U.S. Army Corps
of Engineers
Louisville District

Final
Revised Feasibility Study

Authorized under the
Defense Environmental Restoration Program
for Formerly Used Defense Sites (DERP-FUDS)

Former Nike Missile Site SL-10, Launch Area, Groundwater
Marine, Illinois

Original Prepared by:
U.S. Army Corps of Engineers Buffalo District
Hazardous, Toxic, and Radiological Waste (HTRW)
Design District for North Central Division

August 1996

Revision Prepared by:
Plexus Scientific Corporation
4501 Ford Avenue, Suite 1200
Alexandria, VA 22302

December 2006

NIKE SL-10 LAUNCH AREA GROUNDWATER RI/FS/PP/ROD

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CONTRACTOR STATEMENT OF TECHNICAL REVIEW

Plexus Scientific Corporation has completed this Final Revised Feasibility Study for the Nike SL-10 Launch Area Groundwater Remedial Investigation/Feasibility Study/ Proposed Plan/Record of Decision (RI/FS/PP/ROD) project. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Quality Control Plan. During the independent technical review it was established that policy principles and procedures, utilizing justified and valid assumptions were complied with in preparation of this document. This included review of assumptions; methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing U.S. Army Corps of Engineers' policy.

Review documentation identifying any specific concerns identified during the technical review and their resolution is maintained in the project file.

Bill Millar Project Manager	Date
Piers Causton Technical Reviewer	Date

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Acronyms

1,1-DCE	1,1-dichloroethene
1,2-DCE	1,2-dichloroethene
1,1,2-TCA	1,1,2-trichloroethane
3-D	three-dimensional
ARDL	Advanced Research and Development Laboratory, Inc.
ARAR	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
BRA	baseline risk assessment
CELRL	U.S. Army Corps of Engineers, Louisville District
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulation
cis-1,2-DCE	cis-1,2-dichloroethene
COC	chemical of concern
CTE	central tendency exposure
CWA	Clean Water Act
DERP/FUDS	Defense Environmental Restoration Program/Formerly Used Defense Sites
DoD	Department of Defense
DOT	Department of Transportation
EEI	Envirodyne Engineering, Inc.
EM	electromagnetic
ESE	Environmental Science and Engineering, Inc.
FS	Feasibility Study
GAC	granular activated carbon
GRA	general response action
GSA	General Services Administration
HHRA	human health risk assessment
HRC	hydrogen release compound
IAC	Illinois Administrative Code
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
ISGS	Illinois State Geological Survey
K_{oc}	organic carbon partition coefficient
Law	Law Engineering and Environmental Services, Inc.
MCL	maximum contaminant limit
MCLG	maximum contaminant limit goals
MNA	Monitored Natural Attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PCE	tetrachloroethene

Plexus	Plexus Scientific Corporation
POTW	publicly owned treatment works
PRG	preliminary remediation goal
RAE	reasonable average exposure
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RF	radio frequency
RME	reasonable maximum exposure
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RI/FS/PP/ROD	Remedial Investigation/Feasibility Study/Proposed Plan/Record of Decision
SARA	Superfund Amendment and Reauthorization Act
SDWA	Safe Drinking Water Act
SEC Donohue	SEC Donohue, Inc.
SSL	Soil Screening Levels
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
TACO	Tiered Approach to Corrective Action Objective
TBC	information to be considered
TCE	trichloroethene
trans-1,2-DCE	trans-1,2-dichloroethene
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USEPA	U.S. Environmental Protection Agency
UTS	Universal Treatment Standards
VOC	volatile organic compound

1.0 INTRODUCTION

1.1 Purpose and Organization of Report

The Defense Environmental Restoration Program for Formerly Used Defense Sites (DERP/FUDS) was established by the Department of Defense (DoD) to fulfill its responsibility to restore the environmental integrity of its formerly owned or utilized defense sites. For sites with potential contamination that is a result of past DoD activities, the DERP/FUDS program follows the remedial process outlined by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendment and Reauthorization Act (SARA) of 1986.

This Feasibility Study (FS) has been prepared to provide information to support a remedial decision for the chlorinated solvent groundwater plume associated with the missile assembly and test building located at the former Nike Site SL-10 (SL-10) Launch Area. The Remedial Investigation (RI) and evaluation of potential remedial alternatives are being conducted pursuant to CERCLA, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (U.S. Environmental Protection Agency [USEPA] 1990), Executive Order 12580, and the USEPA *Guidance on Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA 1988).

