed in a bag. As much air as possible is squeezed from the bag before sealing.
4. A picnic cooler (such as a Coleman or other sturdy cooler) is typically used as a shipping container. In preparation for shipping samples, the drain plug is taped shut from the inside and outside, and a large plastic bag is used as a liner for the cooler. Approximately three inches of styrofoam beads is placed in the bottom of the liner.
5. The bottles are placed upright in the lined picnic cooler in such a way that they do not touch and will not touch during shipment.
6. Additional inert packing material is placed in the cooler to partially cover the sample bottles (more than halfway).
7. All samples should be shipped to the laboratory in coolers containing natural ice and will be chilled to approximately 4°C, except for geotechnical samples, which do not require shipment with ice. If samples are required to be shipped to the laboratory with ice, a temperature blank will be prepared at the time samples are packed and included with the samples in the cooler. The temperature blank will consist of a small plastic bottle or 40 mL vial filled with tap water. The fact that a temperature blank is included in the shipment will be recorded on the chain-of-custody form. Ice in double bags will be placed on top of the sample bottles.
8. The cooler is then be filled with inert packing material and the liner taped shut.
9. The original chain-of-custody and one copy is placed inside a plastic bag and the bag is sealed and taped to the inside of the cooler lid. The air bill number and the name of the overnight carrier will be recorded on the chain-of-custody. A copy of the chain-of-custody will be retained by the Site Manager. The laboratory, upon receipt of the samples, will transmit the original copy of the chain-of-custody to Maxim's Analytical Services Coordinator.
10. The cooler is closed and taped shut with strapping tape.
11. Two signed and dated custody seals are placed on the cooler, one on the front and one on the side.
12. The cooler is handed over to the overnight carrier. A standard air bill is necessary for shipping environmental samples. The shipper should be aware of carrier weight or other policy limitations.
13. A label, which identifies the shipper and the receiver, is affixed to each cooler identifying the contents as "Environmental Samples".

6.3 Sample Shipment

All samples will be shipped by overnight courier delivery service. Aqueous samples collected for organic analysis will be delivered to the analytical laboratory within 24 hours of collection. Other samples may be stored at the site for up to 48 hours before they are shipped.

A Shipping Container Checklist Summary is presented in Exhibit 6-1.

SECTION 7

7.0 INVESTIGATION-DERIVED WASTE (IDW) AND DISPOSAL APPROACH

During the performance of field RI activities at NFSS, IDW will be managed in accordance with RCRA requirements and the EPA IDW policy. IDW includes liquid or solid wastes generated during performance of an environmental investigation that cannot be effectively reused, recycled, or decontaminated in the field. IDW typically consists of waste that could potentially pose a risk to human health or the environment (e.g., decontamination wastes). The types of IDW anticipated to be generated during the field activities include: (1) soil cuttings, (2) monitoring well development and purge waters, (3) decontamination fluids, and (4) used personal protective equipment and disposable sampling equipment.

All soil cuttings, monitoring well development and purge water, decontamination fluids, used personal protective equipment, and disposable sampling equipment will be collected and drummed/contained during RI activities. Analytical results from the field samples submitted for laboratory analysis will be used for preliminary waste characterization for soil cuttings and monitoring well development/purge water. Characterization of decontamination fluids, used personal protective equipment, and disposable sampling equipment generated during the project will be accomplished through dedicated sampling and analysis. Additional samples of IDW may be collected for specified waste acceptance criteria required by candidate disposal facilities.

After the analysis of all field samples is completed, a review the soil and groundwater results will occur and determine if it is possible that any analytical parameter could occur in the IDW at concentrations sufficient to cause the IDW to be considered a Hazardous or Mixed waste. Candidate disposal facilities and will be identified their acceptance criteria will be determined. This information will be used to estimate IDW disposal costs. This information will be supplied to the USACE and the USACE will decide on the manner of disposal of the IDW. Prior to making this decision, the USACE may request analysis of IDW samples. The selected disposal facility may also request additional analysis. If the USACE has determined the IDW will be disposed at an off-site facility, the waste containers will be prepared for transport. Manifests will also be prepared for signature by the USACE. If the USACE determines that the IDW may be disposed on-site, the disposal will of the IDW will be in the manner prescribed by the USACE.

7.1 IDW Collection and Containerization

The following sections describe the IDW collection and containerization activities.

7.1.1 Soil Cuttings

Visual inspections, organic vapor measurements, and radiation measurements will be used to evaluate potential presence/absence of contamination in soil cuttings. The cuttings will be containerized in properly labeled DOT-approved 55-gallon steel drums. The drums will be filled to no more than 25 cm (10 in) from the top to prevent rupture during freezing weather. All soil wastes and drill cuttings will be segregated by borehole and containerized at the point of generation.

The drums will be moved to a centralized IDW storage/staging facility (concrete pad with appropriate fencing) in the vicinity of Building 401 and will be stored on pallets.

7.1.2 Development and Purge Water

All development and purge water will be placed in a 1,200 liter (300 gallon) portable storage tank at the point of generation. The contents of this tank will then be transferred and stored on the site in 5,800 liter (1,500 gallon) PVC storage containers which will be located at the centralized IDW storage/staging facility near Building 401.

7.1.3 Steam Cleaning and Equipment Decontamination Liquids

No organic solvents will be used in the field during decontamination of sampling equipment.

Decontamination of environmental sampling equipment will be accomplished using procedures as described in Section 4.0 of Maxim's General Sampling Procedures Manual.

Decontamination water will be collected at the equipment decontamination station and inspected by the Site Manager. All steam cleaning and decontamination water will be placed in a 1,200 liter (300 gallon) portable storage tank at the point of generation. The contents of this tank will then be transferred and stored on the site in 5,800 liter (1,500 gallon) PVC storage containers. The containers will be placed in a centralized location in the vicinity of Building 401.

7.1.4 Disposal of Personal Protective Equipment and Disposable Sampling Equipment

Personal protective equipment IDW includes Tyvek and/or Saranex coveralls, disposable gloves, boot covers, and respirator cartridges. Paper towels, plastic sheets, pumps, tubing, garbage bags, and other disposable tools or supplies may also fall into this category. In no case will trash or other wastes be allowed to remain at the work site overnight.

Used PPE and sanitary waste that are not contaminated will be placed in trash bags at point of generation. These bags of sanitary PPE and waste will be collected in lined, sanitary trash cans with lids. PPE and sanitary waste that are visibly contaminated, or that exhibit radiological contamination above background when measured using hand-held radiological screening instruments, will be placed in a new 55-gallon open-top drum (meeting appropriate HM-181 performance oriented packaging specifications). Prior to the placement of any PPE into trash bags or drums, the PPE will be torn/cut in such a manner as to render it unusable.

7.1.5 Waste Minimization

During project activities, waste generation will be minimized at all times to the greatest extent practicable. Waste will be minimized by limiting access to restricted areas, reuse and decontamination of equipment, and use of nonhazardous materials.

7.2 IDW Container Labeling

Drums containing the same type of waste will be grouped and placed on pallets (four drums to a pallet) within the staging area with labels clearly visible for identification and inspection. Only one size of drum will be placed on each pallet. Labels will be applied adjacent to, but not covering, the container's seam to allow for visual inspection for the seam. Labels will not be placed on the top of the container lid. If a container is not actively being used for waste accumulation, an "Empty" label will be affixed to the container and the container will be stored inverted. Tanks will be labeled on opposite sides and easily visible for identification and inspection. Each tank will be labeled according to the type of waste that it contains (i.e., decontamination water or monitoring well water).

Drums will be staged in single rows of pallets with a minimum 3 feet of aisle space between each row for accessibility and with all labels clearly visible for inspection. All drums or other containers will be properly sealed when not in use and labeled in indelible, waterproof ink.

7.2.1 General Waste Labeling Requirements

Upon initial placement of IDW into a bag, drum, or poly tank, a "Container Label" will be affixed to the container with all required information recorded on the label. Prior to classification, the IDW Container Label will state that analysis for the purposes of classification of the waste is pending. The IDW Container Label will be the only label placed on the drum until analytical results allow final classification.

Radiological results from the environmental soil samples will be compared to background soils radiological results. If any radiological parameter statistically exceeds the background concentration for that parameter, the IDW generated from that soil boring will be considered radiologically contaminated.

7.2.2 Nonhazardous and Hazardous Waste Labeling Requirements

Containers of IDW determined by the USACE to be nonhazardous for RCRA will be marked with a "Nonhazardous Waste" label in addition to the general waste labeling requirements. In addition the "Nonhazardous Waste" label will be used on containers that contain IDW that exhibits radiological contamination but are nonhazardous for RCRA, in conjunction with the radiological label. Containers of IDW determined by the USACE to be RCRA hazardous will be marked with a "Hazardous Waste" label in addition to the general waste labeling requirements. Placement of "Nonhazardous Waste" and "Hazardous Waste" labels onto containers will be completed no later than 30 days after receipt of final analytical results used to characterize and classify the waste.

7.2.3 Radioactive Waste Labeling Requirements

All IDW exhibiting radiological contamination will be labeled with a radioactive material label. Placement of "Radiological Waste" label onto containers will be completed no later than 30 days after receipt of final analytical results used to characterize and classify the waste.

7.3 IDW Field Staging

The following sections describe the IDW staging locations and staging area descriptions.

7.3.1 Staging Area Locations

The staging areas for project wastes will be established within an area or areas designated by the USACE prior to initiation of field activities. If possible, this location will have restricted access. To the greatest extent possible, the waste container storage area will be secured, to prevent unauthorized access.

7.3.2 Staging Area Descriptions

Special requirements for the staging areas will include sufficient space to stage all drums and tanks needed during the project. At this time, the concrete foundation pad of former Building 430 to serve as the centralized solid IDW storage/staging area. Labeling for these containers will follow requirements outlined in Section 7.2. The staging area will be fenced, and applicable warning signs will be posted as needed. All waste containers will be inspected to ensure container integrity and handled in a manner that is protective of human health and the environment.

All waste types generated at the various areas addressed during the project will be containerized as described in Section 7.1, and moved to a staging area within approximately 48 hours of containerization. The wastes will remain within the staging area until approval for disposal is granted by the USACE.

7.4 Waste Characterization and Analysis for Landfill Acceptance Criteria

Typically, samples are collected from the water, soil, and solid waste IDW characterization. Samples are extracted for TCLP constituents by USEPA SW846 Method 1311, and analyzed for: TCLP volatile organic compounds by USEPA SW846 Method 5035/8260B; TCLP semi-volatile organic compounds by USEPA SW846 Method 3550B/8270C; TCLP pesticides by USEPA SW846 Method 3550B/8081A/8082; TCLP herbicides by USEPA SW846 Method 3510C/8151A; TCLP metals by USEPA SW846 Methods 3050B/6010B/7000; ignitability by USEPA SW846 Method 1110; corrosivity as pH by USEPA SW846 Method 9045; and reactivity by USEPA SW846 Section 7.3. Other analytes may be necessary as required by the disposal facility.

In addition to performing analyses to determine if the generated IDW possesses the characteristics of a hazardous waste as outlined in 40 CFR 261, typically, IDW is sampled for the following supplemental analyses:

- moisture content (solids only)
- Paint filter tests (solids only; most disposal facilities require solid waste to pass this test before accepting it for disposal)
- Analysis for the presence of radioactivity:

- gross alpha/beta
- total gamma scan
- Uranium-235/238
- Thorium-230
- Radium-226

Since the radionuclides are considered contaminants of concern for the NFSS, it is anticipated that candidate disposal facilities would require knowledge of their presence or absence before accepting or rejecting the IDW.

The above-reference waste acceptance criteria analyses are relatively standard for most disposal facilities. However, specific waste acceptance analytical requirements cannot be formally defined until a disposal facility is selected for IDW disposal.

7.5 Selection of Disposal Facility

Based upon past experience, the potential candidate handling alternatives which may be appropriate for the NFSS IDW include:

- **Alternative 1 (Off-site Disposal Scenario):** Off-site disposal of solid and/or liquid IDW at an approved Disposal facility(s).
- **Alternative 2 (On-Site Storage Scenario):** Another alternative potentially applicable to the liquid and/or solid IDW which will be generated during RI activities at the NFSS is to containerize the waste(s) as generated and store it on-site until the major remediation activity is initiated. During remediation activities, it is anticipated that the IDW generated during the RI will be disposed of with the K-65 and other residuals associated with the WCS. This scenario appears to be consistent with the approach outlined in USEPA/OERR Directive 9345.3-02 (Management of Investigation-Derived Wastes During Site Investigations, May 1991). In summary, the IDW management approach identified in this document allows for leaving IDW on-site as long as the site is in no worse condition than existed prior to the initiation of investigation activities. Again, waste characterization is a key element in the development of an IDW management strategy for the NFSS site.
- **Alternative 3 (On-Site Treatment Scenario):** This alternative involves the on-site treatment of liquid IDW prior to discharge a receiving stream at the NFSS. The treatment of the liquid IDW will be dictated by its characterization. In addition, this alternative may involve the processing of the solid IDW (chemical solidification and stabilization [CSS] or other appropriate treatment process) for on-site or off-site disposal.
- **Alternative 4 (Disposal On-Site Scenario):** The USACE may determine that the soil and water IDW may be disposed on-site at the point of generation. If not prohibited by state regulations or ARARs, CERCLA has provisions for allowing soil and water IDW to be returned to the point of origin and deposited onto the ground. These provisions are discussed in USEPA/OERR Directive 9345.3-02.

Several off-site disposal facilities, identified through the landfill survey (Task 3), will be evaluated on the following criteria:

- Ability to accept the liquid or solid IDW based upon characteristics analyses and other information available for the IDW
- Permit or licenses to accept the waste anticipated to be sent to the facility
- Treatment/Disposal Costs
- USACE Preference/Approval
- Disposal facility reputation and potential liability
- Insurance

Results of the disposal facility evaluation will be presented in a brief summary report and submitted to the Buffalo District for their use in determining the final disposition of the IDW.

7.6 IDW Preparation Activities Prior to Transportation and Disposal

After IDW characterization is completed, inventory and waste characterization profiles can be prepared for the liquid and solid IDW. These waste profiles will then be sent to the disposal facility(s) for evaluation and final acceptance. Based upon past experience, the coordination is required between the consultant and the disposal facility to finalize the acceptance of the waste(s). Once the waste is accepted, coordination is then required to schedule the transportation of the waste to the disposal facility. Coordination activities typically performed by the consultant include:

- Preparation of waste manifests and getting them signed by the generator. In the case of the IDW at NFSS, the generator would be the USACE.
- Make sure that all of the IDW is packaged and labeled in accordance to disposal facility requirements.
- Stage the IDW containers in an area which can be easily accessed by the disposal facility for transportation. This may require the use of a fork lift to move the containers to or within the IDW staging area.
- If necessary. Provide directions to the disposal facility for the transporter.

7.7 Disposal of IDW

If off-site disposal of the IDW is required, a schedule will be established between the contractor, the USACE and the disposal facility. Typically, on-site representatives will be located at the site to coordinate the IDW pickup.

During IDW loading operations, photographs documenting the pickup activities will be taken. Once the truck is loaded with the IDW, the contractor usually signs the drivers inventory form documenting the volume of waste picked up from the site. If a USACE representative is on-site, that person usually exercises signatory authority.

After the IDW is off-site and transported to the disposal facility, a brief report documenting the disposal of the IDW will be prepared for submission to the USACE for review and approval. This brief report usually includes:

- Type, volume and chemical characterization of the IDW which was sent to a Disposal facility for disposal
- Disposal facility Information w/insurance certificates, etc.
- Narrative and photo documentation of the IDW staging and disposal activities
- Manifest forms/bill of lading forms
- Certification of Treatment and/or Disposal (issued by Disposal facility after these activities are completed)

SECTION 8

8.0 CONTRACTOR CHEMICAL QUALITY CONTROL (CCQC)

As a means of quality control, the following sections describe the responsibilities of the contractor chemical quality control (CCQC) and actions to be performed prior to and during the field activities performed at the NFSS.

8.1 CQC Representative

The Buffalo District Corps of Engineers will identify the onsite chemical quality control (CQC) representative for the project. If no CQC representative is identified, all responsibilities will be assumed by the Site Manager.

8.2 Listing of Field Equipment

A checklist of field equipment and other materials is presented in Exhibit 8-1.

8.3 Description of Activities During CCQC Phases

A listing of activities is presented in Exhibit 8-2.

8.4 Identification of Definable Features of the Work

The following sections describe the definable features of work to be completed at the NFSS.

8.4.1 Planning

The Quality Assurance Project Plan (QAPP), Field Sampling Plan (FSP), Site Safety and Health Plan (SSHP), Radiation Protection Plan (RPP), Quality Control Plan (QCP), and subsequent addenda will be prepared, submitted, and approved by the USACE.

8.4.2 Drilling

Boreholes located in the Building 401 area, the former shop area, the former acidification area, the Baker Smith area, the former radioactive residue storage areas, and the previously uninvestigated areas will be drilled.

8.4.3 Digging with Hand Tools

Surface soil samples and sediment samples will be collected using hand tools.

8.4.4 Sampling

Surface soil, subsurface soil, sediment, surface water, and groundwater samples will be collected during Phase I and Phase II of the RI. Wipe, asbestos, and lead paint samples, as well as a site radiological walkover survey may be accomplished in future sampling events.

8.4.5 Analysis

Surface soil, subsurface soil, sediment, surface water, and groundwater samples will be analyzed in an offsite laboratory for chemical, radiological, and geotechnical parameters. Wipe, asbestos, and lead paint samples may be analyzed in an offsite laboratory during future sampling events.

8.4.6 Reporting

The laboratory analytical data will be submitted as soon as it is available and is concluded to be accurate and correct. The Draft and Final Phase I Remedial Investigation Reports will be subsequently submitted.

8.5 Sample Tables

Tables summarizing all samples including QA samples are presented in Section 4.

8.6 Responsibilities During Project Phases

The CQC representative and the Site Manager will have the following responsibilities during the following project phases.

8.6.1 Preparatory Phase

The Site Manager will be primarily responsible for implementation of the preparatory phase oversight. This will include a review of all work requirements; a physical examination of all required materials and equipment; delegation of inspection of drilling equipment to the drilling subcontractor; an examination of work areas to ascertain completion of all preliminary work; and a demonstration of all field activities. If new sampling or technical personnel arrive on-site during the work effort, the CQC representative must repeat this phase before new personnel begin work.

8.6.2 Initial Phase

The Maxim Site Manager is responsible for overseeing every step of the definable feature of work when that work is first initiated. The CQC representative should oversee the sampling activities and review the work for compliance with contract requirements.

8.6.3 Follow-up Phase

The CQC representative is responsible for continued daily contract compliance until completion of the particular feature of work.

SECTION 9

9.0 DAILY CHEMICAL QUALITY CONTROL REPORTS (DCQCR)

This section is intended to describe daily chemical quality control reports.

During the field investigation activities, DCQCRs will be prepared daily, dated, signed by the CQC representative, and sent to USACE weekly. With respect to radiological, geotechnical, and chemical procedures, these reports should include weather information at the time of sampling, field instrument measurements, calibrations, departures from the approved FSP, deviation from approved geotechnical and field analytical procedures (such as well installation or drilling), problems, and instructions from government personnel. Any deviations that may affect DQOs must be conveyed to USACE personnel (technical manager, project chemist, etc.) immediately. The following will be attached to the DCQCRs: quality assurance sample tables that match up primary and QA samples, copies of chain-of-custody forms, field-generated analytical results, and any other project forms that are generated. An example of this form is presented in Exhibit 9-1.

Laboratory DCQCR's will be prepared daily and submitted to USACE weekly. Daily work progress, samples received and logged in, extractions completed, analysis performed, problems encountered, corrective actions taken, and documentation should be included. Laboratory problems will be reported to USACE personnel immediately so corrective action may be taken. An example of this form is presented in Exhibit 14-1 in the QAPP.

Records of substantive telephone or written communication will be documented by e-mail, fax, or mail.

SECTION 10

10.0 CORRECTIVE ACTIONS

This section is intended to describe corrective actions to be taken in the event a discrepancy is discovered by field personnel, or during a desk or field audit, and/or the laboratory discovers discrepancies or problems.

Typical discrepancies or problems include, but are not limited to: improper sampling procedures, improper instrument calibration procedures, improper sample preservation, problems with samples upon receipt at the laboratory, etc.

The general procedures that should be followed are described in Section 10.0 of the QAPP.

SECTION 11

11.0 PROJECT SCHEDULE

The following schedule is for the activities to be performed at the NFSS.

Deliverable	Due Date (time in calendar days)	Completed/Due
Fernald Paper	Draft 30 days from initial site visit	June 1, 1999
Task 1: Records Review	30 days from initial site visit	
Task 2: Visual Site Inspection and Preparation of Drawings	VSI 15 days from NTP / dwgs 75 days from initial site visit	Initial site inspection April 20, 1999 Detailed site survey completed July 16, 1999
Draft Work Plans Including outline for QCP, SSHP, and RPP	75 days from NTP	July 26, 1999
Final Draft: Work Plan for submittal to Virtual Team	15 days from receipt of comments on Draft	September 27, 1999
Final Work Plans Including outline for QCP, SSHP, and RPP	15 days from receipt of comments Comments Due Oct 18 Final due approximately on Nov 2	
Task 3: Landfill Survey	45 days from AWP Approx. Sept 30	
Task 4: ARARs	30 days from AWP Rev. Approx. Oct 31	
Task 5: Data Needs Determination	40 days from AWP Rev. Approx. Oct 31	
Task 6: FSP/QAPP	50 days from AWP Rev. Approx. Oct 31	
Task 7a: Begin Field Work	60 days from approval of work plans (AWP); Hours dependent upon fieldwork needs Approx. Nov 15	
Task 7a: End Field Work	8 months from start of field work	
Task 8: Interim Action Determination	60 days from AWP	
Task 9: Identify Remedial Areas and Volumes	45 days from end of field work (not authorized)	
Task 10: SSHP/Radiation Protection Plan	Part of Work Plan Rev. Approx. Oct 31	
Task 11: QCP/ITR	75 days from NTP Approx. Sept 30	
Task 12: Community Relations/General Support	Ongoing	
Task 13: Preparation of RI/FS Draft Report (Includes human risk assessment)	6 months from receipt of field data (not authorized)	
Task 13a: Receive Comments on Draft Report	30 days from issue of report (not authorized)	
Task 13b: Preparation of RI/FS Final Report	15 days from end of comment period (not authorized)	

Deliverable	Due Date (time in calendar days)	Completed/Due
Task 14: Prepare Proposed Plan (PP)	15 days from approval of final RI/FS Report (not authorized)	
Task 15: Provide PP Public Meeting Support, Responsiveness summary and Draft ROD	60 days from issuance of proposed plan (not authorized)	

SECTION 12

12.0 ANALYSIS OF FIELD DATA

The following sections describe the analysis of the field data that will be generated during the field activities performed at the NFSS.

12.1 Data Review

Field and laboratory data will be reviewed for completeness, precision, and accuracy. Data will be integrated into Microstation format, tabulated, and related to specific locations.

12.2 Compare Data to Regulatory Limits

Data will be compared to background values and ARARs. Samples which exceed these values will be noted.

12.3 Recommend Phase II Field Investigation

Based on the analysis of the Phase I field investigation data, recommendations for Phase II of the field investigation will be presented in an addendum to the FSP.

SECTION 13

13.0 PRELIMINARY REMEDIAL INVESTIGATION REPORT FORMAT

The following is an outline of the preliminary remedial investigation report that will be generated following completion of the field activities performed at the NFSS.

Executive Summary

- 1.0 Introduction
 - 1.1 Purpose of Report
 - 1.2 Site Background
 - 1.2.1 Site Description
 - 1.2.2 Site History
 - 1.2.3 Previous Investigations
 - 1.3 Report Organization
- 2.0 Study Area Investigation
 - 2.1 Includes field activities associated with site characterization
 - 2.1.1 Surface features
 - 2.1.2 Contaminant Source Investigations
 - 2.1.3 Meteorological Investigations
 - 2.1.4 Surface Water and Sediment Investigation
 - 2.1.5 Geological Investigations
 - 2.1.6 Soil and Vadose Zone Investigations
 - 2.1.7 Groundwater Investigations
 - 2.1.8 Human Population Surveys
 - 2.1.9 Ecological Investigations
 - 2.2 Technical Memoranda Documenting Field Activities
- 3.0 Physical Characteristics of the Site
 - 3.1 Includes results of field activities to determine physical characteristics. These may include some, but not necessarily all of the following:
 - 3.1.1 Surface Features
 - 3.1.2 Meteorology
 - 3.1.3 Surface Water Hydrology
 - 3.1.4 Geology
 - 3.1.5 Soils
 - 3.1.6 Hydrogeology
 - 3.1.7 Demography and Land Use
 - 3.1.8 Ecology
- 4.0 Nature and Extent of Contamination
 - 4.1 Presents the results of site characterization, both natural chemical components and contaminants in some, but not necessarily all, of the following media:

- 4.1.1 Sources (lagoons, sludges, tanks, etc.)
 - 4.1.2 Soil and Vadose Zone
 - 4.1.3 Groundwater
 - 4.1.4 Surface Water and Sediments
 - 4.1.5 Air
- 5.0 Contaminant Fate and Transport
 - 5.1 Potential Routes of Migration (i.e., air, groundwater, etc.)
 - 5.2 Contaminant Persistence
 - 5.2.1 If they are applicable (i.e., for organic contaminants), describe estimated persistence in the study area environment and physical, chemical, and/or biological factors of importance for the media of interest
 - 5.3 Contaminant Migration
 - 5.3.1 Discuss factors affecting contaminant migration for the media of importance (i.e., sorption onto soils, solubility in water, movement of groundwater, etc.)
 - 5.3.2 Discuss modeling methods and results, if applicable
- 6.0 Baseline Risk Assessment
 - 6.1 Human Health Evaluation
 - 6.1.1 Exposure Assessment
 - 6.1.2 Toxicity Assessment
 - 6.1.3 Risk Characterization
 - 6.2 Environmental Evaluation
- 7.0 Summary and Conclusions
 - 7.1 Summary
 - 7.1.1 Nature and Extent of Contamination
 - 7.1.2 Fate and Transport
 - 7.1.3 Risk Assessment
 - 7.2 Conclusions
 - 7.2.1 Data Limitations and Recommendations for Future Work
 - 7.2.2 Recommended Remedial Action Objectives

Appendices

- A Technical Memoranda on Field Activities
- B Analytical Data and QA/QC Evaluation Results
- C Risk Assessment Methods

TABLES

Table 1.1.3.7-1
Listing of Earthquakes Recorded Since 1857 in the NFSS Area
Above the Modern Mercalli Intensity Value of IV

Date	Location	Distance from NFSS	MMI
October 23, 1857	Buffalo, New York	35.4 km (22 mi) South	VI
July 6, 1873	St. Catharines, Ontario, Canada	24.2 km (15 mi) West	VI
August 21, 1879	Northwest of Buffalo, New York	25.8 km (16 mi) South	V
November 12, 1927	Niagara Falls, Ontario, Canada	16.1 km (10 mi) South	IV
August 12, 1929	Attica, New York	72.5 km (45 mi) Southeast	VII
December 2, 1929	Attica, New York	72.5 km (45 mi) South	V
December 3, 1929	Attica, New York	72.5 km (45 mi) Southeast	IV
April 22, 1931	Buffalo, New York	35.4 km (22 mi) South	IV
August 16, 1955	Attica, New York	72.5 km (45 mi) Southeast	V
March 27, 1952	Niagara Falls, New York	16.1 km (10 mi) South	V
July 16, 1965	Attica, New York	72.5 km (45 mi) Southeast	IV
August 27, 1965	Attica, New York	72.5 km (45 mi) Southeast	IV
January 1, 1966	Attica-Varysburg, New York	80.5 km (50 mi) Southeast	VI
June 13, 1967	Attica-Alabama, New York	56.4 km (35 mi) Southeast	VI
August 12, 1969	Attica, New York	72.5 km (45 mi) Southeast	IV

Note: A Modern Mercalli Intensity of I would most likely go unnoticed, a VI would probably be felt by everyone and cause slight damage, and a XII would result in total destruction (Table after Bastedo, 1999)

MMI Modern Mercalli Intensity
NFSS Niagara Falls Storage Site

Table 1.1.4.4-1
Principal Uses of the Groundwater in the Niagara Falls Area
(During 1961-62)

Use/Percentage of Total Usage	Average Pumping of the Lockport Dolomite		Average Pumping of the Unconsolidated deposits and the Queenston Formation	
	(in mld)	(in mgd)	(in mld)	(in mgd)
Agricultural / 5%	1.70	0.45	0.19	0.05
Air conditioning / 1%	0.34	0.09	0.04	0.01
Domestic / 13%	4.43	1.17	0.49	0.13
Industrial / 81%	27.25	7.20	3.03	0.80
Total	33.72	8.91	3.75	0.99

Source: Groundwater in the Niagara Falls Area, New York, With Emphasis on the Water-Bearing Characteristics of the Bedrock, Bulletin GW-53, Richard H. Johnston, U.S. Geological Survey, State of New York Conservation Department, Water Resources Commission, 1964.

Note: mld - million liters per day
mgd - million gallons per day

**Table 1.2.2.1-1
History of the L-50 Residue**

DATE	Action	Volume	Radiological Info
1944	Low grade radioactive residues from the pitchblende ore processing at Linde Air Products (also referenced as Linde Ceramics), Tonawanda, New York were placed at the Manhattan Engineering District portion of the Lake Ontario Ordnance Works site. The L-50 residue was transported in bulk and placed in Buildings 413 and 414 in the water treatment area. These buildings are 62 feet in diameter and 19 feet high. (NFSS-187)		Raw Ore 7% Uranium Oxide (U_3O_8)
1965	Three drums of L-50 residue were discovered during an inspection in Building 412. (NFSS-187)		
1978	L-50 Volume	1,624 m ³ (NFSS-069)	
1979	The three drums containing L-50 residue were moved to building 411. (NFSS-187) L-50 storage buildings 413 and 414 were attempted to be sealed with an asphalt emulsion. (NFSS-054)		
1980	Radium Inventory	1,624 m ³ (NFSS-182)	Uranium 1,000 to 2,100 ppm Radium 7.8 to 12 pph 12x10 ³ pCi/g (NFSS-182)
1982	Buildings 413 and 414 were sealed to reduce emissions of Radon from L-50 residues. (NFSS-133)		
1994	L-50 Volume	1,500 m ³ (NFSS-005)	Uranium 100 to 4,000 ppm 67 to 2,664 pCi/g Radium 7 to 12 pph 5x10 ⁻³ to 8x10 ⁻³ pCi/L (NFSS-133)

**Table 1.2.2.2-1
History of the R-10 Residue**

DATE	Action	Volume	Radiological Info
1944	Low grade radioactive residues from the pitchblende ore processing at Linde Air Products (also referenced as Linde Ceramics), Tonawanda, New York were placed at the Manhattan Engineering District portion of the Lake Ontario Ordnance Works site. (NFSS-187)		Raw Ore 2.6 to 3.0% Uranium Oxide (U_3O_8)
1949	R-10 pile found to be "dusting the surrounding environment". (NFSS-011)		
1955 - 1958	Waste from 1,297 acres of offsite properties that were remediated and declared as surplus is transferred to R-10 pile. (NFSS-011)		
1964 - 1965	R-10 pile covered with dirt and seeded to provide a grass-covered sod layer. (NFSS-054)		
1970 - 1972	Waste from cleanup of surrounding properties and Six Mile creek was placed on the R-10 pile. (NFSS-187)	11,300 to 15,000 m ³ (15,000 to 20,000 yd ³) (NFSS-187)	
1978	R-10 Volume	7,084 m ³ (NFSS-069)	
1980	Radium Inventory	53,340 m ³ (NFSS-182)	Radium 3,200 pCi/g Uranium 1,000 to 145,000 ppm (NFSS-182)
1981	Soil from vicinity property excavated and placed on R-10 pile. (NFSS-054)		
1982	Dike and cutoff wall constructed around the R-10 area. Pile covered with a liner to reduce radon emissions. (NFSS-054)		
1983 - 1984	EPDM liner and concrete block is removed from the R-10 pile. (NFSS-054)		
1994	R-10 Volume	45,000 m ³ (NFSS-005)	Uranium 2,300 pCi/g 1,532 pCi/g Radium 3 ppb 2×10^{-3} pCi/g (NFSS-133)

**Table 1.2.2.3-1
History of the F-32 Residue**

DATE	Action	Volume	Radiological Info.
1944 to early 1950	Radioactive F-32 residues from the torbernite (Q-20) ore processing at Middlesex, New Jersey were transferred to the Lake Ontario Ordnance Works in 1,400 drums. The drums were emptied into the recarbonation pit in the water treatment area. Reusable drums were returned to Middlesex, others were sent to the onsite drum graveyard (location unknown). (NFSS-011) and (NFSS-187)	~252 m ³ (~330 yd ³)	Raw Ore 20 to 50% Uranium Oxide (U ₃ O ₈)
1978	F-32 Volume	110-336 m ³ (NFSS-069)	
1980	Radium Inventory	333 m ³ (444 yd ³) (NFSS-182)	Radium 300 pCi/g (NFSS-182)
1981	The F-32 residue was reported as being stored in Building 410 at the water treatment facility at the LOOW. (NFSS-011)		
1994	F-32 Volume	500 m ³ (NFSS-005) 440 yd ³ (NFSS-133)	Uranium 4,000 to 6,500 ppm 2,664 to 4,329 pCi/g Radium 5 ppb 3x10 ⁻³ pCi/g (NFSS-133)

**Table 1.2.2.4-1
History of the L-30 Residue**

DATE	Action	Volume	Radiological Info
December 1943 - October 1944	Linde Air Products ships sludge (packed wet and stored in wooden barrels) from Linde's warehouse (240 West Utica Street, Buffalo, New York) to the Lake Ontario Ordnance Works. The residue is temporarily stored in structures (possibly buildings 443, 444, and 445; known as the welding, storage, and pipe shops, respectively) in the Baker-Smith Area. (NFSS-187)		Raw Ore 10% Uranium Oxide (U_3O_8)
April 1945	The barrels containing the sludge were noticed to be deteriorating. Seventy-seven barrels were returned to Afrimet via Middlesex, New Jersey and the rest were moved into bulk storage in Building 411 (the cooling water reservoir in the water treatment area). This storage tank was filled by dump trucks discharging their load from the earthen embankment around three sides of the building through holes in the roof. (NFSS-187)		
July 1949	It was reported that water from a French drain ran under Building 411 into the Central Drainage Ditch. Dye testing over a period of several days showed no leakage from inside the building to the ditch. (NFSS-187)		
1952	Characteristics of L-30		Uranium 1,950 ppm (NFSS-182)
1978	L-30 Inventory	4,500 m ³ 6,020 yd ³ (NFSS-069)	
1980	Radium Inventory		Uranium 1,800 to 5,000 ppm Radium 12×10^{-3} pCi/g (NFSS-182)
1994	L-30 Inventory	6,000 m ³ (NFSS-005) 7,960 yd ³ (NFSS-133)	Uranium 440 to 5,000 ppm 293 to 3,300 pCi/g Radium 2 to 12 pCi/g 1×10^{-3} to 8×10^{-3} pCi/g (NFSS-133)

Table 1.2.2.5-1
History of the K-65 Residue

DATE	Action	Volume	Radiological Info
1946 - 1953	African ore uranium operations for the Atomic Energy Commission (AEC) were conducted at the Destrehan Street Plant of the Mallinckrodt Chemical Works refinery in St. Louis, Missouri. (NFSS-187)		Raw Ore 35 to 60% Uranium Oxide (U_3O_8)
1946 - April 1949	All residues were returned to African Metals, Inc. of Belgium (Afrimet or AMCB). (NFSS-187)		
April 1949	Six carloads of 96 drums each (576 drums) were delivered to the Lake Ontario Ordnance Works (LOOW). Two carloads were placed in open air storage on macadam surfaces and covered by tarpaulins. (NFSS-187)	~140 yd ³	
April 1949 - mid 1949	<p>Arrangements were made for a test storage of the K-65 residues in Igloo #9050, which was located north of Balmer Road. The igloo was originally built to house munitions storage. Four carloads of drummed K-65 residue were loaded into the igloo. One car was unloaded near the igloo and the others were unloaded at a platform near the open air storage area. Drums were touched up with paint in an empty building near the igloo unloading platform prior to storage. (NFSS-187) The test storage attempt failed. The failure was due to an initial test reading for radioactivity which registered 29 times the tolerance level of 300 milliRoentgen Equivalent Man/week (mrem/wk). Subsequent readings during the following day were 71 times the 300 mrem/wk tolerance level. (NFSS-011)</p> <p>Permanent storage options were explored after it became apparent that Afrimet was not going to remove the residue in the near future. Also, experience indicated that the drum life was limited due to the corrosive processing chemicals in the residue. LOOW was chosen for the K-65 storage due to its location, low population density, and available concrete structures suitable for residue storage.</p> <p>Engineering studies recommended using the cooling water storage tower (Building 434) as the storage site. The tower consisted of a 275,000 gallon tank supported by a 110 foot concrete tubular base capable of holding 725,000 gallons. The tower was reinforced with wire wrapping bound in gunite, fitted with four six-inch pipes to assist in emptying the tower with water jets, and filled with a 2.25 foot thick floor (elevated about 3.5 feet above ground level). The bottom configuration was painted white and allowed any leakage to be clearly visible through a manhole. (NFSS-187)</p>		

Table 1.2.2.5-1
History of the K-65 Residues
(continued)

DATE	Action	Volume	Radiological Info
1949 - 1950	Additional K-65 residue was stored in drums in the outdoor storage area and in Building 410. (NFSS-011) and (NFSS-150)		
Sept 1950 - April 1951	The bottom section of the tower was filled. Drums were delivered to the tower from a railroad siding and platform on the south side of the tower. Drums were fed by gravity conveyors through a thaw house capable of holding two carloads of drums. The drums were loaded on an elevator, which dumped the contents into a chute positioned to feed either the top or bottom section manholes of the tower. The empty drums were lowered and returned to the platform by gravity conveyor. After the lids were replaced, the drums were painted, loaded onto a boxcar, and returned to St. Louis for reuse. (NFSS-187)		
Sept 1950 to Nov 1951	The top section of the tower was filled to capacity. About 4,700 drums were still in the open air storage area. (NFSS-187)		
1951	The Stearns-Roger Company performed engineering studies to determine if the settling of the residue in the bottom section and the strength of the tower would allow the placement of an additional 1,000 tons of K-65 residue. (NFSS-187)		
Nov 1951	An additional 200 tons of K-65 residue was authorized and placed in the tower. (NFSS-187)		
Feb 1952	An additional 226 tons of K-65 residue was authorized and placed in the tower. (NFSS-187)		
Aug 1952 - Nov 1952	All remaining drummed K-65 residue was shipped to Fernald, Ohio. Of the 5,149 drums shipped, approximately 2,000 required redrumming prior to shipment due to corrosion of the drums. The redrumming was performed using remote devices on Castle Garden Road east of Building 421. (NFSS-187)		
1960	The W. E. Caldwell Company installed five 1-inch and sixty-one 0.875-inch metal bands on the bottom section to reinforce it. (NFSS-187)		
1965	B. M. Heede, Inc., covered the lower 110 feet of the tower with approximately six inches of concrete. This action resulted in sealing the bottom section access port which was located at the 100-foot level. (NFSS-187)		

Table 1.2.2.5-1
History of the K-65 Residues
(continued)

DATE	Action	Volume	Radiological Info
1980	The vent on the roof of Building 434 (the tower) was capped with a steel cap to reduce Radon gas emissions. Pipes penetrating the walls of the tower were also sealed or resealed. (NFSS-054) and (NFSS-011)		
1981	A radiological screening survey was performed on Igloo #9050. No contamination above the guidelines was indicated. (NFSS-187)	3,080m ³	Uranium 1,410 to 1,965 ppm Radium 220 ppb
1982	K-65 Storage Sample		²²² Rn 4 - 117 nCi/l ²²⁶ Ra 217x10 ³ pCi/g (NFSS-182)
1983 - 1985	Approximately 90 percent of the K-65 residues were transferred by hydraulic mining and a 4-inch steel slurry pipeline (approximately 25% solids and 75% water) from Building 434 to Bays A & C in Building 411 (later to be capped and called the Interim Wasted Containment Structure [IWCS]) where the slurry was dewatered. (NFSS-133) The water from the dewatering process was stored in onsite ponds and transferred to one of two 15,000 gallon bladder tanks that were attached to and ion-exchange (Hittmann) treatment system.		²²⁶ Ra 517x10 ³ pCi/g (NFSS-170)
1985	Excavation and transfer of the remaining K-65 residues from Building 434 to Building 411 was completed and the residues were placed in the IWCS at Bay A and the north end of Bay D. (NFSS-133) A demarcation layer was installed to identify the location of the K-65 residues. (NFSS-187) Impounded water was treated and discharged into the central ditch north of the IWCS. (NFSS-011)	3,200yd ³	Uranium 1,000 to 2,000 ppm Radium 180 to 360 ppb (NFSS-150)
late 1985	Building 434 is demolished and the rubble from the above grade and below grade portions of the tower were placed in the IWCS. All other pond liners and PVC piping used in the pipeline system was placed in the IWCS. (NFSS-133)		
1986	The cap over the IWCS was closed and impounded water was treated and discharged into the central ditch north of the IWCS. (NFSS-011)		U 666 to 1,332 pCi/g ²²⁶ Ra 120 to 240 pCi/g (NFSS-133)
1987	Impounded water was treated and discharged into the central ditch north of the IWCS. (NFSS-011)		
1995	K-65 Sample	3,000m ³	²²⁶ Ra 520,000 pCi/g total ²³⁰ Th 54,000 pCi/g total (NFSS-005)

TABLE 1.4-1

**MEDIA TO BE SAMPLED, SAMPLE LOCATIONS, AND TPP OBJECTIVES
 NIAGARA FALLS STORAGE SITE
 LEWISTON, NEW YORK**

Areas of Investigation	Knowledge of Area and Previous Investigation Results	Medium of Concern	Phase I Sampling Scheme to Address the Area of Investigation	DQO Goal(s) from TPP ¹
Interim Waste Containment Structure (IWCS)	The IWCS currently houses the radioactive residues, radioactively contaminated soil, drummed material from off-site, and building debris. The total volume included in the IWCS is 195,000 m ³ (255,000 yd ³). Wells surrounding the IWCS have historically indicated the presence of metals and radiological parameters at low levels in the upper water-bearing zone.	Lower Water-Bearing Zone Groundwater	Sample lower water-bearing zone using 8 existing wells	1, 2, 3a, and 3b
		Bedrock Aquifer Groundwater	Sample existing bedrock aquifer using existing well	
Building 401 Area	Building 401 was a coal-fired boiler house, boron-10 isotope separation plant, and a radioactive storage building. It has or has had several adjacent supporting buildings, where potentially hazardous materials (i.e., waste oil, solvents, or paints) were stored. Former railroad beds, potential outside coal storage, possible contamination from offsite sources, and known samples in the area containing VOCs and elevated levels of radioactivity have been noted around Building 401. Several USTs are depicted on the facility plans near Building 401. UST Fill pipes have been filled with concrete.	Surface Soil	Sample surface soil at 17 locations	3a, 3b, and 4
		Subsurface Soil	Sample subsurface soil at 17 locations	3a, 3b, and 4
		Upper Water-Bearing Zone Groundwater	Sample upper water-bearing zone at 17 locations	1, 2, 3a, and 3b
		Lower Water-Bearing Zone Groundwater	Sample lower water-bearing zone using 3 existing wells	
		Bedrock Aquifer Groundwater	Not addressed in this area during Phase I sampling activities	

TABLE 1.4-1

**MEDIA TO BE SAMPLED, SAMPLE LOCATIONS, AND TPP OBJECTIVES
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Areas of Investigation	Knowledge of Area and Previous Investigation Results	Medium of Concern	Phase I Sampling Scheme to Address the Area of Investigation	DQO Goal(s) from TPP¹
Former Shop Area	<p>The central portion of the NFSS was known as the shop area and contained a parking garage, an equipment maintenance garage and repair shop, material shed, general storehouse, combined shops, millwright shop, and riggers shop. A fuel oil pipeline and UST is depicted on the facility drawings. Radioactive residues were stored in several of the former buildings in this area. Other potentially hazardous materials may have been used in the shops (i.e., solvents and/or thinners).</p> <p>Screened samples indicated the presence of PCBs, PAHs, and VOCs. Levels of aluminum, beryllium, calcium, copper, magnesium, nickel, sodium, zinc, mercury, heptachlor epoxide, and acetone were detected in the soil samples above site-specific background concentrations or NYSDEC TAGM reporting limits. Other metals, pesticides, PCBs, and SVOCs were also reported above the detection limits.</p> <p>Concentrations of aluminum, antimony, iron, lithium, lead, magnesium, manganese, sodium, alpha-BHC, 1,1,1-trichloroethane and PCB were detected in a groundwater sample above site-specific background concentrations or NYSDEC TAGM levels. Other metals, VOCs, SVOCs, and nitroaromatics were also reported above the detection limits.</p>	Surface Soil	Sample surface soil at 12 locations	3a, 3b, and 4
		Subsurface Soil	Sample subsurface soil at 12 locations	3a, 3b, and 4
		Upper Water-Bearing Zone Groundwater	Sample upper water-bearing zone at 12 locations	1, 2, 3a, and 3b
		Lower Water-Bearing Zone Groundwater	Sample lower water-bearing zone using 3 existing wells	
		Bedrock Aquifer Groundwater	Sample bedrock aquifer using existing well	

TABLE 1.4-1

**MEDIA TO BE SAMPLED, SAMPLE LOCATIONS, AND TPP OBJECTIVES
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Areas of Investigation	Knowledge of Area and Previous Investigation Results	Medium of Concern	Phase I Sampling Scheme to Address the Area of Investigation	DQO Goal(s) from TPP¹
Former Acidification Area	<p>The northern central portion of the NFSS was initially used as the acidification and acid storage location for the TNT production plant. Several aboveground tanks storing nitric and sulfuric acids and other potentially hazardous materials, former process sewers, former scrap and waste dump, former sulfuric acid storage, and the former ammonia manufacturing plant are depicted on the facility drawings of this area. Possible fuel oil storage and TNT mix storage may have occurred in this area. Temporary storage locations and constructed vaults for storage of pure uranium, thorium, and radium billets, ingots, bars, and rods reportedly existed in this area.</p> <p>Screened soil samples indicated the presence of PAHs and VOCs. Levels of beryllium, calcium, copper, iron, magnesium, nickel, sodium, and zinc were detected in the soil samples above the site-specific background concentrations or NYSDEC TAGM reporting limits. Other metals and SVOCs in the soil samples were also reported above the detection limits.</p> <p>Concentrations of aluminum, calcium, iron, lead, magnesium, manganese, sodium, and heptachlor epoxide in a groundwater sample were detected above site-specific background concentrations or NYSDEC TAGM reporting limits. Other metals, VOCs, and SVOCs were also reported above the detection limits.</p>	Surface Soil	Sample surface soil zone at 21 locations	3a, 3b, and 4
		Subsurface Soil	Sample subsurface soil at 21 locations	3a, 3b, and 4
		Upper Water-Bearing Zone Groundwater	Sample upper water-bearing zone at 21 locations	3a and 3b
		Lower Water-Bearing Zone Groundwater	Sample lower water-bearing zone using 4 existing wells	
		Bedrock Aquifer Groundwater	Not addressed in this area during Phase I sampling activities	

TABLE 1.4-1

**MEDIA TO BE SAMPLED, SAMPLE LOCATIONS, AND TPP OBJECTIVES
 NIAGARA FALLS STORAGE SITE
 LEWISTON, NEW YORK**

Areas of Investigation	Knowledge of Area and Previous Investigation Results	Medium of Concern	Phase I Sampling Scheme to Address the Area of Investigation	DQO Goal(s) from TPP ¹
Baker Smith Area	<p>The Baker Smith area consisted of a storehouse, pipe shop, welding shop, and machine shop where potentially hazardous materials may have been used. Large loading and unloading platforms are depicted on the facility drawings directly north of this area which could have been an unloading platform for radioactive residues. Radioactive residue had been stored in these buildings prior to their demolition.</p> <p>Screened samples indicated the presence of PAHs and VOCs. Levels of aluminum, beryllium, calcium, copper, iron, and nickel were detected in soil samples above site-specific background concentrations or NYSDEC TAGM reporting limits. Metals and SVOCs were also reported above the detection limits.</p> <p>Concentrations of aluminum, antimony, iron, lithium, magnesium, and sodium were detected in an adjacent groundwater sample above site-specific background concentrations or NYSDEC TAGM reporting limits. Other metals, and nitroaromatics were also reported above the detection limits.</p>	Surface Soil	Sample surface soil at 3 locations	3a, 3b, and 4
		Subsurface Soil	Sample subsurface soil at 3 locations	3a, 3b, and 4
		Upper Water-Bearing Zone Groundwater	Sample upper water-bearing zone at 3 locations	1, 2, 3a, and 3b
		Lower Water-Bearing Zone Groundwater	Sample lower water-bearing zone using existing well	
		Bedrock Aquifer Groundwater	Sample bedrock aquifer using existing well	

TABLE 1.4-1

**MEDIA TO BE SAMPLED, SAMPLE LOCATIONS, AND TPP OBJECTIVES
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Areas of Investigation	Knowledge of Area and Previous Investigation Results	Medium of Concern	Phase I Sampling Scheme to Address the Area of Investigation	DQO Goal(s) from TPP¹
Former Residue Storage Areas	Radioactive residues were previously stored in and/or around Buildings 401, and former Buildings 420, 421, 422, 430, 431, 432, 433, 434, 443, 444, 445, and 722-1. This listing does not include those buildings that were associated with the former water treatment plant or are currently contained within the boundaries of the IWCS. With the exception of Building 401, none of the other listed buildings remain at the site. The area near former Building 434 (the tower) is currently open with a stand of trees ringing its perimeter. Slabs and building foundations are present at many of the former radioactive material storage building locations. No surface soil, subsurface soil, or groundwater samples have been collected in the former residue storage areas.	Surface Soil	Sample surface soil at 4 locations	3a, 3b, and 4
		Subsurface Soil	Sample subsurface soil at 4 locations	3a, 3b, and 4
		Upper Water-Bearing Zone Groundwater	Sample upper water-bearing zone at 4 locations	3a and 3b
		Lower Water-Bearing Zone Groundwater	Sample lower water-bearing zone using existing well	
		Bedrock Aquifer Groundwater	Not addressed in this area during Phase I sampling activities	

TABLE 1.4-1

**MEDIA TO BE SAMPLED, SAMPLE LOCATIONS, AND TPP OBJECTIVES
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Areas of Investigation	Knowledge of Area and Previous Investigation Results	Medium of Concern	Phase I Sampling Scheme to Address the Area of Investigation	DQO Goal(s) from TPP ¹
Onsite Ditches	<p>Two major north-south trending ditches, the Central Ditch and the West Ditch, traverse the NFSS. The Central Ditch is located near the center of the NFSS and flows from south to north. It collects water from the property to the south and east. The West Ditch enters the NFSS property near the Baker Smith area and also collects water from the properties to the south and west. The South 16 Ditch and South 31 Ditch are two major east-west trending ditches that have their confluence with the north-south trending Central Ditch. These ditches potentially receive run-on from the Modern Landfill, Inc. which is directly east of the site. Standing water exists at certain times of the year. Several smaller ditches ("N" Street Ditches, "O" Street Ditches, MacArthur Street West Ditch, and Other Ditches and Depressions) are located around the site and can potentially be impacted by runoff from the mixed acid storage areas, Baker Smith area, Building 401 area, former shop area, former acidification area, radioactive residue storage area, former waste oil and solvent storage, former radioactive material storage areas, and offsite sources; leachate seeping from the IWCS; and discharge of impacted groundwater from the upper water-bearing zone.</p> <p>Concentrations of PCBs, thallium, copper, magnesium and zinc in sediments above background levels. Screened samples indicated the presence of PAH levels in sediments above NYSDEC TAGM reporting limits. Boron and lithium were reported in sediment samples above the detection limits. Water quality parameters, chloride, fluoride, sulfate, nitrogen as nitrate, nitrogen as ammonia, total kjeldahl nitrogen, total phosphorus, biological oxygen demand, chemical oxygen demand, boron, and lithium were reported for the surface water sample.</p>	Surface Water	Sample surface water at 39 locations	3a, 3b, and 4
		Sediment	Sample sediment at 39 locations	3a, 3b, and 4

TABLE 1.4-1

**MEDIA TO BE SAMPLED, SAMPLE LOCATIONS, AND TPP OBJECTIVES
 NIAGARA FALLS STORAGE SITE
 LEWISTON, NEW YORK**

Areas of Investigation	Knowledge of Area and Previous Investigation Results	Medium of Concern	Phase I Sampling Scheme to Address the Area of Investigation	DQO Goal(s) from TPP ¹
Uninvestigated Areas	Subsurface conditions at several areas of the site not included in the previous seven sections have not been characterized. Potential contamination due to undocumented past site practices/activities may have occurred in these areas. These areas may pose potential problems in the site risk assessment if no investigation is performed on them.	Surface Soil	Sample surface soil at 12 locations	3a, 3b, and 4
		Subsurface Soil	Sample subsurface soil at 12 locations	3a, 3b, and 4
	In general, the previously uninvestigated areas not included in the previous sections have not had facility buildings or process equipment. These areas are located across the site and most are open grass. However, in the northern areas and the southeastern corner of the site, these areas are covered with scrub brush and trees.	Upper Water-Bearing Zone Groundwater	Sample upper water-bearing zone at 12 locations	1, 2, 3a, and 3b
		Lower Water-Bearing Zone Groundwater	Sample lower water-bearing zone using 8 existing wells	
		Bedrock Aquifer Groundwater	Sample bedrock aquifer using 2 existing wells	
	No surface soil, subsurface soil, or groundwater samples have been collected in the previously uninvestigated areas.			

- ¹ DQO's are as follows:
- 1 Evaluate presence or absence of chemicals released from WCS (Waste Containment Structure) to 1st or 2nd groundwater aquifer;
 - 2 Determine if chemical infiltration is occurring via groundwater into the WCS;
 - 3a Determine if hazardous substances and radiological activity at site are within limits established by ARARs;
 - 3b Determine Contaminants of Potential Concern;
 - 4 Define site physical features and characteristics; and
 - 11 Determine nature and extent of contamination posing unacceptable risk.

Note: Where possible, DQO 11 will be applied to the results of Phase I of the RI.

TABLE 1.4.7-1
ANALYTICAL METHODS¹

Soil Samples	
Nitroaromatics	8330
TOC	9060
Mercury	7471A
Arsenic, Lead, Lithium, Selenium, Silver, Thallium	3050B/6020
TAL Metals ²	3050B/6010B
Volatile Organic Compounds (VOCs)	5035/8260B
Semi-Volatile Organic Compounds (SVOCs)	3550B/8270C
Pesticides/PCBs	3550B/8081A/8082
TCLP Extraction	1311
Gross α and β	900, Gas Flow, Modified
Thorium-230	HASL 300, Gamma Spec
Radium-226	HASL 300, Gamma Spec
U-235/238	HASL 300, Gamma Spec
Total Uranium	ASTM D5174, KPA
Cation Exchange Capacity	9081
Reactivity	SW-846, Section 7.3
Corrosivity	9040B
Ignitability	SW-846-1110
Water Samples	
Herbicides (TCLP only) ³	3510C/8151A
Dissolved/Total Arsenic, Lead, Lithium, Silver, Thallium	3010A/3020A/6020
Dissolved/Total Mercury	7470A
Other Dissolved Total/TAL Metals	3010A/3020A/6010B
VOCs	5030B/8260B
Pesticides/PCBs	3510C/8081A/8082
Semi-Volatiles	3510C/8270C

TABLE 1.4.7-1	
ANALYTICAL METHODS ¹	
Nitroaromatics	8330
TCLP Extraction ³	1311
Gross α and β	900, Gas Flow
Radium-226	903.1 Modified, Radon Emanation
Thorium-230	HASL 300, Alpha Spec
Uranium-235/238	HASL 300, Alpha Spec
Total Uranium	ASTM D5174, KPA
Reactivity	SW-846, Section 7.3
Corrosivity	9040B
Ignitability	SW-846-1110
Geotechnical Methods	
Particle Size Analysis of Soil	ASTM D422
Liquid Limit, Plastic Limit and Plasticity Index of Soil	ASTM D4318
Moisture Content	ASTM D2216
Soil Density In-Place	ASTM D2937

¹ The most recently promulgated versions of the methods cited above will be used unless otherwise instructed.

² Using TJA 61E Trace ICP.

³ TCLP will be required analysis for samples of investigation derived waste. These samples are not currently included in the scope of work. All other TCLP parameters identified in Table 3-8.

ASTM = American Society for Testing and Materials

PCB = Polychlorinated Biphenyls

TAL = Target Analyte List

TCLP = Toxic Characteristic Leachate Procedure

TOC = Total Organic Carbon

TABLE 2-1

**KEY PERSONNEL ASSIGNMENTS AND QUALIFICATIONS FOR THE RI
AT THE NFSS, LEWISTON, NEW YORK**

Project Assignment	Degree	Qualifications
<u>Project Principal</u> Max Gricevich	MS, Biology	25+ years of experience in HTRW projects including site investigations and related environmental evaluations/studies at DOD/DOE/State sites.
<u>Project Manager</u> Thomas Lachajczyk	MS, Meteorology	25+ years of experience in HTRW projects including site investigations and related environmental evaluations/studies at DOD/DOE/State sites. Experience in radiological contaminant migration modeling and cost analysis for risk radiological waste disposal.
<u>Health & Safety Officer</u> Gregory Dawdy	BS, Biology	15+ years of experience in HTRW projects including experience as Health & Safety Officer at DOD and DOE sites.
<u>Data Manager</u> David Collins	MS, Chemistry	10+ years of experience in HTRW projects including data management and implement third-party data validation for site investigations.
<u>Sr. Technical Consultant</u> Michael Giordano, PE	BS, Chemical Engineering	20+ years of experience in HTRW projects including site investigations and related environmental evaluations/studies at DOD/DOE sites. Previously site-specific experience at NFSS.
<u>Project Certified Industrial Hygienist</u> Yvonne Freix, CIH	BS, Chemistry	12+ years of experience in HTRW projects as Radiation Safety Officer.
<u>Radiation Safety Officer</u> Douglass A. Haas	Registered Radiological Protection Technologist	10+ years of experience as Radiation Safety Officer at USACE HTRW sites.
<u>Site Manager</u> Timothy Biggs, PG	MS, Geology	7+ years of experience in HTRW projects including management of field projects for site investigations, remedial investigations, and related environmental evaluations/studies.
<u>Analytical Services</u> Paul Smith, CHMM	BS, Chemistry	10+ years of experience in HTRW projects including laboratory interface for site investigations, remedial investigations, and related environmental evaluations/studies.
<u>Risk Assessment Manager</u> Brian Mulhearn	BS, Toxicology	9 years of experience in HTRW projects including site investigations, baseline risk assessments and related environmental evaluations/studies at DOD and DOE sites.
<u>Principal Engineer</u> Dave E. Germeroth, PE	BS, Civil Engineering	10+ years of experience in HTRW projects including site investigations, feasibility studies and related environmental evaluations/studies. Extensive experience in decontamination and decommissioning of radiologically contaminated structures at DOE sites.

TABLE 4.2-1

**SAMPLE CONTAINERS, PRESERVATIVES
AND STORAGE REQUIREMENTS**

Parameter	Preservative	Holding Time	Containers	Container Preparation
WATER				
Volatile TCL Organics, Compounds (VOCs)	4°C, No headspace, HCL, pH <2 and Na ₂ S ₂ O ₃ , if chlorinated	14 days	Three 40 ml glass vials, with Teflon-lined septum and screw caps	Precleaned bottles from supplier
Semi-Volatile TCL Organic Compounds (SVOCs)	4°C	7 days until extraction, 40 days after extraction	Two 1-liter amber with Teflon-lined lid (Three 1-liter for QC)	Precleaned bottles from supplier
Total Metals	HNO ₃ , pH <2	6 months, except Hg 28 days	One 1-liter (64 oz) high density polyethylene bottles with Teflon-lined lids	Precleaned bottles from supplier
Dissolved Metals	Field filtered, HNO ₃ pH <2	6 months, except Hg 28 days	One 1-liter (64 oz) high density polyethylene bottles with Teflon-lined lids	Precleaned bottles from supplier
Radionuclides	HNO ₃ , pH <2	6 months	One 1-gallon, high density polyethylene bottles with Teflon-lined lids	Precleaned bottles from supplier
Gross α and β	HNO ₃ , pH <2	6 months	One 1-liter, high density polyethylene bottles with Teflon-lined lids	Precleaned bottles from supplier
Total Organic Carbon (TOC)	H ₂ SO ₄ , pH <2, (no headspace), 4°C	28 days	One 250-ml amber glass with Teflon-lined lids	Precleaned bottles from supplier
Pesticides/PCBs	4°C	7 days until extraction, 40 days after extraction	Two 1-liter (three for QC) amber with Teflon-lined lids	Precleaned bottles from supplier
Nitroaromatics	4°C	7 days until extraction, 40 days after extraction	Two 1-liter (four for QC) amber with Teflon-lined lids	Precleaned bottles from supplier
TCLP* The following pertains to analysis of liquid wastes generated during the RI:				
TCLP-VOCs	No headspace	14 days until TCLP, 14 days after TCLP	500-ml amber glass with Teflon-lined septum and screw lids	Precleaned bottles from supplier

TABLE 4.2-1**SAMPLE CONTAINERS, PRESERVATIVES
AND STORAGE REQUIREMENTS**

Parameter	Preservative	Holding Time	Containers	Container Preparation
TCLP-SVOCs	None	TCLP Extraction - 14 days, Analysis Extraction - 7 days after TCLP Extraction, Analysis - 40 days after Analysis Extraction	Two 1-liter amber with Teflon-lined lids	Precleaned bottles from supplier
TCLP-Pesticides	None	TCLP Extraction - 14 days, Analysis Extraction - 7 days after TCLP Extraction, Analysis - 40 days after Analysis Extraction	Two 1-liter amber with Teflon-lined lids	Precleaned bottles from supplier
TCLP-Herbicides	None	TCLP Extraction - 14 days, Analysis Extraction - 7 days after TCLP Extraction, Analysis - 40 days after Analysis Extraction	Two 1-liter amber with Teflon-lined lids	Precleaned bottles from supplier
TCLP-Metals	None	6 months (28 days for Hg) until TCLP Extraction, 6 months (28 days for Hg) until analysis.	One 1-liter high density polyethylene bottles with Teflon-lined lids	Precleaned bottles from supplier
Reactivity	4°C	7 days	One-gallon amber glass (reactivity sample container)	Precleaned bottles from supplier
Corrosivity	4°C	7 days	Taken from reactivity sample container	Precleaned bottles from supplier
Ignitability	4°C	7 days	Taken from reactivity sample container	Precleaned bottles from supplier
SOIL				
Total Metals	4°C	6 months, except Hg 28 days	8-oz. glass with Teflon- lined lid (inorganic sample container)	Precleaned bottles from supplier
Radionuclides	None	6 months	8-oz. glass wide- mouthed with Teflon- lined lids	Precleaned bottles from supplier

TABLE 4.2-1

**SAMPLE CONTAINERS, PRESERVATIVES
AND STORAGE REQUIREMENTS**

Parameter	Preservative	Holding Time	Containers	Container Preparation
Gross α and β	None	6 months	4-oz. glass wide-mouthed with Teflon-lined lid	Precleaned bottles from supplier
Cation Exchange Capacity	4°C	None specified	Taken from inorganic sample container	Precleaned bottles from supplier
Pesticides/PCBs	4°C	14 days before extraction, 40 days after extraction	8-oz. amber glass wide-mouthed container (organic sample container)	Precleaned bottles from supplier
Volatile TCL Organics	4°C, Sodium Bisulfate ¹ , Methanol ¹	14 days	3-40-ml VOA vials with Teflon septa, and magnetic stir bar pre-weighed in the laboratory.	Precleaned bottles from supplier, pre-weighed at laboratory
Semi-Volatile Organic Compounds (SVOCs)	4°C	14 days before extraction, 40 days after extraction	Taken from organic sample container	Precleaned bottles from supplier
Nitroaromatics	4°C	14 days before extraction, 40 days after extraction	Taken from organic sample container	Precleaned bottles from supplier
TOC	4°C	28 days	Taken from inorganic sample container	Precleaned bottles from supplier
TCLP ² - The following pertains to the analysis of solid waste generated during the RI:				
TCLP-VOCs	no headspace	TCLP - extraction 14 days, Analysis - 14 days after extraction.	Two 4-oz. wide-mouth glass containers with Teflon-lined lids	Precleaned bottle from supplier
TCLP-SVOCs	None	TCLP extraction - 14 days, Analysis extraction - 7 days after TCLP extraction, Analysis - 40 days after TCLP extraction.	Two 16-oz. amber wide-mouth glass with Teflon-lined lids (TCLP organic container)	Precleaned bottles from supplier
TCLP-Pesticides	None	TCLP extraction - 14 days, Analysis extraction - 7 days after TCLP extraction, Analysis - 40 days after TCLP extraction.	Taken from TCLP organic container	Precleaned bottle from supplier

TABLE 4.2-1**SAMPLE CONTAINERS, PRESERVATIVES
AND STORAGE REQUIREMENTS**

Parameter	Preservative	Holding Time	Containers	Container Preparation
TCLP-Herbicides	None	TCLP extraction - 14 days, Analysis extraction - 7 days after TCLP extraction, Analysis - 40 days after TCLP extraction.	Taken from TCLP organic container	Precleaned bottles from supplier
TCLP-Metals	None	6 months (28 days for Hg) for TCLP-extraction, Analysis within 6 months (28 days Hg) after TCLP extraction.	Taken from TCLP organic container	Precleaned bottles from supplier
Reactivity	4°	7 days	8-oz amber wide-mouth glass with Teflon-lined lid (reactivity container)	Precleaned bottle from supplier
Corrosivity	4°	7 days	Taken from reactivity container	Precleaned bottles from supplier
Ignitability	4°	7 days	Taken from reactivity container	Precleaned bottles from supplier

*TCLP will be required for analysis of samples of investigation-derived waste. These samples are not currently included in the scope of work.

¹ Preserved in the field using pre-measured aliquots of preservative encapsulated in Teflon ampules. Four sample containers will be collected. Two samples will be preserved with sodium bisulfate (with a stir bar included). One sample will be preserved with methanol. The fourth sample will be collected in a 2-oz. container for analysis for moisture content.

² TCLP will be required analysis for samples of investigation derived waste. These samples are not currently included in the scope of work.

TCLP = Toxic Characteristic Leachate Procedure

TABLE 4.2-2

FIELD SCREENING/ANALYSIS EQUIPMENT AND CALIBRATION FREQUENCY

Item	Brand	Model No.	Type Screening	Calibration Frequency
Toxic Gas Monitor	4 Gas Combustable Meter	TMX412	Oxygen, LEL, Hydrogen sulfide, or carbon monoxide	Factory calibrated prior to initiation of field activities
Organic Vapor Detector	HNU	PS101, IS101	Organic vapors	Beginning and end of each day according to factory instructions
Organic Vapor Detector	Thermo Environmental OVM	580B	Organic vapors	Beginning and end of each day according to factory instructions
Vapor Detector Tubes	Sensidyne/GasTech	Model 800	Vapor detecting pump/sampling system and detector tubes	None
Water Quality Meter	Hydrolab YSI	4041 Surveyor II 600XL	pH, conductivity, temperature, ORP and DO	Beginning and end of each day according to factory instructions
Alpha, Beta, and Gamma Radiation Survey Meter	Ludlum	Model 3	alpha, beta, and gamma radiation	Factory calibrated prior to initiation of field activities
Decontamination Equipment				
Plastic Sheeting, Buckets, Brushes, DI and Tap Water Sprayers, Liquinox or Alconox, Tap Water, and DI Water				
Sampling Equipment				
Soil / Sediment	Stainless steel shovel, stainless steel spoons, stainless steel Ekman dredge, stainless steel bucket auger, drilling rig with hollow stem augers, split spoons, continuous sampler, packing material, labels, sampling containers			
Groundwater/Surface Water	Teflon® bailers and minibailers; Masterflex peristaltic pump; electronic water level indicator with stainless steel leader; rope; funnel; 0.45 micron in-line filters; Teflon and silicone tygon tubing; 12-volt battery; submersible pump; Portable generator; packing material; labels; preservatives; sample containers; foot valve			

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SS201-001	Building 401 Area	Soil Boring 201	Surface Soil		X	X			X	X		
NFSS99SS202-002	Building 401 Area	Soil Boring 202	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS203-003	Building 401 Area	Soil Boring 203	Surface Soil		X	X			X	X		
NFSS99SS204-004	Building 401 Area	Soil Boring 204	Surface Soil	QC-005, QA-006, MS/MSD-007	X	X		X	X	X	X	
NFSS99SS205-008	Building 401 Area	Soil Boring 205	Surface Soil		X	X			X	X		
NFSS99SS206-009	Building 401 Area	Soil Boring 206	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS207-010	Building 401 Area	Soil Boring 207	Surface Soil		X	X		X	X	X		
NFSS99SS208-011	Building 401 Area	Soil Boring 208	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS209-012	Building 401 Area	Soil Boring 209	Surface Soil	QC-013	X	X	X	X	X	X	X	X
NFSS99SS210-014	Building 401 Area	Soil Boring 210	Surface Soil		X	X			X	X		
NFSS99SS211-015	Building 401 Area	Soil Boring 211	Surface Soil		X	X	X		X	X	X	
NFSS99SS212-016	Building 401 Area	Soil Boring 212	Surface Soil		X	X			X	X		
NFSS99SS213-017	Building 401 Area	Soil Boring 213	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS214-018	Building 401 Area	Soil Boring 214	Surface Soil		X	X			X	X		
NFSS99SS215-019	Building 401 Area	Soil Boring 215	Surface Soil		X	X		X	X	X	X	
NFSS99SS216-020	Building 401 Area	Soil Boring 216	Surface Soil		X	X	X		X	X		
NFSS99SS217-021	Building 401 Area	Soil Boring 217	Surface Soil	QC-022, QA-023, MS/MSD-021	X	X	X	X	X	X	X	X
NFSS99SS301-025	Former Shop Area	Soil Boring 301	Surface Soil			X			X	X		

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SS302-026	Former Shop Area	Soil Boring 302	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS303-027	Former Shop Area	Soil Boring 303	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS304-028	Former Shop Area	Soil Boring 304	Surface Soil		X	X		X	X	X		
NFSS99SS305-029	Former Shop Area	Soil Boring 305	Surface Soil			X			X	X	X	
NFSS99SS306-030	Former Shop Area	Soil Boring 306	Surface Soil		X	X		X	X	X		
NFSS99SS307-031	Former Shop Area	Soil Boring 307	Surface Soil			X		X	X	X		
NFSS99SS308-032	Former Shop Area	Soil Boring 308	Surface Soil			X		X	X	X		
NFSS99SS309-033	Former Shop Area	Soil Boring 309	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS310-034	Former Shop Area	Soil Boring 310	Surface Soil		X	X		X	X	X		
NFSS99SS311-035	Former Shop Area	Soil Boring 311	Surface Soil		X	X	X	X	X	X		
NFSS99SS312-036	Former Shop Area	Soil Boring 312	Surface Soil		X	X			X	X		
NFSS99SS401-037	Former Acidification Area	Soil Boring 401	Surface Soil	QC-038	X	X		X	X	X		
NFSS99SS402-039	Former Acidification Area	Soil Boring 402	Surface Soil		X	X		X	X	X		
NFSS99SS403-040	Former Acidification Area	Soil Boring 403	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS404-041	Former Acidification Area	Soil Boring 404	Surface Soil		X	X		X	X	X		
NFSS99SS405-042	Former Acidification Area	Soil Boring 405	Surface Soil		X	X		X	X	X	X	

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SS406-043	Former Acidification Area	Soil Boring 406	Surface Soil			X	X	X	X	X		X
NFSS99SS407-044	Former Acidification Area	Soil Boring 407	Surface Soil			X		X	X	X		X
NFSS99SS408-045	Former Acidification Area	Soil Boring 408	Surface Soil			X		X	X	X		
NFSS99SS409-046	Former Acidification Area	Soil Boring 409	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS410-047	Former Acidification Area	Soil Boring 410	Surface Soil			X		X	X	X		X
NFSS99SS411-048	Former Acidification Area	Soil Boring 411	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS412-049	Former Acidification Area	Soil Boring 412	Surface Soil			X		X	X	X		
NFSS99SS413-050	Former Acidification Area	Soil Boring 413	Surface Soil			X	X	X	X	X	X	
NFSS99SS414-051	Former Acidification Area	Soil Boring 414	Surface Soil			X	X	X	X	X		
NFSS99SS415-052	Former Acidification Area	Soil Boring 415	Surface Soil		X	X	X	X	X	X	X	
NFSS99SS416-053	Former Acidification Area	Soil Boring 416	Surface Soil			X		X	X	X		
NFSS99SS417-054	Former Acidification Area	Soil Boring 417	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS418-055	Former Acidification Area	Soil Boring 418	Surface Soil		X	X	X	X	X	X	X	X

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SS419-056	Former Acidification Area	Soil Boring 419	Surface Soil			X		X	X	X		
NFSS99SS420-057	Former Acidification Area	Soil Boring 420	Surface Soil		X	X		X	X	X		
NFSS99SS421-058	Former Acidification Area	Soil Boring 421	Surface Soil			X		X	X	X		
NFSS99SS501-059	Baker Smith Area	Soil Boring 501	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS502-060	Baker Smith Area	Soil Boring 502	Surface Soil	QC-061, QA-062, MS/MSD-063	X	X	X	X	X	X	X	X
NFSS99SS503-064	Baker Smith Area	Soil Boring 503	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS601-065	Former Radioactive Residue Storage Areas	Soil Boring 601	Surface Soil			X		X	X	X		
NFSS99SS602-066	Former Radioactive Residue Storage Areas	Soil Boring 602	Surface Soil	QC-067	X	X	X	X	X	X	X	X
NFSS99SS603-068	Former Radioactive Residue Storage Areas	Soil Boring 603	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS604-069	Former Radioactive Residue Storage Areas	Soil Boring 604	Surface Soil			X		X	X	X		
NFSS99SS801-070	Uninvestigated Areas	Soil Boring 801	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS802-071	Uninvestigated Areas	Soil Boring 802	Surface Soil			X		X	X	X		
NFSS99SS803-072	Uninvestigated Areas	Soil Boring 803	Surface Soil			X		X	X	X		
NFSS99SS804-073	Uninvestigated Areas	Soil Boring 804	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS805-074	Uninvestigated Areas	Soil Boring 805	Surface Soil		X	X	X	X	X	X	X	X

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SS806-075	Uninvestigated Areas	Soil Boring 806	Surface Soil		X			X	X	X		
NFSS99SS807-076	Uninvestigated Areas	Soil Boring 807	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS808-077	Uninvestigated Areas	Soil Boring 808	Surface Soil			X		X	X	X		
NFSS99SS809-078	Uninvestigated Areas	Soil Boring 809	Surface Soil		X	X	X	X	X	X	X	X
NFSS99SS810-079	Uninvestigated Areas	Soil Boring 810	Surface Soil		X			X	X	X		X
NFSS99SS811-080	Uninvestigated Areas	Soil Boring 811	Surface Soil	QC-081, QA-082, MS/MSD-083	X	X	X	X	X	X	X	X
NFSS99SS812-084	Uninvestigated Areas	Soil Boring 812	Surface Soil			X		X	X	X		X
NFSS99SB201-085-X ³	Building 401 Area	Soil Boring 201	Subsurface Soil		X	X	⁴	⁴	X	X	⁴	⁴
NFSS99SB202-086-X	Building 401 Area	Soil Boring 202	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB203-087-X	Building 401 Area	Soil Boring 203	Subsurface Soil		X	X	⁴	⁴	X	X	⁴	⁴
NFSS99SB204-088-X	Building 401 Area	Soil Boring 204	Subsurface Soil		X	X	⁴	X	X	X	X	⁴
NFSS99SB205-089-X	Building 401 Area	Soil Boring 205	Subsurface Soil		X	X	⁴	⁴	X	X	⁴	⁴
NFSS99SB206-090-X	Building 401 Area	Soil Boring 206	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB207-091-X	Building 401 Area	Soil Boring 207	Subsurface Soil		X	X	⁴	X	X	X	⁴	⁴
NFSS99SB208-092-X	Building 401 Area	Soil Boring 208	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB209-093-X	Building 401 Area	Soil Boring 209	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB210-094-X	Building 401 Area	Soil Boring 210	Subsurface Soil		X	X	⁴	⁴	X	X	⁴	⁴
NFSS99SB211-095-X	Building 401 Area	Soil Boring 211	Subsurface Soil		X	X	X		X	X	X	
NFSS99SB212-096-X	Building 401 Area	Soil Boring 212	Subsurface Soil		X	X	⁴	⁴	X	X	⁴	⁴

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
 NIAGARA FALLS STORAGE SITE
 LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SB213-097-X	Building 401 Area	Soil Boring 213	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB214-098-X	Building 401 Area	Soil Boring 214	Subsurface Soil		X	X	⁴	⁴	X	X	⁴	⁴
NFSS99SB215-099-X	Building 401 Area	Soil Boring 215	Subsurface Soil		X	X	⁴	X	X	X	X	⁴
NFSS99SB216-100-X	Building 401 Area	Soil Boring 216	Subsurface Soil		X	X	X	⁴	X	X	⁴	⁴
NFSS99SB217-101-X	Building 401 Area	Soil Boring 217	Subsurface Soil	QC-102-X	X	X	X	X	X	X	X	X
NFSS99SB301-103-X	Former Shop Area	Soil Boring 301	Subsurface Soil		⁴	X	⁴	⁴	X	X	⁴	⁴
NFSS99SB302-104-X	Former Shop Area	Soil Boring 302	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB303-105-X	Former Shop Area	Soil Boring 303	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB304-106-X	Former Shop Area	Soil Boring 304	Subsurface Soil	QC-107, QA-108, MS/MSD-109	X	X	⁴	X	X	X	⁴	⁴
NFSS99SB305-110-X	Former Shop Area	Soil Boring 305	Subsurface Soil		⁴	X	⁴	⁴	X	X	X	⁴
NFSS99SB306-111-X	Former Shop Area	Soil Boring 306	Subsurface Soil		X	X	⁴	X	X	X	⁴	⁴
NFSS99SB307-112-X	Former Shop Area	Soil Boring 307	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	⁴
NFSS99SB308-113-X	Former Shop Area	Soil Boring 308	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	⁴
NFSS99SB309-114-X	Former Shop Area	Soil Boring 309	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB310-115-X	Former Shop Area	Soil Boring 310	Subsurface Soil		X	X	⁴	X	X	X	⁴	⁴
NFSS99SB311-116-X	Former Shop Area	Soil Boring 311	Subsurface Soil		X	X	X	X	X	X	⁴	⁴
NFSS99SB312-117-X	Former Shop Area	Soil Boring 312	Subsurface Soil		X	X	⁴	⁴	X	X	⁴	⁴
NFSS99SB401-118-X	Former Acidification Area	Soil Boring 401	Subsurface Soil		X	X		X	X	X		

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SB402-119-X	Former Acidification Area	Soil Boring 402	Subsurface Soil		X	X	⁴	X	X	X	⁴	⁴
NFSS99SB403-120-X	Former Acidification Area	Soil Boring 403	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB404-121-X	Former Acidification Area	Soil Boring 404	Subsurface Soil		X	X	⁴	X	X	X	⁴	⁴
NFSS99SB405-122-X	Former Acidification Area	Soil Boring 405	Subsurface Soil		X	X	⁴	X	X	X	X	⁴
NFSS99SB406-123-X	Former Acidification Area	Soil Boring 406	Subsurface Soil		⁴	X	X	X	X	X	⁴	X
NFSS99SB407-124-X	Former Acidification Area	Soil Boring 407	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	X
NFSS99SB408-125-X	Former Acidification Area	Soil Boring 408	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	⁴
NFSS99SB409-126-X	Former Acidification Area	Soil Boring 409	Subsurface Soil	QC-127-X	X	X	X	X	X	X	X	X
NFSS99SB410-128-X	Former Acidification Area	Soil Boring 410	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	X
NFSS99SB411-129-X	Former Acidification Area	Soil Boring 411	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB412-130-X	Former Acidification Area	Soil Boring 412	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	⁴
NFSS99SB413-131-X	Former Acidification Area	Soil Boring 413	Subsurface Soil	QC-132, QA-133, MS/MSD-134	⁴	X	X	X	X	X	X	⁴
NFSS99SB414-135-X	Former Acidification Area	Soil Boring 414	Subsurface Soil		⁴	X	X	X	X	X	⁴	⁴

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SB415-136-X	Former Acidification Area	Soil Boring 415	Subsurface Soil		X	X	X	X	X	X	X	⁴
NFSS99SB416-137-X	Former Acidification Area	Soil Boring 416	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	⁴
NFSS99SB417-138-X	Former Acidification Area	Soil Boring 417	Subsurface Soil	QC-139-X	X	X	X	X	X	X	X	X
NFSS99SB418-140-X	Former Acidification Area	Soil Boring 418	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB419-141-X	Former Acidification Area	Soil Boring 419	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	⁴
NFSS99SB420-142-X	Former Acidification Area	Soil Boring 420	Subsurface Soil		X	X	⁴	X	X	X	⁴	⁴
NFSS99SB421-143-X	Former Acidification Area	Soil Boring 421	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	⁴
NFSS99SB501-144-X	Baker Smith Area	Soil Boring 501	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB502-145-X	Baker Smith Area	Soil Boring 502	Subsurface Soil	QC-146, QA-147, MS/MSD-148	X	X	X	X	X	X	X	X
NFSS99SB503-149-X	Baker Smith Area	Soil Boring 503	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB601-150-X	Former Radioactive Residue Storage Areas	Soil Boring 601	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	⁴
NFSS99SB602-151-X	Former Radioactive Residue Storage Areas	Soil Boring 602	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB603-152-X	Former Radioactive Residue Storage Areas	Soil Boring 603	Subsurface Soil		X	X	X	X	X	X	X	X

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SB604-153-X	Former Radioactive Residue Storage Areas	Soil Boring 604	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	⁴
NFSS99SB801-154-X	Uninvestigated Areas	Soil Boring 801	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB802-155-X	Uninvestigated Areas	Soil Boring 802	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	⁴
NFSS99SB803-156-X	Uninvestigated Areas	Soil Boring 803	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	⁴
NFSS99SB804-157-X	Uninvestigated Areas	Soil Boring 804	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB805-158-X	Uninvestigated Areas	Soil Boring 805	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB806-159-X	Uninvestigated Areas	Soil Boring 806	Subsurface Soil		X	⁴	⁴	X	X	X	⁴	⁴
NFSS99SB807-160-X	Uninvestigated Areas	Soil Boring 807	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB808-161-X	Uninvestigated Areas	Soil Boring 808	Subsurface Soil		⁴	X	⁴	X	X	X	⁴	⁴
NFSS99SB809-162-X	Uninvestigated Areas	Soil Boring 809	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB810-163-X	Uninvestigated Areas	Soil Boring 810	Subsurface Soil		X	⁴	⁴	X	X	X	⁴	X
NFSS99SB811-164-X	Uninvestigated Areas	Soil Boring 811	Subsurface Soil		X	X	X	X	X	X	X	X
NFSS99SB812-165-X	Uninvestigated Areas	Soil Boring 812	Subsurface Soil	QC-166	⁴	X	⁴	X	X	X	⁴	X
NFSS99GW201-167	Building 401 Area	Soil Boring 201	Groundwater	QC-168, QA-169, MS/MSD-170	X	X			X	X		
NFSS99GW202-171	Building 401 Area	Soil Boring 202	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW203-172	Building 401 Area	Soil Boring 203	Groundwater		X	X			X	X		
NFSS99GW204-173	Building 401 Area	Soil Boring 204	Groundwater		X	X		X	X	X	X	
NFSS99GW205-174	Building 401 Area	Soil Boring 205	Groundwater		X	X			X	X		