Plexus Scientific Corporation (Plexus) has been contracted by the United States Army Corps of Engineers (USACE), Louisville District (CELRL) (Contract Number DACA27-98-D-0031, Delivery Order 0008), to revise the *Draft Feasibility Study* prepared for the site by the Buffalo District USACE (USACE 1996).

The FS is an intermediate step in the remedial process, occurring during and following the RI process and before Remedial Design and Remedial Action take place. The purpose of the FS is to screen, evaluate and compare remedial alternatives. The FS evaluates alternatives to address the unacceptable risk associated with the possible land use exposures. The process involves three basic phases; the development of alternatives, the screening of alternatives and the detailed analysis of alternatives. Remedial alternatives are first screened by their effectiveness, implementability and relative cost. The detailed analysis of the alternatives further defines each alternative, provides an assessment and summary of each against the nine evaluation criteria and provides a comparative analysis among them.

This FS report is organized as follows:

- Section 1 - Introduction
- Section 2 - Identification and Screening of Technologies
- Section 3 - Development and Screening of Alternatives
- Section 4 - Detailed Analysis of Alternatives
- Section 5 – References

1.2 Approach

CERCLA §121 (d)(1) requires remedial actions to attain a degree of cleanup that assures protection of human health and the environment [42 U.S.C. §9621 (d)(1)]. This requirement is implemented through a risk assessment based on site-specific

exposures that identifies contaminant exposure pathways. These exposure pathways present either a current or potential future unacceptable risk. When such a risk is identified, a response action is required. The unacceptable risks presented by contamination at the Nike SL-10 Launch Area will be addressed in accordance with the Illinois Groundwater Standards.

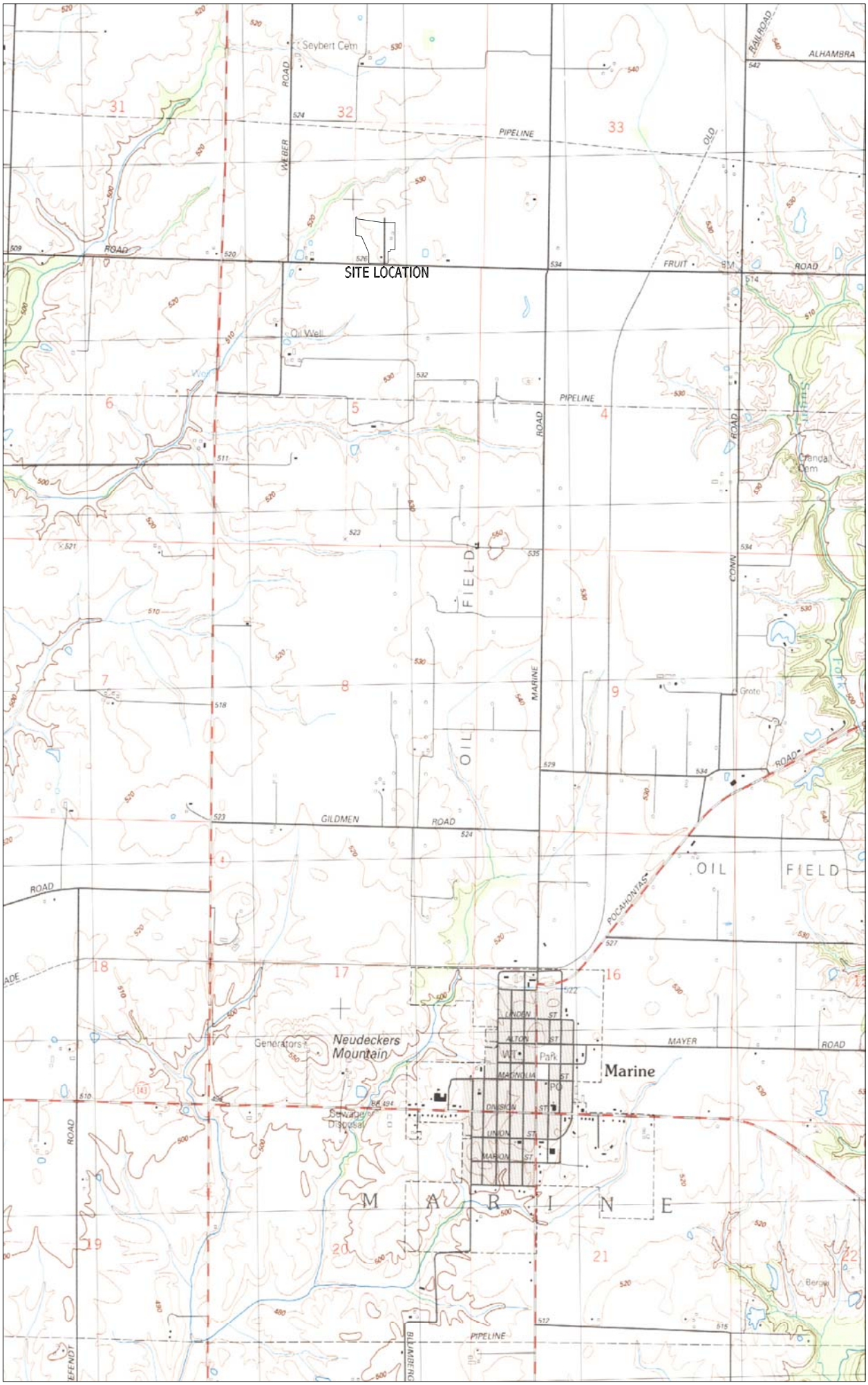
The RI included a contamination assessment and human health risk assessment (HHRA) (Plexus 2005). The HHRA provided an assessment of the potential health risks associated with a residential land use and exposures to chemicals at the site in the absence of any remedial action. The HHRA found that the total risks, from exposure to carcinogens to a child and an adult living on the site and using groundwater for drinking and bathing would both exceed the upper-end of the USEPA risk range (1E-04). The hazard quotients for exposure to non-carcinogens were over the USEPA risk benchmark of 1 for an adult and a child resident of the site using groundwater from the plume for drinking and bathing/showering. Based on an average exposure (central tendency exposure [CTE]), the total cancer risks to the child and adult both exceed the upper-end of the USEPA risk range (1E-04). In the reasonable maximum exposure (RME) scenario, the total risk to the child is driven by the drinking water ingestion route. The vast majority of the adult risk in the RME scenario comes from inhalation of volatile organic compounds (VOCs) while showering. The risks from trichloroethene (TCE) in groundwater contribute over 95% of the total child and adult risk.