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99GW206-175	Building 401 Area	Soil Boring 206	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW207-176	Building 401 Area	Soil Boring 207	Groundwater	QC-177	X	X		X	X	X		
NFSS99GW208-178	Building 401 Area	Soil Boring 208	Groundwater	QC-179, QA-180, MS/MSD-181	X	X	X	X	X	X	X	X
NFSS99GW209-182	Building 401 Area	Soil Boring 209	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW210-183	Building 401 Area	Soil Boring 210	Groundwater		X	X			X	X		
NFSS99GW211-184	Building 401 Area	Soil Boring 211	Groundwater		X	X	X		X	X	X	
NFSS99GW212-185	Building 401 Area	Soil Boring 212	Groundwater		X	X			X	X		
NFSS99GW213-186	Building 401 Area	Soil Boring 213	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW214-187	Building 401 Area	Soil Boring 214	Groundwater		X	X			X	X		
NFSS99GW215-188	Building 401 Area	Soil Boring 215	Groundwater		X	X		X	X	X	X	
NFSS99GW216-189	Building 401 Area	Soil Boring 216	Groundwater		X	X	X		X	X		
NFSS99GW217-190	Building 401 Area	Soil Boring 217	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW301-191	Former Shop Area	Soil Boring 301	Groundwater			X			X	X		
NFSS99GW302-192	Former Shop Area	Soil Boring 302	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW303-193	Former Shop Area	Soil Boring 303	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW304-194	Former Shop Area	Soil Boring 304	Groundwater		X	X		X	X	X		
NFSS99GW305-195	Former Shop Area	Soil Boring 305	Groundwater			X			X	X	X	
NFSS99GW306-196	Former Shop Area	Soil Boring 306	Groundwater		X	X		X	X	X		
NFSS99GW307-197	Former Shop Area	Soil Boring 307	Groundwater			X		X	X	X		

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99GW308-198	Former Shop Area	Soil Boring 308	Groundwater			X		X	X	X		
NFSS99GW309-199	Former Shop Area	Soil Boring 309	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW310-200	Former Shop Area	Soil Boring 310	Groundwater		X	X		X	X	X		
NFSS99GW311-201	Former Shop Area	Soil Boring 311	Groundwater	QC-202	X	X	X	X	X	X		
NFSS99GW312-203	Former Shop Area	Soil Boring 312	Groundwater		X	X			X	X		
NFSS99GW401-204	Former Acidification Area	Soil Boring 401	Groundwater		X	X		X	X	X		
NFSS99GW402-205	Former Acidification Area	Soil Boring 402	Groundwater		X	X		X	X	X		
NFSS99GW403-206	Former Acidification Area	Soil Boring 403	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW404-207	Former Acidification Area	Soil Boring 404	Groundwater		X	X		X	X	X		
NFSS99GW405-208	Former Acidification Area	Soil Boring 405	Groundwater		X	X		X	X	X	X	
NFSS99GW406-209	Former Acidification Area	Soil Boring 406	Groundwater			X	X	X	X	X		X
NFSS99GW407-210	Former Acidification Area	Soil Boring 407	Groundwater			X		X	X	X		X
NFSS99GW408-211	Former Acidification Area	Soil Boring 408	Groundwater			X		X	X	X		
NFSS99GW409-212	Former Acidification Area	Soil Boring 409	Groundwater		X	X	X	X	X	X	X	X

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99GW410-213	Former Acidification Area	Soil Boring 410	Groundwater			X		X	X	X		X
NFSS99GW411-214	Former Acidification Area	Soil Boring 411	Groundwater	QC-215, QA-216, MS/MSD-217	X	X	X	X	X	X	X	X
NFSS99GW412-218	Former Acidification Area	Soil Boring 412	Groundwater			X		X	X	X		
NFSS99GW413-219	Former Acidification Area	Soil Boring 413	Groundwater			X	X	X	X	X	X	
NFSS99GW414-220	Former Acidification Area	Soil Boring 414	Groundwater			X	X	X	X	X		
NFSS99GW415-221	Former Acidification Area	Soil Boring 415	Groundwater		X	X	X	X	X	X	X	
NFSS99GW416-222	Former Acidification Area	Soil Boring 416	Groundwater			X		X	X	X		
NFSS99GW417-223	Former Acidification Area	Soil Boring 417	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW418-224	Former Acidification Area	Soil Boring 418	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW419-225	Former Acidification Area	Soil Boring 419	Groundwater			X		X	X	X		
NFSS99GW420-226	Former Acidification Area	Soil Boring 420	Groundwater	QC-227	X	X		X	X	X		
NFSS99GW421-228	Former Acidification Area	Soil Boring 421	Groundwater			X		X	X	X		
NFSS99GW501-229	Baker Smith Area	Soil Boring 501	Groundwater		X	X	X	X	X	X	X	X

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99GW502-230	Baker Smith Area	Soil Boring 502	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW503-231	Baker Smith Area	Soil Boring 503	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW601-232	Former Radioactive Residue Storage Areas	Soil Boring 601	Groundwater			X		X	X	X		
NFSS99GW602-233	Former Radioactive Residue Storage Areas	Soil Boring 602	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW603-234	Former Radioactive Residue Storage Areas	Soil Boring 603	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW604-235	Former Radioactive Residue Storage Areas	Soil Boring 604	Groundwater			X		X	X	X		
NFSS99GW801-236	Uninvestigated Areas	Soil Boring 801	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW802-237	Uninvestigated Areas	Soil Boring 802	Groundwater			X		X	X	X		
NFSS99GW803-238	Uninvestigated Areas	Soil Boring 803	Groundwater			X		X	X	X		
NFSS99GW804-239	Uninvestigated Areas	Soil Boring 804	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW805-240	Uninvestigated Areas	Soil Boring 805	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW806-241	Uninvestigated Areas	Soil Boring 806	Groundwater		X			X	X	X		
NFSS99GW807-242	Uninvestigated Areas	Soil Boring 807	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW808-243	Uninvestigated Areas	Soil Boring 808	Groundwater			X		X	X	X		
NFSS99GW809-244	Uninvestigated Areas	Soil Boring 809	Groundwater		X	X	X	X	X	X	X	X
NFSS99GW810-245	Uninvestigated Areas	Soil Boring 810	Groundwater		X			X	X	X		X
NFSS99GW811-246	Uninvestigated Areas	Soil Boring 811	Groundwater		X	X	X	X	X	X	X	X

TABLE 4.3-1

**PHASE I - SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99GW812-247	Uninvestigated Areas	Soil Boring 812	Groundwater	QC-248, QA-249, MS/MSD-250		X		X	X	X		X

Notes:

- ¹ Volatile organics (by USEPA SW846 Method 5035/8260B)
Semi-volatile organics (by USEPA SW846 Methods 3550B/8270B)
Pesticides and PCBs (by USEPA SW846 Methods 3550B, 8081A, and 8082)
Metals (by USEPA SW846 Methods 3050B/6010B/7000)
Radiological speciation: uranium-235, uranium-238, thorium-230, radium-226 (by HASL 300), gross alpha and beta radiation (by Method 900), and total uranium (by ASTM D5174)
Total Organic Carbon (by USEPA SW846 Method 9060)
Cation Exchange Capacity (by USEPA SW846 Method 9081)
Nitroaromatics (by USEPA SW846 Method 8330)
- ² QC - denotes quality control field duplicate, QA - denotes quality assurance split sample, MS/MSD - denotes the matrix spike/matrix spike duplicate sample
- ³ -X denotes bottom depth of sample in subsurface borings
- ⁴ Additional analytes for subsurface boring samples will be determined in the field if conditions (headspace detection, gamma detection, visual appearance, or olfactory) warrant.

Additional subsurface samples will begin with the unique number 386.

10 percent Duplicate, 5 percent Quality Control and MS/MSD samples will be taken for any additional subsurface samples taken.

TABLE 4.4-1

**PHASE I - EXISTING WELL GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99BH05-251	Former Shop Area	Well BH-05	Groundwater		X	X	X	X	X	X		X
NFSS99BH12-252	Uninvestigated Areas	Bedrock Well BH-12	Groundwater		X	X		X	X	X		
NFSS99BH15-253	Former Shop Area	Bedrock Well BH-15	Groundwater		X	X		X	X	X		
NFSS99BH16-254	Former Acidification Area	Well BH-16	Groundwater		X	X	X	X	X	X		X
NFSS99BH28-255	Former Acidification Area	Well BH-28	Groundwater		X	X		X	X	X		
NFSS99BH29-256	Former Acidification Area	Well BH-29	Groundwater	QC-257, QA-258, MS/MSD-259	X	X		X	X	X		
NFSS99BH36-260	Former Shop Area	Well BH-36	Groundwater		X	X		X	X	X		
NFSS99BH39-261	Building 401 Area	Well BH-39	Groundwater		X	X		X	X	X		
NFSS99BH40-262	Building 401 Area	Well BH-40	Groundwater		X	X		X	X	X		
NFSS99BH45-263	Former Acidification Area	Well BH-45	Groundwater		X	X	X	X	X	X		X
NFSS99BH46-264	Former Shop Area	Well BH-46	Groundwater	QC-265	X	X		X	X	X		
NFSS99BH48-266	Uninvestigated Areas	Well BH-48	Groundwater		X	X		X	X	X		
NFSS99BH49-267	IWCS	Well BH-49	Groundwater		X	X		X	X	X		
NFSS99BH50-268	Uninvestigated Areas	Well BH-50	Groundwater		X	X	X	X	X	X		X
NFSS99BH51-269	Uninvestigated Areas	Well BH-51	Groundwater		X	X	X	X	X	X		X
NFSS99BH52-270	Uninvestigated Areas	Well BH-52	Groundwater		X	X	X	X	X	X		X

TABLE 4.4-1

**PHASE I - EXISTING WELL GROUNDWATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99BH153-271	Former Radioactive Residue Storage Areas	Well BH-53	Groundwater	QC-272, QA-273, MS/MSD-274	X	X		X	X	X		
NFSS99BH56-275	Uninvestigated Areas	Well BH-56	Groundwater		X	X	X	X	X	X		X
NFSS99BH57-276	Uninvestigated Areas	Bedrock Well BH-57	Groundwater		X	X	X	X	X	X		X
NFSS99BH58-277	Building 401 Area	Well BH-58	Groundwater		X	X		X	X	X		
NFSS99BH59-278	Uninvestigated Areas	Well BH-59	Groundwater		X	X		X	X	X		
NFSS99BH60-279	Uninvestigated Areas	Well BH-60	Groundwater		X	X		X	X	X		
NFSS99BH61-280	Baker-Smith Area	Well BH-61	Groundwater		X	X	X	X	X	X		X
NFSS99BH62-281	Baker-Smith Area	Bedrock Well BH-62	Groundwater	QC-282	X	X	X	X	X	X		X
NFSS99BH63-283	Uninvestigated Areas	Well BH-63	Groundwater		X	X		X	X	X		
NFSS99BH64-284	IWCS	Well BH-64	Groundwater		X	X		X	X	X		
NFSS99BH65-285	IWCS	Well BH-65	Groundwater		X	X		X	X	X		
NFSS99BH66-286	IWCS	Well BH-66	Groundwater		X	X		X	X	X		
NFSS99BH67-287	IWCS	Well BH-67	Groundwater		X	X		X	X	X		
NFSS99BH68-288	IWCS	Bedrock Well BH-68	Groundwater		X	X		X	X	X		
NFSS99BH69-289	IWCS	Well BH-69	Groundwater		X	X		X	X	X		
NFSS99BH70-290	IWCS	Well BH-70	Groundwater		X	X		X	X	X		
NFSS99BH71-291	IWCS	Well BH-71	Groundwater		X	X		X	X	X		

Notes:

- ¹
- Volatile organics (by USEPA SW846 Method 5035/8260B)
 - Semi-volatile organics (by USEPA SW846 Methods 3550B/8270B)
 - Pesticides and PCBs (by USEPA SW846 Methods 3550B, 8081A, and 8082)
 - Metals (by USEPA SW846 Methods 3050B/6010B/7000)
 - Radiological speciation: uranium-235, uranium-238, thorium-230, radium-226 (by HASL 300), total alpha and beta radiation (by Method 900), and total uranium (by ASTM D5174)
 - Total Organic Carbon (by USEPA SW846 Method 9060)
 - Cation Exchange Capacity (by USEPA SW846 Method 9081)
 - Nitroaromatics (by USEPA SW846 Method 8330)
- ²
- QC - denotes quality control field duplicate, QA - denotes quality assurance split sample, MS/MSD - denotes the matrix spike/matrix spike duplicate sample

TABLE 4.5-1

**PHASE I - SEDIMENT AND SURFACE WATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
 NIAGARA FALLS STORAGE SITE
 LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SW701-292	IWCS North Ditch	Location 701	Surface Water		X	X	X	X	X	X		X
NFSS99SD701-293	IWCS North Ditch	Location 701	Sediment		X	X	X	X	X	X	X	X
NFSS99SW702-294	IWCS Central Ditch	Location 702	Surface Water		X	X	X	X	X	X		X
NFSS99SD702-295	IWCS Central Ditch	Location 702	Sediment		X	X	X	X	X	X	X	X
NFSS99SW703-296	IWCS South Ditch	Location 703	Surface Water		X	X	X	X	X	X		X
NFSS99SD703-297	IWCS South Ditch	Location 703	Sediment	QC-298, QA-299 MS/MSD-300	X	X	X	X	X	X	X	X
NFSS99SW704-301	Central Ditch	Location 704	Surface Water		X	X	X	X	X	X		X
NFSS99SD704-302	Central Ditch	Location 704	Sediment		X	X	X	X	X	X	X	X
NFSS99SW705-303	Central Ditch	Location 705	Surface Water			X		X	X	X		
NFSS99SD705-304	Central Ditch	Location 705	Sediment			X		X	X	X		
NFSS99SW706-305	Central Ditch	Location 706	Surface Water		X		X	X	X	X		
NFSS99SD706-306	Central Ditch	Location 706	Sediment		X		X	X	X	X		
NFSS99SW707-307	Central Ditch	Location 707	Surface Water			X		X	X	X		
NFSS99SD707-308	Central Ditch	Location 707	Sediment			X		X	X	X		
NFSS99SW708-309	Central Ditch	Location 708	Surface Water	QC-310	X			X	X	X		
NFSS99SD708-311	Central Ditch	Location 708	Sediment		X			X	X	X		
NFSS99SW709-312	Central Ditch	Location 709	Surface Water			X	X	X	X	X		
NFSS99SD709-313	Central Ditch	Location 709	Sediment			X	X	X	X	X		
NFSS99SW710-314	Central Ditch	Location 710	Surface Water		X	X	X	X	X	X		X

TABLE 4.5-1

**PHASE I - SEDIMENT AND SURFACE WATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SD710-315	Central Ditch	Location 710	Sediment		X	X	X	X	X	X	X	X
NFSS99SW711-316	"O" Street South Ditch	Location 711	Surface Water					X	X	X		
NFSS99SD711-317	"O" Street South Ditch	Location 711	Sediment					X	X	X		
NFSS99SW712-318	West Ditch	Location 712	Surface Water		X	X	X	X	X	X		X
NFSS99SD712-319	West Ditch	Location 712	Sediment	QC-320, QA-321, MS/MSD-322	X	X	X	X	X	X	X	X
NFSS99SW713-323	West Ditch	Location 713	Surface Water		X	X	X	X	X	X		X
NFSS99SD713-324	West Ditch	Location 713	Sediment		X	X	X	X	X	X	X	X
NFSS99SW714-325	West Patrol Road Ditch	Location 714	Surface Water		X	X	X	X	X	X		X
NFSS99SD714-326	West Patrol Road Ditch	Location 714	Sediment		X	X	X	X	X	X	X	X
NFSS99SW715-327	Modern Ditch	Location 715	Surface Water		X	X	X	X	X	X		X
NFSS99SD715-328	Modern Ditch	Location 715	Sediment		X	X	X	X	X	X	X	X
NFSS99SW716-329	South 31 Ditch	Location 716	Surface Water		X		X	X	X	X		
NFSS99SD716-330	South 31 Ditch	Location 716	Sediment	QC-331	X		X	X	X	X		
NFSS99SW717-332	South 31 Ditch	Location 717	Surface Water		X	X	X	X	X	X		X
NFSS99SD717-333	South 31 Ditch	Location 717	Sediment		X	X	X	X	X	X	X	X
NFSS99SW718-334	South 31 Ditch	Location 718	Surface Water	QC-335, QA-336, MS/MSD-337	X	X	X	X	X	X		X
NFSS99SD718-338	South 31 Ditch	Location 718	Sediment		X	X	X	X	X	X	X	X
NFSS99SW719-339	Building 401 Ditch	Location 719	Surface Water	QC-340		X			X	X		

TABLE 4.5-1

**PHASE I - SEDIMENT AND SURFACE WATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SD719-341	Building 401 Ditch	Location 719	Sediment			X			X	X		
NFSS99SW720-342	South 16 Ditch	Location 720	Surface Water			X	X	X	X	X		
NFSS99SD720-343	South 16 Ditch	Location 720	Sediment			X	X	X	X	X		
NFSS99SW721-344	South 16 Ditch	Location 721	Surface Water			X		X	X	X		
NFSS99SD721-345	South 16 Ditch	Location 721	Sediment			X		X	X	X		
NFSS99SW722-346	South 16 Ditch	Location 722	Surface Water		X	X	X	X	X	X		X
NFSS99SD722-347	South 16 Ditch	Location 722	Sediment		X	X	X	X	X	X	X	X
NFSS99SW723-348	Castle Garden Road West Ditch	Location 723	Surface Water		X	X	X	X	X	X		X
NFSS99SD723-349	Castle Garden Road West Ditch	Location 723	Sediment		X	X	X	X	X	X	X	X
NFSS99SW724-350	"O" Street South Ditch	Location 724	Surface Water				X	X	X	X		
NFSS99SD724-351	"O" Street South Ditch	Location 724	Sediment				X	X	X	X		
NFSS99SW725-352	"O" Street South Ditch	Location 725	Surface Water			X		X	X	X		
NFSS99SD725-353	"O" Street South Ditch	Location 725	Sediment			X		X	X	X		
NFSS99SW726-354	"O" Street North Ditch	Location 726	Surface Water		X	X		X	X	X		
NFSS99SD726-355	"O" Street North Ditch	Location 726	Sediment		X	X		X	X	X		
NFSS99SW727-356	"O" Street North Ditch	Location 727	Surface Water				X		X	X		
NFSS99SD727-357	"O" Street North Ditch	Location 727	Sediment				X		X	X		
NFSS99SW728-358	"O" Street North Ditch	Location 728	Surface Water			X		X	X	X		

TABLE 4.5-1

**PHASE I - SEDIMENT AND SURFACE WATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SD728-359	"O" Street North Ditch	Location 728	Sediment	QC-360, QA-361, MS/MSD-362		X		X	X	X		
NFSS99SW729-363	"O" Street North Ditch	Location 729	Surface Water		X	X	X	X	X	X		X
NFSS99SD729-364	"O" Street North Ditch	Location 729	Sediment		X	X	X	X	X	X	X	X
NFSS99SW730-365	"O" Street North Ditch	Location 730	Surface Water			X			X	X		
NFSS99SD730-366	"O" Street North Ditch	Location 730	Sediment			X			X	X		
NFSS99SW731-367	MacArthur Street West Ditch	Location 731	Surface Water		X	X	X	X	X	X		X
NFSS99SD731-368	MacArthur Street West Ditch	Location 731	Sediment		X	X	X	X	X	X	X	X
NFSS99SW732-369	MacArthur Street West Ditch	Location 732	Surface Water		X	X	X	X	X	X		X
NFSS99SD732-370	MacArthur Street West Ditch	Location 732	Sediment		X	X	X	X	X	X	X	X
NFSS99SW733-371	MacArthur Street West Ditch	Location 733	Surface Water	QC-372	X	X	X	X	X	X		X
NFSS99SD733-373	MacArthur Street West Ditch	Location 733	Sediment		X	X	X	X	X	X	X	X
NFSS99SW734-374	Depressed Area	Location 734	Surface Water		X	X	X	X	X	X		X
NFSS99SD734-375	Depressed Area	Location 734	Sediment		X	X	X	X	X	X	X	X
NFSS99SW735-376	CWM Ditch	Location 735	Surface Water		X	X	X	X	X	X		X
NFSS99SD735-377	CWM Ditch	Location 735	Sediment		X	X	X	X	X	X	X	X
NFSS99SW736-378	"N" Street North Ditch	Location 736	Surface Water			X		X	X	X		

TABLE 4.5-1

**PHASE I - SEDIMENT AND SURFACE WATER SAMPLE LOCATIONS AND ANALYSES REQUIRED
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK**

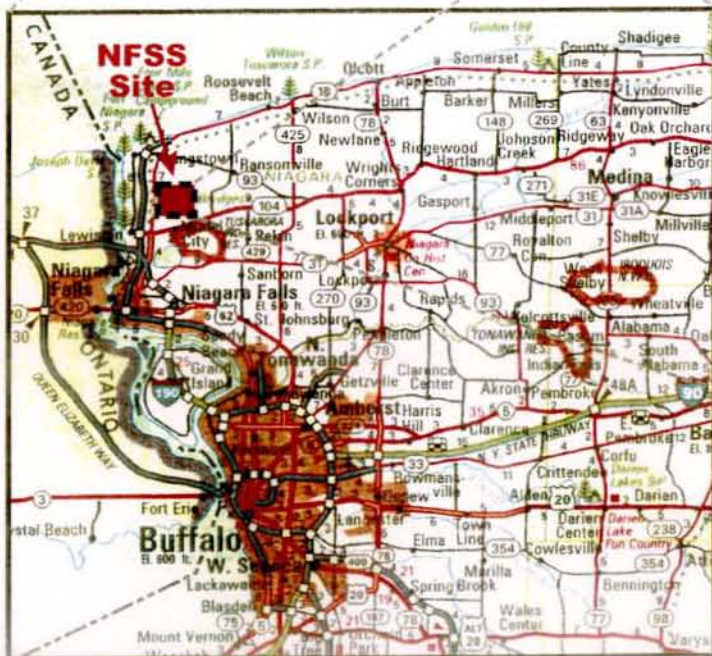
Identification					Parameters ¹							
Sample Number	Area of Investigation	Sample Location	Matrix	Field QC Duplicate, QA Split, or MS/MSD Samples ²	VOCs	SVOCs	Pesticides and PCBs	Metals	Radiological Species	TOC	Cation Exchange Capacity	Nitro-aromatics
NFSS99SD736-379	"N" Street North Ditch	Location 736	Sediment			X		X	X	X		
NFSS99SW737-380	"N" Street North Ditch	Location 737	Surface Water		X		X		X	X		
NFSS99SD737-381	"N" Street North Ditch	Location 737	Sediment		X		X		X	X		
NFSS99SW738-382	"N" Street South Ditch	Location 738	Surface Water			X		X	X	X		
NFSS99SD738-383	"N" Street South Ditch	Location 738	Sediment			X		X	X	X		
NFSS99SW739-384	"N" Street South Ditch	Location 739	Surface Water		X	X	X	X	X	X		X
NFSS99SD739-385	"N" Street South Ditch	Location 739	Sediment		X	X	X	X	X	X	X	X

Notes:

- ¹
- Volatile organics (by USEPA SW846 Method 5035/8260B)
 - Semi-volatile organics (by USEPA SW846 Methods 3550B/8270B)
 - Pesticides and PCBs (by USEPA SW846 Methods 3550B, 8081A, and 8082)
 - Metals (by USEPA SW846 Methods 3050B/6010B/7000)
 - Radiological speciation: uranium-235, uranium-238, thorium-230, radium-226 (by HASL 300), total alpha and beta radiation (by Method 900), and total uranium (by ASTM D5174)
 - Total Organic Carbon (by USEPA SW846 Method 9060)
 - Cation Exchange Capacity (by USEPA SW846 Method 9081)
 - Nitroaromatics (by USEPA SW846 Method 8330)

- ² QC - denotes quality control field duplicate, QA - denotes quality assurance split sample, MS/MSD - denotes the matrix spike/matrix spike duplicate sample

FIGURES



SITE LOCATION MAP
Niagara Falls Storage Site
Lewiston, New York

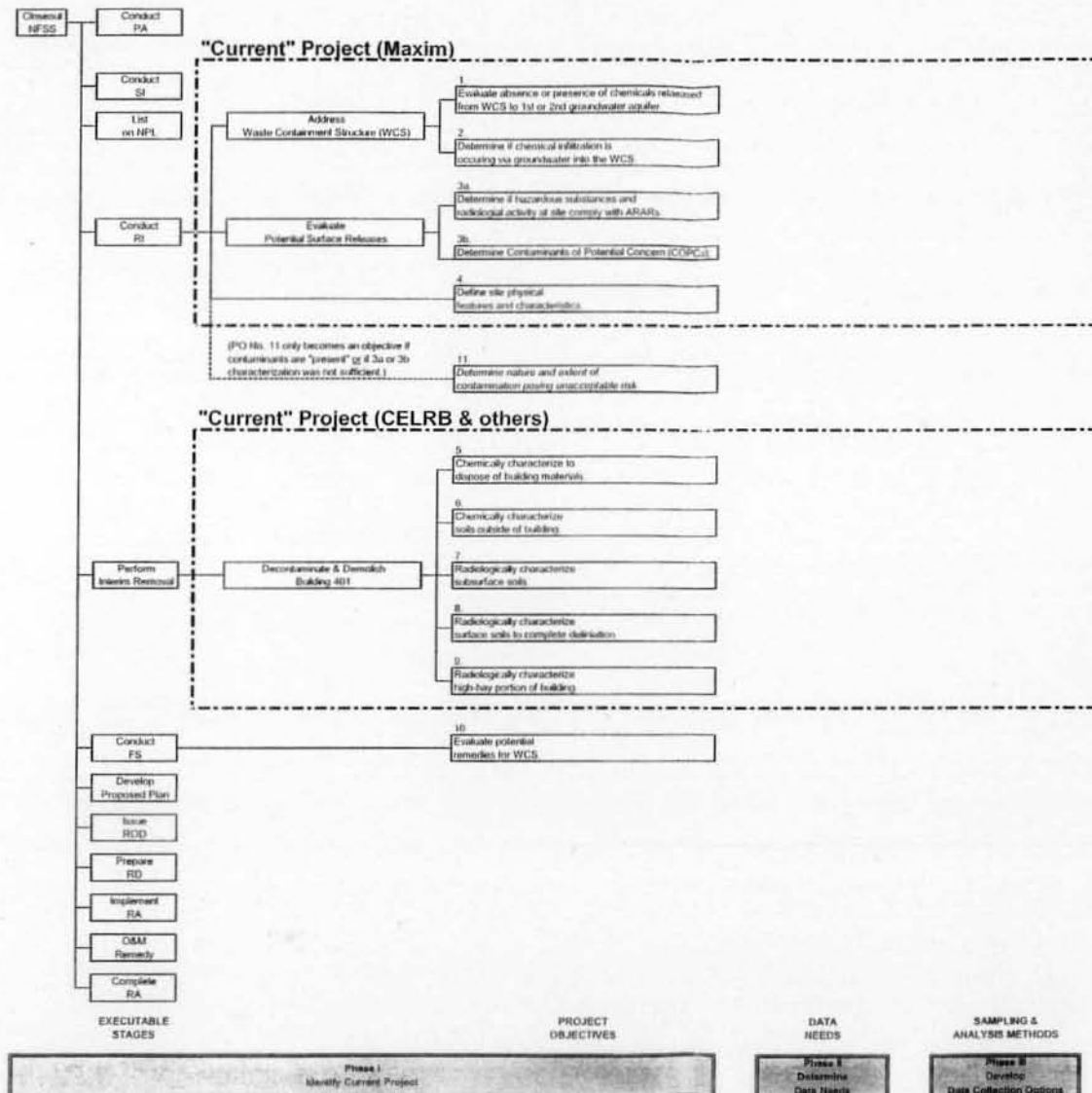


SCALE 1:35,000
CONTOUR INTERVAL 5 FEET
NATIONAL GEODESIC DATUM OF 1983

MAXIM TECHNOLOGIES INC.

Project #: 9905006 Figure #: 1.D-1
Scale: As indicated Date: 09-20-99
Drawn by: DCJ Checked by: JLR

SAINT LOUIS



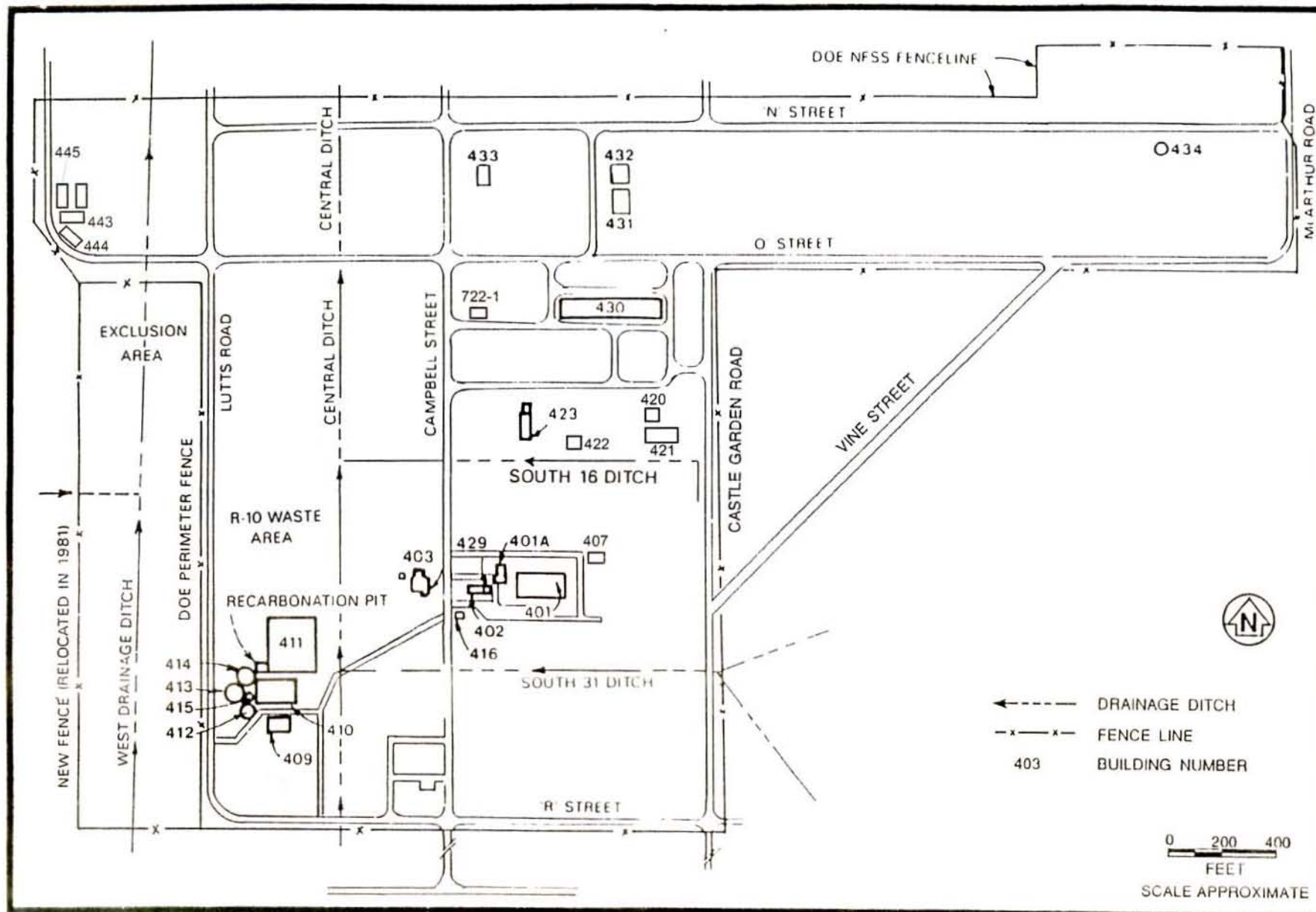
Primary Objectives for Collection Of Analytical Data at NFSS

MAXIM TECHNOLOGIES INC.

PROJECT # 9905006
Scale: N/A
Drawn by: DCJ

Figure # 1.0-2
Date: 09-20-99
Checked by: TL

SAINT
LOUIS



ORIGINAL NFSS BUILDING LOCATIONS
Niagara Falls Storage Site
Lewiston, New York

MAXIM

TECHNOLOGIES INC

SAINT LOUIS

Project #: 9905006

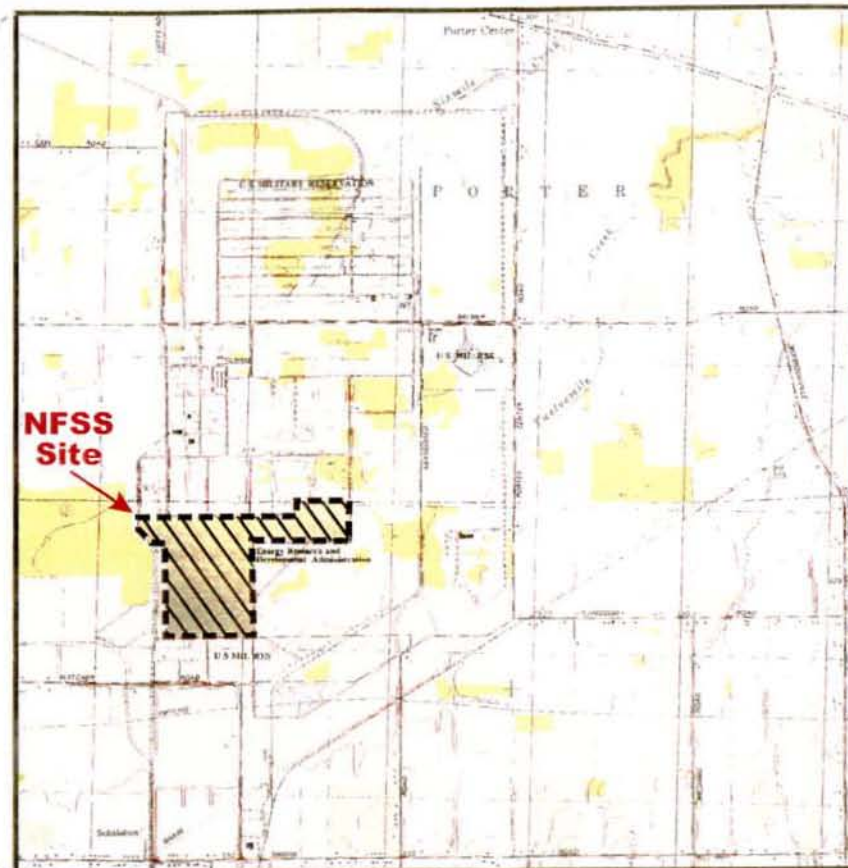
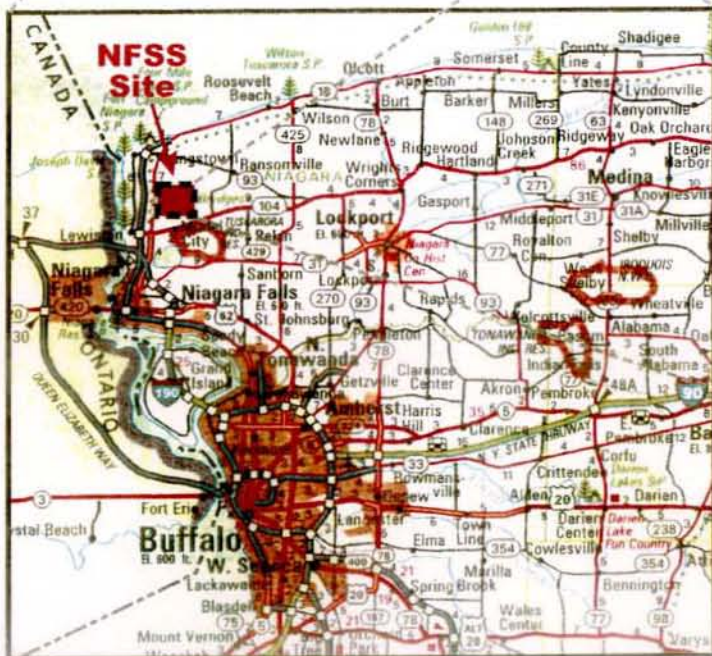
Figure #: 1.1.1-1

Scale: As indicated

Date: 09-20-99

Drawn by: DCJ

Checked by: DCJ



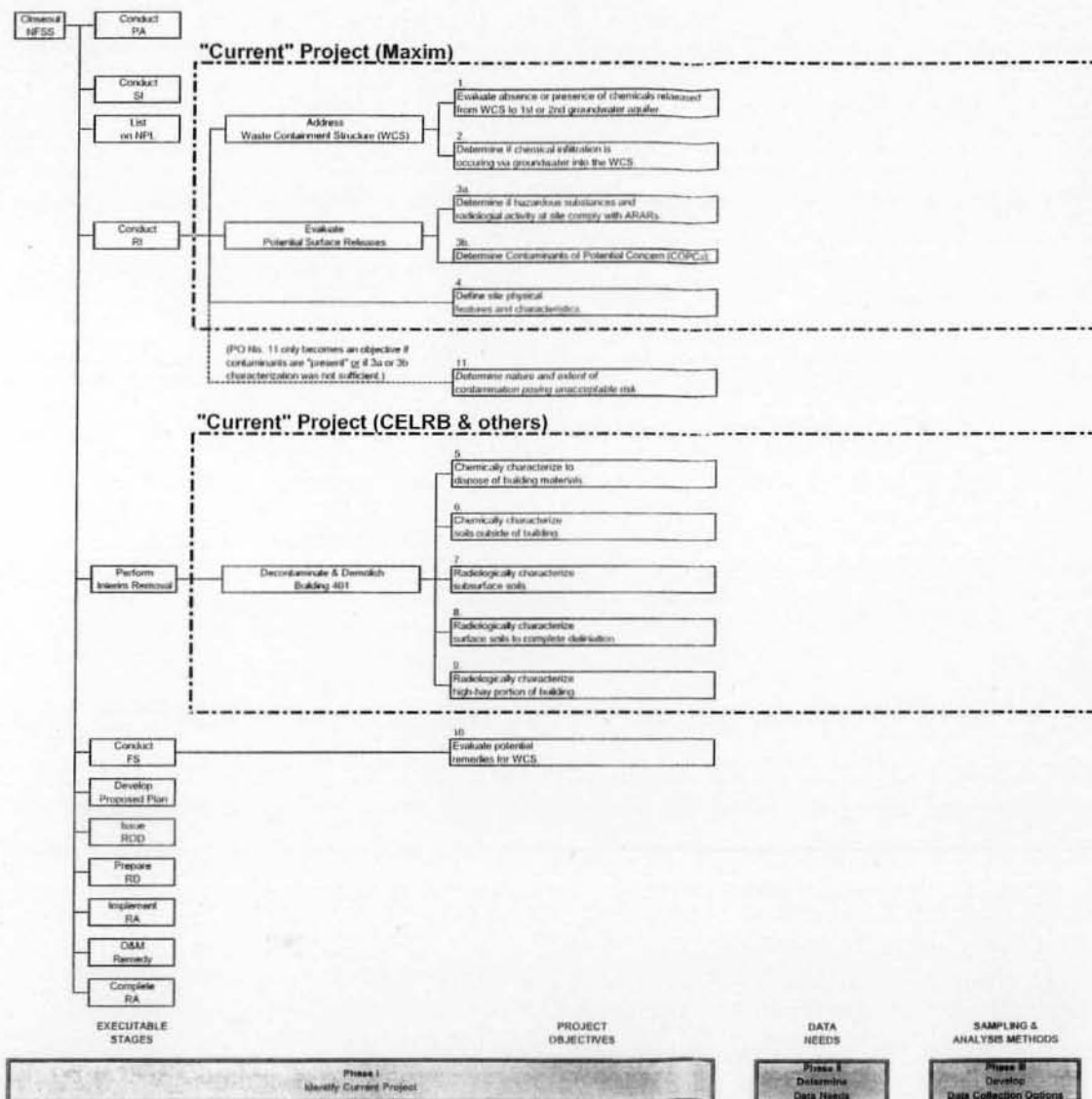
SCALE 1:25,000
 CONTOUR INTERVAL 5 FEET
 HIGHEST ADJUSTED ELEVATION 540.0

SITE LOCATION MAP
 Niagara Falls Storage Site
 Lewiston, New York

MAXIM TECHNOLOGIES INC.

Project #: 9905006 Figure #: 1.D-1
 Scale: As indicated Date: 09-20-99
 Drawn by: DCJ Checked by: JLR

SAINT LOUIS



Primary Objectives for Collection Of Analytical Data at NFSS

MAXIM TECHNOLOGIES INC.

PROJECT # 9905006

Scale: N/A

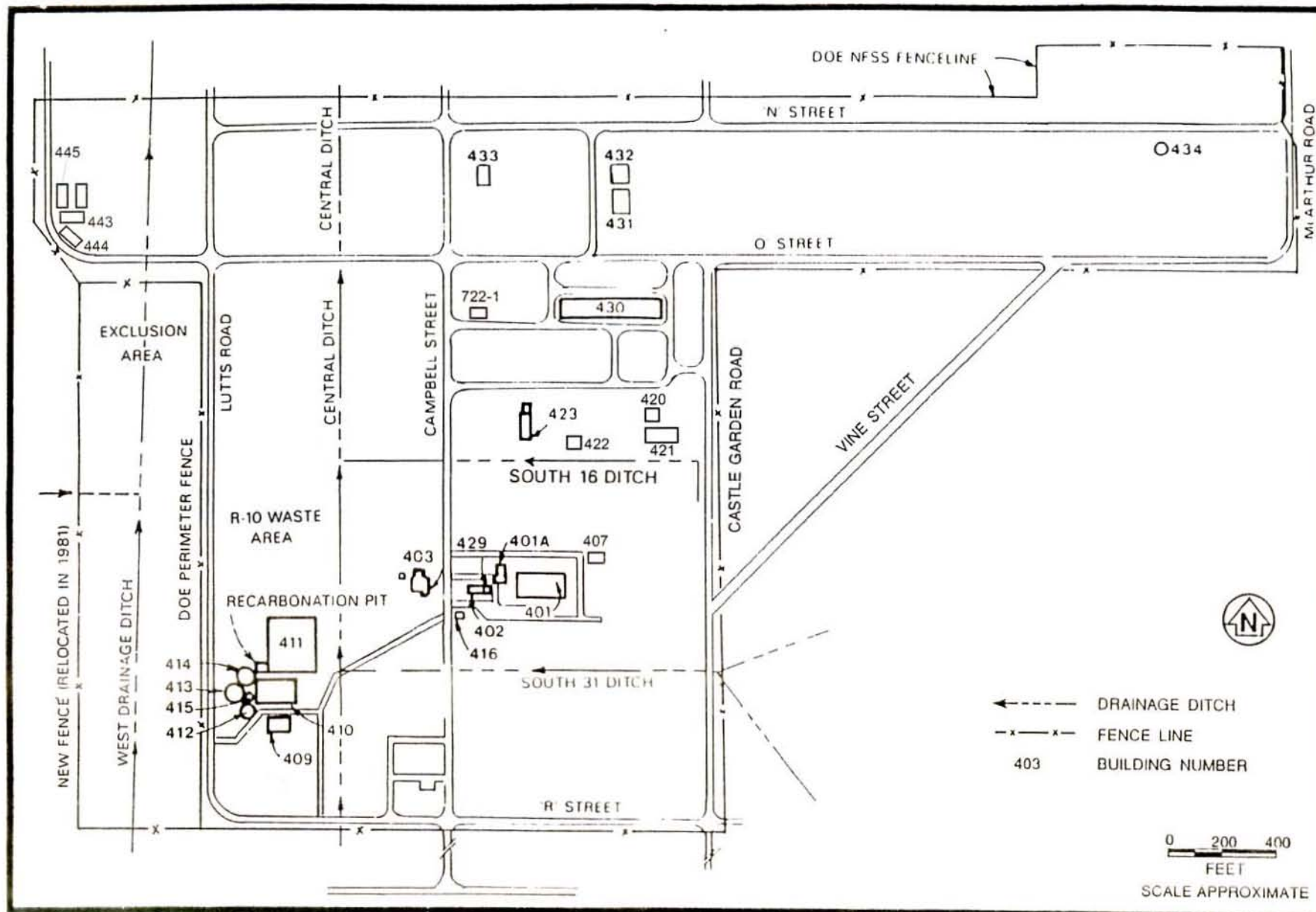
Drawn by: DCJ

Figure # 1.0-2

Date: 09-20-99

Checked by: TL

SAINT LOUIS



ORIGINAL NFSS BUILDING LOCATIONS
Niagara Falls Storage Site
Lewiston, New York

MAXIM

TECHNOLOGIES INC

SAINT LOUIS

Project #: 9905006

Figure #: 1.1.1-1

Scale: As indicated

Date: 09-20-99

Drawn by: DCJ

Checked by: DCJ

(APPROXIMATE SCALE OF THIS VIEW IS 1" = 400')

ERA	PERIOD	EPOCH	GROUP	ROCK TYPE
P A L E O Z O I C	DEVONIAN	Late	Conewango	Shale (sh) and Sandstone
			Conneaut	
			Canadaway	Shale
			West Falls	Shale
			Sonyea	Shale
		Middle	Genesee	
			Tully Ls	
			Hamilton	Limestone (ls)
		Early	Onondaga Formation	Limestone
			Tristates	
			Heidelberg	
	SILURIAN	Late	Salina	(see enlargement)
			Lockport	Dolomite Dolomite and Limestone
			Clinton	Dolomite Shale Shale and Limestone Dolomite
		Early	Medina	Sandstone Sandstone and Shale Sandstone
			Queenston Shale	
	ORDOVICIAN	Late		

Source: Adapted from Rogers et al. 1990

Note: The vertical line pattern represents unconformities – places where no rock record exists for that span of time. The record is missing because rock was removed by erosion before the deposition of the next unit, or because no deposition occurred during that time.

The vertical axis of this pattern represents time, not thickness. The scale along this axis is only approximate.

Akron – dolomite
Bertie – dolomite
Camillus – shale
Syracuse – shale, dolomite, salt*, and anhydrite**
Vernon – shale, salt* and anhydrite**

* Major deposits are to the south and east of the Tonawanda area

** Anhydrite is calcium sulphate (CaSO_4) that turns into gypsum ($\text{CaSO}_4 \cdot \text{H}_2\text{O}$) when exposed to water

REGIONAL GEOLOGIC STRATAGRAPHIC COLUMN
Niagara Falls Storage Site
Lewiston, New York

MAXIM

TECHNOLOGIES INC

SAINT LOUIS

Project #: 9905006

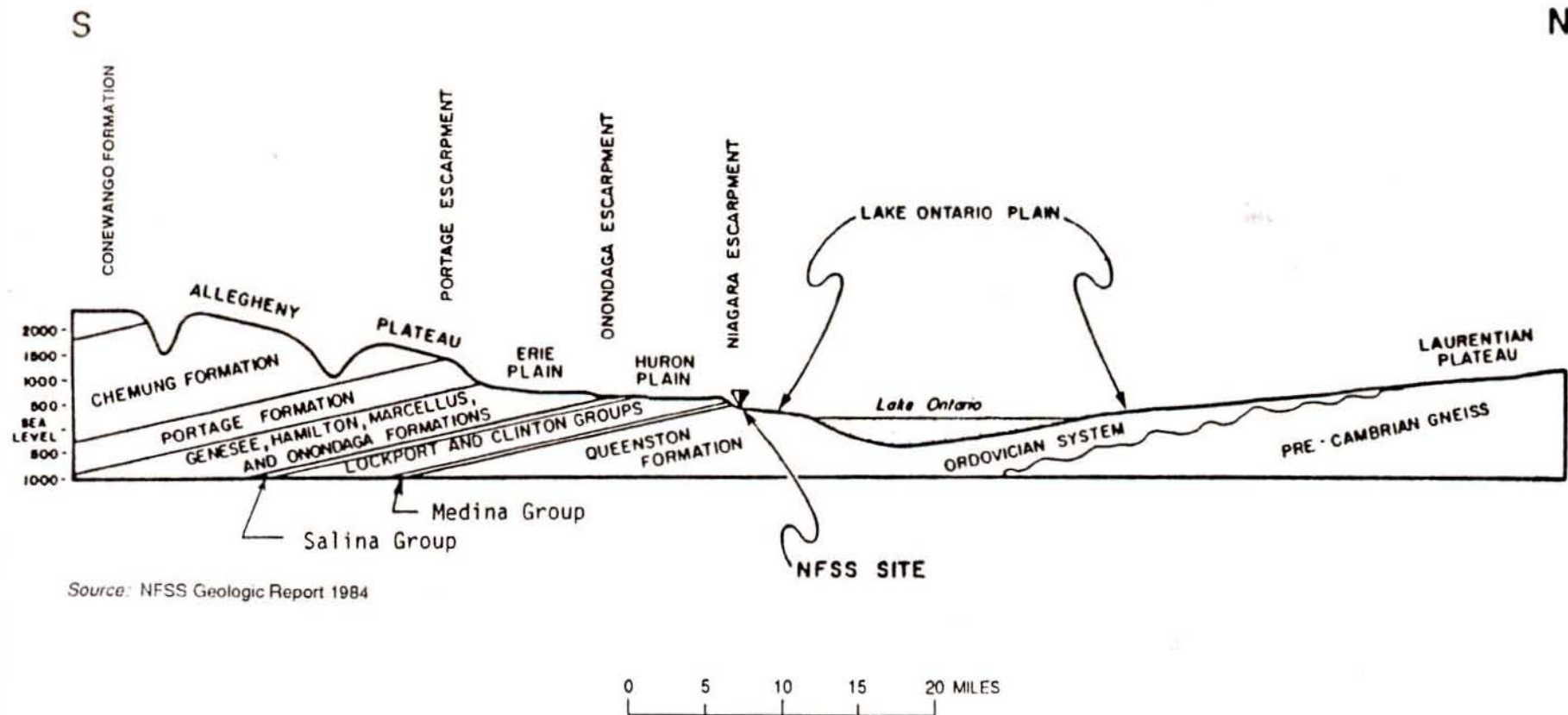
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Scale: As indicated

Date: 09-20-99

Drawn by: DCJ

Checked by: JLR

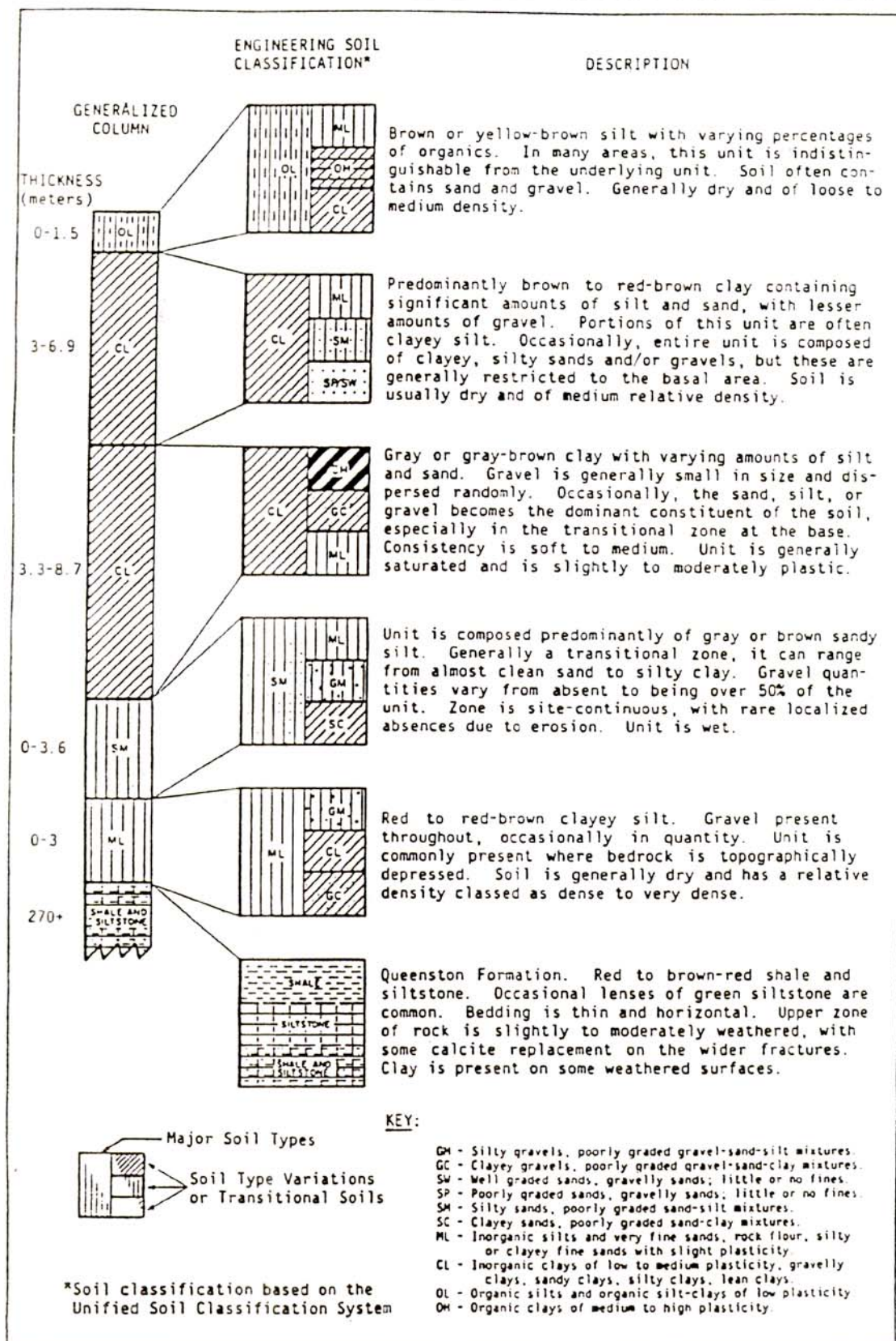


Notes:

1. Modified from Kindle and Taylor, 1913.
2. Surficial Deposits are not shown.

GENERALIZED REGIONAL GEOLOGIC CROSS-SECTION
Niagara Falls Storage Site
Lewiston, New York

MAXIM TECHNOLOGIES INC. SAINT LOUIS
Project #: 9905006 Figure #: 1.1.3-2
Scale: As indicated Date: 09-20-99
Drawn by: DCJ Checked by: JLR



GENERALIZED SITE SPECIFIC
GEOLOGIC STRATAGRAPHIC COLUMN
Niagara Falls Storage Site
Lewiston, New York

MAXIM

TECHNOLOGIES INC

Project #: 9905006

Figure #: 1.1.3-3

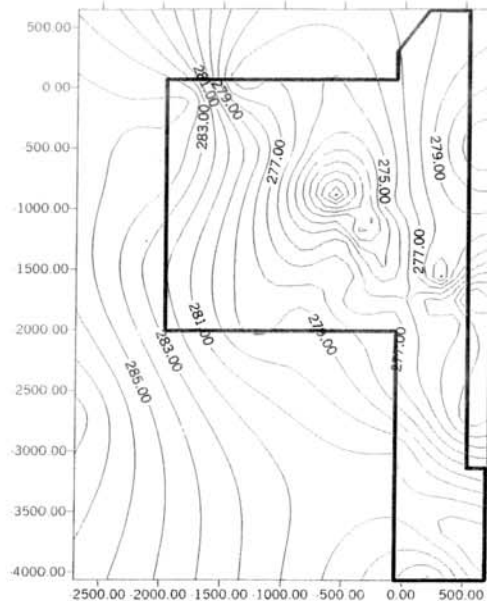
Scale: As indicated

Date: 09-20-99

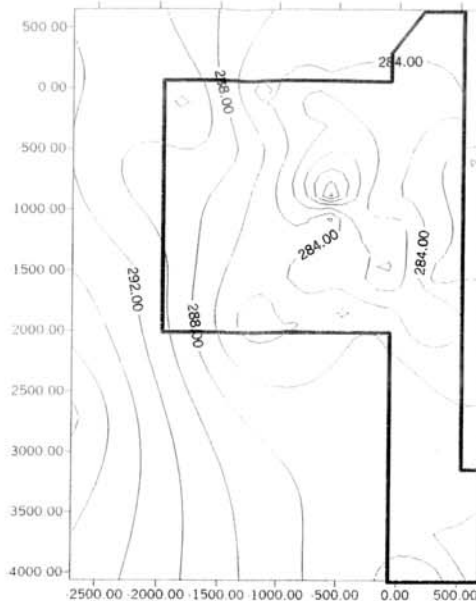
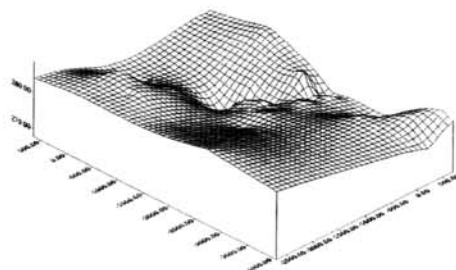
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Checked by: JLR

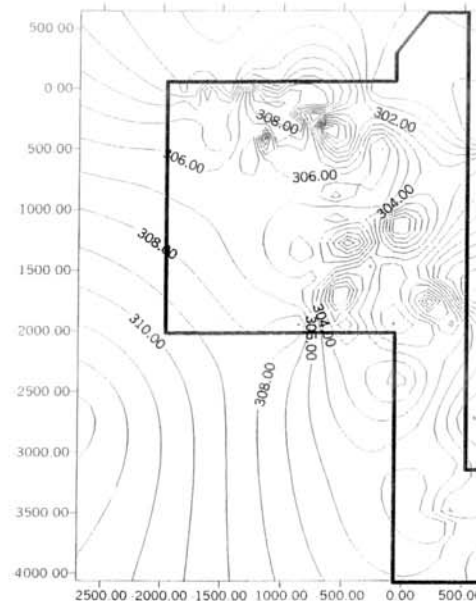
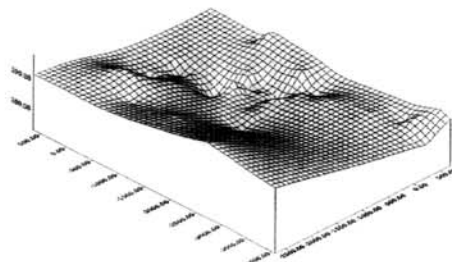
SAINT LOUIS



BEDROCK
(QUEENSTON FORMATION)
(1-ft contour interval)



BOTTOM OF
GRAY CLAY LAYER
(2-ft contour interval)



TOP OF
GRAY CLAY LAYER
(1-ft contour interval)

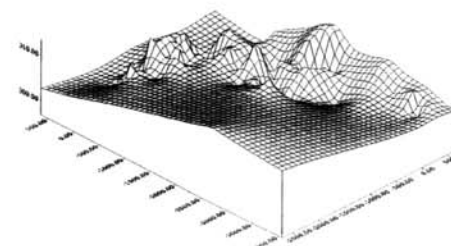
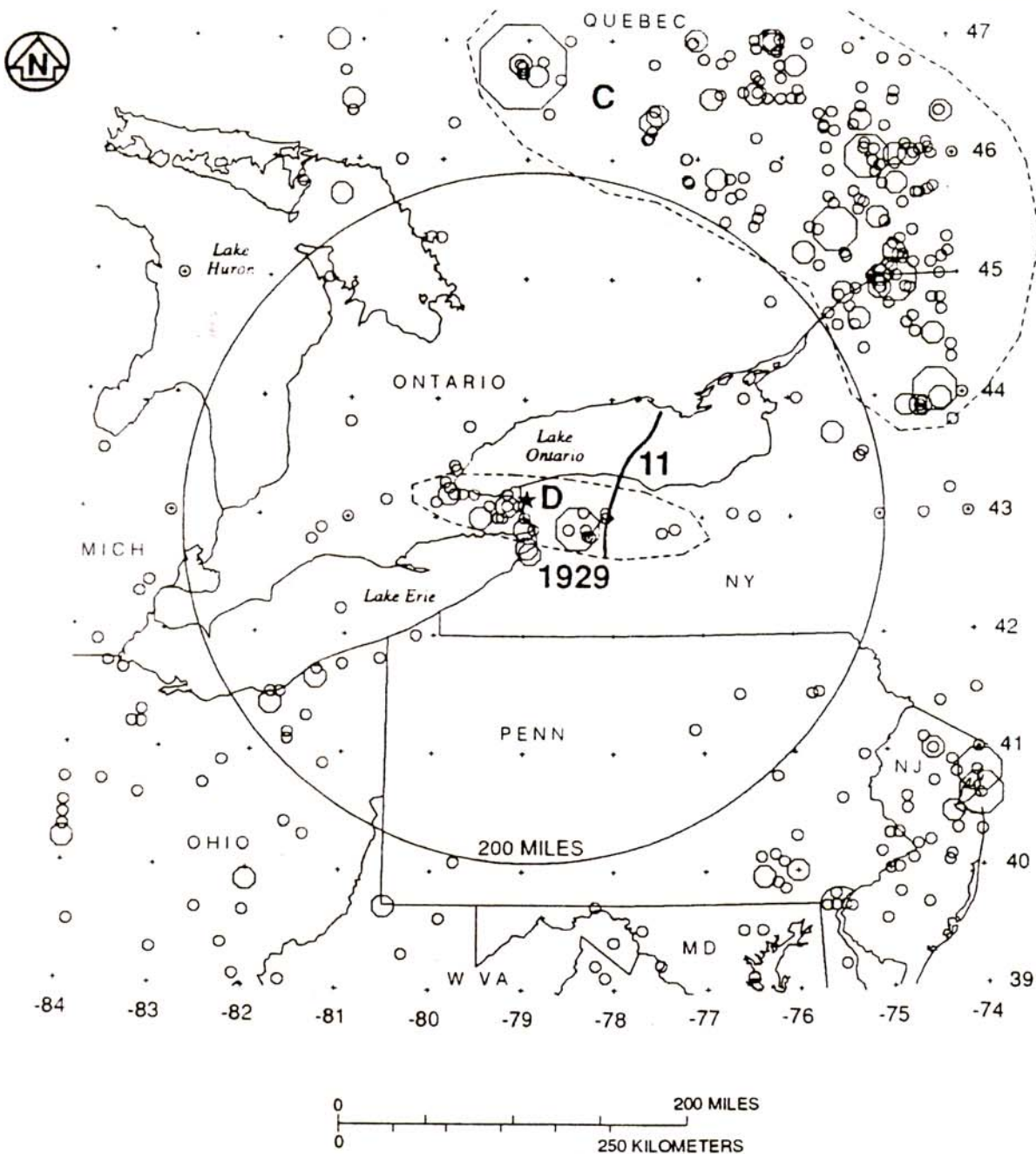


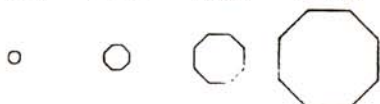
Figure 1.1.3-4
Contours of Geologic Units
Niagara Falls Storage Site
Lewiston, New York



EXPLANATION

Magnitude Scale

3.0-3.9 4.0-4.9 5.0-5.9 6.0-6.9



Earthquake locations and magnitude values are from Armbruster and Seeber (1992).

Seismic Source Zones (enclosed by dashed lines)

C = Western Quebec

D = Niagara

11 = Clarendon-Linden structure (bold line)

1929 = Location of Attica, New York, earthquake of August 12, 1929

★ = Niagara Falls Storage Site

NIAGARA SEISMIC SOURCE ZONE
Niagara Falls Storage Site
Lewiston, New York

MAXIM

TECHNOLOGIES INC

Project #: 9905006

Figure #: 1.1.3.7-1

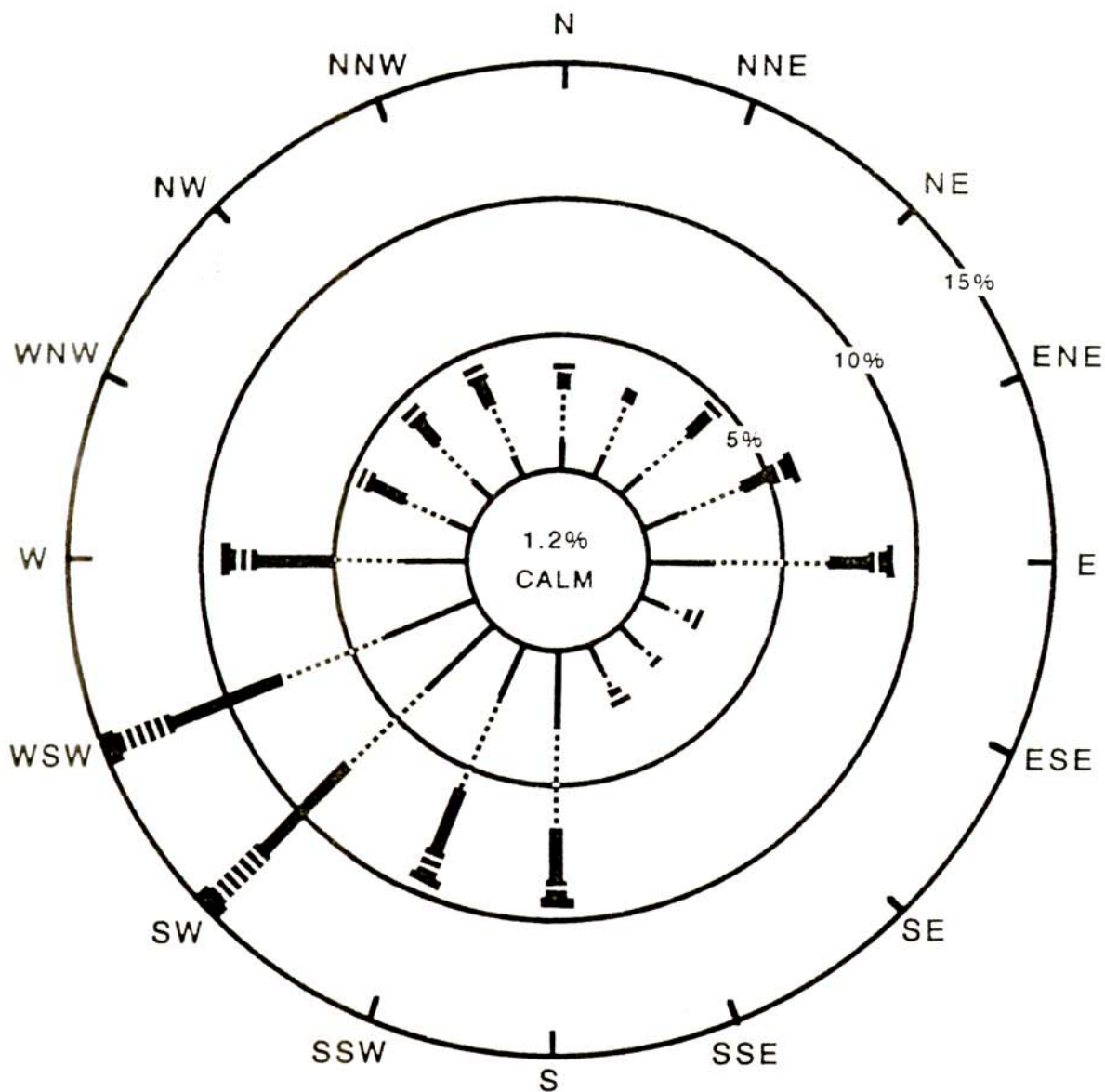
Scale: As indicated

Date: 09-20-99

Drawn by: DCJ

Checked by: JLR

SAINT LOUIS



BASED ON DATA FROM
ON-SITE METEOROLOGICAL
STATION DURING 1985

NFSS WIND ROSE FROM 1985
Niagara Falls Storage Site
Lewiston, New York

MAXIM

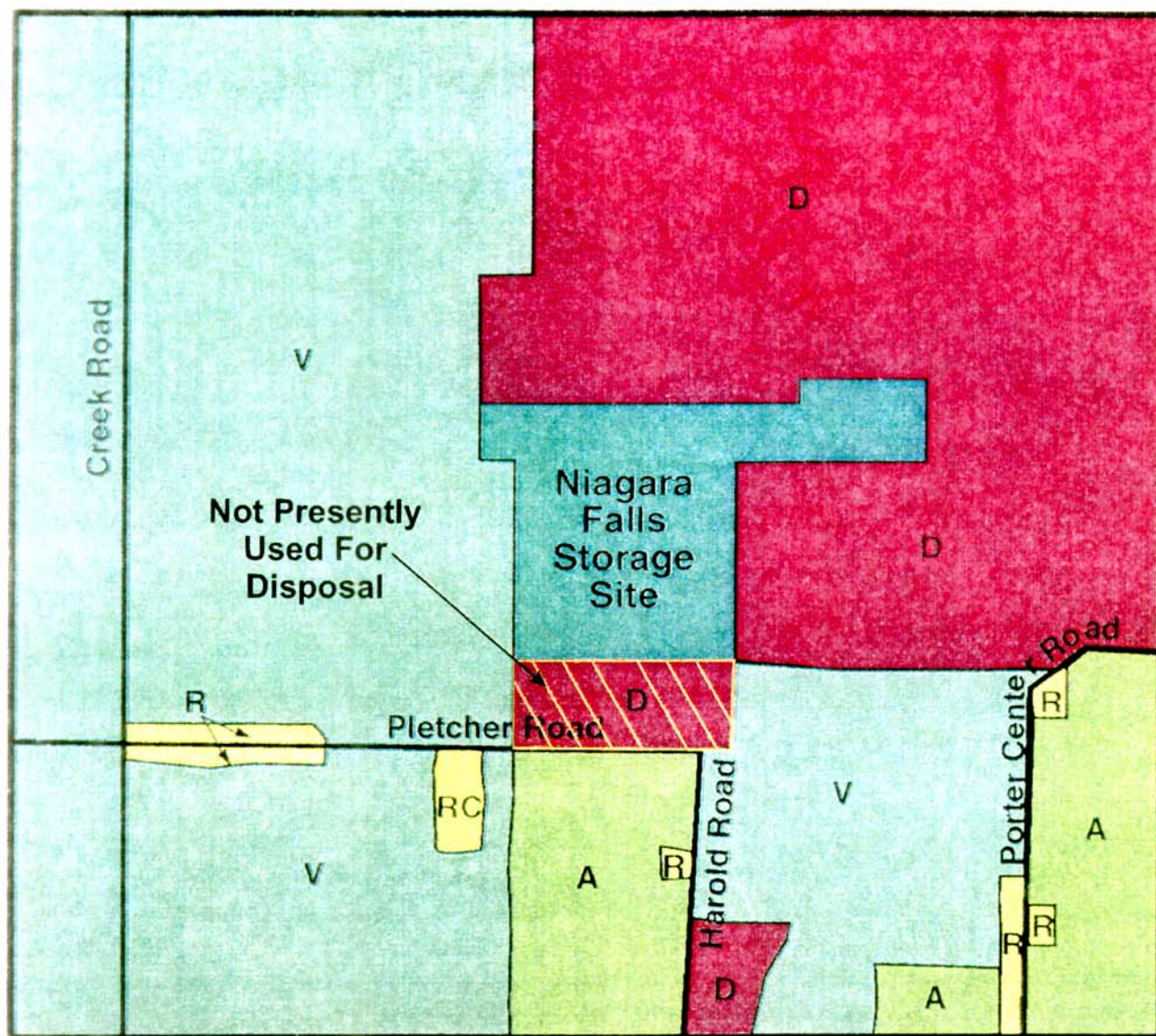
TECHNOLOGIES INC

Project #: 9905006
Scale: As indicated
Drawn by: DCJ

Figure #: 1.1.5-1
Date: 09-20-99
Checked by: JLR

SAINT
LOUIS

Present Land Use



Based on aerial photographs, site visits, and USGS topographic map, 1:2400 scale, Ransomville Quadrangle, (Photo revised 1980)

R Residential
RC Recreational
A Agricultural

D Waste Disposal
V Vacant

0 ————— 0.5 MI
 0 ————— 0.8 KM



CURRENT SURROUNDING LAND USE TYPES
 Niagara Falls Storage Site
 Lewiston, New York

MAXIM

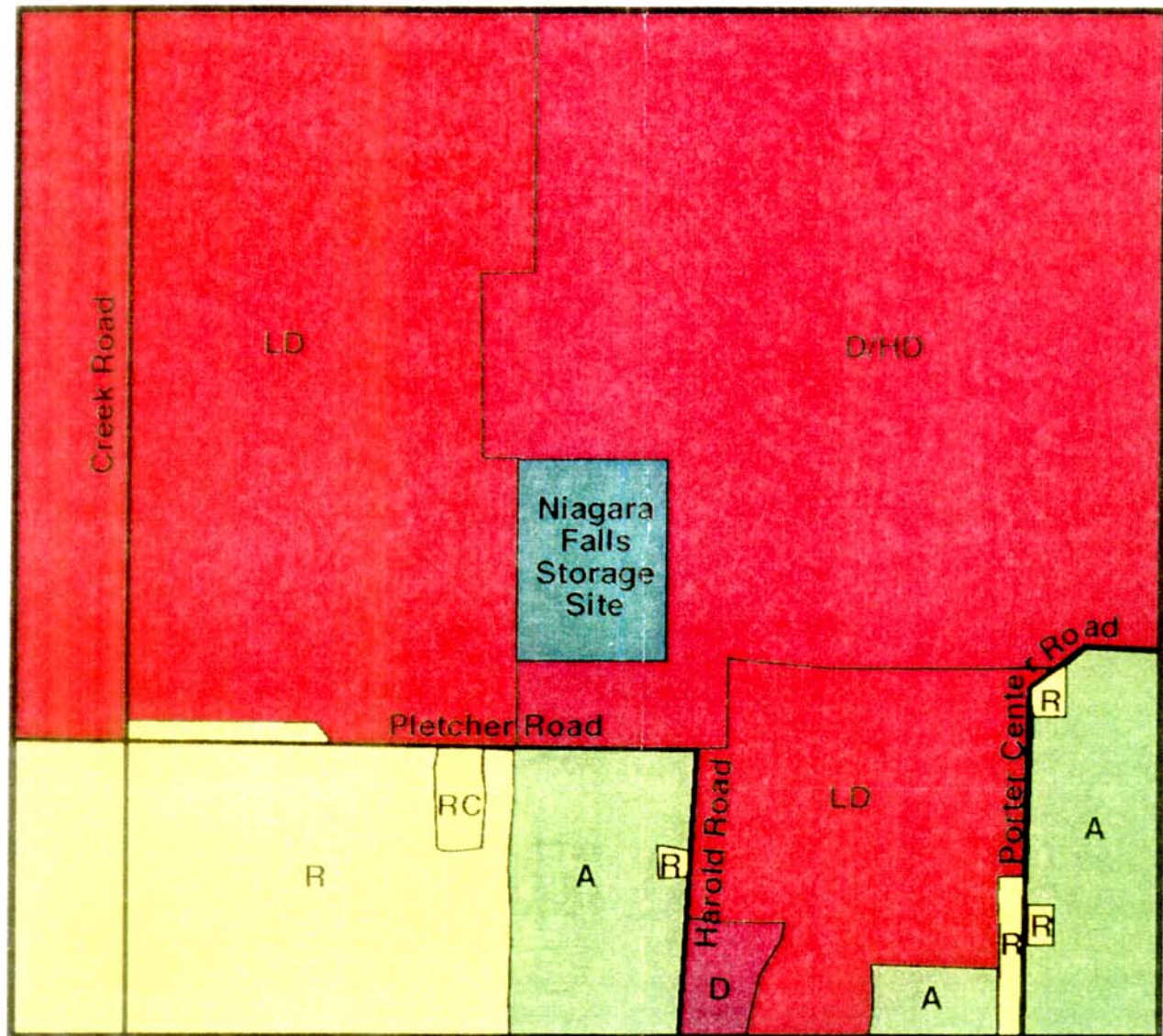
TECHNOLOGIES INC

Project #: 9905006
 Scale: As indicated
 Drawn by: DCJ

Figure #: 1.1.7-1
 Date: 09-20-99
 Checked by: JLR

SAINT LOUIS

Future Land Use (to year 2700)



Based on aerial photographs, site visits, and USGS topographic map, 1:2400 scale, Ransomville Quadrangle, (Photo revised 1980)

R	Residential	D/HD	Waste Disposal/Heavy Industrial
RC	Recreational	D	Waste Disposal
A	Agricultural	LD	Light Industrial

0 0.5 MI
0 0.8 KM



PROJECTED SURROUNDING LAND USE TYPES
Niagara Falls Storage Site
Lewiston, New York

MAXIM

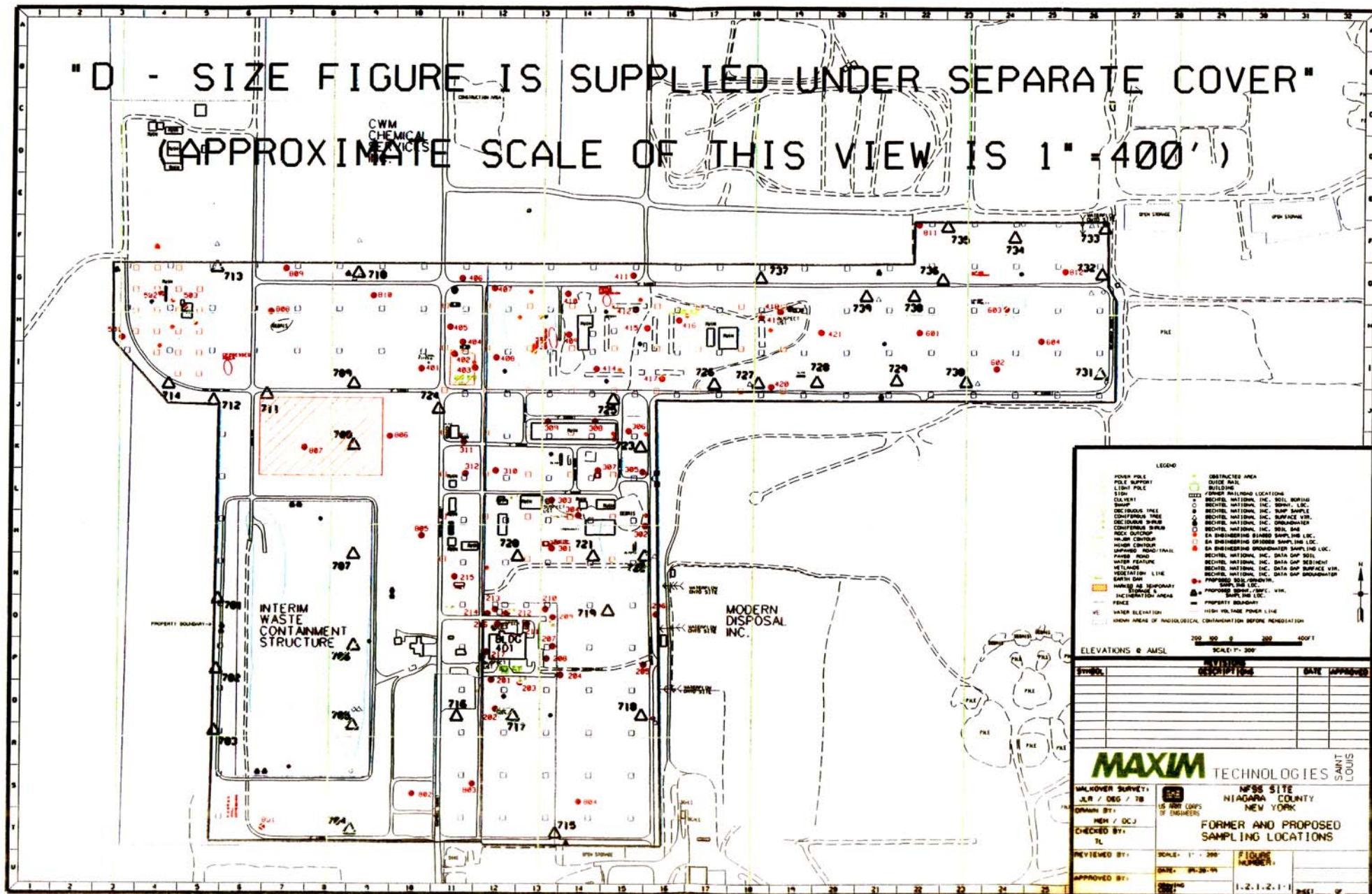
TECHNOLOGIES INC

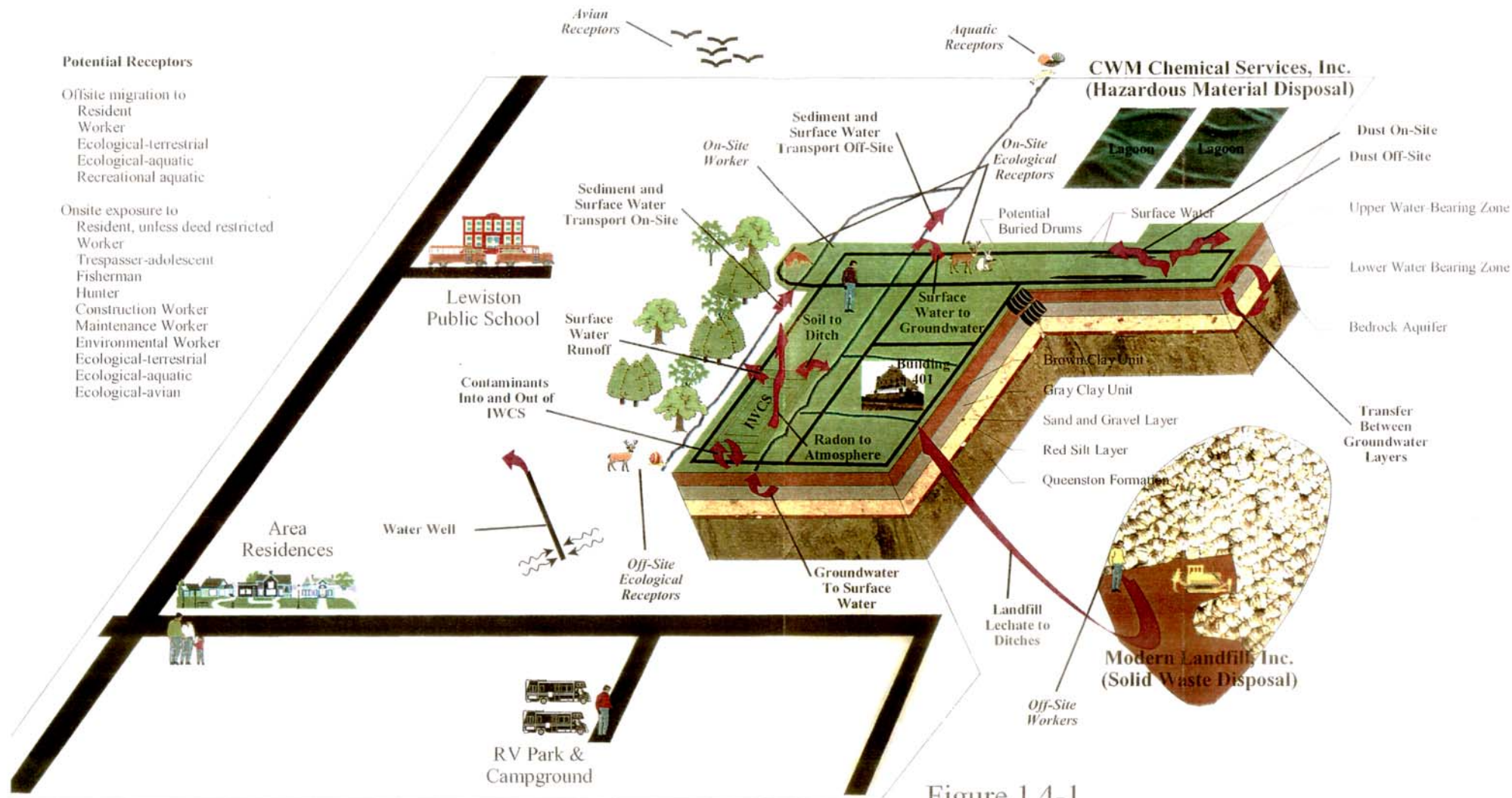
Project #: 9905006
Scale: As indicated
Drawn by: DCJ

Figure #: 1.1.7-2
Date: 09-20-99
Checked by: JLR

SAINT
LOUIS

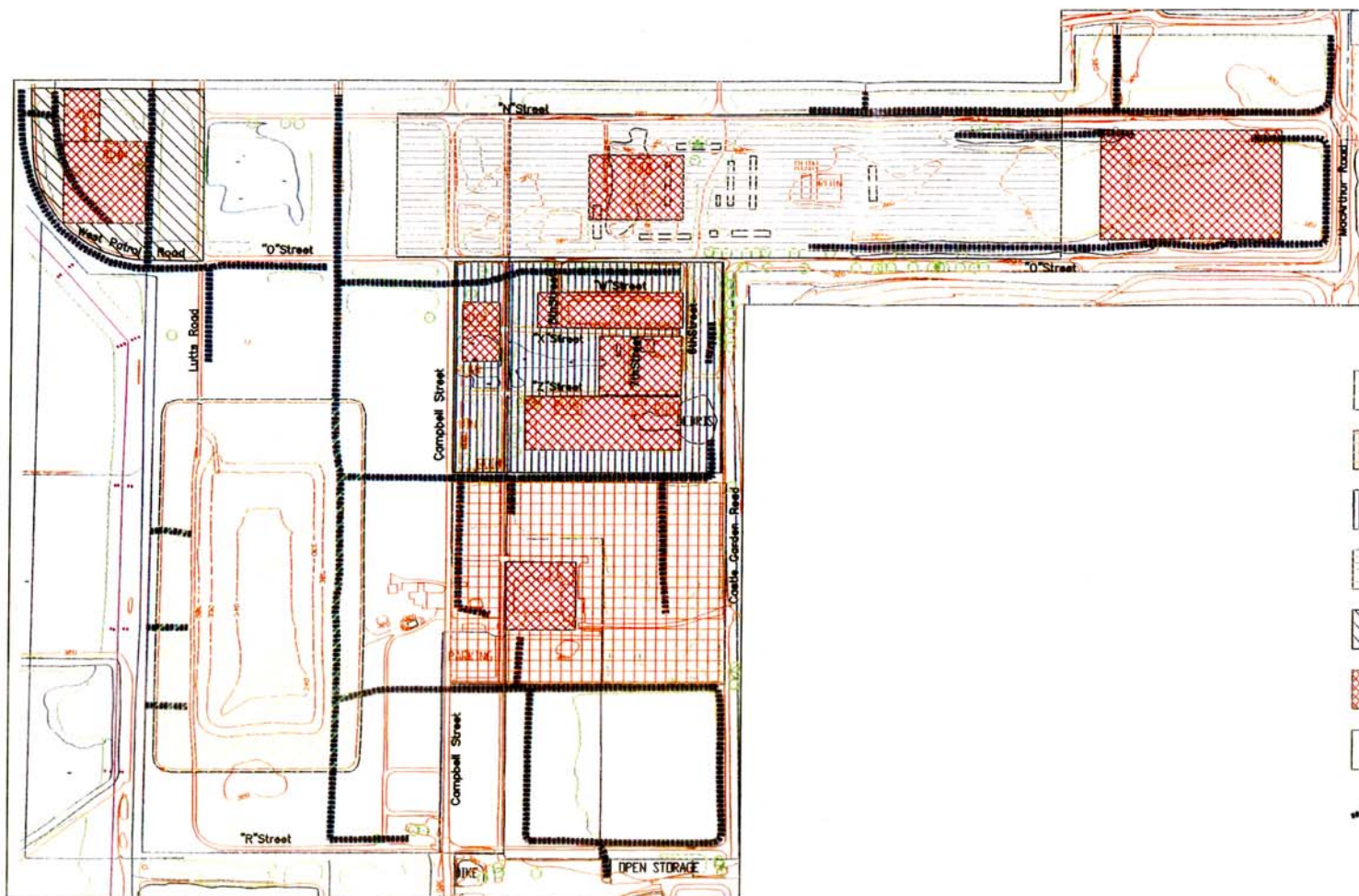
(APPROXIMATE SCALE OF THIS VIEW IS 1" = 400')





This conceptual model is a dynamic document to be updated based on site-specific information obtained during the investigation and refined in the risk assessment, which will include specific exposure routes.