1.3 Background Information

1.3.1 Site Description

1.3.1.1 Location

SL-10 is located in Madison County, Illinois (Figure 1). The Launch Area is roughly 3 miles north of the town of Marine, Illinois. The groundwater plume under investigation is located at the Launch Area. The Launch Area is 19.87 acres in size, and includes the missile assembly and test building, a generator building, warheading building, ready building, acid fueling station; well and pump house, three missile magazines (referred to in other reports as silos), other support buildings, and a sand filter that was previously part of the septic system (Figure 2). The ready building was formerly used as a residence (now used for storage). There was a well at the ready building that was used for potable water that has been abandoned. Two underground storage tanks that serviced the ready building and generator building have been removed. There are various roads, walkways, pads, and utilities throughout the property. The Launch Area was fenced and the fencing is maintained around most of the site (Plexus 2004).



SITE LOCATION

Source: Marine Quadrangle 7.5 Minute Series Topographic

N

0 2500

SCALE IN FEET

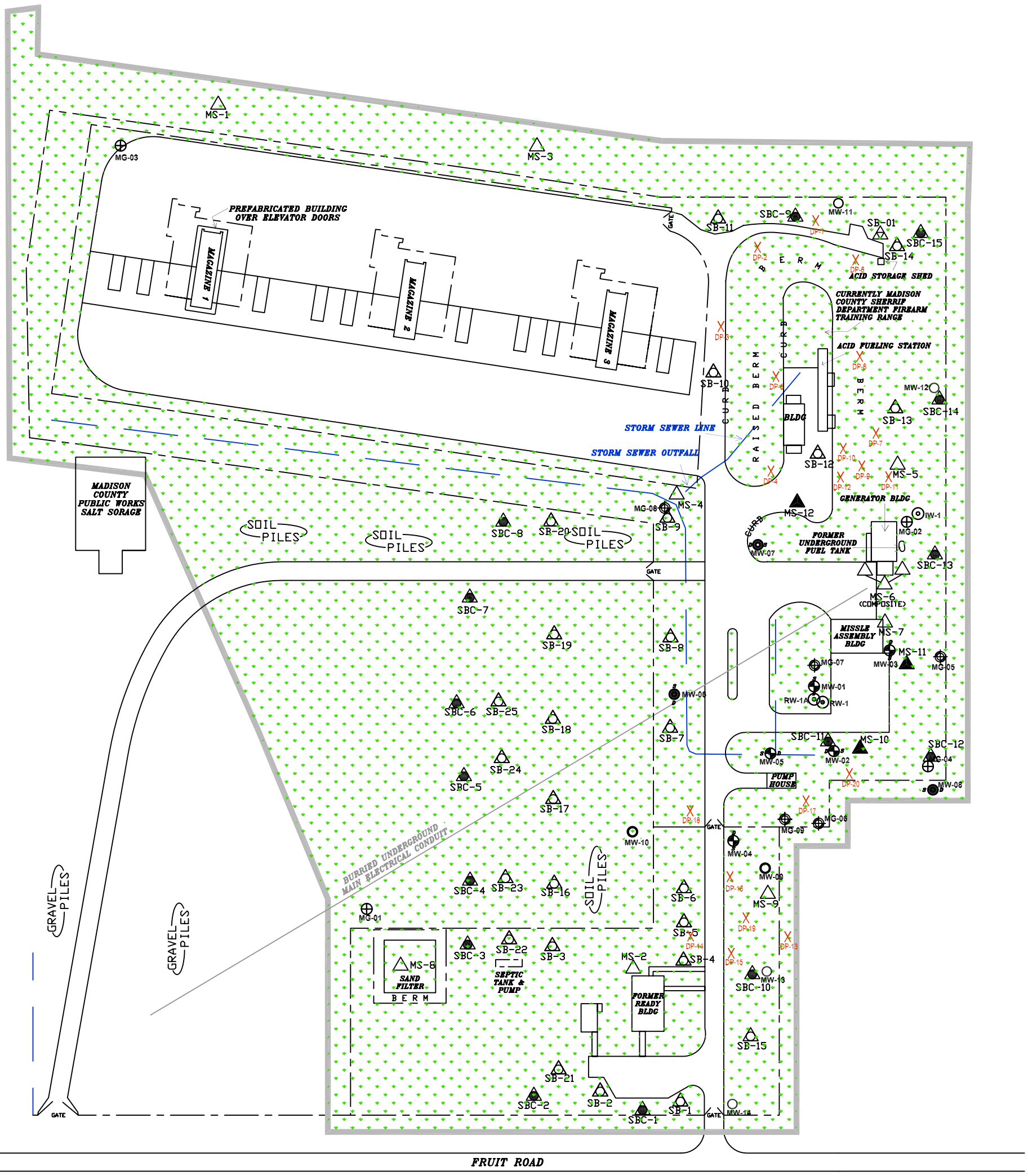
Figure 1
Location of the Former Nike Site SL-10 Launch Area

Nike Site SL-10
Groundwater
Feasibility Study
RI/FS/PP/ROD Proj.

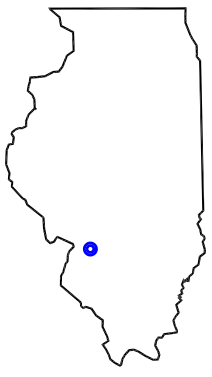