Figure 1.4-1
Preliminary Conceptual Model of the NFSS
Illustrating Potential Contaminated Media,
Migration Pathways, and Potential Receptors



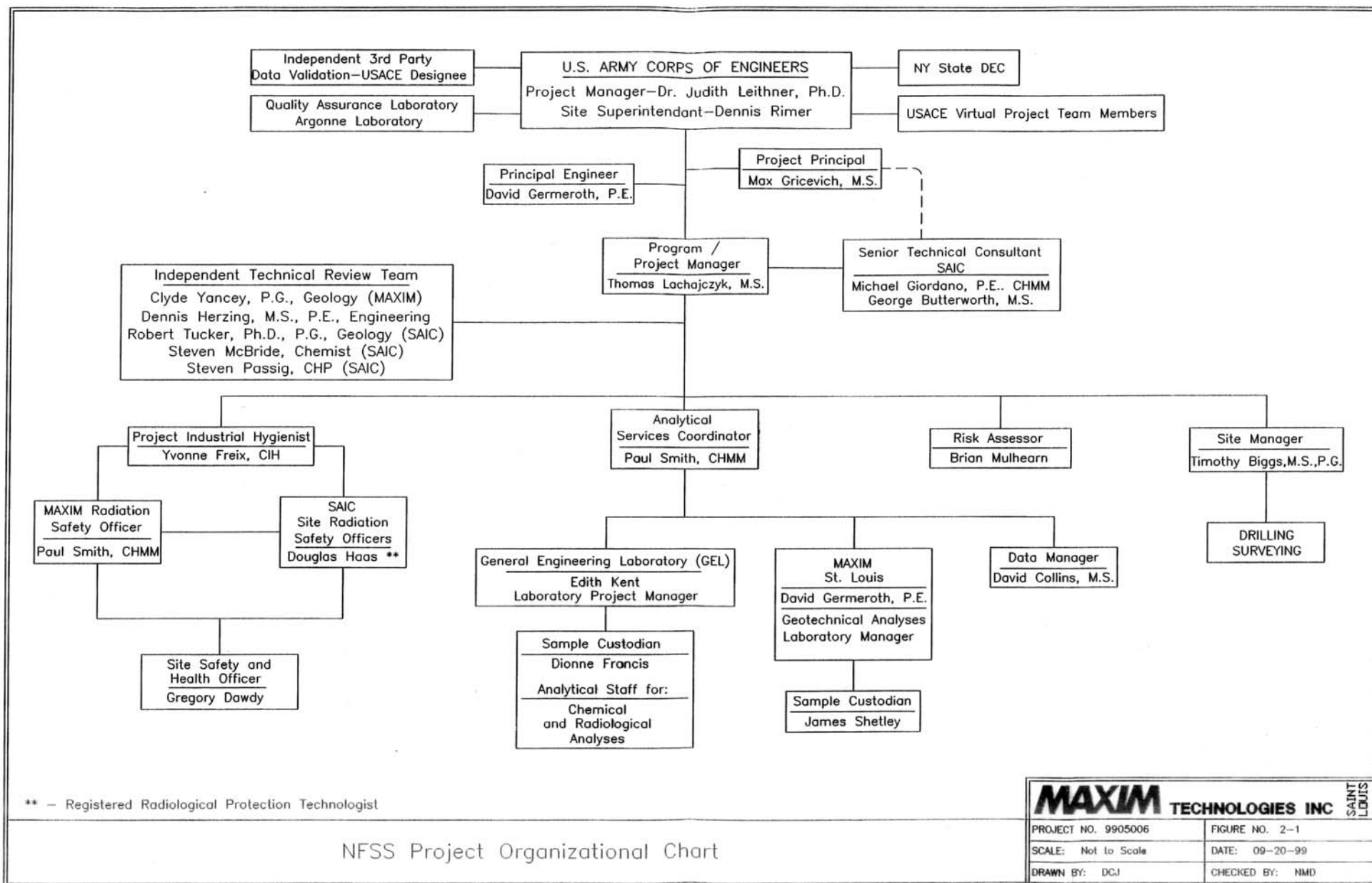
LEGEND:

-  IWCS
-  Building 401 Area
-  Former Shop Area
-  Former Acidification Area
-  Baker Smith Area
-  Former Radioactive Residue Storage Area (Included within each indicated area)
-  Previously Uninvestigated Areas
-  Ditches

0 400' 800'
Scale in Feet

NFSS Areas of Investigation

MAXIM TECHNOLOGIES INC SAINT LOUIS	
PROJECT NO. 9905006	FIGURE NO. 1.4.3-1
SCALE: 1" = 400'	DATE: 09-20-99
DRAWN BY: DCJ	CHECKED BY: JLR



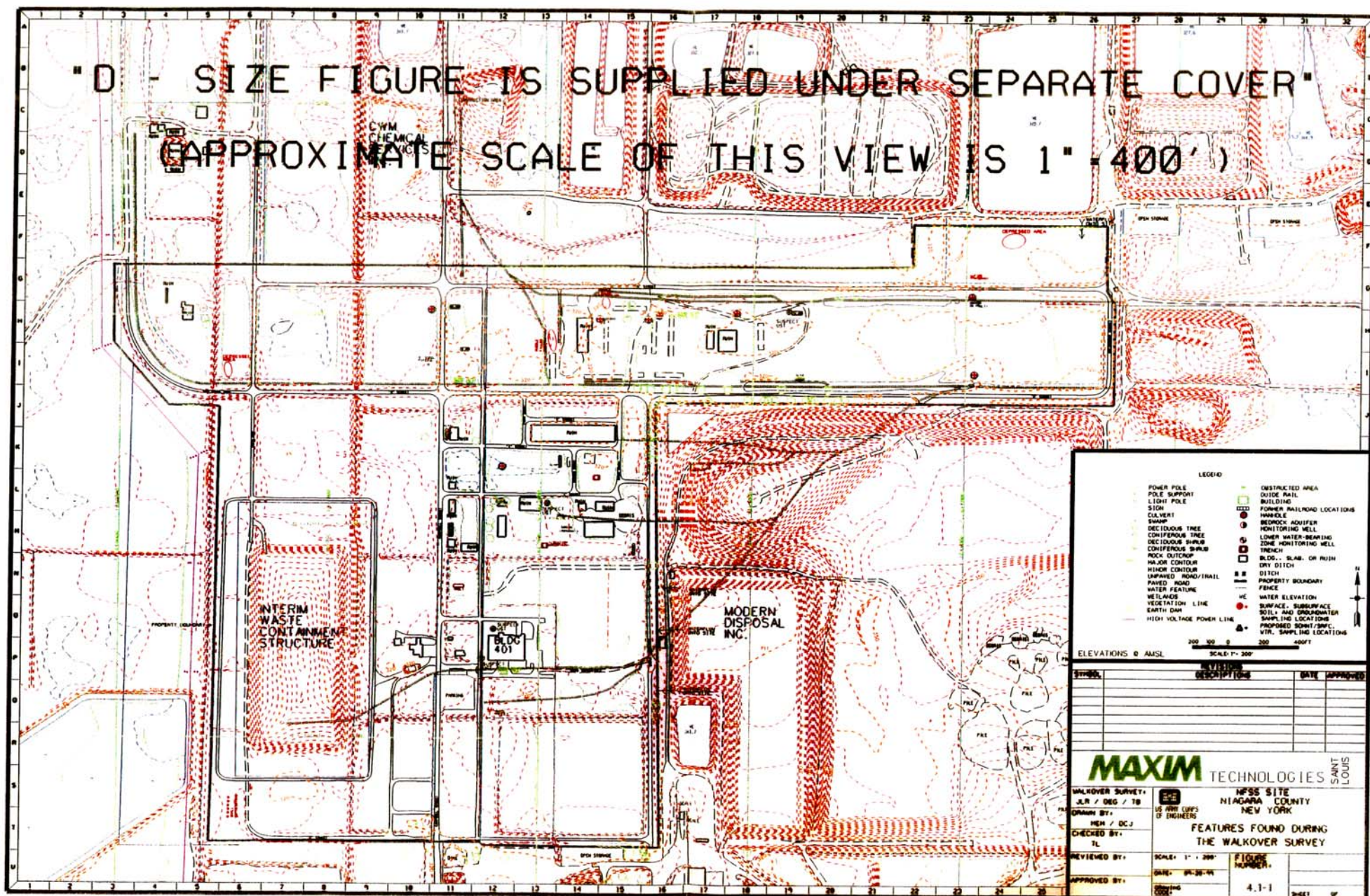
** — Registered Radiological Protection Technologist

NFSS Project Organizational Chart

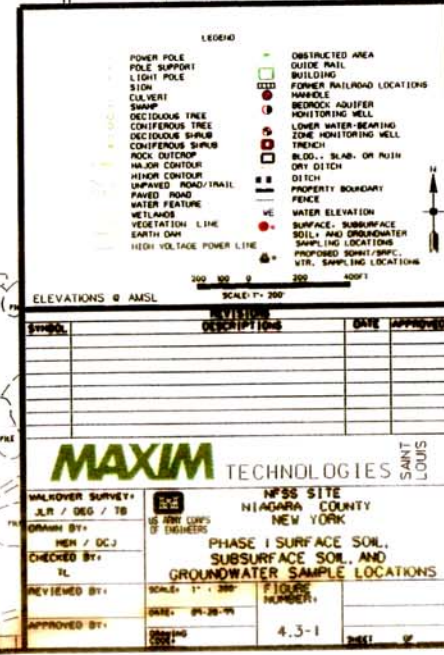
MAXIM TECHNOLOGIES INC SAINT LOUIS	
PROJECT NO. 9905006	FIGURE NO. 2-1
SCALE: Not to Scale	DATE: 09-20-99
DRAWN BY: DCJ	CHECKED BY: NMD

"D - SIZE FIGURE IS SUPPLIED UNDER SEPARATE COVER"

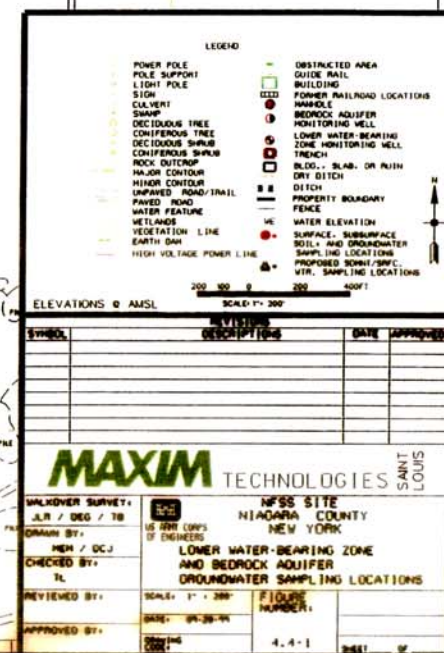
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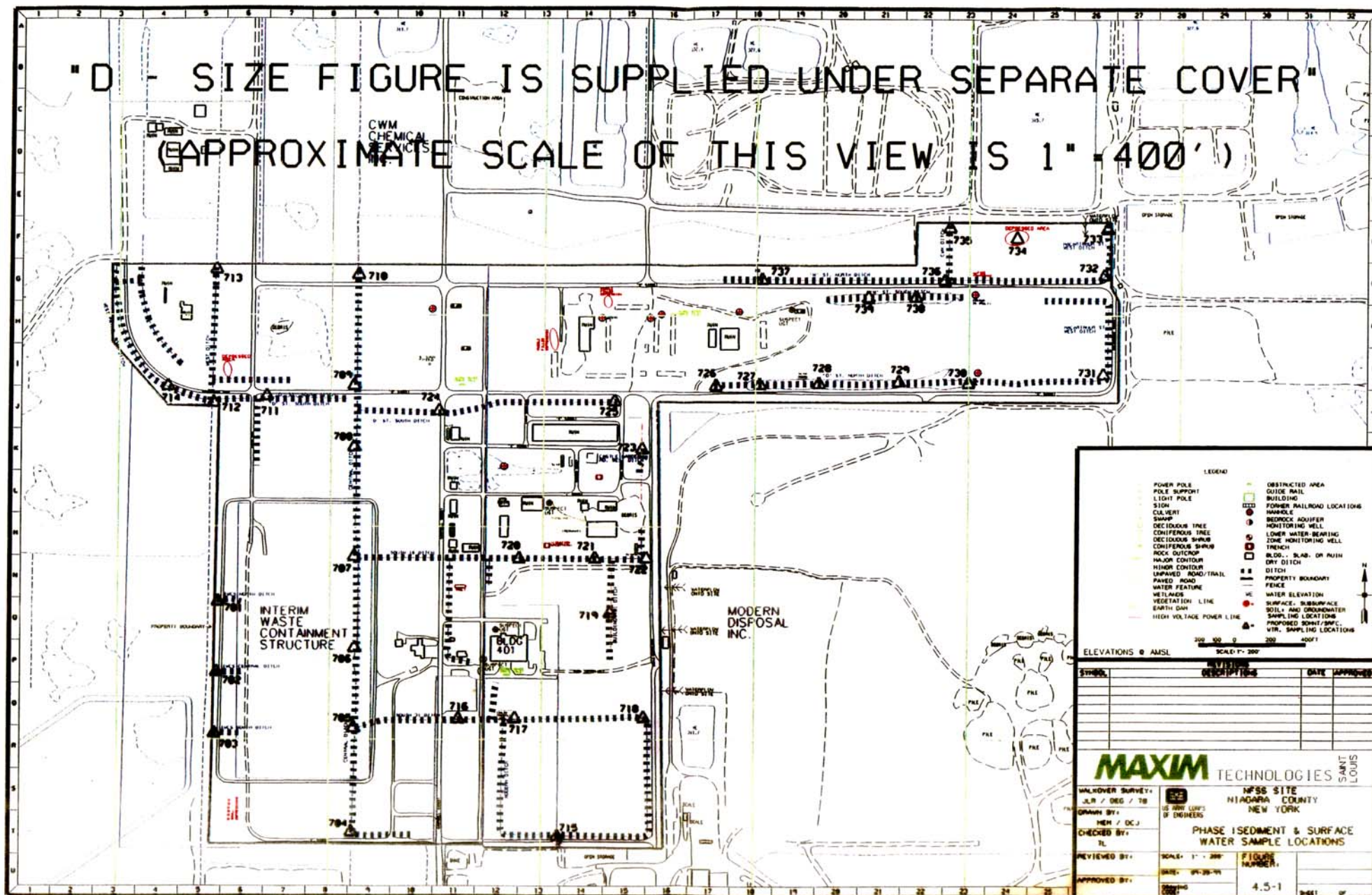
(APPROXIMATE SCALE OF THIS VIEW IS 1" = 400')



(APPROXIMATE SCALE OF THIS VIEW IS 1" = 400')



(APPROXIMATE SCALE OF THIS VIEW IS 1" = 400')



EXHIBITS

HTRW DRILLING LOG				DISTRICT		HOLE NUMBER	
1. COMPANY NAME				2. DRILLING SUBCONTRACTOR		SHEET OF SHEETS	
3. PROJECT				4. LOCATION			
5. NAME OF DRILLER				6. MANUFACTURER'S DESIGNATION OF DRILL			
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT				8. HOLE LOCATION			
				9. SURFACE ELEVATION			
				10. DATE STARTED		11. DATE COMPLETED	
12. OVERBURDEN THICKNESS				13. DEPTH GROUNDWATER ENCOUNTERED			
13. DEPTH DRILLED INTO ROCK				14. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED			
14. TOTAL DEPTH OF HOLE				17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)			
15. GEOTECHNICAL SAMPLES		DISTURBED		UNDISTURBED		19. TOTAL NUMBER OF CORE BOXES	
20. SAMPLES FOR CHEMICAL ANALYSIS		VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
22. DISPOSITION OF HOLE		BACKFILLED		MONITORING WELL		OTHER (SPECIFY)	
						23. SIGNATURE OF INSPECTOR	

LOCATION SKETCH/COMMENTS

SCALE:

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PROJECT

Hole No.

EXHIBIT 4-1 / FIELD DRILLING LOG
Niagara Falls Storage Site
Lewiston, New York

MAXIM

TECHNOLOGIES INC

SAINT LOUIS

Project #: 9905006

Figure #: 4-1

Scale: As indicated

Date: 07-22-99

Drawn by: DCJ

Checked by: NMD

HTRW DRILLING LOG					Hole Number	
Project			Inspector		Sheet of	
Elev. (a)	Depth (b)	Description of Materials (c)	Field Screening Results (d)	Geotech Sample or CORE Box No. (e)	Analytical Sample No. (f)	Remarks (g)
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					

Project:

Hole No.

EXHIBIT 4-1 / FIELD DRILLING LOG (CON'T)
Niagara Falls Storage Site
Lewiston, New York

MAXIM

TECHNOLOGIES INC.

SAINT LOUIS

Project #: 9905006

Figure # 4-1

Scale: As indicated

Date: 07-22-99

Drawn by: DCJ

Checked by: NMD

Date Drilled _____
Date Installed _____
Drilling Firm _____

Well/Boring No. _____
Date(s) _____
Logger _____

Static Water Level Before Development _____ TOC

Depth of Sediment in Well:
Before Development: _____ After Development: _____

Water Column Length _____ Well Casing ID _____
Borehole Diameter _____ Length of Screen _____
Total Depth of Well _____ TOC Stand Pipe Height _____

Water Column
Quantity/Foot = $0.3 \frac{V_{bl}}{V_p} - \frac{V_p}{V_p} + \frac{V_p}{V_p} = \text{_____ ft}^3/\text{ft} \times 7.5 = \text{_____ gal}/\text{ft}$

Total Water Column Quantity = _____ ft x _____ gal/ft = _____ gal
Water Column Length

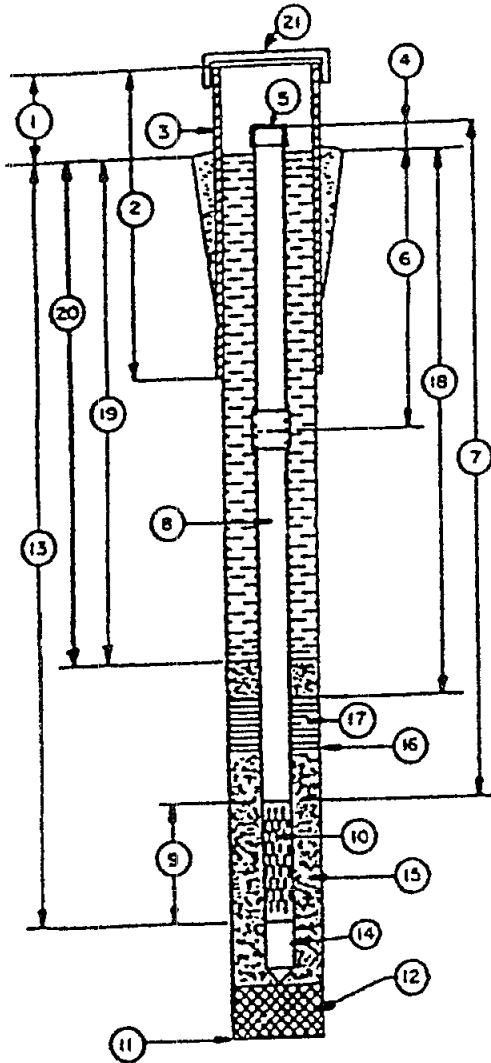
Quantity of
Water to be
Removed = _____ + _____ x 5 = _____
Quantity of Water Lost and
Used During Drilling Water Column
Quantity Quantity to be
Removed

EXHIBIT 4-2 / WELL DEVELOPMENT FORM
Niagara Falls Storage Site
Lewiston, New York

MAXIM TECHNOLOGIES INC. SAINT LOUIS	
Project #: 9905006	Figure # 4-2
Scale As indicated	Date: 07-22-99
Drawn by: DCJ	Checked by: NMD

Well Construction Details

Location _____ / Job No. _____ Well No. _____
 Date of Installation _____ Time Start _____ Time Complete _____
 Ground Surface Elevation _____ Drill Firm _____ Driller _____
 Logger _____ Signature _____ Water Level _____



1. Height of Protective Casing Above Ground _____
2. Total Length of Protective Casing _____
3. Type of Protective Casing _____
4. Height of Well Standpipe Above Ground _____
5. Type of Stand Pipe Cap _____
6. Depth to First Joint _____
Interval _____ Type _____
7. Total Length of Blank Pipe _____
8. Type of Blank Pipe _____ Diam. _____
9. Length of Screen _____
10. Type of Screen _____
11. Total Depth of Boring _____ Hole Diam. _____
12. Type of Material _____
13. Depth to Bottom of Screen _____
14. Well Point Length _____
15. Type of Screen Filter Pack _____
Quantity Used _____
16. Depth to Top of Filter Pack _____
17. Type of Seal _____
Quantity Used _____
18. Depth to Top of Seal _____
19. Depth to Top of Secondary Sand _____
20. Depth of Concrete Grout _____
Type of Grout Mixture _____
21. Type of Protective Casing Cap _____

All depth measurements of well detail are from ground surface unless otherwise indicated.

Remarks: _____

EXHIBIT 4-3 / WELL CONSTRUCTION FORM
 Niagara Falls Storage Site
 Lewiston, New York

MAXIM

TECHNOLOGIES INC. SAINT LOUIS

Project #: 9905006
 Scale: As indicated
 Drawn by: DCJ

Figure # 4-3
 Date: 07-22-99
 Checked by: NMD

		Lab No.
Project No.		Parameters:
MAXIM Source	_____	
	_____	Preservative:
Date and Time	_____	
Sampler	_____	

		Lab No.
Project No.		Parameters:
MAXIM Source	_____	
	_____	Preservative:
Date and Time	_____	
Sampler	_____	

		Lab No.
Project No.		Parameters:
MAXIM Source	_____	
	_____	Preservative:
Date and Time	_____	
Sampler	_____	

MAXIM

EXHIBIT 5-1

EXAMPLE OF SAMPLE CONTAINER LABELS

Project No.

By:

Chk'd By:

Date:

LABORATORY WORK REQUEST

Page ____ of ____

Project Number _____

Date Work In _____

Report To _____

Requested By: _____

Received By: _____

Date Required _____

SPECIAL INSTRUCTIONS:

SAMPLE IDENTIFICATION						ANALYSES REQUESTED														
ITEM	LAB NO.	SITE CODE SAMPLE DESIGNATION	DATE COLLECTED	PRESERVATION	CONTAINER														COMMENTS	
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
13																				
14																				
15																				
16																				
17																				
18																				
19																				
20																				
Items Transferred		Relinquished By	Date	Time	Received By	Reason For Transfer					ROUTING									
											<input type="checkbox"/> GC <input type="checkbox"/> GCMS <input type="checkbox"/> GCMS MGR <input type="checkbox"/> INORG LAB MGR									
											<input type="checkbox"/> LAB MGR									
											<input type="checkbox"/> OFFICE MGR									
											<input type="checkbox"/> DATA MGR									

EXHIBIT 5-2

Maxim Technologies, Inc.

CHAIN OF CUSTODY/LABORATORY ANALYSIS FORM

Project No.

By:

Chk'd By:

Date:

EXHIBIT 6-1

SHIPPING CONTAINER CHECKLIST SUMMARY

ATTN: CORPS OF ENGINEERS CONTRACTORS:

Failure to properly handle or document the project samples could jeopardize the usability of the sample results and ultimately the project. Prior to sending this cooler to the Laboratory, please check the following items:

- Is the project clearly identified on the Chain-of-Custody (official project name, project location, project phase)? Is the United States Army Corps of Engineers project number from the Sampling Plan or Work Plan clearly indicated on the Chain-of-Custody?
- Are all enclosed sample containers clearly labelled with waterproof (permanent) ink?
- Are the desired analyses indicated on the bottle labels and Chain-of-Custody and are the metals defined on the Chain-of-Custody (e.g., metals - lead, cadmium, etc.)?
- Does the information on the Chain-of-Custody match the information on the sample container labels?
- Have you placed the Chain-of-Custody in a plastic bag and attached it to the inside of the cooler lid?
- Have the samples been properly preserved (acid or base and cooling to 4°C)?
- Is there a Contractor point of contact including name and phone number clearly shown on the Chain-of-Custody?
- Is there sufficient ice (double bagged in ziplocks) or "blue ice" in the cooler? It is recommended that the samples be prechilled before packing.

This is a partial list of the requirements for proper documentation and shipping of the environmental samples, please refer to the Work Plan or Sampling Plan for further details.

EXHIBIT 8-1

CHECKLIST OF FIELD EQUIPMENT AND OTHER MATERIALS

1. Contract specification.
2. Contract plans.
3. Sampling and analysis plan.
4. Example tables for recording of all data.
5. Base maps for documenting sampling locations.
6. Quality assurance (QA) sample table to match up the quality control (QC) and QA samples.
7. Technical reference books for the identification of chemical hazards.
8. Hazardous waste manifest forms.
9. Reference materials for proper completion of manifests.
10. Field screening instruments.
11. Calibration gas.
12. Calibration standards.
13. Instrument operating manual, with copy provided to the quality assurance personnel as an attachment to the DCQCR, if not already provided in the sampling and analysis plan.
14. Backup instrument for field screening.
15. Established procedures for instrument repair.
16. Standard operating procedures for decontamination.
17. Decontamination materials including solvents, rinse water, tissue, etc.
18. Sample collection equipment.
19. Labels for sample containers.

EXHIBIT 8-1
(Continued)

CHECKLIST OF FIELD EQUIPMENT AND OTHER MATERIALS

20. Examples of completed sample shipping documents, e.g., air bills.
21. Sample containers of the types to be used for each analysis.
22. Chain-of-custody forms.
23. Chain-of-custody seals.
24. Sample shipping coolers.
25. Strapping tape.
26. Sample packing materials, including plastic bags and vermiculite.
27. Ice packs to cool sample cooler.
28. Laboratory information: name, address, phone number, point of contact, turnaround time for the analyses, and documentation that all labs have been notified that the samples will be shipped and confirmation that the laboratory will accept the samples.
29. Copy of a phone log with USACE QA laboratory showing that the government QA samples have been scheduled with the laboratory.
30. Copy of ENG Form 4025, which remedial action contractors will use to transmit analytical data.

EXHIBIT 8-2

CHECKLIST OF ACTIVITIES

1. The CQC representative shall review all pertinent sections of the plans and specifications during the preparatory meeting in order to ensure that all field personnel are cognizant of the overall project data quality objectives (DQOs) as well as any specific sampling and analysis requirements. This should include reading the sections aloud, if necessary, to clarify the requirements.
2. Likewise the SAP (i.e., QAPP and FSP) should be reviewed in details.
3. All instruments should be calibrated during the preparatory inspection meeting using certified calibration standards, gases, etc.
4. Equipment decontamination procedures will be demonstrate in detail using the proper decontamination solutions in accordance with the sampling and analysis plan.
5. A full set of sample custody forms will be completed to be used as a guide during sampling. The sample numbering system will be discussed. The laboratory addresses and phone numbers will be recorded on the form. analytical test methods will be discussed and recorded on the form. Caution should be exercised to assure that the test method is clearly specified. Sample representation will be recorded on the form. All required data should be documented on this sample form.
6. The sampling team should demonstrate in detail how each type of sample will be collected, using the intended sample containers, sampling equipment, decontamination procedures, and data reporting requirements.
7. Laboratory turnaround times shall be established and documented in the minutes of the preparatory meeting. The CQC representative shall present a tracking system to assure that all data are received in a timely manner.

Initial Phase Checklist of Activities

1. The CQC representative should oversee the sampling activities and review the work for compliance with contract requirements.
2. Individual sample labels and chain-of-custody forms will be inspected for accuracy, completeness, and consistency.
3. The packaging and shipping of the samples will also be inspected by the CQC representative.

EXHIBIT 8-2
(Continued)

CHECKLIST OF ACTIVITIES

4. Initial instrument calibration and ongoing calibrations will be observed, verified, and documented.
5. Field notes will be inspected to assure that all pertinent data are recorded in accordance with the contract requirements. These notes shall include identification of field control samples (replicate samples, split samples, field blanks, etc.), detailed sketches showing the sample locations, and any other items identified from Instruction F-1 as applicable to the project. These sample locations should be recorded daily on the as-built drawings.
6. The sampling team leader should complete the table which matches up primary QC and QA samples, at the conclusion of each day of sampling and attach a copy of the DCQCR.

Follow-Up Phase

1. The CQC representative is responsible for continued daily contract compliance until completion of the particular feature of work.

EXHIBIT 9-1
DAILY FIELD QUALITY CONTROL REPORT
Page 1 of 2

Date _____ COE Project Manager _____

Date _____ Maxim Project Manager _____

Weather: _____ Site Manager _____

Temperature _____ Project Number _____

Humidity _____ Site _____

Wind _____

Cloudiness _____

Subcontractors on site: _____

Equipment on site: _____

Work performed including sampling: _____

Quality Control Activities (including calibration): _____

EXHIBIT 9-1
DAILY FIELD QUALITY CONTROL REPORT
Page 2 of 2

Health and Safety Levels and Activities: _____

Problems and Corrective Action: _____

Special Notes: _____

By: _____

Title: _____

APPENDICES

APPENDIX A

USACE SCOPE OF WORK

APPENDIX B

METHOD 5035

CLOSED-SYSTEM PURGE-AND-TRAP AND EXTRACTION FOR VOLATILE ORGANICS IN SOIL AND WASTE SAMPLES

1.0 SCOPE AND APPLICATION

1.1 This method describes a closed-system purge-and-trap process for the analysis of volatile organic compounds (VOCs) in solid materials (e.g., soils, sediments, and solid waste). While the method is designed for use on samples containing low levels of VOCs, procedures are also provided for collecting and preparing solid samples containing high concentrations of VOCs and for oily wastes. For these high concentration and oily materials, sample collection and preparation are performed using the procedures described here, and sample introduction is performed using the aqueous purge-and-trap procedure in Method 5030. These procedures may be used in conjunction with any appropriate determinative gas chromatographic procedure, including, but not limited to Methods 8015, 8021, and 8260.

1.2 The low soil method utilizes a hermetically-sealed sample vial, the seal of which is never broken from the time of sampling to the time of analysis. Since the sample is never exposed to the atmosphere after sampling, the losses of VOCs during sample transport, handling, and analysis are negligible. The applicable concentration range of the low soil method is dependent on the determinative method, matrix, and compound. However, it will generally fall in the 0.5 to 200 µg/kg range.

1.3 Procedures are included for preparing high concentration samples for purging by Method 5030. High concentration samples are those containing VOC levels of >200 µg/kg.

1.4 Procedures are also included for addressing oily wastes that are soluble in a water-miscible solvent. These samples are also purged using Method 5030..

1.5 Method 5035 can be used for most volatile organic compounds that have boiling points below 200°C and that are insoluble or slightly soluble in water. Volatile, water-soluble compounds can be included in this analytical technique. However, quantitation limits (by GC or GC/MS) are approximately ten times higher because of poor purging efficiency.

1.6 Method 5035, in conjunction with Method 8015 (GC/FID), may be used for the analysis of the aliphatic hydrocarbon fraction in the light ends of total petroleum hydrocarbons, e.g., gasoline. For the aromatic fraction (BTEX), use Method 5035 and Method 8021 (GC/PID). A total determinative analysis of gasoline fractions may be obtained using Method 8021 in series with Method 8015.

1.7 As with any preparative method for volatiles, samples should be screened to avoid contamination of the purge-and-trap system by samples that contain very high concentrations of purgeable material above the calibration range of the low concentration method. In addition, because the sealed sample container cannot be opened to remove a sample aliquot without compromising the integrity of the sample, multiple sample aliquots should be collected to allow for screening and reanalysis.

1.8 The closed-system purge-and-trap equipment employed for low concentration samples is not appropriate for soil samples preserved in the field with methanol. Such samples should be analyzed using Method 5030 (see the note in Sec. 6.2.2).

1.9 This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 SUMMARY OF METHOD

2.1 Low concentration soil method - generally applicable to soils and other solid samples with VOC concentrations in the range of 0.5 to 200 µg/kg.

Volatile organic compounds (VOCs) are determined by collecting an approximately 5-g sample, weighed in the field at the time of collection, and placing it in a pre-weighed vial with a septum-sealed screw-cap (see Sec. 4) that already contains a stirring bar and a sodium bisulfate preservative solution. The vial is sealed and shipped to a laboratory or appropriate analysis site. The entire vial is then placed, unopened, into the instrument carousel. Immediately before analysis, organic-free reagent water, surrogates, and internal standards (if applicable) are automatically added without opening the sample vial. The vial containing the sample is heated to 40°C and the volatiles purged into an appropriate trap using an inert gas combined with agitation of the sample. Purged components travel via a transfer line to a trap. When purging is complete, the trap is heated and backflushed with helium to desorb the trapped sample components into a gas chromatograph for analysis by an appropriate determinative method.

2.2 High concentration soil method - generally applicable to soils and other solid samples with VOC concentrations greater than 200 µg/kg.

The sample introduction technique in Sec. 2.1 is not applicable to all samples, particularly those containing high concentrations (generally greater than 200 µg/kg) of VOCs which may overload either the volatile trapping material or exceed the working range of the determinative instrument system (e.g., GC/MS, GC/FID, GC/EC, etc.). In such instances, this method describes two sample collection options and the corresponding sample purging procedures.

2.2.1 The first option is to collect a bulk sample in a vial or other suitable container without the use of the preservative solution described in Sec. 2.1. A portion of that sample is removed from the container in the laboratory and is dispersed in a water-miscible solvent to dissolve the volatile organic constituents. An aliquot of the solution is added to 5 mL of reagent water in a purge tube. Surrogates and internal standards (if applicable) are added to the solution, then purged using Method 5030, and analyzed by an appropriate determinative method. Because the procedure involves opening the vial and removing a portion of the soil, some volatile constituents may be lost during handling.

2.2.2 The second option is to collect an approximately 5-g sample in a pre-weighed vial with a septum-sealed screw-cap (see Sec 4) that contains 5 mL of a water-miscible organic solvent (e.g., methanol). At the time of analysis, surrogates are added to the vial, then an aliquot of the solvent is removed from the vial, purged using Method 5030 and analyzed by an appropriate determinative method.

2.3 High concentration oily waste method - generally applicable to oily samples with VOC concentrations greater than 200 µg/kg that can be diluted in a water-miscible solvent.

Samples that are comprised of oils or samples that contain significant amounts of oil present additional analytical challenges. This procedure is generally appropriate for such samples when they are soluble in a water-miscible solvent.

2.3.1 After demonstrating that a test aliquot of the sample is soluble in methanol or polyethylene glycol (PEG), a separate aliquot of the sample is spiked with surrogates and diluted in the appropriate solvent. An aliquot of the solution is added to 5 mL of reagent water in a purge tube, taking care to ensure that a floating layer of oil is not present in the purge tube. Internal standards (if applicable) are added to the solution which is then purged using Method 5030 and analyzed by an appropriate determinative method.

2.3.2 Samples that contain oily materials that are not soluble in water-miscible solvents must be prepared according to Method 3585.

3.0 INTERFERENCES

3.1 Impurities in the purge gas and from organic compounds out-gassing from the plumbing ahead of the trap account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running method blanks. The use of non-polytetrafluoroethylene (non-PTFE) plastic coating, non-PTFE thread sealants, or flow controllers with rubber components in the purging device must be avoided, since such materials out-gas organic compounds which will be concentrated in the trap during the purge operation. These compounds will result in interferences or false positives in the determinative step.

3.2 Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal of the sample vial during shipment and storage. A trip blank prepared from organic-free reagent water and carried through sampling and handling protocols serves as a check on such contamination.

3.3 Contamination by carryover can occur whenever high-concentration and low-concentration samples are analyzed in sequence. Where practical, samples with unusually high concentrations of analytes should be followed by an analysis of organic-free reagent water to check for cross-contamination. If the target compounds present in an unusually concentrated sample are also found to be present in the subsequent samples, the analyst must demonstrate that the compounds are not due to carryover. Conversely, if those target compounds are not present in the subsequent sample, then the analysis of organic-free reagent water is not necessary.

3.4 The laboratory where volatile analysis is performed should be completely free of solvents. Special precautions must be taken to determine methylene chloride. The analytical and sample storage area should be isolated from all atmospheric sources of methylene chloride, otherwise random background levels will result. Since methylene chloride will permeate through PTFE tubing, all GC carrier gas lines and purge gas plumbing should be constructed of stainless steel or copper tubing. Laboratory workers' clothing previously exposed to methylene chloride fumes during common liquid/liquid extraction procedures can contribute to sample contamination. The presence of other organic solvents in the laboratory where volatile organics are analyzed will also lead to random background levels and the same precautions must be taken.

4.0 APPARATUS AND MATERIALS

4.1 Sample Containers

The specific sample containers required will depend on the purge-and-trap system to be employed (see Sec. 4.2). Several systems are commercially available. Some systems employ 40-mL clear vials with a special frit and equipped with two PTFE-faced silicone septa. Other

systems permit the use of any good quality glass vial that is large enough to contain at least 5 g of soil or solid material and at least 10 mL of water and that can be sealed with a screw-cap containing a PTFE-faced silicone septum. Consult the purge-and-trap system manufacturer's instructions regarding the suitable specific vials, septa, caps, and mechanical agitation devices.

4.2 Purge-and-Trap System

The purge-and-trap system consists of a unit that automatically adds water, surrogates and internal standards (if applicable) to a vial containing the sample, purges the VOCs using an inert gas stream while agitating the contents of the vial, and also traps the released VOCs for subsequent desorption into the gas chromatograph. Such systems are commercially available from several sources and shall meet the following specifications.

4.2.1 The purging device should be capable of accepting a vial sufficiently large to contain a 5-g soil sample plus a magnetic stirring bar and 10 mL of water. The device must be capable of heating a soil vial to 40°C and holding it at that temperature while the inert purge gas is allowed to pass through the sample. The device should also be capable of introducing at least 5 mL of organic-free reagent water into the sample vial while trapping the displaced headspace vapors. It must also be capable of agitating the sealed sample during purging, (e.g., using a magnetic stirring bar added to the vial prior to sample collection, sonication, or other means). The analytes being purged must be quantitatively transferred to an absorber trap. The trap must be capable of transferring the absorbed VOCs to the gas chromatograph (see 4.2.2).

NOTE: The equipment used to develop this method was a Dynatech PTA-30 W/S Autosampler. This device was subsequently sold to Varian, and is now available as the Archon Purge and Trap Autosampler. See the Disclaimer at the front of this manual for guidance on the use of alternative equipment.

4.2.2 A variety of traps and trapping materials may be employed with this method. The choice of trapping material may depend on the analytes of interest. Whichever trap is employed, it must demonstrate sufficient adsorption and desorption characteristics to meet the quantitation limits of all the target analytes for a given project and the QC requirements in Method 8000 and the determinative method. The most difficult analytes are generally the gases, especially dichlorodifluoromethane. The trap must be capable of desorbing the late eluting target analytes.

NOTE: Check the responses of the brominated compounds when using alternative charcoal traps (especially Vocab 4000), as some degradation has been noted when higher desorption temperatures (especially above 240 - 250°C) are employed. 2-Chloroethyl vinyl ether is degraded on Vocab 4000 but performs adequately when Vocab 3000 is used. The primary criterion, as stated above, is that all target analytes meet the sensitivity requirements for a given project.

4.2.2.1 The trap used to develop this method was 25 cm long, with an inside diameter of 0.105 inches, and was packed with Carboxpack/Carboxieve (Supelco, Inc.).

4.2.2.2 The standard trap used in other EPA purge-and-trap methods is also acceptable. That trap is 25 cm long and has an inside diameter of at least 0.105 in. Starting from the inlet, the trap contains the equal amounts of the adsorbents listed below. It is recommended that 1.0 cm of methyl silicone-coated packing (35/60 mesh Davison, grade 15 or equivalent) be inserted at the inlet to extend the life of the trap.

the analysis of dichlorodifluoromethane or other fluorocarbons of similar volatility is not required, then the charcoal can be eliminated and the polymer increased to fill 2/3 of the trap. If only compounds boiling above 35°C are to be analyzed, both the silica gel and charcoal can be eliminated and the polymer increased to fill the entire trap.