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE

PLEXUS scientific

Project No.	File No.
8032-08C	Fig 01 area map.pdf



SITE LOCATION



LEGEND

DP-1	DIRECT PUSH GROUNDWATER SAMPLING LOCATIONS
MW-9	SINGLE MONITORING WELLS
MW-8	NESTED PAIRS MONITORING WELLS
MG-1	MONITORING WELL 1-4 (ENVIRODYNE 1998)
MG-5	MONITORING WELL 5-9 (SEC DONOHUE 1992)
MW-1	MONITORING WELL (NESTED PAIR) 1-5 (LAW 2002)
RW-1	RECOVERY WELL 1-2 (LAW 2002)
IW-1	INFILTRATION WELL (LAW 2002)
MGR-1	FORMER WATER SUPPLY WELL
MS-1	SOIL SAMPLE 1-9 (ENVIRODYNE 1988)
MS-10	SOIL SAMPLE 10-12 (SEC DONOHUE 1992)
SB-1	SOIL BORING 1-25 (ARDL 1994)
SBC-1	SOIL BORING CONFIRMATION 1-15 (ARDL 1994)
SB-01	GEOLOGICAL PROFILE BOREHOLE (LAW 2002)
S	SHALLOW WELL
D	DEEP WELL
	FENCE
	DRAINAGE DITCH & STORM SEWER
	FORMER SL-10 BOUNDRY
	GRASS

N

Source:
Total Votatile Organic Compound Concentration In Groundwater August 4, 1998
by Law Engineering and Environmental Services, Inc.
Figure 2-3 Former Nike Site and Locations of Soil Boreholes / Monitoring Wells
May 1994 by ARDL
7.5 Minute Quadrangle
Figure 2-3 Former Nike Site and Locations of Soil Boreholes / Monitoring Wells
1992 by SEC Donohue
Figure 3-1 Soil and Groundwater Sampling Sites 1988 by Envirodyne

0 100 200
SCALE IN FEET

Figure 2
Nike Site SL-10
Launch Area Layout

Nike Site SL-10
Groundwater
Feasibility Study
RI/FS/PP/ROD Proj.

U.S. ARMY ENGINEER DISTRICT, LOUISVILLE

PLEXUS scientific

Project No. 8032-08C
File No. Fig 2 Site Layout

1.3.1.2 Geology

SL-10 lies in the Interior Lowlands physiographic province (King 1977). Within the Illinois physiographic divisions, the site is in the Springfield Plain (Illinois Department of Natural Resources (IDNR) 1997). During the Pleistocene, glaciers advanced into Illinois from several directions at various times, influencing the surface geology. Illinoisan-age glaciation that advanced into the State from the east and northeast influenced the Madison County area. An extensive ground moraine of glacial till covers the area of the site. The ground moraine is characteristically flat-lying (Illinois State Geological Survey (ISGS) 1999).

The surficial Quaternary deposit in the area of the site is the Illinois Episode, Glasford Formation (IDNR 1996). The glacial drift in the area is mapped as being between 50 and 100 feet thick (IDNR 1997). SEC Donohue, Inc. (SEC Donohue) logged boring MG-6 at the site to 92 feet below ground surface (bgs) and reported that the boring was still in glacial till at 92 feet; bedrock was not encountered (SEC Donohue 1992). The bedrock underlying the site is Pennsylvanian in age and would likely be the Modesto Formation or Bond Formation. The area of the site is in the Illinois Basin bedrock structure on the west side of the basin (IDNR 1997).

Glacial till stratigraphy at the site was characterized in the RI and previous investigations as clay and silt mixtures from the surface to roughly 20 feet bgs (overlying clay/silt), sandy silt (sandy silt unit) from roughly 20 to 30 feet bgs, and clayey silt to silty clay from roughly 30 to 92 feet bgs (underlying clay/silt) (Applied Research and Development Laboratory [ARDL] 1994, Envirodyne Engineers, Inc. [EEI] 1988, Law Engineering and Environmental Services, Inc. [Law] 2002, Plexus 2005, and SEC Donohue 1992). In the RI, the material from roughly 20 to 30 feet was described as predominantly sandy silt, and gravel was detected at most locations, comprising up to 20 % of the material. Lenses of sandy gravel, gravelly silt, silt, and sandy silt have been described in previous studies in the deeper part of the 20- to 30-foot zone. Boring logs from the RI work and previous studies are presented in Appendix C of the RI report (Plexus 2005).

1.3.1.3 Soil and Vadose Zone

The soils across the site are saturated from roughly 3 feet to the surface at least seasonally; thus, the vadose zone at the site is relatively thin. Portions of the site are low-lying, with water pooling in areas for at least part of the year. The vadose zone material at the site consists of dark brown to gray, mottled, fine-grained materials, silt, and clay (ARDL 1994, EEI 1988, LAW 2002, Plexus 2005 and SEC Donohue 1992).

1.3.1.4 Groundwater Hydrology

The water-bearing material at the site is encountered within the first 5 feet bgs typically from 0 to 3 feet. This material in very general terms consists of less than 20 feet of clay/silt (overlying clay/silt unit), followed by several feet of more permeable sandy silt (sandy silt unit); beneath this material is a clayey silt to a silty clay. The contamination at the site is present in the overlying clay/silt and more widespread in the sandy silt zone (underlying clay/silt).

Several wells were previously installed in the clayey silt to silty clay (underlying clay/silt unit) below the sandy silt unit. Chlorinated solvents have not been detected in this material, except for low concentrations of chlorinated solvents detected in a well next to the missile assembly and test building, MW-03D. These low levels of chlorinated solvents were detected in the deeper of two wells in a well pair. The groundwater in the shallower well, MW-03S, contains the highest concentrations of chlorinated solvents detected at the site.

SEC Donohue was tasked with investigating the depth of the contamination and installed a well, MG-6, that was screened from 81 to 91 feet bgs. This well is screened in what was described as dense low-permeability till. The recharge rate at this well is so low that it has never been sampled.

1.3.1.4.1 Lithology and Stratigraphy

EEI installed four shallow groundwater monitoring wells at the site in 1988. SEC Donohue installed an additional five groundwater monitoring wells of various depths at the site in 1992. ARDL collected grab groundwater samples from 40 locations in 1994. Law installed a recovery well, an injection well, and five nested pairs of monitoring wells on the site as part of the Pilot Study in 1998 and 1999. Plexus installed an additional eight wells, six in nested pairs and two single wells, as part of the work in 2002. In May 2003, Plexus installed 20 temporary wells and collected groundwater samples from them. The temporary wells were then abandoned. Well MG-4 was damaged by frost heaving over the years and was abandoned in May 2003. Plexus installed four additional groundwater monitoring wells at the site in August 2003. Well locations at the site are summarized in Figure 2.