4.2.2.2.1 2,6-Diphenylene oxide polymer - 60/80 mesh, chromatographic grade (Tenax GC or equivalent).

4.2.2.2.2 Methyl silicone packing - OV-1 (3%) on Chromosorb-W 60/80 mesh or equivalent.

4.2.2.2.3 Coconut charcoal - Prepare from Barnebey Cheney CA-580-26, or equivalent, by crushing through 26 mesh screen.

4.2.2.3 Trapping materials other than those listed above also may be employed provided that they meet the specifications in Sec. 4.2.3, below.

4.2.3 The desorber for the trap must be capable of rapidly heating the trap to the temperature recommended by the trap material manufacturer, prior to the beginning of the flow of desorption gas. Several commercial desorbers (purge-and-trap units) are available.

4.3 Syringe and Syringe Valves

4.3.1 25-mL glass hypodermic syringes with Luer-Lok (or equivalent) tip (other sizes are acceptable depending on sample volume used).

4.3.2 2-way syringe valves with Luer ends.

4.3.3 25-μL micro syringe with a 2 inch x 0.006 inch ID, 22° bevel needle (Hamilton #702N or equivalent).

4.3.4 Micro syringes - 10-, 100-μL.

4.3.5 Syringes - 0.5-, 1.0-, and 5-mL, gas-tight with shut-off valve.

4.4 Miscellaneous

4.4.1 Glass vials

4.4.1.1 60-mL, septum-sealed, to collect samples for screening, dry weight determination.

4.4.1.2 40-mL, screw-cap, PTFE lined, septum-sealed. Examine each vial prior to use to ensure that the vial has a flat, uniform sealing surface.

4.4.2 Top-loading balance - Capable of accurately weighing to 0.01 g.

4.4.3 Glass scintillation vials - 20-mL, with screw-caps and PTFE liners, or glass culture tubes with screw-caps and PTFE liners, for dilution of oily waste samples.

4.4.4 Volumetric flasks - Class A, 10-mL and 100-mL, with ground-glass stoppers.

4.4.5 2-mL glass vials, for GC autosampler - Used for oily waste samples extracted with methanol or PEG.

4.4.6 Spatula, stainless steel - narrow enough to fit into a sample vial.

4.4.7 Disposable Pasteur pipettes.

4.4.8 Magnetic stirring bars - PTFE- or glass-coated, of the appropriate size to fit the sample vials. Consult manufacturer's recommendation for specific stirring bars. Stirring bars may be reused, provided that they are thoroughly cleaned between uses. Consult the manufacturers of the purging device and the stirring bars for suggested cleaning procedures.

4.5 Field Sampling Equipment

4.5.1 Purge-and-Trap Soil Sampler - Model 3780PT (Associated Design and Manufacturing Company, 814 North Henry Street, Alexandria, VA 22314), or equivalent

4.5.2 EnCore™ sampler - (En Chem, Inc., 1795 Industrial Drive, Green Bay, WI 54302), or equivalent.

4.5.3 Alternatively, disposable plastic syringes with a barrel smaller than the neck of the soil vial may be used to collect the sample. The syringe end of the barrel is cut off prior to sampling. One syringe is needed for each sample aliquot to be collected.

4.5.4 Portable balance - For field use, capable of weighing to 0.01 g.

4.5.5 Balance weights - Balances employed in the field should be checked against an appropriate reference weight at least once daily, prior to weighing any samples, or as described in the sampling plan. The specific weights used will depend on the total weight of the sample container, sample, stirring bar, reagent water added, cap, and septum.

5.0 REAGENTS

5.1 Organic-free reagent water - All references to water in this method refer to organic-free reagent water, as defined in Chapter One.

5.2 Methanol, CH₃OH - purge-and-trap quality or equivalent. Store away from other solvents

5.3 Polyethylene glycol (PEG), H(OCH₂CH₂)_nOH - free of interferences at the detection limit of the target analytes.

5.4 Low concentration sample preservative

5.4.1 Sodium bisulfate, NaHSO₄ - ACS reagent grade or equivalent.

5.4.2 The preservative should be added to the vial prior to shipment to the field, and must be present in the vial prior to adding the sample.

5.5 See the determinative method and Method 5000 for guidance on internal standards and surrogates to be employed in this procedure.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

Refer to the introductory material in this chapter, Organic Analytes, Sec. 4.1, for general sample collection information. The low concentration portion of this method employs sample vials that are filled and weighed in the field and never opened during the analytical process. As a result sampling personnel should be equipped with a portable balance capable of weighing to 0.01 g.

6.1 Preparation of sample vials

The specific preparation procedures for sample vials depend on the expected concentration range of the sample, with separate preparation procedures for low concentration soil samples and high concentration soil and solid waste samples. Sample vials should be prepared in a fixed laboratory or other controlled environment, sealed, and shipped to the field location. Gloves should be worn during the preparation steps.

6.1.1 Low concentration soil samples

The following steps apply to the preparation of vials used in the collection of low concentration soil samples to be analyzed by the closed-system purge-and-trap equipment described in Method 5035.

6.1.1.1 Add a clean magnetic stirring bar to each clean vial. If the purge-and-trap device (Sec. 4.2) employs a means of stirring the sample other than a magnetic stirrer (e.g., sonication or other mechanical means), then the stir bar is omitted.

6.1.1.2 Add preservative to each vial. The preservative is added to each vial prior to shipping the vial to the field. Add approximately 1 g of sodium bisulfate to each vial. If samples markedly smaller or larger than 5 g are to be collected, adjust the amount of preservative added to correspond to approximately 0.2 g of preservative for each 1 g of sample. Enough sodium bisulfate should be present to ensure a sample pH of ≤ 2 .

6.1.1.3 Add 5 mL of organic-free reagent water to each vial. The water and the preservative will form an acid solution that will reduce or eliminate the majority of the biological activity in the sample, thereby preventing biodegradation of the volatile target analytes.

6.1.1.4 Seal the vial with the screw-cap and septum seal. If the double-ended fritted, vials are used, seal both ends as recommended by the manufacturer.

6.1.1.5 Affix a label to each vial. This eliminates the need to label the vials in the field and assures that the tare weight of the vial includes the label. (The weight of any markings added to the label in the field is negligible).

6.1.1.6 Weigh the prepared vial to the nearest 0.01 g, record the tare weight, and write it on the label.

6.1.1.7 Because volatile organics will partition into the headspace of the vial from the aqueous solution and will be lost when the vial is opened, surrogates, matrix spikes, and internal standards (if applicable) should only be added to the vials after the sample has been added to the vial. These standards should be introduced back in the

laboratory, either manually by puncturing the septum with a small-gauge needle or automatically by the sample introduction system, just prior to analysis.

6.1.2 High concentration soil samples collected without a preservative

When high concentration samples are collected without a preservative, a variety of sample containers may be employed, including 60-mL glass vials with septum seals (see Sec. 4.4).

6.1.3 High concentration soil samples collected and preserved in the field

The following steps apply to the preparation of vials used in the collection of high concentration soil samples to be preserved in the field with methanol and analyzed by the aqueous purge-and-trap equipment described in Method 5030.

6.1.3.1 Add 10 mL of methanol to each vial.

6.1.3.2 Seal the vial with the screw-cap and septum seal.

6.1.3.3 Affix a label to each vial. This eliminates the need to label the vials in the field and assures that the tare weight of the vial includes the label. (The weight of any markings added to the label in the field is negligible).

6.1.3.4 Weigh the prepared vial to the nearest 0.01 g, record the tare weight, and write it on the label.

NOTE: Vials containing methanol should be weighed a second time on the day that they are to be used. Vials found to have lost methanol (reduction in weight of >0.01 g) should not be used for sample collection.

6.1.3.5 Surrogates, internal standards and matrix spikes (if applicable) should be added to the sample after it is returned to the laboratory and prior to analysis.

6.1.4 Oily waste samples

When oily waste samples are known to be soluble in methanol or PEG, sample vials may be prepared as described in Sec. 6.1.3, using the appropriate solvent. However when the solubility of the waste is unknown, the sample should be collected without the use of a preservative, in a vial such as that described in Sec. 6.1.2.

6.2 Sample collection

Collect the sample according to the procedures outlined in the sampling plan. As with any sampling procedure for volatiles, care must be taken to minimize the disturbance of the sample in order to minimize the loss of the volatile components. Several techniques may be used to transfer a sample to the relatively narrow opening of the low concentration soil vial. These include devices such as the EnCore™ sampler, the Purge-and-Trap Soil Sampler™ and a cut plastic syringe. Always wear gloves whenever handling the tared sample vials.

6.2.1 Low concentration soil samples

6.2.1.1 Using an appropriate sample collection device, collect approximately 5 g of sample as soon as possible after the surface of the soil or other solid material has been exposed to the atmosphere: generally within a few minutes at most. Carefully wipe the exterior of the sample collection device with a clean cloth or towel.

6.2.1.2 Using the sample collection device, add about 5 g (2 - 3 cm) of soil to the sample vial containing the preservative solution. Quickly brush any soil off the vial threads and immediately seal the vial with the septum and screw-cap. Store samples on ice at 4°C.

NOTE: Soil samples that contain carbonate minerals (either from natural sources or applied as an amendment) may effervesce upon contact with the acidic preservative solution in the low concentration sample vial. If the amount of gas generated is very small (i.e., several mL), any loss of volatiles as a result of such effervescence may be minimal if the vial is sealed quickly. However, if larger amounts of gas are generated, not only may the sample lose a significant amount of analyte, but the gas pressure may shatter the vial if the sample vial is sealed. Therefore, when samples are known or suspected to contain high levels of carbonates, a test sample should be collected, added to a vial, and checked for effervescence. If a rapid or vigorous reaction occurs, discard the sample and collect low concentration samples in vials that do not contain the preservative solution.

6.2.1.3 When practical, use a portable balance to weigh the sealed vial containing the sample to ensure that 5.0 ± 0.5 g of sample were added. The balance should be calibrated in the field using an appropriate weight for the sample containers employed (Sec. 4.5.5). Record the weight of the sealed vial containing the sample to the nearest 0.01 g.

6.2.1.4 Alternatively, collect several trial samples with plastic syringes. Weigh each trial sample and note the length of the soil column in the syringe. Use these data to determine the length of soil in the syringe that corresponds to 5.0 ± 0.5 g. Discard each trial sample.

6.2.1.5 As with the collection of aqueous samples for volatiles, collect at least two replicate samples. This will allow the laboratory an additional sample for reanalysis. The second sample should be taken from the same soil stratum or the same section of the solid waste being sampled, and within close proximity to the location from which the original sample was collected.

6.2.1.6 In addition, since the soil vial cannot be opened without compromising the integrity of the sample, at least one additional aliquot of sample must be collected for screening, dry weight determination, and high concentration analysis (if necessary). This third aliquot may be collected in a 60-mL glass vial or a third 40-mL soil sample vial. However, this third vial must *not* contain the sample preservative solution as an aliquot will be used to determine dry weight. If high concentration samples are collected in vials containing methanol, then two additional aliquots should be collected: one for high concentration analysis collected in a vial containing methanol, and another for the dry weight determination in a vial without either methanol or the low concentration aqueous preservative solution.

6.2.1.7 If samples are known or expected to contain target analytes over a wide range of concentrations, thereby requiring the analyses of multiple sample aliquots, it may be advisable and practical to take an additional sample aliquot in a low concentration soil vial containing the preservative, but collecting only 1-2 g instead of the 5 g collected in Sec. 6.2.1.1. This aliquot may be used for those analytes that exceed the instrument calibration range in the 5-g analysis.

6.2.1.8 The EnCore™ sampler has not been thoroughly evaluated by EPA as a sample storage device. While preliminary results indicate that storage in the EnCore™ device may be appropriate for up to 48 hours, samples collected in this device should be transferred to the soil sample vials as soon as possible, or analyzed within 48 hours.

6.2.1.9 The collection of low concentration soil samples in vials that contain methanol is not appropriate for samples analyzed with the closed-system purge-and-trap equipment described in this method (see Sec. 6.2.2).

6.2.2 High concentration soil samples preserved in the field

The collection of soil samples in vials that contain methanol has been suggested by some as a combined preservation and extraction procedure. However, this procedure is not appropriate for use with the low concentration soil procedure described in this method.

NOTE: The use of methanol preservation has not been formally evaluated by EPA and analysts must be aware of two potential problems. First, the use of methanol as a preservative and extraction solvent introduces a significant dilution factor that will raise the method quantitation limit beyond the operating range of the low concentration direct purge-and-trap procedure (0.5-200 µg/kg). The exact dilution factor will depend on the masses of solvent and sample, but generally exceeds 1000, and may make it difficult to demonstrate compliance with regulatory limits or action levels for some analytes. Because the analytes of interest are volatile, the methanol extract cannot be concentrated to overcome the dilution problem. Thus, for samples of unknown composition it may still be necessary to collect an aliquot for analysis by this closed-system procedure and another aliquot preserved in methanol and analyzed by other procedures. The second problem is that the addition of methanol to the sample is likely to cause the sample to fail the ignitability characteristic, thereby making the unused sample volume a hazardous waste.

6.2.2.1 When samples are known to contain volatiles at concentrations high enough that the dilution factor will not preclude obtaining results within the calibration range of the appropriate determinative method, a sample may be collected and immediately placed in a sample vial containing purge-and-trap grade methanol.

6.2.2.2 Using an appropriate sample collection device, collect approximately 5 g of sample as soon as possible after the surface of the soil or other solid material has been exposed to the atmosphere; generally within a few minutes at most. Carefully wipe the exterior of the sample collection device with a clean cloth or towel.

6.2.2.3 Using the sample collection device, add about 5 g (2 - 3 cm) of soil to the vial containing 10 mL of methanol. Quickly brush any soil off the vial threads and immediately seal the vial with the septum and screw-cap. Store samples on ice at 4°C.

6.2.2.4 When practical, use a portable balance to weigh the sealed vial containing the sample to ensure that 5.0 ± 0.5 g of sample were added. The balance should be calibrated in the field using an appropriate weight for the sample containers employed (Sec. 4.5.5). Record the weight of the sealed vial containing the sample to the nearest 0.01 g.

6.2.2.5 Alternatively, collect several trial samples with plastic syringes. Weigh each trial sample and note the length of the soil column in the syringe. Use these data to determine the length of soil in the syringe that corresponds to 5.0 ± 0.5 g. Discard each trial sample.

6.2.2.6 Other sample weights and volumes of methanol may be employed provided that the analyst can demonstrate that the sensitivity of the overall analytical procedure is appropriate for the intended application.

6.2.2.7 The collection of at least one additional sample aliquot is required for the determination of the dry weight, as described in Sec. 6.2.1.6. Samples collected in methanol should be shipped as described in Sec. 6.3, and must be clearly labeled as containing methanol, so that the samples are not analyzed using the closed-system purge-and-trap equipment described in this procedure.

6.2.3 High concentration soil sample not preserved in the field

The collection of high concentration soil samples that are not preserved in the field generally follows similar procedures as for the other types of samples described in Secs. 6.2.1 and 6.2.2, with the obvious exception that the sample vials contain neither the aqueous preservative solution nor methanol. However, when field preservation is not employed, it is better to collect a larger volume sample, filling the sample container as full as practical in order to minimize the headspace. Such collection procedures generally do not require the collection of a separate aliquot for dry weight determination, but it may be advisable to collect a second sample aliquot for screening purposes, in order to minimize the loss of volatiles in either aliquot.

6.2.4 Oily waste samples

The collection procedures for oily samples depend on knowledge of the waste and its solubility in methanol or other solvents.

6.2.4.1 When an oily waste is known to be soluble in methanol or PEG, the sample may be collected in a vial containing such a solvent (see Sec. 6.1.4), using procedures similar to those described in Sec. 6.2.2.

6.2.4.2 When the solubility of the oily waste is not known, the sample should either be collected in a vial without a preservative, as described in Sec. 6.2.3, or the solubility of a trial sample should be tested in the field, using a vial containing solvent. If the trial sample is soluble in the solvent, then collect the oily waste sample as described in Sec. 6.2.2. Otherwise, collect an unpreserved sample as described in Sec. 6.2.3.

6.3 Sample handling and shipment

All samples for volatiles analysis should be cooled to approximately 4°C, packed in appropriate containers, and shipped to the laboratory on ice, as described in the sampling plan.

6.4 Sample storage

6.4.1 Once in the laboratory, store samples at 4°C until analysis. The sample storage area should be free of organic solvent vapors.

6.4.2 All samples should be analyzed as soon as practical, and within the designated holding time from collection. Samples not analyzed within the designated holding time must be noted and the data are considered minimum values.

6.4.3 When the low concentration samples are strongly alkaline or highly calcareous in nature, the sodium bisulfate preservative solution may not be strong enough to reduce the pH of the soil/water solution to below 2. Therefore, when low concentration soils to be sampled are known or suspected to be strongly alkaline or highly calcareous, additional steps may be required to preserve the samples. Such steps include: addition of larger amounts of the sodium bisulfate preservative to non-calcareous samples, storage of low concentration samples at -10°C (taking care not to fill the vials so full that the expansion of the water in the vial breaks the vial), or significantly reducing the maximum holding time for low concentration soil samples. Whichever steps are employed, they should be clearly described in the sampling and QA project plans and distributed to both the field and laboratory personnel. See Sec. 6.2.1.2 for additional information.

7.0 PROCEDURE

This section describes procedures for sample screening, the low concentration soil method, the high concentration soil method, and the procedure for oily waste samples. High concentration samples are to be introduced into the GC system using Method 5030. Oily waste samples are to be introduced into the GC system using Method 5030 if they are soluble in a water-miscible solvent, or using Method 3585 if they are not.

7.1 Sample screening

7.1.1 It is highly recommended that all samples be screened prior to the purge-and-trap GC or GC/MS analysis. Samples may contain higher than expected quantities of purgeable organics that will contaminate the purge-and-trap system, thereby requiring extensive cleanup and instrument maintenance. The screening data are used to determine which is the appropriate sample preparation procedure for the particular sample, the low concentration closed-system direct purge-and-trap method (Sec. 7.2), the high concentration (methanol extraction) method (Sec. 7.3), or the nonaqueous liquid (oily waste) methanol or PEG dilution procedure (Sec. 7.4).

7.1.2 The analyst may employ any appropriate screening technique. Two suggested screening techniques employing SW-846 methods are:

7.1.2.1 Automated headspace (Method 5021) using a gas chromatograph (GC) equipped with a photoionization detector (PID) and an electrolytic conductivity detector (HECD) in series, or,

7.1.2.2 Extraction of the sample with hexadecane (Method 3820) and analysis of the extract on a GC equipped with a FID and/or an ECD.

7.1.3 The analyst may inject a calibration standard containing the analytes of interest at a concentration equivalent to the upper limit of the calibration range of the low concentration soil method. The results from this standard may be used to determine when the screening results approach the upper limit of the low concentration soil method. There are no linearity or other performance criteria associated with the injection of such a standard and other approaches may be employed to estimate sample concentrations.

7.1.4 Use the low concentration closed-system purge-and-trap method (Sec. 7.2) if the estimated concentration from the screening procedure falls within the calibration range of the selected determinative method. If the concentration exceeds the calibration range of the low concentration soil method, then use either the high concentration soil method (Sec. 7.3) or the oily waste method (Sec. 7.4).

7.2 Low concentration soil method (Approximate concentration range of 0.5 to 200 µg/kg - the concentration range is dependent upon the determinative method and the sensitivity of each analyte.)

7.2.1 Initial calibration

Prior to using this introduction technique for any GC or GC/MS method, the system must be calibrated. General calibration procedures are discussed in Method 8000, while the determinative methods and Method 5000 provide specific information on calibration and preparation of standards. Normally, external standard calibration is preferred for the GC methods (non-MS detection) because of possible interference problems with internal standards. If interferences are not a problem, or when a GC/MS method is used, internal standard calibration may be employed.

7.2.1.1 Assemble a purge-and-trap device that meets the specification in Sec 4.2 and that is connected to a gas chromatograph or a gas chromatograph/mass spectrometer system.

7.2.1.2 Before initial use, a Carbowack/Carbosieve trap should be conditioned overnight at 245°C by backflushing with an inert gas flow of at least 20 mL/minute. If other trapping materials are substituted for the Carbowack/Carbosieve, follow the manufacturers recommendations for conditioning. Vent the trap effluent to the hood, not to the analytical column. Prior to daily use, the trap should be conditioned for 10 minutes at 245°C with backflushing. The trap may be vented to the analytical column during daily conditioning; however, the column must be run through the temperature program prior to analysis of samples.

7.2.1.3 If the standard trap in Sec. 4.2.2.2 is employed, prior to initial use, the trap should be conditioned overnight at 180°C by backflushing with an inert gas flow of at least 20 mL/min, or according to the manufacturer's recommendations. Vent the trap effluent to the hood, not to the analytical column. Prior to daily use, the trap should be conditioned for 10 min at 180°C with backflushing. The trap may be vented to the analytical column during daily conditioning; however, the column must be run through the temperature program prior to analysis of samples.

7.2.1.4 Establish the purge-and-trap instrument operating conditions. Adjust the instrument to inject 5 mL of water, to heat the sample to 40°C, and to hold the sample at 40°C for 1.5 minutes before commencing the purge process, or as recommended by the instrument manufacturer.

7.2.1.5 Prepare a minimum of five initial calibration standards containing all the analytes of interest and surrogates, as described in Method 8000, and following the instrument manufacturer's instructions. The calibration standards are prepared in organic-free reagent water. The volume of organic-free reagent water used for calibration must be the same volume used for sample analysis (normally 5 mL added to the vial before shipping it to the field plus the organic-free reagent water added by the instrument). The calibration standards should also contain approximately the same amount of the sodium bisulfate preservative as the sample (e.g., ~1 g), as the presence of the preservative will affect the purging efficiencies of the analytes. The internal standard solution must be added automatically, by the instrument, in the same fashion as used for the samples. Place the soil vial containing the solution in the instrument carousel. In order to calibrate the surrogates using standards at five concentrations, it may be necessary to disable the automatic addition of surrogates to each vial containing a calibration standard (consult the manufacturer's instructions). Prior to purging, heat the sample vial to 40°C for 1.5 minutes, or as recommended by the manufacturer.

7.2.1.6 Carry out the purge-and-trap procedure as outlined in Secs. 7.2.3. to 7.2.5.

7.2.1.7 Calculate calibration factors (CF) or response factors (RF) for each analyte of interest using the procedures described in Method 8000. Calculate the average CF (external standards) or RF (internal standards) for each compound, as described in Method 8000. Evaluate the linearity of the calibration data, or choose another calibration model, as described in Method 8000 and the specific determinative method.

7.2.1.8 For GC/MS analysis, a system performance check must be made before this calibration curve is used (see Method 8260). If the purge-and-trap procedure is used with Method 8021, evaluate the response for the following four compounds: chloromethane; 1,1-dichloroethane; bromoform; and 1,1,2,2-tetrachloroethane. They are used to check for proper purge flow and to check for degradation caused by contaminated lines or active sites in the system.

7.2.1.8.1 Chloromethane is the most likely compound to be lost if the purge flow is too fast.

7.2.1.8.2 Bromoform is one of the compounds most likely to be purged very poorly if the purge flow is too slow. Cold spots and/or active sites in the transfer lines may adversely affect response.

7.2.1.8.3 Tetrachloroethane and 1,1-dichloroethane are degraded by contaminated transfer lines in purge-and-trap systems and/or active sites in trapping materials.

7.2.1.9 When analyzing for very late eluting compounds with Method 8021 (i.e., hexachlorobutadiene, 1,2,3-trichlorobenzene, etc.), cross-contamination and memory effects from a high concentration sample or even the standard are a common problem.

Extra rinsing of the purge chamber after analysis normally corrects this. The newer purge-and-trap systems often overcome this problem with better bakeout of the system following the purge-and-trap process. Also, the charcoal traps retain less moisture and decrease the problem.

7.2.2 Calibration verification

Refer to Method 8000 for details on calibration verification. A single standard near the mid-point of calibration range is used for verification. This standard should also contain approximately 1 g of sodium bisulfate.

7.2.3 Sample purge-and-trap

This method is designed for a 5-g sample size, but smaller sample sizes may be used. Consult the instrument manufacturer's instructions regarding larger sample sizes, in order to avoid clogging of the purging apparatus. The soil vial is hermetically sealed at the sampling site, and MUST remain so in order to guarantee the integrity of the sample. Gloves must be worn when handling the sample vial since the vial has been tared. If any soil is noted on the exterior of the vial or cap, it must be carefully removed prior to weighing. Weigh the vial and contents to the nearest 0.01 g, even if the sample weight was determined in the field, and record this weight. This second weighing provides a check on the field sampling procedures and provides additional assurance that the reported sample weight is accurate. Data users should be advised on significant discrepancies between the field and laboratory weights.

7.2.3.1 Remove the sample vial from storage and allow it to warm to room temperature. Shake the vial gently, to ensure that the contents move freely and that stirring will be effective. Place the sample vial in the instrument carousel according to the manufacturer's instructions.

7.2.3.2 Without disturbing the hermetic seal on the sample vial, add 5 mL of organic-free reagent water, the internal standards, and the surrogate compounds. This is carried out using the automated sampler. Other volumes of organic-free reagent water may be used, however, it is imperative that all samples, blanks, and calibration standards have exactly the same final volume of organic-free reagent water. Prior to purging, heat the sample vial to 40°C for 1.5 minutes, or as described by the manufacturer.

7.2.3.3 For the sample selected for matrix spiking, add the matrix spiking solution described in Sec. 5.0 of Method 5000, either manually, or automatically following the manufacturer's instructions. The concentration of the spiking solution and the amount added should be established as described in Sec. 8.0 of Method 8000.

7.2.3.4 Purge the sample with helium or another inert gas at a flow rate of up to 40 mL/minute (the flow rate may vary from 20 to 40 mL/min, depending on the target analyte group) for 11 minutes while the sample is being agitated with the magnetic stirring bar or other mechanical means. The purged analytes are allowed to flow out of the vial through a glass-lined transfer line to a trap packed with suitable sorbent materials.

7.2.4 Sample Desorption

7.2.4.1 Non-cryogenic interface - After the 11 minute purge, place the purge-and-trap system in the desorb mode and preheat the trap to 245°C without a flow

of desorption gas. Start the flow of desorption gas at 10 mL/minute for about four minutes (1.5 min is normally adequate for analytes in Method 8015). Begin the temperature program of the gas chromatograph and start data acquisition.

7.2.4.2 Cryogenic interface - After the 11 minute purge, place the purge-and-trap system in the desorb mode, make sure that the cryogenic interface is at -150°C or lower, and rapidly heat the trap to 245°C while backflushing with an inert gas at 4 mL/minute for about 5 minutes (1.5 min is normally adequate for analytes in Methods 8015). At the end of the 5-minute desorption cycle, rapidly heat the cryogenic trap to 250°C. Begin the temperature program of the gas chromatograph and start the data acquisition.

7.2.5 Trap Reconditioning

After desorbing the sample for 4 minutes, recondition the trap by returning the purge-and-trap system to the purge mode. Maintain the trap temperature at 245°C (or other temperature recommended by the manufacturer of the trap packing materials). After approximately 10 minutes, turn off the trap heater and halt the purge flow through the trap. When the trap is cool, the next sample can be analyzed.

7.2.6 Data Interpretation

Perform qualitative and quantitative analysis following the guidance given in the determinative method and Method 8000. If the concentration of any target analyte exceeds the calibration range of the instrument, it will be necessary to reanalyze the sample by the high concentration method. Such reanalyses need only address those analytes for which the concentration exceeded the calibration range of the low concentration method. Alternatively, if a sample aliquot of 1-2 g was also collected (see Sec. 6.2.1.7), it may be practical to analyze that aliquot for the analytes that exceeded the instrument calibration range in the 5-g analysis. If results are to be reported on a dry weight basis, proceed to Sec. 7.5

7.3 High concentration method for soil samples with concentrations generally greater than 200 µg/kg.

The high concentration method for soil is based on a solvent extraction. A solid sample is either extracted or diluted, depending on sample solubility in a water-miscible solvent. An aliquot of the extract is added to organic-free reagent water containing surrogates and, if applicable, internal and matrix spiking standards, purged according to Method 5030, and analyzed by an appropriate determinative method. Wastes that are insoluble in methanol (i.e., petroleum and coke wastes) are diluted with hexadecane (see Sec. 7.3.8).

The specific sample preparation steps depend on whether or not the sample was preserved in the field. Samples that were not preserved in the field are prepared using the steps below, beginning at Sec. 7.3.1. If solvent preservation was employed in the field, then the preparation begins with Sec. 7.3.4.

7.3.1 When the high concentration sample is not preserved in the field, the sample consists of the entire contents of the sample container. Do not discard any supernatant liquids. Whenever practical, mix the contents of the sample container by shaking or other mechanical means without opening the vial. When shaking is not practical, quickly mix the contents of the vial with a narrow metal spatula and immediately reseal the vial.

7.3.2 If the sample is from an unknown source, perform a solubility test before proceeding. Remove several grams of material from the sample container. Quickly reseal the container to minimize the loss of volatiles. Weigh 1-g aliquots of the sample into several test tubes or other suitable containers. Add 10 mL of methanol to the first tube, 10 mL of PEG to the second, and 10 mL of hexadecane to the third. Swirl the sample and determine if it is soluble in the solvent. Once the solubility has been evaluated, discard these test solutions. If the sample is soluble in either methanol or PEG, proceed with Sec. 7.3.3. If the sample is only soluble in hexadecane, proceed with Sec. 7.3.8.

7.3.3 For soil and solid waste samples that are soluble in methanol, add 9.0 mL of methanol and 1.0 mL of the surrogate spiking solution to a tared 20-mL vial. Using a top-loading balance, weigh 5 g (wet weight) of sample into the vial. Quickly cap the vial and reweigh the vial. Record the weight to 0.1 g. Shake the vial for 2 min. If the sample was not soluble in methanol, but was soluble in PEG, employ the same procedure described above but use 9.0 mL of PEG in place of the methanol. Proceed with Sec. 7.3.5.

NOTE: The steps in Secs. 7.3.1, 7.3.2, and 7.3.3 must be performed rapidly and without interruption to avoid loss of volatile organics. These steps must be performed in a laboratory free from solvent fumes.

7.3.4 For soil and solid waste samples that were collected in methanol or PEG (see Sec. 6.2.2), weigh the vial to 0.1 g as a check on the weight recorded in the field, add the surrogate spiking solution to the vial by injecting it through the septum, shake for 2 min, as described above, and proceed with Sec. 7.3.5.

7.3.5 Pipet approximately 1 mL of the extract from either Sec. 7.3.3 or 7.3.4 into a GC vial for storage, using a disposable pipet, and seal the vial. The remainder of the extract may be discarded. Add approximately 1 mL of methanol or PEG to a separate GC vial for use as the method blank for each set of samples extracted with the same solvent.

7.3.6 The extracts must be stored at 4°C in the dark, prior to analysis. Add an appropriate aliquot of the extract (see Table 2) to 5.0 mL of organic-free reagent water and analyze by Method 5030 in conjunction with the appropriate determinative method. Proceed to Sec. 7.0 in Method 5030 and follow the procedure for purging high concentration samples.

7.3.7 If results are to be reported on a dry weight basis, determine the dry weight of a separate aliquot of the sample, using the procedure in Sec. 7.5, after the sample extract has been transferred to a GC vial and the vial sealed.

7.3.8 For solids that are not soluble in methanol or PEG (including those samples consisting primarily of petroleum or coking waste) dilute or extract the sample with hexadecane using the procedures in Sec. 7.0 of Method 3585.

7.4 High concentration method for oily waste samples

This procedure for the analysis of oily waste samples involves the dilution of the sample in methanol or PEG. However, care must be taken to avoid introducing any of the floating oil layer into the instrument. A portion of the diluted sample is then added to 5.0 mL of organic-free reagent water, purged according to Method 5030, and analyzed using an appropriate determinative method.

For oily samples that are not soluble in methanol or PEG (including those samples consisting primarily of petroleum or coking waste), dilute or extract with hexadecane using the procedures in Sec. 7.0 of Method 3585.

The specific sample preparation steps depend on whether or not the sample was preserved in the field. Samples that were not preserved in the field are prepared using the steps below, beginning at Sec. 7.4.1. If methanol preservation was employed in the field, then the preparation begins with Sec. 7.4.3.

7.4.1 If the waste was not preserved in the field and it is soluble in methanol or PEG, weigh 1 g (wet weight) of the sample into a tared 10-mL volumetric flask, a tared scintillation vial, or a tared culture tube. If a vial or tube is used instead of a volumetric flask, it must be calibrated prior to use. This operation must be performed prior to opening the sample vial and weighing out the aliquot for analysis.

7.4.1.1 To calibrate the vessel, pipet 10.0 mL of methanol or PEG into the vial or tube and mark the bottom of the meniscus.

7.4.1.2 Discard this solvent, and proceed with weighing out the 1-g sample aliquot.

7.4.2 Quickly add 1.0 mL of surrogate spiking solution to the flask, vial, or tube, and dilute to 10.0 mL with the appropriate solvent (methanol or PEG). Swirl the vial to mix the contents and then shake vigorously for 2 minutes.

7.4.3 If the sample was collected in the field in a vial containing methanol or PEG, weigh the vial to 0.1 g as a check on the weight recorded in the field, add the surrogate spiking solution to the vial by injecting it through the septum. Swirl the vial to mix the contents and then shake vigorously for 2 minutes and proceed with Sec. 7.4.4.

7.4.4 Regardless of how the sample was collected, the target analytes are extracted into the solvent along with the majority of the oily waste (i.e., some of the oil may still be floating on the surface). If oil is floating on the surface, transfer 1 to 2 mL of the extract to a clean GC vial using a Pasteur pipet. Ensure that no oil is transferred to the vial.

7.4.5 Add 10 - 50 μ L of the methanol extract to 5 mL of organic-free reagent water for purge-and-trap analysis, using Method 5030.

7.4.6 Prepare a matrix spike sample by adding 10 - 50 μ L of the matrix spike standard dissolved in methanol to a 1-g aliquot of the oily waste. Shake the vial to disperse the matrix spike solution throughout the oil. Then add 10 mL of extraction solvent and proceed with the extraction and analysis, as described in Secs. 7.4.2 - 7.4.5. Calculate the recovery of the spiked analytes as described in Method 8000. If the recovery is not within the acceptance limits for the application, use the hexadecane dilution technique in Sec. 7.0 of Method 3585.

7.5 Determination of % Dry Weight

If results are to be reported on a dry weight basis, it is necessary to determine the dry weight of the sample.

NOTE: It is highly recommended that the dry weight determination only be made after the analyst has determined that no sample aliquots will be taken from the 60-mL vial for high

concentration analysis. This is to minimize loss of volatiles and to avoid sample contamination from the laboratory atmosphere. There is no holding time associated with the dry weight determination. Thus, this determination can be made any time prior to reporting the sample results, as long as the vial containing the additional sample has remained sealed and properly stored.

7.5.1 Weigh 5-10 g of the sample from the 60-mL VOA vial into a tared crucible.

7.5.2 Dry this aliquot overnight at 105°C. Allow to cool in a desiccator before weighing. Calculate the % dry weight as follows:

$$\% \text{ dry weight} = \frac{\text{g of dry sample}}{\text{g of sample}} \times 100$$

WARNING: The drying oven should be contained in a hood or vented. Significant laboratory contamination may result from a heavily contaminated hazardous waste sample.

8.0 QUALITY CONTROL

8.1 Refer to Chapter One for specific quality control procedures and Method 5000 for sample preparation QC procedures.

8.2 Before processing any samples, the analyst should demonstrate through the analysis of an organic-free reagent water method blank that all glassware and reagents are interference free. Each time a set of samples is extracted, or there is a change in reagents, a method blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement.

8.3 Initial Demonstration of Proficiency - Each laboratory must demonstrate initial proficiency with each sample preparation and determinative method combination it utilizes, by generating data of acceptable accuracy and precision for target analytes in a clean matrix. The laboratory must also repeat this demonstration whenever new staff are trained or significant changes in instrumentation are made. See Sec. 8.0 of Methods 5000 and 8000 for information on how to accomplish this demonstration.

8.4 Sample Quality Control for Preparation and Analysis - See Sec. 8.0 in Method 5000 and Method 8000 for procedures to follow to demonstrate acceptable continuing performance on each set of samples to be analyzed. These include the method blank, either a matrix spike/matrix spike duplicate or a matrix spike and duplicate sample analysis, a laboratory control sample (LCS), and the addition of surrogates to each sample and QC sample.

8.5 It is recommended that the laboratory adopt additional quality assurance practices for use with this method. The specific practices that are most productive depend upon the needs of the laboratory and the nature of the samples. Whenever possible, the laboratory should analyze standard reference materials and participate in relevant performance evaluation studies.

9.0 METHOD PERFORMANCE

9.1 Single laboratory accuracy and precision data were obtained for the method analytes in three soil matrices, sand, a soil collected 10 feet below the surface of a hazardous landfill, called the

C-Horizon, and a surface garden soil. Each sample was fortified with the analytes at a concentration of 20 ng/5 g, which is equivalent to 4 µg/kg. These data are listed in tables found in Method 8260.

9.2 Single laboratory accuracy and precision data were obtained for certain method analytes when extracting oily liquid using methanol as the extraction solvent. The data are presented in a table in Method 8260. The compounds were spiked into three portions of an oily liquid (taken from a waste site) following the procedure for matrix spiking described in Sec. 7.4. This represents a worst case set of data based on recovery data from many sources of oily liquid.

10.0 REFERENCES

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9. Hewitt, A. D., "Methods of Preparing Soil Samples for Headspace Analysis of Volatile Organic Compounds: Emphasis on Salting Out", 12th Annual Waste Testing and Quality Assurance Symposium, Washington, DC, 1996, 322-9.
10. Hewitt, A. D., Miyares, P. H., Leggett, D. C., Jenkins, T. F., "Comparison of Analytical Methods for Determination of Volatile Organic Compounds", *Envir Sci Tech*, 1992; 26; 1932-8.

TABLE 1

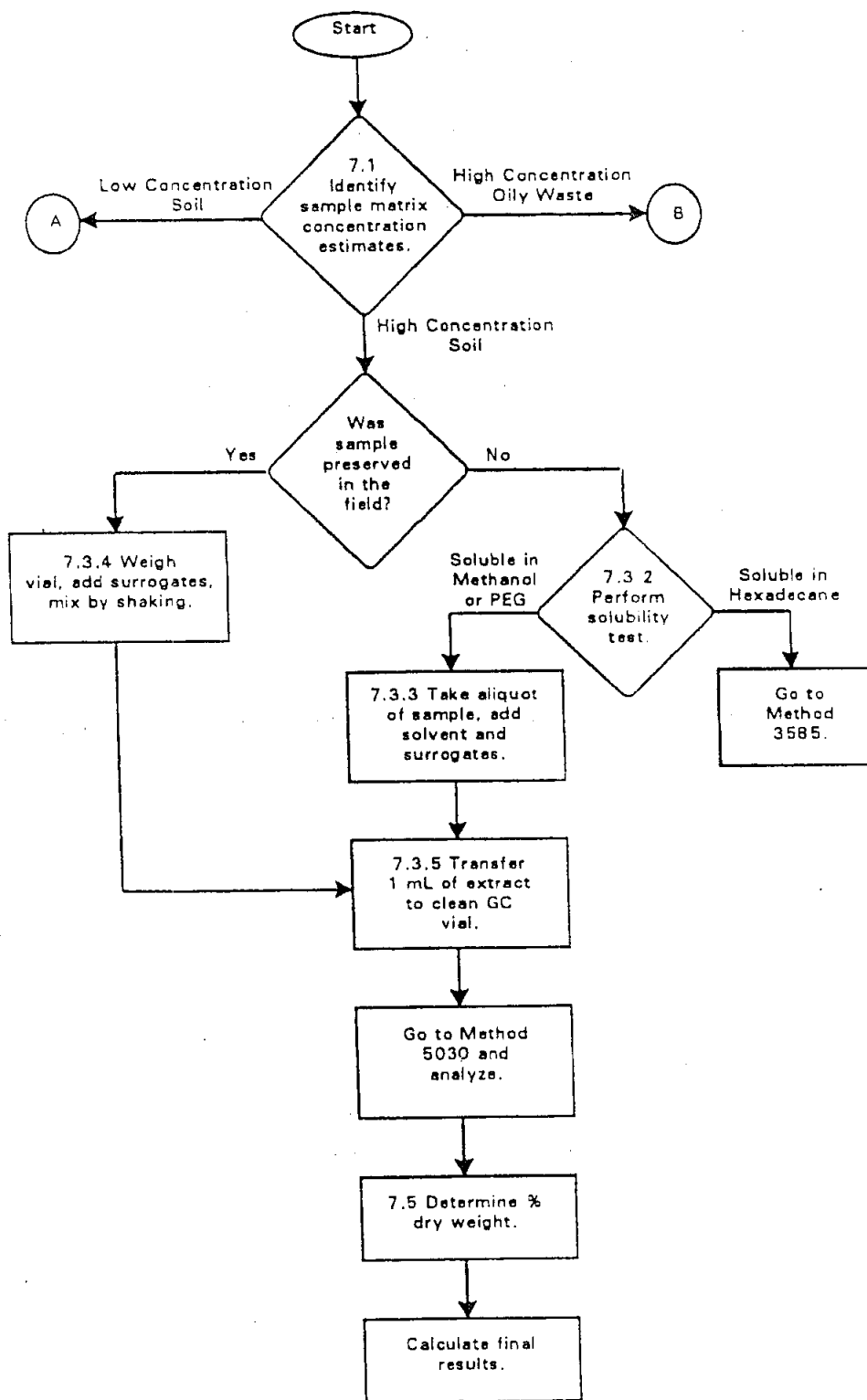
QUANTITY OF METHANOL EXTRACT REQUIRED FOR ANALYSIS OF
HIGH CONCENTRATION SOILS/SEDIMENTS

Approximate Concentration Range			Volume of Methanol Extract ^a
500	-	10,000 µg/kg	100 µL
1,000	-	20,000 µg/kg	50 µL
5,000	-	100,000 µg/kg	10 µL
25,000	-	500,000 µg/kg	100 µL of 1/50 dilution ^b

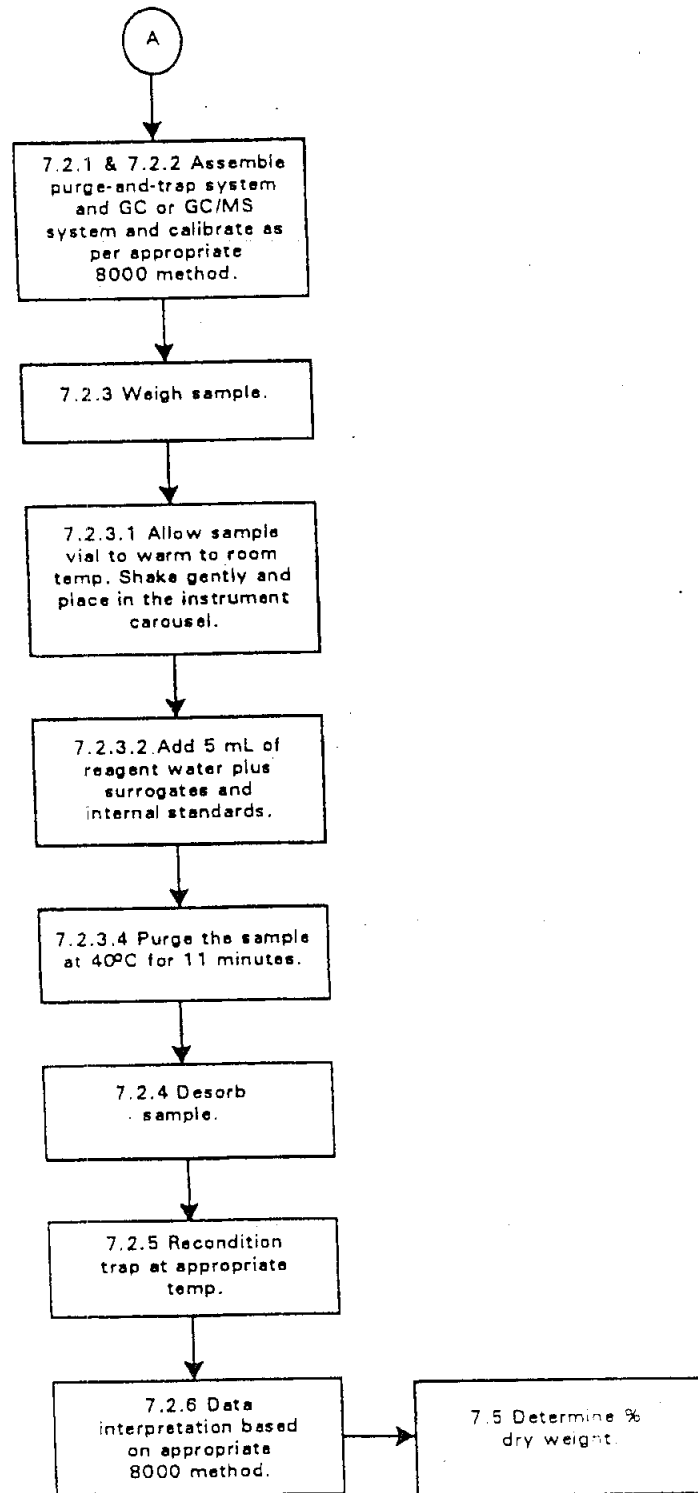
Calculate appropriate dilution factor for concentrations exceeding those in this table

- ^a The volume of methanol added to 5 mL of water being purged should be kept constant. Therefore, add to the 5-mL syringe whatever volume of methanol is necessary to maintain a total volume of 100 µL of methanol.
- ^b Dilute an aliquot of the methanol extract and then take 100 µL for analysis.

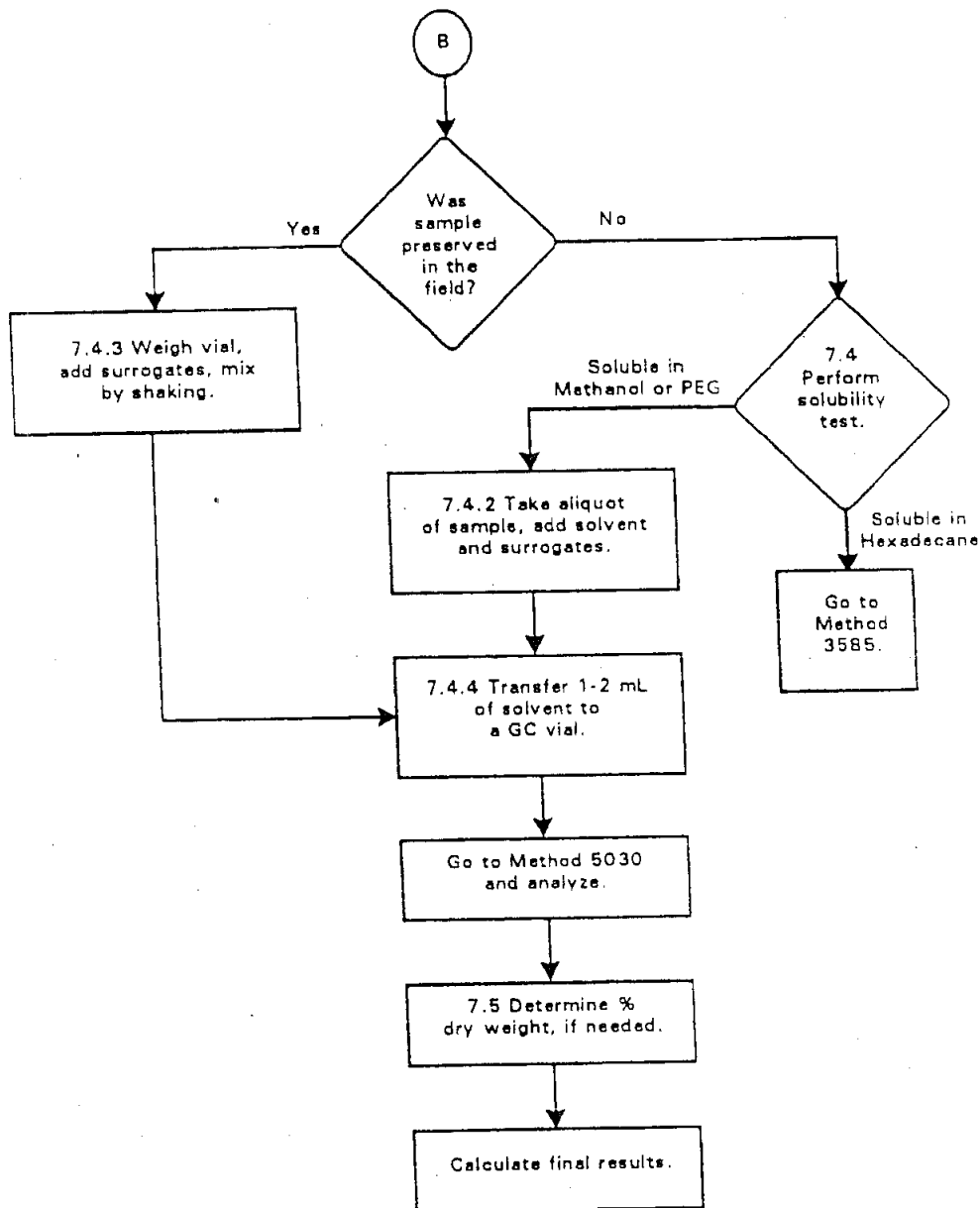
METHOD 5035
CLOSED-SYSTEM PURGE-AND-TRAP AND EXTRACTION
FOR VOLATILE ORGANICS IN SOIL AND WASTE SAMPLES



METHOD 5035 (CONTINUED)



METHOD 5035 (CONTINUED)



APPENDIX C

Independent Technical Review Comments

Maxim Technologies, Inc.

Remedial Investigation
Niagara Falls Storage Site
Niagara County, New York

Contract DACW49-97-D-0001
Delivery Order 0012

Reviewer: Mr. Clyde L. Yancey, P.G.
Maxim Technologies, Inc.-Dallas, TX

Documents

Reviewed: Draft Field Sampling Plan (FSP)

Note: Mr. Yancey's comments are in non-bold text; Maxim responses are in bold text

1. You might consider publishing this in two volumes: volume 1 containing text and volume 2 containing figures and tables. Makes it much easier for reader.

Appendices A, B, and C were removed. This reduction in bulk should make the FSP more manageable and easier for the reader.

2. Section 1.1.3 – The stratigraphic column indicates Queenston Shale (Fig. 1.1.3-1) whereas the text, cross-section and second stratigraphic column refer to the Queenston Formation. Most likely that "Shale" is an informal/local/member term, but you may want to update to "Formation" on Figure 1.1.3-1 to reflect formal nomenclature.

Due to the stratigraphic column being a scanned document, it will not be changed. However, all text will be revised to read "Formation" rather than "Shale"

3. Figure 1.1.2-1 – Might want to provide more line definition to the Site Boundary Line as well as label it, or put it in the Legend. This is an important feature.

Agreed. This has been added to all figures which include the site boundary.

4. Section 1.1.3.3, Second paragraph – Suggested sentence rewording: *Lateral facies changes, characterized by increased sand and silt occur within the upper 0.9 to 1.5 m (3-5 ft).*

Agreed. The text will be changed as suggested.

5. I assume that when presenting various length/area/volume/etc dimensions (and corresponding metric conversions), that you are following a convention that dictates

whole numbers less than 10 be written out as opposed to numeric representation. If not, use the numeric.

Agreed. The convention suggested is the one used.

6. Section 1.1.4 – See attached markups.

Agreed. The text will be edited as suggested.

7. Sections 1.1.4.1 through 1.1.4.3 –General comment- Might consider a little more development here in regards to site-specific aquifer (or actual lack of aquifer) characteristics such as hydraulic conductivity and ambient water quality. This information can be used to "set the stage" for additional data acquisition needs as well as any proposed compliance strategies (based on limited yield, widespread ambient contamination, etc).

Agreed. These sections have been modified to incorporate the suggested characteristics as well as other aquifer characteristics.

8. Section 1.1.4.2 – Would it be appropriate here to mention that the lower water-bearing zone is considered the uppermost aquifer for compliance purposes?

Yes. Language to this effect is included in the revised text.

9. Section 1.2.1.3.1 through 1.2.1.3.3 – Were the temporary groundwater sampling wells in the upper water-bearing zone?

Yes. The text will be revised to reflect this.

10. Section 1.3.1 – IWCS area – Text states that cap was completed in 1986, and additional material was placed in 1991 and "the cap was replaced." The 1994 BNI report stresses the fact that the 1991 material placement did not penetrate or otherwise compromise the integrity of the 1986 cap. It was my understanding that the 1991 material was placed adjacent to or on top of the 1986 cap and additional clay cover was added.

Agreed. The text will be changed to reflect the "consolidation of the material into the IWCS" the reference to the cap being replaced was removed.

11. Section 1.3.1 – IWCS area – "excludes sampling/analyses within the boundaries of the IWCS".....What are the "boundaries," the fence or does the author mean no sampling on or through the disposal cell?

The statement was intended to indicate that no sampling on or through the IWCS will be conducted.

12. Figure 1.3-2 – Might want to show the fence around the IWCS on this figure.

The fence has been included on all figures depicting the IWCS.

13. Section 1.3.2 – What's an LSA container? Not in the acronym list and don't recall it's being defined earlier in text.

The term "LSA", a term used by the USACE escort during the initial site visit on April 20, 1999, has been deleted. They are now simply referred to as "containers".

14. Page 1-17 – see margin notes

Agreed. The text will be edited to reflect that the pipeline is partially buried.

15. Page 1-18 – See margin notes

Agreed. The text will be edited as suggested.

16. Section 1.3.8 – Do the uninvestigated areas consist of everything else in Figure 1.3-1 not covered by a pattern? Or is there a color I am not seeing because of B&W copy?

Yes, the uninvestigated areas are represented by a color. Colored copies will be distributed in the revised draft.

17. I have a problem with the two sentences "Potential contamination due to undocumented past site practices/activities may have occurred in these areas. These areas may pose potential problems in the site risk assessment if no investigation is performed on them." A commercial client would probably go ballistic over a statement like that. A more gentle approach might read: "The potential exists within these areas for adverse environmental impacts based on historic practices/activities at the NFSS. To be protective of human health and the environment, it is critical to characterize these areas from the standpoint of filling potential data gaps in the site baseline risk assessment." Just a suggestion.

Maxim disagrees with this suggestion and will leave the text as it was originally stated.

18. No Figure 2-1 in this document.

A copying omission. The organization chart will be included in all copies of the revised draft.

19. Section 3.1.1 – The USACE statement of work indicates under Task 1 that resources from other pertinent technology resources, such as DOE EM-50 should be reviewed. We make no reference to this request in the text. Also, typo on this page.

EM-50 is a feasibility study related document and will be reviewed nearer to the end of the RI process. Typo was corrected as suggested.

20. Page 3-2 – see margin comments.

Agreed. The text will be edited as suggested.

21. Section 3.1.7 – In the USACE statement of work, Task 7 is listed as *Specification and Acquisition of Field Data*, not Remedial Investigation.

This task has been modified per negotiations between Maxim and USACE-Buffalo District.

22. The USACE statement of work calls out 15 discrete tasks, but the document only discusses 13. Also, Task 13 addresses the FS as well as RI. Should these other tasks be addressed here? If not, should a disclaimer be provided stating why they are not?

The extraneous tasks not germane to the proposed Phase I RI field activities have been removed.

23. Page 3-5, see margin notes.

Agreed. The text will be edited as suggested.

24. Section 4.1.1 – Phase 1 sampling will consist of 69 samples, am I to assume that Phase 2 will tier off of results/information obtained during phase 1? Probably should state something to this effect.

Agreed. Text to this effect is included in Section 1 of the revised draft.

25. Page 4-3, see margin notes.

The first typo should read "or". 15 grams is the correct total weight for the three Encore samples. Procedures related to VOC sampling by Method 5035 are now described in Appendix B of the revised draft.

26. Page 4-4 markup

Agreed. The text will be edited as suggested.

27. Page 4-8, 4th paragraph, first sentence: *The borehole will be advanced until the first saturated zone is encountered and will be terminated after a few inches of the underlying Gray Clay Unit is penetrated.* Is this an either/or situation? I am assuming that if you hit groundwater, you will sample at the interface, then abandon the boring. If you don't hit groundwater before encountering the Gray Clay, you will sample at the Gray Clay

interface, then abandon. It's not real clear. See other markups.

The text is edited to reflect that the borings will be terminated after penetrating a few inches of the Gray Clay Unit. Other markups have been edited as suggested. This information is now included in Section 4.1.2.1 of the revised draft.

28. 4.2.2.3.1 – "cpm" is not in acronym list, or defined (at least I couldn't find it).

"cpm" means counts per minute. This has been added to both the text and the acronym list.

29. Markups on page 4-10.

Agreed. The text will be edited as suggested.

30. Markup page 4-13

Agreed. The text will be edited as suggested.

31. Markups pages 4-14 and 4-16

Agreed the words "due to contamination" were removed. The bowl will not be covered for headspace readings. PID measurements will be taken during the homogenization process.

32. Section 4.5.2.1.2 – I am assuming the water levels in the temporary wells will be made from ground surface, and followed at some time later by an elevation survey.

Agreed. The text will be edited to incorporate this comment and will be included in Section 4.1.3.1 of the revised draft.

33. Section 4.5 general comment – From what I read you will be setting both temporary and permanent monitor wells. It is not clear in your description of sampling locations (Building 401, Former Shop Area, etc), which will be permanent and which will be temporary. Figure 4.1.1.1-1 does not show this either.

The revised draft will state that all Phase I RI wells will be temporary wells.

34. Section 4.5.2.1.1 – *Development Record*, it should be stated that development occurs only in permanent wells.

Agreed. The text will be edited to incorporate this comment.

35. Section 4.5.3.7 – Slug tests are okay, and the equations supposedly correct for the influence of gravel packs, but if we are to base a 3-D flow model at some point in time

off slug test results, I would worry. Something you might consider proposing are short term pumping tests (1 to 2 hours), just enough to ensure the aquifer has been stressed. If there are any nearby wells, use them as observation wells. Once you are rigged up to do these, you can generally get 5 tests a day. It could be done during the second phase of sampling, once you have a handle on approximate yields (based on Phase 1 slug tests), and the most appropriate places to gather hydraulic data. One test per area of concern, and then incorporate across the flow model grid. I have used this method at several sites, and it has worked well (as opposed to slug tests or a long term, site wide pumping test). This is not a big budget item, and results in better data.

Slug testing will not be performed in Phase I activities and therefore reference to slug testing will be removed for the revised draft. We agree with your suggestion that pump tests are more accurate than slug tests and will consider this if 3-D modeling is performed in the future.

36. Another characterization tool you might consider running by the Corps is the use of airborne hyperspectral imaging. This technology is great at establishing a complete environmental baseline, and is easily coupled with GIS. From this data, one can identify vegetation types/density/stress, mineral components of soils (possibly leading to delineation of ground contamination), and surface water variations. Several firms throughout the US have this capability. I am aware of one in Albuquerque that is developing different spectral imaging cameras through grants from the DOE and may be able to come up with their own dollars for demonstration on various projects.

This technology will not be performed in Phase I RI activities, but may be considered for future activities.

Independent Technical Review Comments

Maxim Technologies, Inc.

Remedial Investigation
Niagara Falls Storage Site
Niagara County, New York

Contract DACW49-97-D-0001
Delivery Order 0012

Reviewer: Mr. Dennis R. Herzing, M.S., P.E.
HVC & Associates-Freeburg, Illinois

Documents

Reviewed: Draft Quality Control Plan (QCP), Draft Quality Assurance Project Plan (QAPP),
Draft Field Sampling Plan (FSP), Draft Site Safety and Health Plan (SSHP)

Note: Mr. Herzing's comments are in non-bold text; Maxim responses are in bold text

Draft Field Sampling Plan

Page 1-7: Correct typos - see attached mark-up.

Agreed. The typos were corrected as suggested.

Page 1-9: 1.1.7 refers to Figure 1.1.7-2 which shows land use projections for the year 2700.

Land use projections 700 years into the future are questionable. Is there an error in the date of the projections?

There is no error. This projection was completed by Bechtel National Incorporated and accepted by the USDOE.

Page 1-12: The last "sentence" of section 1.2.1.2.2 is not a complete sentence. See attached mark-up.

Agreed. The text was edited as suggested.

Page 3-1: Correct typo. See attached mark-up.

Agreed. The typo was corrected as suggested.

Page 3-4: Correct typo. See attached mark-up.

Agreed. The typo was corrected as suggested.

Page 3-5: Items (6) and (9) reference "building". It would be more clear to specify which building. I believe these items refer only to building 401.

Agreed. The text will be revised to read "Building 401".

Page 4-3: Correct typo. See attached mark-up.

Agreed. All reference to Method 5035 sampling for VOCs has been moved to Appendix B of the revised draft.

Page 4-5: Section 4.2 discusses subsurface soil sampling below 30 cm. in the soil column. It may be prudent to define the maximum depth of the borings here.

Section 4.2.1 Seems to indicate that only one set of soil samples will be collected from each boring at the soil interface with the first water-bearing zone. The collection of shallower soil samples from boreholes is mentioned in 4.2.2.3.3 but should probably also be mentioned here to avoid confusion.

Discussion of the maximum depth of borings and depths from which soil samples will be collected can be found in Section 4.1.2.1 of the current draft FSP. Borings will be advanced no deeper than the upper part of the Gray Clay Unit, which is anticipated to be encountered between 10 to 20 feet below ground surface. A minimum of one subsurface soil sample will be collected from each boring. If field observations indicate that potential soil contamination exists at other depths, samples may be collected at the discretion of the Maxim Engineer/Geologist with the concurrence of the USACE-Buffalo District site representative.

Page 4-10: Correct typo. See attached mark-up.

Agreed. All reference to Method 5035 sampling for VOCs has been moved to Appendix B of the revised draft.

Page 4-13: Section 4.3.1 appears to contain an extraneous sentence. See attached mark-up

Agreed. This sentence will be removed from the narrative.

Page 4-14: Correct typo. See attached mark-up.

Agreed. Reference to sampling locations has been moved to Section 1 of the revised draft.

Page 4-15: Correct typo. See attached mark-up.

Agreed. All reference to Method 5035 sampling for VOCs has been moved to Appendix B of the revised draft.

Page 4-23: Section 4.5.1.2, last sentence indicates no field analysis will be performed. Field testing for pH, conductivity, temperature, etc. will be performed. The same sentence refers to surface soil samples. This should read groundwater samples.

Agreed. The last sentence of this section has been removed.

Page 4-32: Section 4.8.1, third sentence refers to asbestos sampling and should refer to lead paint sampling.

This section has been deleted as lead paint sampling will not be performed in the Phase I RI.

Page 4-35: Second paragraph discusses examination of electrical and plumbing systems. It should be clarified whether this will only be visual examination or will confirmatory sampling and analysis be performed.

This section has been deleted as the Building 401 demolition survey will not be performed in the Phase I RI.

Page 4-37: Section 4.11.2.3 Indicates that soil samples will be taken to verify the field survey. It should be specified whether these will be surface soil samples or subsurface soil samples.

This section has been deleted as the radiological verification surface scan will not be performed in the Phase I RI.

Page 5-4: First sentence, refers to sediment sample number when describing the general sample numbering system. See attached mark-up.

Agreed. The words "for sediment " will be removed from the narrative.

Page 6-1: Correct typo. See attached mark-up.

Agreed. The typo was corrected as suggested.

Page 7-4: Correct typo. See attached mark-up.

Agreed. The typo was corrected as suggested.

Figures: The text on many of the 11x17 size drawings is difficult to read. D-size drawings were not furnished in the review package sent to me.

The figures have been modified to facilitate the ease of viewing without the D-size drawings. However, the D-size drawings will be included in all copies in the next draft revision.

Independent Technical Review Comments

Maxim Technologies, Inc.

Remedial Investigation
Niagara Falls Storage Site
Niagara County, New York

Contract DACW49-97-D-0001
Delivery Order 0012

Reviewer: Mr. Steve L. McBride, Chemistry
SAIC

Documents

Reviewed: Draft Field Sampling Plan (FSP)

Note: Mr. McBride's comments are in non-bold text; Maxim responses are in bold text Notes, Questions, Comments

Comment conventions

Para Paragraph
..... Indicates direct quote within the draft FSP
Sec. Section
Sent. Sentence
Rev. Revision

1. Should historical data, be formatted and/or input to a database which mirrors the new database format?

The historical data has been incorporated into a database as suggested.

2. Web site for NFSS?

It is Maxim's understanding that the USACE-Buffalo District will put this document on the world wide web.

3. Section 1 No comments.

No responses

4. Section 2 No comments.

No responses

5. Section 3, Scope and Objectives

6. 3.1.3 Task 3
Suggest changing word ... legal to feasible.
...whether off-site disposal is feasible.

Reference to this task has been deleted as it does not apply to field activities regarding the FSP.

7. Also add (if still part of the scope): Establish current Agency and public view/position on site options for low level radioactive waste removal or retention.

Reference to this task has been deleted as it does not apply to field activities regarding the FSP.

8. 3.1.7 TASK 7 (pg. 3-3, top)
For the one-third full suite analyses- is this many results needed for pesticides, PCBs and herbicides for the NFSS?

Maxim believes that very little useful chemical data exists from previous investigations that could be used in a risk assessment. Previous investigations have indicated the presence of chemicals such as heptachlor epoxide, DDT, dieldrin, endrin and other organic pesticides . Therefore, Maxim believes these analyses are necessary to adequately perform a baseline risk assessment.

9. 3.1.13.3 TASK 13B
Is there a document number or date for the current Scope of Work? The SOW (Appendix D, Feb. 1999) does include text about Fate and Transport Modeling.

The only formal SOW issued to Maxim was the February, 1999 SOW. The Fate and Transport Modeling task was removed from the SOW during project negotiations, but may be performed in the future if warranted.

10. 3.1.13.3 TASK 13C
Suggest adding at end of para:
Impacts to data comparability resulting from changes in sampling and analytical methods will be considered for report discussion, where appropriate.

Reference to this task has been deleted as it does not apply to field activities regarding the FSP.

11. 3.2 Goals/Objectives
Suggest:
In general, envir. data (chemical, radiological, geotechnical and hydrogeological) from.....to characterize the surface soil, subsurf.....the NFSS in support of the RI/FS process. When completed the FS will provide a list of remedial alternatives (options) for the site.

Agreed. Maxim has added text to this effect, with the exception of the last sentence. Maxim's current SOW does not include a FS.

(1) should this be ...first and second..... or ...upper and lower. ..

The text has been edited to state "first or second".

(2) Is this correct? To see if chemicals are getting into the IWCS? Is this to determine the potential for a mixed waste scenario? See comment for QAPP DQO 2, sec. 3.1.1

This statement is correct and was documented at the Technical Project Planning workshop in Amherst, New York on June 8 and 9, 1999.

(3a).....at the site....

Agreed. The text will be edited as suggested.

(6) Is this surface, subsurface or both? Which building or all buildings?

This is both subsurface and surface soils. The text will be revised to state "Building 401".

Section 4, Field Activities

12. 4.1.1.1.1 IWCS

References to specific areas of investigation have been removed from Section 4 of the revised draft. Please refer to Section 1 of the revised draft.

13. 4.2.2.3.3 Selection
....will be submitted to and under go....

Agreed. The text will be edited as suggested.

14. 4.2.2.3.4 (pg. 4-10, bottom para, 2nd sentence)
add be: ...sample will be homogenized....

Agreed. Please refer to Section 4.1.1 of the revised draft.

15. 4.2.2.5 Sampling for P/Geotech. Analysis
Refer to method list- Is pH or hydraulic conductivity data needed for these samples?

pH and hydraulic conductivity parameters are not scheduled to be analyzed at this time.

16. 4.2.2.8 Field QC
The method MS/MSD requirement is correctly stated. However, MS/MSDs should be selected by the project data management or field manager to maximize opportunities to gain useful information about the project's matrices. The lab does not have any such information and has no vested interest in how meaningful the data is to the project.

Agreed. MS/MSD samples are designated for specific sampling locations in the revised draft. If sufficient volume for MS/MSD analyses cannot be recovered, the Maxim Geologist/Engineer, with the concurrence of the USACE-Buffalo District field representative, will choose a different sampling location at which to collect the MS/MSD samples.

17. Last sentence ...and divided...

Agreed. Please refer to Section 4.1.1 of the revised draft.

18. 4.3.2.1 Sampling/Sed.

Excluding grass and roots from the sample, as vegetation, makes sense – How are stones and gravel not part of what may make up the sediment matrix?

Maxim believes that stones and gravel are not likely to sorb chemical or radioactive contaminants and laboratory analysis of stones and gravel is not practical. Maxim intends to discard stones and gravel.

19. add be: ...sample will be homogenized....

Agreed. Please refer to Section 4.1.1 of the revised draft.

20. 4.3.2.5 Field QC

The method MS/MSD requirement is correctly stated. However, MS/MSDs should be selected by the project data management or field manager to maximize opportunities to gain useful information about the project's matrices. The lab does not have any such information and has no vested interest in the how meaningful the data is to the project.

Agreed. MS/MSD samples are designated for specific sampling locations in the revised draft. If sufficient volume for MS/MSD analyses cannot be recovered, the Maxim Geologist/Engineer, with the concurrence of the USACE-Buffalo District field representative, will choose a different sampling location at which to collect the MS/MSD samples.

21. Last sentence ...and divided...

Agreed. Please refer to Section 4.1.1 of the revised draft.

22. 4.4.2.6 Field QC....

MS/MSDs should be selected by Maxim, this is especially true for a water matrix where you have to provide extra sample. Otherwise you are collecting and shipping extra water just so the lab can select the MS/MSD and they have to dispose of all the other extra sample volumes that were not needed.

Agreed. MS/MSD samples are designated for specific sampling locations in the revised draft. If sufficient volume for MS/MSD analyses cannot be recovered, the Maxim Geologist/Engineer, with the concurrence of the USACE-Buffalo District field representative, will choose a different sampling location at which to collect the MS/MSD samples.

23. 4.5.2.7 Same as above.

Agreed. See response to comment 22.

24. 4.6 on pg. 4-28 to end of sec. 4, pg 4-37

This collection of NIPS (not included in present scope) was not reviewed and it may be better to store this text separate from the draft submittal to the USACE to bring out later if and when its needed. Unless, of course, if this information was asked for in addition to the present scope.

Agreed. Activities described in Sections 4.6 through 4.11.2.3 will not be performed in Phase I of the RI. These sections will be removed from the revised draft.

Section 5

25. Sec. 5.1 Field Log....
Suggest ending 1st sentence after word events. Delete the rest of this sent.

Agreed. The text will be edited as suggested.

26. 5.5 Documentation.....
pg 5-6 bottom para, 1st sent.: The labs internal chain of custody would take over at this point.
Top of pg 5-7, cont. 1st para, last sent.: same as above

Agreed. The word "Maxim: will be replaced with the word "laboratory".

27. 5.6 Corrections....
Pg 5-7 last para, 1st sent.: rev.with Maxim's project manager. The Maxim project manager will determine when the USACE needs to be contacted regarding lab issues and problem resolution.

Agreed. The text will be edited as suggested.

28. Section 6 No comments.

No responses.

29. Section 7
7.5 Waste....
pg 7-2, 1st para, 2nd sent. in TCLP the P is procedure, not potential.

Agreed. The text will be edited as suggested.

30. 2nd bullet of additional methods- paint filter test may be part of the TCLP, the TCLP method has to determine whether the sample is solid, liquid or both.

Agreed. The text will be edited as suggested.

31. 7.8 Disposal
Pg 7-4, 1st para, last sent.: I suggest that this sentence be revised to better reflect the clients options, oversight interest, and historic position.

Agreed. The text will be edited as suggested.

32. Section 8 No comments.

No response.

33. Section 9 No comments.

No response.

Section 10 No comments.

No response.

34. Section 11 No comments.

No response.

35. Section 12

Sec. 12.3 Recommend....

Suggest rev. to last sent.:(PCOC), with respect to Areas of Concern (AOC), will....

Agreed. Maxim recommends the text be revised to state...(PCOC), with respect to the Areas of Investigation, will...

Independent Technical Review Comments

Maxim Technologies, Inc.

Remedial Investigation
Niagara Falls Storage Site
Niagara County, New York

Contract DACW49-97-D-0001
Delivery Order 0012

Reviewer: Dr. Robert Tucker, Ph.D., P.G., Senior Geologist
SAIC

Documents

Reviewed: Draft Field Sampling Plan (FSP)

Note: Dr. Tucker's comments are in non-bold text; Maxim responses are in bold text.

1. P1-3 Section 1.1.1 2nd paragraph 2nd sentence. How did the material get from building 434 to 411. By pipe by tanker?

The material was slurried and piped aboveground to Building 411.

2. P. 1-6 Section 1.1.4, What is the direction of regional groundwater flow? Is there information on the direction of local groundwater flow?

These issues are addressed in the revised draft. Please refer to Section 1.1.4 and its subsections for a more detailed discussion of the hydrogeology.

3. P 1-9 Section 1.1.7. A 700 year projection of land usage? I would think that a 70 year projection would be suspect.

This projection was completed by Bechtel National Incorporated and accepted by the USDOE.

4. P 2-4 Section 2.7. Mr. Douglas Haas will be the RSO.

Agreed. The text has been edited as suggested.

5. P 4-5 Section 4.1.2.8 EM200-1-3 recommends a solvent wash during decontamination for organic sampling. I would recommend an acid wash for decontamination during radiological sampling. SAIC's normal procedure would be an Alconox wash, water rinse, 10% nitric acid wash, DI water rinse, isopropanol wash, DI water rinse, air dry. See also ASTM procedures D5088 and D5608.

In general, the EM200-1-3 recommends that different acid or solvent rinses be used based on the of classification of constituents (i.e., VOA, low molecular weight compounds [methanol

rinse]; BNA, pesticides, PCBs, high molecular weight compounds [hexane rinse]; Organic Bases [acid rinse and isopropyl alcohol rinse]; Organic Acids [base wash, isopropyl alcohol rinse]; trace metals [acid rinse]; Salts [none]; Acidic Compounds [base wash]; Basic Compounds [acid rinse]; and Caustics [none]). During this investigation, the majority of the samples would be analyzed for the full suite of constituents. These samples would be collected from the same sampling device (i.e., split spoon, continuous sampler, Eckman dredge, etc). Based on this, it seems appropriate that the potential for cross-contamination due to solvent rinses exceeds the potential for cross-contamination due to the specified decontamination procedures. Therefore, solvent, acidic or basic rinses will not be included in the decontamination procedure.

Similarly, the decontamination procedure using nitric acid during the radiological sampling will not be incorporated at this time. Please refer to the last paragraph of Section 4.1 of the revised draft for decontamination procedures.

6. P. 4-5 Section 4.2.1 How are the other 51 locations going to be selected?

This section has been modified. Please refer to Section 4.0 of the revised draft for details. The other 51 locations will be selected based on the results of the Phase I investigation, and a preliminary risk assessment review.

7. P 4-8 Section 4.2.2.2, Last paragraph. Using the next sample interval to decide on whether or not to take a sample can result in loss of volatiles. It may be several minutes (5-10) before you know if the saturated zone has been encountered in the next sample. It is then too late to take a good volatile organic sample.

The sample will be put in a sealed plastic bag and put into an iced cooler to minimize volatilization. Additionally, a portion of each sample will be screened for organic vapors. The sample with the highest organic vapor reading will be collected for VOC analysis.

8. P. 4-10 Section 4.2.2.3.4 2nd paragraph 3rd sentence. "split spoon OR zip-lock bag ..."

Agreed. All reference to Method 5035 sampling for VOCs has been moved to Appendix B of the revised draft.

9. P. 4-12 Section 4.2.2.9 see comment 5.

Please see response to comment 5.

10. P. 4-24 Section 4.5.2.1.4, Recommend that radiological groundwater samples also be filtered.

To Maxim's knowledge, there is no USEPA or NYSDEC guidance regarding ARARs or risk assessment for dissolved radionuclides in groundwater. However, Maxim is willing to consider collecting filtered radiological groundwater samples if the USACE-Buffalo District believes

it is warranted.

11. P. 4-25. Section 4.5.2.8 See comment 5.

Please see response to comment 5.

**COMMENTS TO MAXIM TECHNOLOGIES, INC.
DRAFT FIELD SAMPLING PLAN
FROM
DR. JUDITH S. LEITHNER
USACE-BUFFALO DISTRICT**

Remedial Investigation
Niagara Falls Storage Site
Niagara County, New York

Contract DACW-49-97-D-0001
Delivery Order 0012

Note: Dr. Leithner's comments are in bold text; Maxim's responses are standard text.

General Comments:

1. Please make the document much more concise. Some examples:

A. Please omit the appendices containing reprints of others' work. You are indeed to have used these documents to help formulate your FSP, but please simply cite the references. If reviewers need to read these documents to understand your FSP, then you have not adequately explained their use in your own plan. Additionally, reproduction of multiple copies of these documents adds cost, but limited value, to the FSP.

Agreed. Maxim has removed these appendices and cited the references as requested.

B. Please, in general, leave out duplicate material. For example, you have appended the USACE scope of work (SOW), but you also take 4 pages to describe the same material. Please use only the appended SOW.

Agreed. Maxim believes it has significantly reduced duplicated material in the final draft of the FSP. The SOW is included as an appendix in the revised FSP.

C. The description of *activities* (vs. restatement of the SOW) as described in your SOW summary section is suitable for those tasks associated with field sampling, but items like Public Relations are not part of a FSP and should not be included here. (If the purpose of this section was to assure that we are on the same wavelength with the SOW, please settle this in our conference calls and not in the FSP).

Agreed. Maxim believes it has eliminated non-field sampling related SOW activities from the revised FSP.

D. Please go through this FSP and eliminate other excess material. The above items are examples, but you should follow this philosophy through in the rest of the document.

Agreed. Maxim believes it has streamlined the revised FSP to exclude excess material.

2. Because this is a formal document that will, when finalized, be placed in the administrative record, formal titles and company names must be used. For example:

A. Please use formal company names. "Chemical Waste Management" no longer exists as a company name for the property that borders NFSS on the north. The formal name is: CWM Chemical Services, Inc." Also, please use Bechtel National, Inc. instead of just Bechtel.

Agreed. Maxim has used formal company names/titles in the revised FSP.

B. Please use formal titles for people you list in section 2. If your people have doctorates or professional engineers' licenses, so state. This applies to everyone listed in this section including subcontractors and USACE personnel (including me). Informalities in a working relationship are valuable, but they should not be used in a document that will comprise part of the site administrative record. (Is this a new concept for the person who has written this section? Things like this need to be caught in your internal reviews before USACE sees these documents.)

Agreed. Section 2 has been modified to include formal names and titles for all project personnel.

3. In general, you have reviewed large numbers of documents pertaining to this site and have provided an excellent summary of the site history. However, application of this historical summary to preparation of your FSP was extremely limited.

Maxim has attempted to better apply our understanding of the site history in preparation of the revised FSP. This task is somewhat difficult because a significant amount of the analytical results are perceived by Maxim to be "screening" type data that may not be adequate for a baseline risk assessment. Please refer to Sections 1.0 and 1.4 of the revised FSP for more details.

A. Site history was appropriately used to select general sampling areas. For example, knowledge that there were shops in a given area suggested that samples should be taken there. Selection of general areas using this rationale was well done. However, that appears to be the only way historical information was used to plan your strategy. This is a serious deficiency. For example:

1. In our TPP workshop, we stated that our primary purpose of technical project planning is to fill in data gaps to get the data we need but not to duplicate previous efforts if they are useful. With this in mind, I would have expected you to take your summary of existing data and apply it to your FSP. Which pieces of data (if any) can you use as part of this RI? Your sampling strategy was set forth as though no other suitable data exists for the site. If you decide to exclude everything but your own data (and it appears you have done that), what is your rationale? Why did you Xerox copies of previous data without discussing its utility (versus its content) in your FSP? Your plan needs to give clear explanations for your FSP rationale.

Since the TPP workshop, Maxim has conducted a more thorough review of existing analytical data for the NFSS supplied to us by USACE and incorporated the results into a database. We have included a discussion of perceived data gaps in the revised FSP. Maxim believes that it has better used existing data in preparing the revised FSP (please refer to Section 1 of the revised FSP). We believe that much of the existing data is useful, but mainly for planning purposes related to the RI rather than being defensible data that could be used for risk assessment purposes. Maxim is in the process of contacting Bechtel National, Inc. and EA Engineering, Science, and Technology regarding analytical data sheets, QA/QC, laboratory certificates, and data validation from previous investigations of which we have no record. Without this information, it is not possible to determine if this data can be used for risk assessment purposes.

Maxim considers a significant part of the existing analytical data to be "screening" data. For example, the investigation around Building 401 primarily included samples analyzed with a field gas chromatograph for only a few organic analytes, excluding those normally associated with the potential underground storage tanks present near the building. To our knowledge, either no extensive studies have been conducted to determine site or local background values for the sampled media or that information has not been supplied to Maxim. In most instances, there is a lack of specific information (i.e., survey data) that would allow us to determine locations of previous sampling points. Maxim included excerpts from previous investigations to demonstrate what we perceive to be a lack of potentially useable data for risk assessment purposes.

2. You propose to analyze each sampling point for full suite parameters instead of for parameters related to operations thought to have occurred there. If this is what you suggest, you need to provide a sound rationale for this decision. Perhaps a less generic approach could make sense. If you know, for example, that a building was previously a boiler house with no other known uses, you may want to target PAH analysis for all samples and full suite parameter analysis for only a subset of the total samples. The document needs to describe your reasoning for choosing one of these approaches over the other.

Agreed. Maxim has reduced the full suite TCL/TAL analysis to approximately one-third of each sampled media as outlined in the USACE-Buffalo District SOW. We have based

our rationale for choosing analytical parameters at each sampling location on: results of previous investigations, locations of former/current buildings, knowledge of former site activities/processes, facility maps, topography, and findings during our site reconnaissance. We have included full suite analysis for at least one sampling location in each of the eight Areas of Investigation discussed in Section 1 of the revised FSP. Based on our findings in the Phase I RI, it may be possible to reduce the number of different analyses in some areas or it may be advisable to increase the number of different analyses in some areas for Phase II of the RI.

Specific Comments:

Section 1:

- 1. Page 1-1, second line under 1.0: Maxim was contracted to perform a remedial investigation (RI) only, not an RI/FS.**

Agreed. The text has been modified as suggested.

- 2. Page 1-2, second paragraph, line 9: Text refers to the tower being a cooling water tower. I had understood that this was a water reservoir for use with the fire fighting system. Will you please check this?**

Please refer to the attached LOOW as-built drawing (NFSS-283). It does not appear that fire control water lines were located near Building 434, but it does appear that Building 434 was a part of the cooling water system. The elevated Fire Storage tank was located west of the acidification area with fire control water lines running north of "O" Street and south of "N" Street.

- 3. Geology section (1.1.3): Good job!**

Acknowledged. Thank you.

- 4. Section 1.1.4, Hydrogeology: The well search was done using past data. Was there any contact of local data sources during the 3-day site visit to make this data more current? This data and some of that presented in the table section is very old.**

Agreed. No well search activities were initiated during our site visit. Maxim has removed all references to the well search from the revised FSP and has identified it as a data gap in Section 1.3. The three-days were utilized to perform a thorough site reconnaissance, stake proposed boring locations, and to meet with representatives of CWM Chemical Services, Inc. and Modern Landfill.

- 5. Page 1-10: Section 1.2.1.1: For example, first sentence. Please do not state that cleanup was performed without also stating specifics of constituents of concern**

and cleanup levels. Otherwise, the reader has no concept of what site conditions prevail after the cleanup. If this information is not in the records, please specify.

Agreed. Concerning former remedial actions at the NFSS, Maxim has modified the narrative to include language that no specific information regarding confirmation sampling, cleanup criteria, volume of media treated/disposed, etc. was included in the records.

5. Page 1-10, third paragraph: Please spell out IWCS the first time it is used.

The acronym was spelled out on page 1-3, second paragraph. Maxim will insure that IWCS is spelled out the first time it is used in the revised draft.

6. Page 1-10, next to last sentence. Text says that material was encapsulated within an impermeable membrane. How was this done? What kind of membrane?

Maxim is not sure how this was done. We have added a sentence to the revised draft noting that no details were provided in the report. Please note that the reference for this report is corrected to NFSS-306 in the revised draft.