A review of the boring logs prepared by several of the investigators was performed and a generalized soil stratigraphy was developed. All investigators agree that from the surface to between 19 and 28 feet bgs is a zone of clay and silt. Many of the wells installed at the site are screened in this overlying clay/silt, typically from 10 to 15 feet bgs. These wells were referred to as “shallow wells” in the RI Report. The overlying clay/silt is saturated with groundwater from near the surface to the bottom.

Below this overlying clay/silt is a unit that was described differently by different investigators. This unit is characterized by the presence of sand and sometimes gravel mixed with silt. This material varies in composition from gravel to sand to sandy silt to silt. The sand and silt mixtures typically had traces of gravel. The depth to the top of this sandy silt unit varies in some logs to as deep as 24 and 28 feet bgs, but for most of the site the sandy silt unit begins at 19 to 20 feet bgs. Other investigators found what might be lenses and stringers of silt and clay within the sandy silt zone. Many borings did not penetrate through the sandy silt, typically ending at 30 feet within the sandy silt. SEC Donohue drilled MG-6 to a depth of 92 feet bgs and put the base of the sandy silt at 34 feet bgs. In the borings installed by Law, the base of the sandy silt varied substantially, from 21 to 31 feet bgs. The deeper borings completed by Plexus intersected the sandy silt at roughly 20 feet bgs and, when terminated at 31 feet, were still in the sandy silt material. A three-dimensional (3-D) model of the sandy silt unit was

generated with the boring log information; Figure 3 illustrates the model of the relationship of the sandy silt stratigraphic unit to the lithology logged at the site in soil borings. Where there is no stratigraphic data, the model appears to over estimate the thickness of the unit; the corners appear be thicker where there are no borings. These thick corners are an artifact of the model. Many of the wells at the site were screened in the sandy silt; these wells were referred to as “deep wells” in this RI Report. The sandy silt is saturated from top to bottom across the site and contains the bulk of the VOC contamination detected in the groundwater at the site.

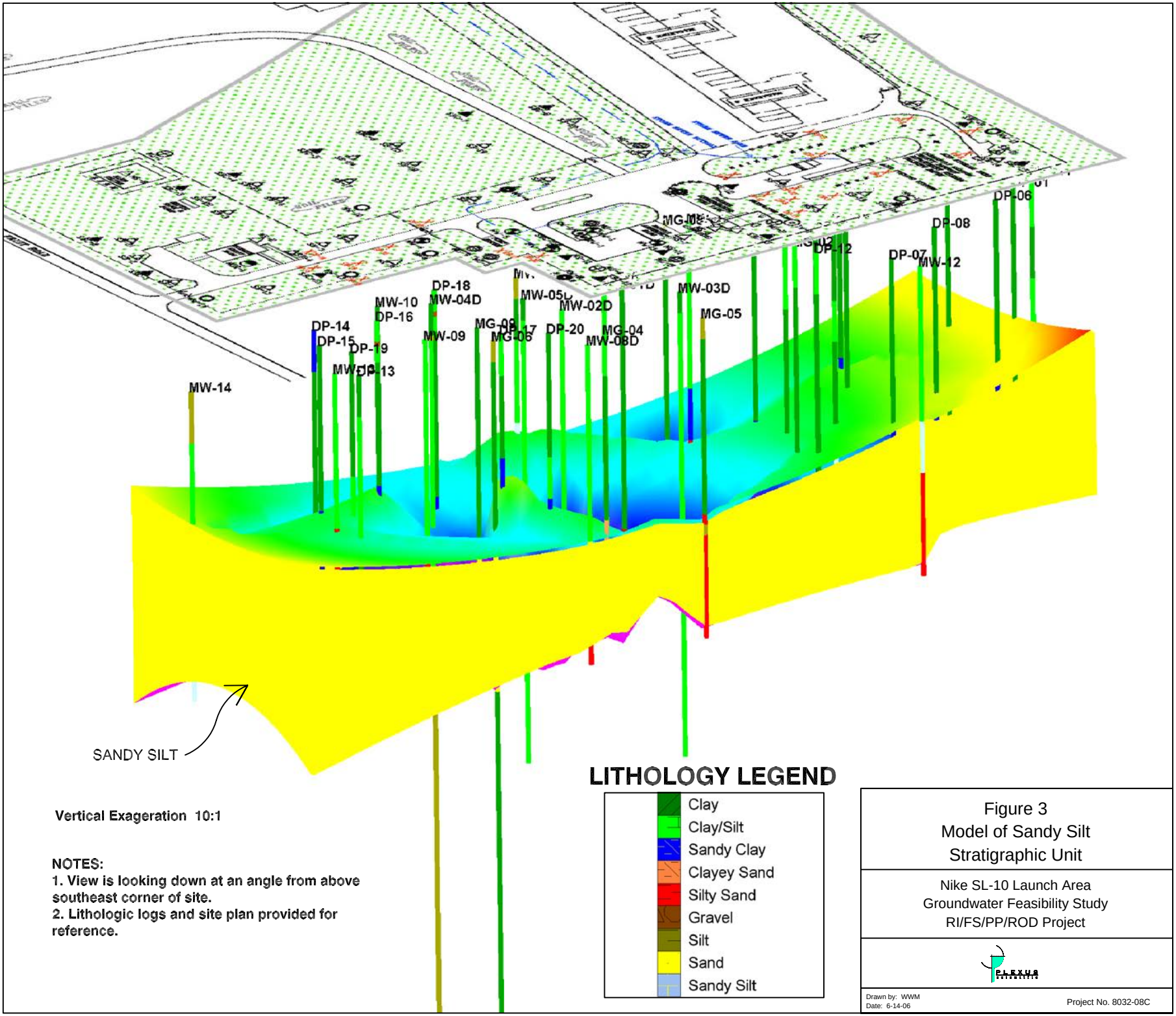
In borings that penetrated the sandy silt, the underlying material was described as silt to clayey silt to silty clay to clay. This material is referred to as the underlying clay/silt stratigraphic unit. In the five borings that were deeper than 31 feet, coarser grained material (sand and gravel) was encountered within the fine-grained material (silt and clay). These coarse-grained materials do not seem continuous beneath the site and may represent sand and gravel lenses.