7. Page 1-11, last full paragraph: what is meant by miscellaneous indicators?

The miscellaneous indicators include general water quality parameters such as pH, conductivity and temperature. The text has been edited to include this information in the revised draft.

8. Section 1.2.1.2.2. Data gap characterization: You have described a limited data gap characterization by BNI. What is YOUR assessment of data gaps prevailing at the site? Do you agree with BNI? Have you addressed these gaps specifically in your FSP?

Maxim's assessment of data gaps is included in the discussion of the previous sampling history in Section 1 of the revised FSP. Maxim agrees with some of the data gaps identified by BNI and believes several other potential data gaps may exist.

9. Page 1-17, top line: The cap was not replaced. Material was placed over the original cap in 1991 and a new cap was added over the original cap. The original IWCS was not penetrated, and the original cap was not replaced.

Agreed. Maxim has edited the revised draft to reflect this fact.

10. Page 1-18, first paragraph: Why do you think fuel oil storage and TNT mix storage occurred in the former acidification area? Did you decide this based on evidence of tanks cradles? Is there a reason why you thought this might be fuel oil instead of acid or toluene? (e.g. staining?) Please explain your thoughts

As-built drawings (NFSS-283) and the Industrial Facilities, Formerly T.N.T. Plant, Youngstown, New York, Reconstruction Finance Corporation, Undated (circa. 1945) (NFSS-178) map show a large (presumably aboveground) tank which is labeled as "Fuel Oil". This tank location is north of "O" Street and east of Campbell Street in the Acidification area. Additionally, tanks labeled "TNT Mix Storage" were depicted on the same drawings. No surficial staining was observed during the July 13-16, 1999 site reconnaissance, but the vegetation was thick in this area.

11. Page 1-18: 1.3.5: What potentially hazardous materials would you expect. Please specify some examples.

The following hazardous materials may have been associated with activities in the Baker Smith area:

storehouse – transuranic KAPL wastes and cleaners

pipe shop – cutting oils, solvents, cleaners, heavy metals, and PCBs

welding shop – heavy metals and solvents

machine shop – cutting oils, heavy metals, solvents, and PCBs

12. Page 1-19: top paragraph: Is potential drainage from Modern Landfill the only reason you wish to investigate the onsite ditches?

No. Maxim recommends sampling on-site ditches due to potential: surface water/sediment runoff from former NFSS process and storage areas, discharge of groundwater from the upper and lower water-bearing zones to the Central Ditch and other ditches, and runoff from other off-site properties such as the CWM Chemical Services, Inc.

Section 2

- 1. Section 2.1 (Corps of Engineers Project Manager) needs to be rewritten. You will be receiving more direction/interaction from USACE than document approval, schedule and budget tracking and LRB's coordination of its own staff. As your client (and as the funding agency), we expect to take a leadership position in this project, not simply a position of tracking your paperwork and expenditures. Please replace your text with the text that follows this paragraph. Please note that reference to the Buffalo District has, in most cases, been changed to USACE. This is to emphasize that we have a virtual team associated with the project ("One Door to the Corps", part of our current Corps-wide management strategy). Also, please note that Dennis Rimer's title is changed to Site Superintendent. We are not allowed to call him a Site Manager by internal Corps policy.**

Dr. Judy Leithner is the USACE Project Manager for this project. She has the responsibility for technical project direction, review and approval of contractor

work plans and reports, allocation of overall project resources, tracking and management of the overall project schedule and budget, and management of contractor oversight by other USACE staff. In case of any problems, Dr. Leithner can be contacted at (716) 879-4234 (e-mail address: Judith.S.Leithner@usace.army.mil). Requests from any third parties for project information should be addressed to Dr. Leithner at the following address:

**Dr. Judith Leithner, CELRB-PE-EE
U. S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207-3199**

Mr. Dennis Rimer will be the USACE Site Superintendent. The USACE Site Superintendent will oversee field activities for the USACE, and will have authority to approve all field decisions exclusive of those that require a scope change or commitment of additional resources. In those instances, the decision must be approved by Dr. Leithner and the LRB Contracting Officer, Mrs. Mary Price.

Agreed. The text has been modified as suggested in the revised draft of the FSP.

- 2. Page 2-3, Section 2.5, SAIC Technical Services Coordinator. Mr. Giordano's responsibilities are not quite what I had thought they were. These look much less significant than I would have expected. Please clarify (not necessarily in this document).**

Agreed. Maxim has revised the text to indicate that Mr. Giordano will also participate in the development of plans, reports, and assessments, attend pertinent meetings, participate in development of sampling strategy, and provide site-specific continuity based on previous experience at the NFSS and other FUSRAP projects.

- A. We had thought Mike would be using his former site knowledge to assist with preparation of the FSP. Was this done? Knowledge of former testing appears not to have been used in selecting sampling strategy.**

Mr. Giordano has consulted with Maxim and has provided suggestions and guidance concerning selection of sampling locations and analytes based on previous experience at the site. He also provided recommendations to ensure sampling strategy for this site was consistent with USACE's approval for other FUSRAP sites. His recommendations have been incorporated into the Draft Final Work Plans.

- B. I don't see mention of any risk assessors in Maxim's organization. A risk assessor should be helping to develop your FSP, as some of the data will be used to assess baseline risk. Are you using SAIC for this (I thought you were). If not, please provide the credentials of your risk assessor ASAP. While we have said**

we would provide guidance on radiation baseline risk assessment, we still expect any chemical risk assessment to be thoroughly done without our help.

Mr. Brian Mulhearn of Maxim is the risk assessor. His qualifications are stated in the FSP text and his resume is included in Appendix A of the QAPP.

- 1. Page 2-4, section 2.7. Please add that Maxim's Radiation Safety Officer will interface with radiation safety officers at USACE.**
- 2. Page 2-4, section 2.7. Please add that Maxim's Site Safety and Health Officer will interface with the Site Safety and Health Officer at USACE.**

Agreed. Text has been edited as suggested.

- 3. Page 2-6, Section 2.9. You list 11 potential site managers, which you indicate will change as task requirements change. These are all good people, but the changing of site manager with the task appears to lose project continuity. This philosophy raises serious concerns. Please describe, in more detail, how you plan to maintain continuity under these circumstances.**

The text will be edited to reflect that Timothy Biggs will be the Site Manager. If it becomes necessary to use an alternate Site Manager, that person will report to Mr. Biggs.

Section 3

- 1. Section 3.1.2: Nice job on the maps.**

Acknowledged. Thank you.

- 2. Page 3-4, top line. You mention the ITR as mentioned in the QCP. The described ITR involved one person. Actually, the ITR is to involve one person from each of the major technical areas involved in the SOW and should be done by senior people. We were recently cited on an internal audit because we forgot to add a health physicist to our ITR team for a SOW. The same audit team will notice omissions in these work plans if we don't address them now.**

The QCP has been revised to include additional ITR members from each major technical area. In the revised FSP, the ITR was expanded to include a senior chemist, two geologists, and an engineer.

- 3. As part of your QCP/ITR implementation, we remind you that you will need to submit a Certification of Completion upon ITR finalization.**

Signed/dated Certification of Completion forms have been included in the revised FSP

4. **Page 3-4, section 3.1.13.1: As is stated, the USACE will provide further direction for the radiological baseline risk assessment. However, in the event that one must be done, you will still need to have a risk assessor qualified to handle this aspect of the work with some direction from USACE. Our risk assessors will certainly review your work and provide some guidance, but you will still be expected to do the majority of the task within Maxim.**

5. Agreed. It was not our intent to suggest that Maxim would not perform the baseline risk assessment. Mr. Brian Mulhearn is Maxim's risk assessor.

6. **Page 3-4, Section 3.2:**

A. Please note that one of your goals is to complete an RI under CERCLA.

Agreed. Maxim has acknowledged this fact in the revised FSP.

B. The main goal of the TPP was to plan such that we obtain all needed data but no extraneous data. This has not come across in the FSP.

Please refer to Maxim's response to your General Comment 3.A.1.

C. Please delineate which objectives are supported by the SOW (in bold or other method). Not all of our reviewers will be intimately familiar with the SOW.

Agreed. Maxim has designated by bold text those objectives that are supported by the SOW in Section 3.2 of the revised FSP.

D. Please put your data quality objectives in the FSP as well as the QAPP.

Agreed. The DQOs have been added to the revised FSP.

Section 4:

1. **Page 4-1, Section 4.1. As we discussed, there has been considerable surficial soil movement since the previous operations that occurred on site. Site history can help identify areas where this has occurred. In those instances, surficial soil samples will not be indicators of what exists in the subsurface.**

Agreed. Maxim did not intend to indicate that surface soil conditions would necessarily be indicators of subsurface soil conditions. While it is true that site history helps identify areas where soil movement has occurred, we have not found details in the USACE supplied documents that indicate lateral or vertical extent of grading/filling/excavation activities.

2. **Section 4.1.1. Text says that USACE directed Maxim to sample surface soil at each proposed boring location. Actually, Maxim proposed this protocol and the**

USACE said that this could make sense if boring locations were suitably chosen. We did not direct you to do this yet, as the proposed FSP must be approved by the team, the CX and the state before sampling locations and strategies are fixed.

Agreed. Maxim has revised the text to indicate Maxim and the USACE agreed that surface soil samples should be collected at each boring location.

- 3. Page 4-2, 4.1.1.1.7, Onsite Ditches: It is stated that surficial sampling is not applicable to these areas. Please provide reasons for this statement. Also, throughout your document, please provide reasons for conclusions. Please don't (anywhere) make unsupported statements. Otherwise, reviewers may disapprove a perfectly reasonable suggestion because they don't understand your actual intent.**

Surficial sediment samples will be collected in the onsite ditches as indicated in Section 4.2 of the revised FSP. Maxim believes it has provided more detailed rationale for recommended Phase I RI activities in the revised FSP.

4. Page 4-5, section 4.2.1, Rationale.

A. Again, Maxim proposed a sampling protocol and the USACE said that this could make sense if boring locations were suitably chosen. We did not direct you to do this yet, as the proposed FSP must be approved by the team, the CX and the state before sampling locations and strategies are fixed. Until these work plans are reviewed by all parties and comments have been resolved, you must consider your plans as tentative.

Maxim did not intend to indicate that the USACE directed the selection of the boring locations. Maxim has revised the text to indicate that Maxim and the USACE agreed that a minimum of one subsurface soil sample would be analyzed from each boring (near the soil/groundwater interface) and that other subsurface samples are recommended to be analyzed if field observations indicated that potential contamination exists within that particular interval. Additional samples to be submitted for laboratory analysis will be selected at the discretion of the Maxim Engineer/Geologist with the concurrence of the USACE site representative.

Analytical parameters for groundwater should be determined before you are in the field. If there is not enough well production to obtain all desired samples, then a hierarchy of sample types will be provided to Maxim by USACE as was appropriately proposed by Nancy Dickens.

Agreed. Maxim has recommended groundwater analytical parameters in the revised FSP. The USACE has provided a hierarchy of analytes in the event that sufficient volume of groundwater cannot be recovered from a boring/well to complete the desired analyses. This hierarchy is discussed in Section 4.1.3.2.

1. **Comments on chemistry/sampling protocols are provided by Fred Kozminski under separate cover. The chemistry section will require considerable work as stated by Fred.**

Maxim has responded to Mr. Kozminski's comments and has included these responses in the revised FSP.

2. **Page 4-33, section 4.9. The structural integrity of building 401 is no longer in question. USACE has performed a structural survey of the building and its basic structure is sound.**

All reference to the structural integrity of Building 401 has been removed from the revised FSP as no Phase I RI activities are scheduled for this building.

3. **Page 4-36, Surface Radiological Scan. Text says this is not included in the present SOW. I strongly disagree. The SOW says " If such data is not found, the Contractor shall include a surficial scan of property in the area as designated on Figure 2 (which was later changed to the whole site) and shall propose the methodology for performing the scan in the work plans." You have provided a brief methodology, but discuss the implementation as though the work is not to be done under this SOW. Because you have stated that you found no data, this scan is part of the SOW. Your final cost estimate does not exclude this work from the SOW. We need to talk about this ASAP.**

After consulting with SAIC, Maxim recommends that the surface radiological scan be postponed until analytical results from the Phase I RI are reviewed. If radiological impact is determined to exist in any of the sampled media, Maxim recommends that an addendum to the Final FSP be prepared and the work be performed in Phase II of the RI

Section 7:

1. **Section 7.6: Under alternative 2 (IDW) please check the NFSS generator status and determine how long we are allowed to retain the IDW (which your cost estimate assumed was all hazardous waste) on site.**

Maxim will complete this task and report the findings to the USACE.

**COMMENTS TO MAXIM TECHNOLOGIES, INC.
DRAFT FIELD SAMPLING PLAN
FROM
ALFRED KOZMINSKI
USACE-BUFFALO DISTRICT**

Remedial Investigation
Niagara Falls Storage Site
Niagara County, New York

Contract DACW-49-97-D-0001
Delivery Order 0012

Note: Mr. Kozminski's comments are in bold text; Maxim's responses are in standard text.

General comments:

The sampling plan needs additional DQO refinement. I have three concerns. 1. The regulatory action levels may not be appropriate, e.g. the NYSDEC TAGM cleanup guidance has various interpretations associated with it, therefore varying the action levels, especially for the VOA/SVOA fractions. 2. Appropriate cleanup criteria and risk assessment quantitation limits may not be equivalent. 3. The laboratory reporting limits may or may not meet the appropriate regulatory action levels.

Section 3.1.4 ARARS has been added to the QAPP in response to these general comments.

1. DQOs for the subject phase of this project were discussed during the Technical Project Planning workshop held in Amherst, New York on June 8-9, 1999. The results of that discussion are reflected in our discussion of DQOs in the QAPP prepared for this project. That discussion is summarized in the FSP. The consensus at the meeting was that NYSDEC TAGM guidance was the appropriate guidance to use as a basis for initial screening of contaminant levels. Maxim plans to use it for that purpose. TAGM values are very conservative. TAGM values will not be used as "cleanup criteria" or as "action levels".

2. Cleanup goals will be developed through the RI/FS process. Risk assessment results will be among the primary pieces of information used in establishing cleanup criteria for the site.

3. It is true that laboratory reporting levels may or may not meet appropriate regulatory action levels. Regulatory action levels, however, will be defined through the CERCLA process and are not specified in advance.

Table 4.3.1.1 gives justification for samples to be collected. It should also identify the potential and known analytes of concern. The result would be a more efficient sampling and analysis plan.

Maxim believes that inclusion of this information in the sediment/surface water sampling location and surface soil, subsurface soil, and groundwater sampling location tables would be a duplication of information summarized in the narrative of Section 1.4 of the final draft. Previous investigations at the NFSS have indicated several contaminants of potential concern (i.e., VOCs, SVOCs, Metals, Pesticides/PCBs, Radiological, and Nitroaromatics). To summarize in tabular form the occurrence of each individual analyte within these chemical families for the five proposed sampled media at each of the 69 boring locations and 39 sediment/surface water sampling locations in the eight areas of investigation would result in a very large and complex table.

Geological transport indicators, e.g. upgradient/downgradient, mobilities, soil composition, etc. should be incorporated in the development of the sampling plan. This would more accurately indicate the distribution of known contamination.

Please refer to Sections 1.1.3 and 1.1.4 and their subsections for a more detailed discussion of regional and local geology/hydrogeology including estimated hydraulic conductivities, groundwater velocities, groundwater flow direction, and hydraulic gradients of the geologic strata. No detailed discussion of chemical mobility is included due to what Maxim perceives as a lack of definitive information regarding the type, extent, and concentrations of the chemicals of potential concern at the NFSS. One example of the chemical mobility issue is indicated by the presence of nitroaromatics in a groundwater sample just north of the Baker-Smith area during the Phase I of the RI performed by EA Engineering, Science, and Technology. This analyte was detected several thousand feet from the former TNT production area.

**Analytical evaluation of IDW will need a less generic approach.
Waste acceptors should be contacted for more definitive acceptance criteria.
Will the waste acceptor consider a weight % result for Uranium and extrapolated Thorium and Radium weight % concentrations with subsequent activity calculations with assumptions?**

Maxim has summarized potential analytical requirements for IDW characterization in Section 7 of the FSP based on contacts with licensed/permitted potential waste acceptors. It is not possible to determine analytical requirements for the IDW until analytical results for the Phase I RI sampled media are received. Maxim will relay these results to potential waste acceptors for further guidance regarding disposal characterization.

Please define more clearly, the two phased approach to this project.

Maxim believes that the recommended two-phased approach will achieve the project objectives in the most effective manner. Section 1.4 of the final draft of the FSP and Section 3.1.3 of the QAPP describe and clearly define the purpose of this approach.

1. Pg. 4-11, section 4.2.2.5, last para

Maxim laboratory may need a NRC license to accept radiologically contaminated samples for physical testing parameters. I consider this similar to chemical analysis of mixed analyte samples.

Maxim has an NRC license to accept low-level radioactive samples and has conducted geotechnical testing of mixed waste samples for the past several years. References to the license have been added to Section 5 of the QAPP and a copy of the license is provided in Appendix F of that document.

2. Pg. 4-12, section 4.2.2.8, 2nd para

Co-located duplicate samples imply 2 independent samples as opposed to one sample that would be homogenized and split into two samples. The latter is the procedure normally employed.

Quality Assurance split samples and MS/MSD samples should be collected at a rate of 1 in 20 or 5% of the investigative samples.

Collection of duplicate, split, and MS/MSD soil samples for VOC analysis is described in Appendix B of the final draft of the FSP. Collection of duplicate, split, and MS/MSD soil samples for all other analyses is described in Section 4.1.1 of the final draft of the FSP. Samples collected for non-VOC analysis will be homogenized as suggested and split into the appropriate fractions. Samples collected for VOC analysis will be co-located at adjacent locations within the prime sample.

All references to the collection rate of QA and MS/MSD samples in the FSP and QAPP have been revised to indicate they will be collected at a rate of 1 per every 20 field samples.

3. section 4.2.2.9

Where possible decon procedures should be minimized, e.g. use of new dedicated, throw away sampling equipment is preferred.

Agreed. Maxim will use dedicated, disposable sampling equipment when possible. Examples of disposable sampling equipment that will be used are bailers, groundwater filters, and downhole tubing/pumps.

4. Pg. 4-23, section 4.5.1.2

Is SW846 method 9081 indeed the procedure for cation exchange?

Transuranics are elements with atomic numbers > Uranium. These are artificially prepared and are not expected to be found on-site.

According to General Engineering Laboratories, SW-846 Method 9081 is the correct method number for cation exchange capacity.

According to historical documents, transuranics may have been present in the wastes from the Knolls Atomic Power Laboratory. These wastes were stored at the NFSS near Building 401 and the Baker Smith Area. Animal remains from the University of Rochester may also have contained transuranic radionuclides. Some of the radioactive wastes were incinerated on-site. This historical information is presented in Section 1 of the FSP.

5. Pg. 4-24, Section 4.5.2.1.3

Water Quality parameters must be measured in-situ and they should be measured after each well volume removal. In addition a maximum of 5 well volumes should be purged, even if stabilization is not achieved. Please indicate the stabilization criteria. EPA low-flow purging and sampling procedures should be used.

Maxim will measure the water quality parameters in-situ and recommends that measurements be collected prior to purging, after each well casing plus well annulus is removed, and when purging is complete. Maxim recommends that a minimum of three and a maximum of five well casing plus well annulus volumes be removed from each well. Please refer to Section 4.1.3.2 of the final draft of the FSP for a more detailed description of purging procedures, including recommended stabilization criteria.

6. Pg. 4-25, section 4.5.2.7, 3rd para

This paragraph has conflicting statements relative to the type of QC duplicate and QA split samples to be taken. In addition Argonne National Labs will be the QA Lab for this project. QA split samples and MS/MSDs will be taken at a rate of 5% of the investigative samples. QC duplicate samples will be taken at a rate of 10% of the investigative samples.

The address for sample receipt at Argonne National Labs is:

**Argonne National Laboratory
Bldg. 205
Room L176
9700 S. Cass Avenue
Argonne, IL 60439**

Attn. Alice Birmingham

**Telephone 630 252 4473 or 4379
Fax 5655**

QA/QC and MS/MSD groundwater samples, with the exception of VOC samples, will be collected by alternately pumping (via the low-flow peristaltic pumps) approximately

equal aliquots into each sample container until an adequate volume for analysis has been collected. Collection of QA/QC and MS/MSD groundwater samples for VOC analysis will be from the same Teflon bailer as the prime sample. Groundwater will be slowly discharged into each individual 40-milliliter vial utilizing Teflon tips until the vial is filled. The vial will then be immediately capped and the next vial will be filled.

All references to the QA laboratory in the FSP have been revised to indicate the QA laboratory is Argonne National Laboratory. Section 13.2 of the QAPP has been revised to include the above-noted address. The FSP has been revised to reflect that: (1) QA and MS/MSD samples will be collected at the rate of 1 per 20 field samples collected; (2) QC samples will be collected at the rate of 1 per 10 field samples collected.

7. Section 4.5.2.8

Please indicate what equipment is expected to need decon.

No sampling equipment will need decontaminated due to the use of dedicated disposable items. However, the in-situ water quality meter and the water level indicator will require decontamination at each groundwater sampling location.

Pg. 4-29, section 4.6.2.1

Hexane will not solubilize inorganic constituents. A dilute acid solution may be more appropriate for the inorganics.

All references to the wipe sampling section have been removed as this activity will not be conducted in the Phase I RI.

Pg. 4-33, section 4.8.2.2

Will this XRF procedure be performed on site and is this a nondestructive procedure, e.g. can it be performed without removing paint from the surface? If your response to the above is yes then there would be minimal decon for this procedure.

All references to the lead paint sampling section have been removed as this activity will not be conducted in the Phase I RI.

Pg. 4-37, section 4.1.1.2.3

Off-site alpha spectroscopy will not confirm an on-site gamma walkover survey. Is off-site confirmation needed here? Also is gross alpha-beta necessary? E.g. what additional info will be gotten?

If off-site analysis is performed you will want to analyze for iso-U, Th, Ra, and progeny by alpha spectroscopy.

Per SAIC guidance, Maxim recommends that a gamma walkover will not be included in the Phase I RI activities. This activity is proposed to be postponed until radiological

analytical results are received for the Phase I RI activities (please refer to Section 4.6 of the final draft for further detail).

Maxim requested via telephone conference with Dr. Leithner on 7/19/99 that the Phase I RI analytical parameters include gross alpha and gross beta. During this call, Keith Hall, USACE-Buffalo District health physicist, indicated that analysis for gross alpha and beta was a good idea. Dr. Leithner verbally indicated that the parameters should be included along with dissolved metals. ARARs exist for gross alpha in drinking water (MCL = 15 pCi/L). In addition, the presence or absence of radionuclides not included in the analytical program can be postulated based on the difference between gross alpha and beta (and gamma, when performed) results and the analytical results for the radionuclides included in the analytical program.

Analysis of additional radionuclides including progeny were not included in the original cost proposal estimate and would substantially increase analytical costs. Analysis for progeny probably would be considered excess data beyond basic and optimal data needs. Gross alpha and beta is a relatively inexpensive method for determining if analysis of additional radionuclides is necessary. If there is a substantial difference between results for alpha and beta (and gamma, when performed) and the results for the radionuclides, additional radionuclides could be included in the Phase II RI analytical program.

Pg. 5-3, section 5.3, 5th sentence

The QA split samples going to Argonne Labs will have QA appended to the sample number as a suffix.

Agreed. Maxim has included this information in Section 5.3 of the final draft as suggested.

Pg. 5-5, section 5.4.4

- a. All sample shipping containers will indicate security with custody seals.**
- b. The temperature blank will be prepared in the field concurrent with the samples.**

Agreed. Maxim has edited the final draft to indicate that a minimum of two custody seals will be placed on all shipping containers. The final draft also states that the temperature blanks will be prepared in the field at the time of the sampling and will be placed in the shipping container with the field samples.

Pg. 6-1, section 6.1.1

Please give procedure for security of samples if kept on site overnight.

Maxim recommends that any samples kept on site overnight will be placed in a locked and secured building or trailer. Language to this effect has been added to Section 6.1.1 of the final draft of the FSP.

Section 6.1.1

- a. **GEL Labs revalidation will include explosive analysis, (EPA 8330)**
- b. **Radiological isotopic analysis should be performed for the 3 nuclides of concern.**

GEL is currently certified for explosives and the revalidation will include explosives. MRD certification included in Appendix F of the first draft of the QAPP (Appendix G in the revised QAPP) did not indicate GEL was certified to perform explosives. Documentation verifying current certification for explosives will be included in the Draft Final QAPP.

In addition to the three radionuclides of concern (uranium-235/238, thorium-230, and radium-226), total uranium was added to the list because potential ARARs exist. Gross alpha and gross beta were added for the reasons stated in the response to your comment concerning page 4-37, Section 4.1.1.2.3.

Pg. 6-3, section 6.2.1

- a. **#4, loose vermiculite should not be used as packaging material. Delete the last sentence in this section.**
- b. **#5, cardboard should not be used as packaging material. Ice should not be used as packaging material.**
- c. **#6, only natural ice will be acceptable for this project. Delete the 2nd sentence and the following two bullets. Also delete the sentence following the two bullets.**
- d. **#10, custody seals should always be placed on the sample shipping coolers.**

- a. Agreed. Perlite or vermiculite will not be used as packaging material. Maxim will edit the text as suggested and remove the last sentence of the referenced section.
- b. Agreed. Neither cardboard nor ice will be used as packaging material. The text will be modified to reflect this suggestion.
- c. Agreed. Maxim recommends the text be edited to state "All chemical and radioactive samples will be shipped to the laboratory in coolers containing natural ice and will be chilled to approximately 4°C."
- d. Agreed. Maxim recommends the text be edited to state "Two signed custody seals..."

Table 4.1.1.1.1

Please edit these tables to reflect the comments above regarding rates of collection for all QA/QC samples and any changes for analytical parameters, e.g. radiological isotopic analysis for U, Th, Ra and the appropriate progeny.

Tables in the draft final of the FSP will be edited to indicated the rates of collection of QA/QC samples. Please see response to FSP comments regarding page 4-37, section 4.1.1.2.3 and section 6.1.1.

DOCUMENT REVIEW COMMENT SHEET

Project: Niagara Falls Storage Site, Lewiston, NY - Field Sampling Plan Remedial Investigation
 Reviewer: Michelle Rhodes Date: 8/2/99

Comment No.	Page / Section	USACE Comment	Maxim Response
1	Pg. 3 / 1.1.1	Does 403 have an associated garage, or is the associated garage #429? "And" may need to be removed from sentence 8 in the 2 nd ¶?	Yes, Building 403 has an associated garage. Building 429 is a separate building. Maxim does not find the word "and" in sentence 8 of the second paragraph of Section 1.1.1 on page 3.
2	Pg. 3 / 3.1.10	Contractor submission of a "Certificate of Completion" upon ITR finalization is missing from Task 10	Maxim has added a sentence to the end of Section 3.1.8 Task 11 of the revised FSP indicating that a Certificate of Completion was submitted to the USACE.
3	Pg. 2 / 1.1.1	Sentence 4 in the 2 nd ¶ should say, "...Building 434, the water tower of LOOW." The tower stored water in case of fire, not used for cooling	Please refer to Maxim's response to Dr. Leithner's comment regarding Section 1, page 1-2, second paragraph, line 9 of the FSP for clarification.
4	General	We may wish to consider additional sediment and surface water samples in existing ditch network as recommended by Maxim	Acknowledged. Sediment/surface water sampling is discussed in Sections 1 and 4 of the revised FSP.
5	Pg. 3 / 3.1.10	Any mention of contractor designing an Activity Hazard Analysis?	The Activity Hazard Analysis is located in the Site Safety and Health Plan.

REFERENCES

REFERENCES

<i>NFSS Report Number</i>	CITATION
<u>NFSS-011</u>	Excerpt from untitled report, Section 4.3, NFSS.
<u>NFSS-020</u>	Environmental Monitoring Plan for the Niagara Falls Storage Site, Lewiston, NY DOE/OR/21949-309, FUSRAP Contract No. DE-AC05-91OR21949, November 1991
<u>NFSS-045</u>	Supplemental Field Sampling Plan for the Niagara Falls Storage Site, prepared for US DOE, Oak Ridge OPS Office, FUSRAP; by Science Applications International Corp., Contract DE- AC05-91OR21950, June 1994
<u>NFSS-054</u>	FAILURE ANALYSIS REPORT, for the Niagara Falls Storage Site, Lewiston, New York, Prepared for: USDOE, Oak Ridge Operations Office, under Contract No. DE-AC05- 91OR21949; By Bechtel National, Inc., Oak Ridge, Tennessee, Bechtel Job No. 4503 November 1994
<u>NFSS-067</u>	Environmental Surveillance Plan for the Department of Energy's Niagara Falls Storage Site, Lewiston, New York, September 9, 1981, John P. Englert and Stuart L. Hinnefeld, NLO, Inc. for U.S.DOE. DOE Document No. 03683.
<u>NFSS-072</u>	Niagara Falls Storage Site Annual Environmental Report For Calendar Year 1990, Lewiston, New York, August 1991, Prepared by Bechtel for USDOE. DOE Document No. DOE/OR.21949-289.
<u>NFSS-077</u>	Performance Monitoring Report for the Niagara Falls Storage Site Waste Containment Structure, Lewiston, New York, July-December 1988 and Calendar Year 1989, June 1990, by J. S. Blanke, N. M. Bengel, and W. F. Stanley of Bechtel National Inc for USDOE. DOE Document No. DOE/OR/20722-270.
<u>NFSS-081</u>	Niagara Falls Storage Site Environmental Report for Calendar Year 1992, 1397 Pletcher Road, Lewiston, New York, May 1993, Prepared by Bechtel National Inc. For USDOE. DOE Document No. DOE/OR/21949-367.
<u>NFSS-084</u>	Geologic Report, Niagara Falls Storage Site, Lewiston, New York, June 1994, prepared by Bechtel National Inc. for USDOE. DOE Document No. DOE/OR/20722-8(DE840134540).
<u>NFSS-087</u>	Niagara Falls Storage Site Annual Site Environmental Report, Lewiston, New York, Calendar Year 1986, June 1987, Prepared by Bechtel National Inc. for USDOE. DOE Document No. DOE/OR/20711-150.
<u>NFSS-089</u>	Performance Monitoring Report for the Niagara Falls Storage Site Waste Containment Structure, Lewiston, New York, Calendar Year 1986, July 1987, prepared by Bechtel National Inc. for USDOE. DOE Document No. DOE OR/20722-159.
<u>NFSS-090</u>	Performance Monitoring Report for the Niagara Falls Storage Site Waste Containment Structure, Lewiston, New York, calendar Year 1987 and January -June of 1988, January 1989, prepared by Bechtel National Inc. for USDOE. DOE Document No. DOE/OR/20711- 208 (058516).
<u>NFSS-096</u>	Niagara Falls Storage Site Environmental Monitoring Report, Calendar Year 1983, July 1984 prepared by Bechtel National Inc, for USDOE. DOE Document No. DOE OR/2077- 18.

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<u>NFSS-136</u>	Niagara Falls Storage Site (NFSS), Environmental Monitoring Report, Calendar Year 1981, Prepared by Bechtel National Inc. for USDOE, May 1982. DOE Document No. 10-05-202-002A.
<u>NFSS-145</u>	Final Environmental Impact Statement, Long-Term Management of the Existing Radioactive Wastes and Residues at the Niagara Falls Storage Site, USDOE, April 1986. DOE Document No. DOE/EIS-0109F, Site Category UC-70A.
<u>NFSS-148</u>	Niagara Falls Storage Site Annual Site Environmental Monitoring report, Lewiston, New York, Calendar Year 1985, Prepared by Bechtel National Inc for USDOE, April 1986. DOE Document No. DOE/OR/20722-98.
<u>NFSS-150</u>	The Niagara Falls Storage Site Remedial Action Project, Lowell F. Campbell of USDOE and Gary Coxon of Bechtel, Presented to the American Nuclear Society 1985 Annual Meeting, June 11, 1985.
<u>NFSS-151</u>	Niagara Falls Storage Site Environmental Monitoring Report, Lewiston, New York, Calendar Year 1984, Prepared by Bechtel National Inc for USDOE, July 1985. DOE Document No. DOE/OR/20722-55.
<u>NFSS-179</u>	Draft Chemical Characterization Report for the Niagara Falls Storage Site, Lewiston, New York, Prepared by Badri Kapoor of Bechtel National Inc for USDOE, December 1991.
<u>NFSS-187</u>	Background and Resurvey Recommendation for the Atomic Energy Commission Portion of the Lake Ontario Ordnance Works, Prepared by The Aerospace corporation for USDOE, November 1982. DOE Document No. 09668.
<u>NFSS-189</u>	Groundwater in the Niagara Falls Area, New York, With Emphasis on the Water Bearing Characteristics of the Bedrock, Bulletin GW-53, Richard H. Johnston, U.S. Geological Survey, State of New York Conservation Department, Water Resources Commission. 1964.
<u>NFSS-191</u>	Niagara Falls Storage site Long-Range Planning Study, Phase II, Prepared by Bechtel National Inc. for USDOE, September 1982. DOE Document No. 10-05- AB-007.
<u>NFSS-193</u>	Hydrologic and Geologic Characterization of the DOE-Niagara Falls Storage Site, Prepared by Acres American Inc. for NLO Incorporated, September 30, 1981. DOE Document No. 04294.
<u>NFSS-218</u>	Soil Gas Survey, Niagara Falls Storage Site, Lewiston, New York, Prepared by Target Environmental Services Inc. for Bechtel National Inc.
<u>NFSS-219</u>	Niagara Falls Storage Site Environmental Report For Calendar Year 1992, Prepared by Bechtel National Inc for USDOE, May 1993. FUSRAP Document No. DOE/OR 21949-367.
<u>NFSS-220</u>	Supplemental Hydrogeologic Investigation for Modern Landfill Inc., Report and Plans Prepared by Wehran-New York for Modern Landfill, April 1990.
<u>NFSS-234</u>	Magnetic Survey, Lake Ontario Ordnance Works Site, Operable Unit No. 2, Lewiston, New York, Prepared by Hager-Richter Geoscience Inc. for Acres International Corporation October 1991. Lake Ontario Ordnance Works Document No. LOOW.91.
<u>NFSS-257</u>	Geological and Hydrological Data Compilation for the Niagara Falls Storage Site Prepared by Bechtel National Inc., for Dr. Robert Vocke of Argonne National Lab, December 29, 1982. FUSRAP Document No. 09456.
<u>NFSS-267</u>	Health and Safety Plan for the Niagara Falls Storage Site, by USDOE, for the Niagara Falls Site Office, December 15, 1997 DOE FUSRAP Document No. 191-HSP, Rev 3.
<u>NFSS-271</u>	Results of the Mobile Gamma Scanning Activities in Niagara Falls, prepared by ORNL, for USDOE, August 1985, FUSRAP Document No. ORNL/RASA-85/1.

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<u>NFSS-283</u>	Miscellaneous Property Information of Lake Ontario Ordnance Works, for an unclassified Agency, 1942 through 1981.
<u>NFSS-284</u>	Further Clarification Relative to Disposal of the K-65 Residues at the Material Production Center from Richard J. Guimond of the USEPA and a Geotechnical Post-Construction Report from Bechtel National Inc., for David J. Ullrich of the Waste Management Division, January 10, 1991. FUSRAP 113138.
<u>NFSS-287</u>	Final Report on a Comprehensive Characterization and Hazard Assessment of the DOE-Niagara Falls Storage Site, prepared by Battelle Columbus Laboratories, for USDOE, June 1981.
<u>NFSS-290</u>	Interim Summary Report on the Comprehensive Radiological Survey of the DOE-Niagara Falls Storage Site, prepared by B.S. Ausmus, J.F. Dettorre, and T.L. Anderson of Battelle Columbus Laboratories under subcontract to National Lead Company of Ohio for The U.S. Department of Energy Remedial Action Program, dated August 1980. FUSRAP Document No. BMI-2061/UC-11.
<u>NFSS-302</u>	Hydrologic and Geologic Characterization of the DOE-Niagara Falls Storage Site prepared by Acres American Incorporated, Buffalo, New York, for NLO, Incorporated, Fernald, Ohio, dated September 30, 1981. FUSRAP Document No. 135747.
<u>NFSS-303</u>	Performance Monitoring Report for the Niagara Falls Storage Site Waste Containment Structure, Lewiston, New York, Calendar Year 1990, Formerly Utilized Sites Remedial Action Program (FUSRAP), Contract No. DE-AC05-91OR21949, prepared by J.A. Blanke, M.M. Benge, and W.F. Stanley of Bechtel National, Inc., Oak Ridge, TN for US Department of Energy, Oak Ridge Field Office, Bechtel Job No. 14501, dated March 1992. FUSRAP Document No. DOE/OR/21949-303. Also Corrective Action Process Request re: Hazardous Waste Generator by Bechtel for FUSRAP, Car No. 91-Q-45, dated Nov. 18, 1991. FUSRAP Document No. 089644.
<u>NFSS-307</u>	Hazard Ranking System Score for Niagara Falls Storage Site, Lewiston, New York, prepared by John D. Schoolfield, Bechtel National, Inc., Oak Ridge, Tennessee, Bechtel Job No. 14501, dated June 11, 1992. FUSRAP Document No. 090577.
<u>NFSS-309</u>	Niagara Falls Storage Site Environmental Surveillance Report for Calendar Year 1993, 1397 Pletcher Road, Lewiston, New York, prepared by US Department of Energy, Oak Ridge Operations Office, Under Contract No. DE-AC05-91OR21949 by Bechtel National, Inc., Oak Ridge, TN, Bechtel Job No. 14501, dated May 1994. FUSRAP Document No. DOE/OR/21949-379.
<u>NFSS-310</u>	Niagara Falls Storage Site (NFSS) Environmental Monitoring Report, Calendar Year 1982, prepared by Bechtel National, Inc., Nuclear Fuel Operations, P.O. Box 350, Oak Ridge, TN for US Department of Energy Under Contract No. DE-AC05-81OR20722, May 1983. FUSRAP Document No. 10-05-202-002. Also Status of NFSS SPDES Permit, by DOE Oak Ridge Operations, dated Apr 12 1983. E-15078.
<u>NFSS-316</u>	Environmental Surveillance Results for 1997 for the Niagara Falls Storage Site - FUSRAP Technical Memorandum No. 158-98-005 Rev. 0, ESTM 1997 - NFSS, to Judy Leitner - USACE, from David L. Schlick - Buffalo District FUSRAP, dated May 1, 1998. FUSRAP Document No. 14501-158-30N-601-001
<u>NFSS-339</u>	Environmental Monitoring Plan for Niagara Falls Storage Site following Installation of Final Cap, prepared for United States Department of Energy, Oak Ridge Operations Office, Under Contract No. DE-AC05-81OR20722, by Bechtel National, Inc., Oak Ridge, TN, Bechtel Job No. 14501, dated August 1985. FUSRAP Document No. DOE/OR/20722-54.

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<u>NFSS-342</u>	New York Contamination Survey - Final Report, for US Army Toxic and Hazardous Materials Agency, Edgewood Area, Aberdeen Proving Ground, Maryland 21010, by New York State Assembly, Task Force on Toxic Substances Investigation, dated 4 January 1979. FUSRAP Document No. LOOW.74.
<u>NFSS-402</u>	Understanding of hydrogeological conditions and risks of the sites bordering the Niagara Falls Storage Site (NFSS), letter to Dr. Robert Andrews, Board on Radioactive Waste Management, National Research Council, from Joshua Goldowitz, CGWP and Deborah E. Greenholtz of Hydro-Logic, Inc., Rochester, NY 14618, dated November 8, 1994. FUSRAP Document No. 1423379.
<u>NFSS-405</u>	Niagara Falls Storage Site - 1995 Environmental Surveillance Report, letter to residents (list attached), from Ronald E. Kirk, Former Sites Restoration Division, Department of Energy, Oak Ridge Operations, Oak Ridge, TN, dated May 31, 1996. FUSRAP Document No. 142727.
<u>NFSS-406</u>	Chemical Data Gap Characterization at Niagara Falls Storage Site (NFSS) FUSRAP Technical Memorandum, No. 158-96-012 Rev. 0, FUSRAP Project, Job 14501, to Larry Baldy from Badri Kapoor of Bechtel, dated September 3, 1996. FUSRAP Document No. 146000.
<u>NFSS-407</u>	NFS - Midyear Environmental Surveillance Report for the Niagara Falls Storage Site, Bechtel Interoffice Memorandum to H.R. Baldy, from Angie John, File No. 158-7430, dated October 3, 1996. FUSRAP Document No. 146781.
<u>NFSS-409</u>	Niagara Falls Storage Site - 1994 Environmental Surveillance Information letter from Ronald E. Kirk, Former Sites Restoration Division, Department of Energy, Oak Ridge Operations, Oak Ridge, TN, to multiple addresses, dated May 31, 1996; along with "Environmental Surveillance Results for 1994 for the Niagara Falls Storage Site" FUSRAP Technical Memorandum, No. 158-96-009, Rev. 0, FUSRAP Project, Job 14501 to Jason Darby- FSRD, from James C. McCague - FUSRAP, dated June 1, 1996. FUSRAP Document No. 142614.
<u>NFSS-442</u>	Draft Report for Phase I Remedial Investigation at the Former Lake Ontario Ordnance Works (LOOW), to USACE Baltimore District by EA Engineering, Science, and Technology, dated December 1998.
<u>NFSS-443</u>	Quarterly Glaciolacustrine Silt/Sand Unit (GSS) Potentiometric Map-Third Quarter, 1999, from Rebecca Zayatz of CWM Chemical Services L.L.C. to Dr. Paul Merges, Director Bureau of Radiation and Hazardous Site Management, NYSDEC, August 18, 1999.
	A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells, Prepared by H. Bouwer and R.C. Rice of the U.S. Water Conservation Laboratory, Agricultural Research Service, U.S. Department of Agriculture. Water Resources Research Volume 12, Number 3, January 23, 1976
	Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, Prepared by the United States Environmental Protection Agency, EPA 540-G-89/004, October 1988
	Chemical Data Quality Management for Hazardous, Toxic, Radioactive Waste Remedial Activities, USACE Engineer Regulation ER 1110-1-263, April 30, 1998
	Requirements for the Preparation of Sampling and Analysis Plans, USACE Engineer Manual EM200-1-3, September 1, 1994
	Monitoring Well Design, Installation, Documentation at Hazardous, Toxic, and Radioactive Waste Sites, USACE Engineer Manual EM1110-1-4000, November 1, 1998