Four on-site wells (MG-6, MW-3D, MW-4D, and MW-5D) were screened below the sandy silt. These wells were not sampled as part of the RI and were only discussed individually within the RI report. Well MG-6, screened below the sandy silt, has a standing groundwater elevation significantly below the elevations of groundwater in the other wells. Well MW-4D was found to recover much more slowly after pumping than wells screened in the overlying clay/silt and sandy silt units. These phenomena may be explained by the presence of an aquitard or aquiclude below the sandy silt. The underlying clay/silt unit below the sandy silt unit at the site is typical of an aquitard or aquiclude.

Cross section locations and cross sections have been prepared and are presented in Figures 4, 5, and 6. Figure 4 shows the locations of the cross sections, and Figures 5 and 6 present cross sections A-A’ and B-B’. These cross sections show the lithology described by various investigators from borings and wells at the site. This lithology has been interpreted, and the resulting stratigraphy is presented in the panels between the lithologic logs. In addition, the screened intervals are presented as cyan columns next to the wells in the cross section, and the depths to groundwater from the three field events in 2002/2003, as applicable, are illustrated next to each of the wells. Cross section A-A’ shows a view of the subsurface materials from north to south through the center of the area impacted by chlorinated solvents. Cross section B-B’ shows a view from west to east across the plume. The screened intervals are presented for comparison to the soil types encountered in each boring. The shallow wells are all screened from 10 to 15 feet bgs. These cross sections will be used to better interpret the chemical data and plume distribution later in this report.

1.3.1.4.2 Piezometric Surface, Groundwater Flow Direction, and Gradient

The piezometric surface for shallow and deep wells (as defined in the RI) were compared and in general they appear to be the same. The piezometric surface is shallow typically within several feet of the surface. The groundwater flow direction fluctuates with time but is generally to the southwest. The groundwater gradient has been estimated for several events and is relatively flat and has been estimated between 0.003 and 0.02 feet/foot.



Vertical Exageration 10:1

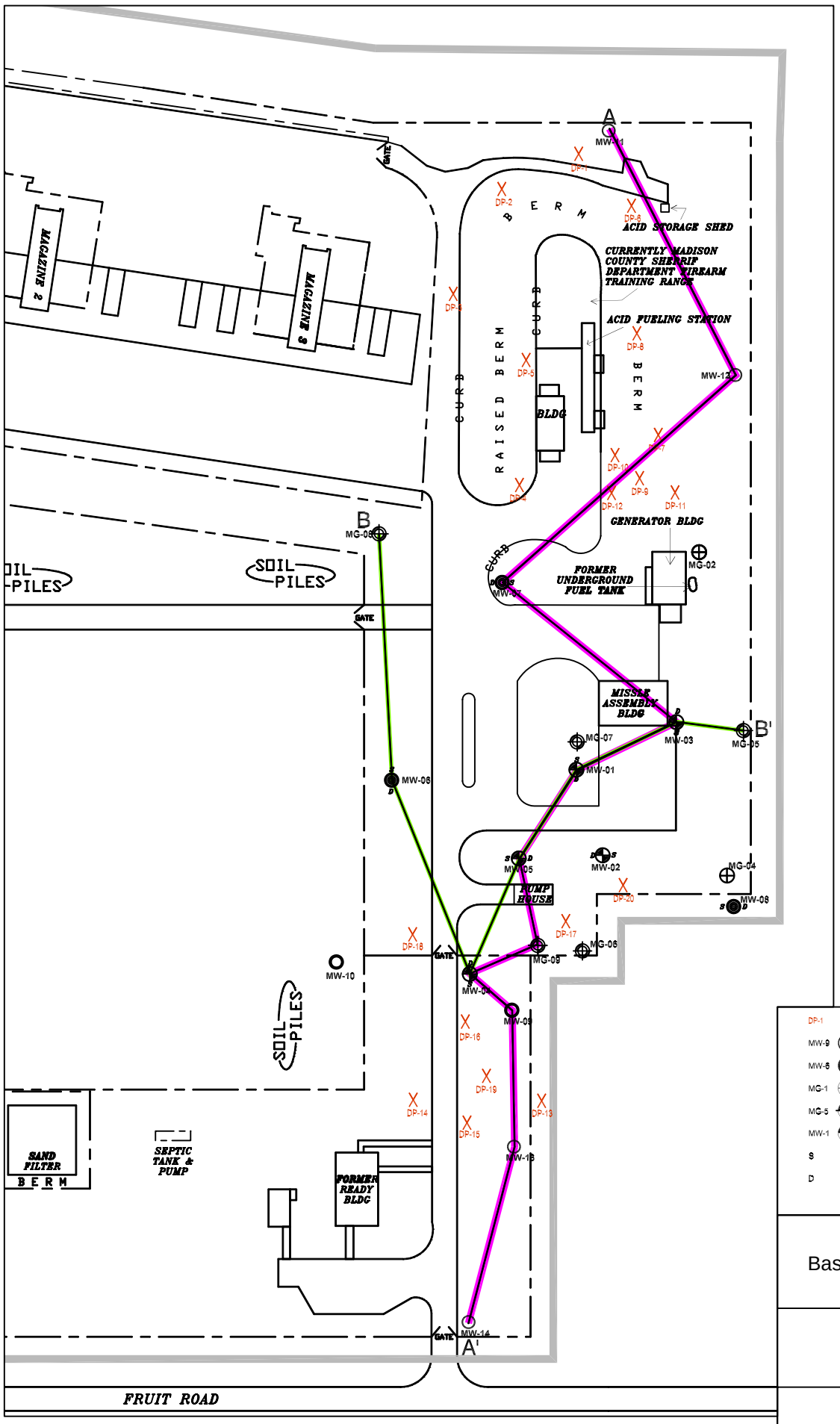
NOTES:
1. View is looking down at an angle from above southeast corner of site.
2. Lithologic logs and site plan provided for reference.

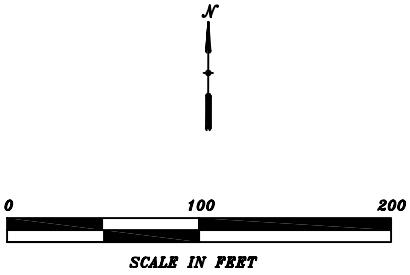
Figure 3
Model of Sandy Silt Stratigraphic Unit

Nike SL-10 Launch Area
Groundwater Feasibility Study
RI/FS/PP/ROD Project

Drawn by: WWM
Date: 6-14-06

Project No. 8032-08C





B-B'

A-A'

DP-1	DIRECT PUSH TEMPORARY WELLS (PLEXUS 2003)
MW-9	SINGLE MONITORING WELLS (PLEXUS 2002, 2003)
MW-6	NESTED PAIRS MONITORING WELLS (PLEXUS 2002)
MG-1	MONITORING WELL 1-4 (ENVIRODYNE 1998)
MG-5	MONITORING WELL 5-9 (SEC DONOHUE 1992)
MW-1	MONITORING WELL (NESTED PAIR) 1-5 (LAW 2002)
S	SHALLOW
D	DEEP

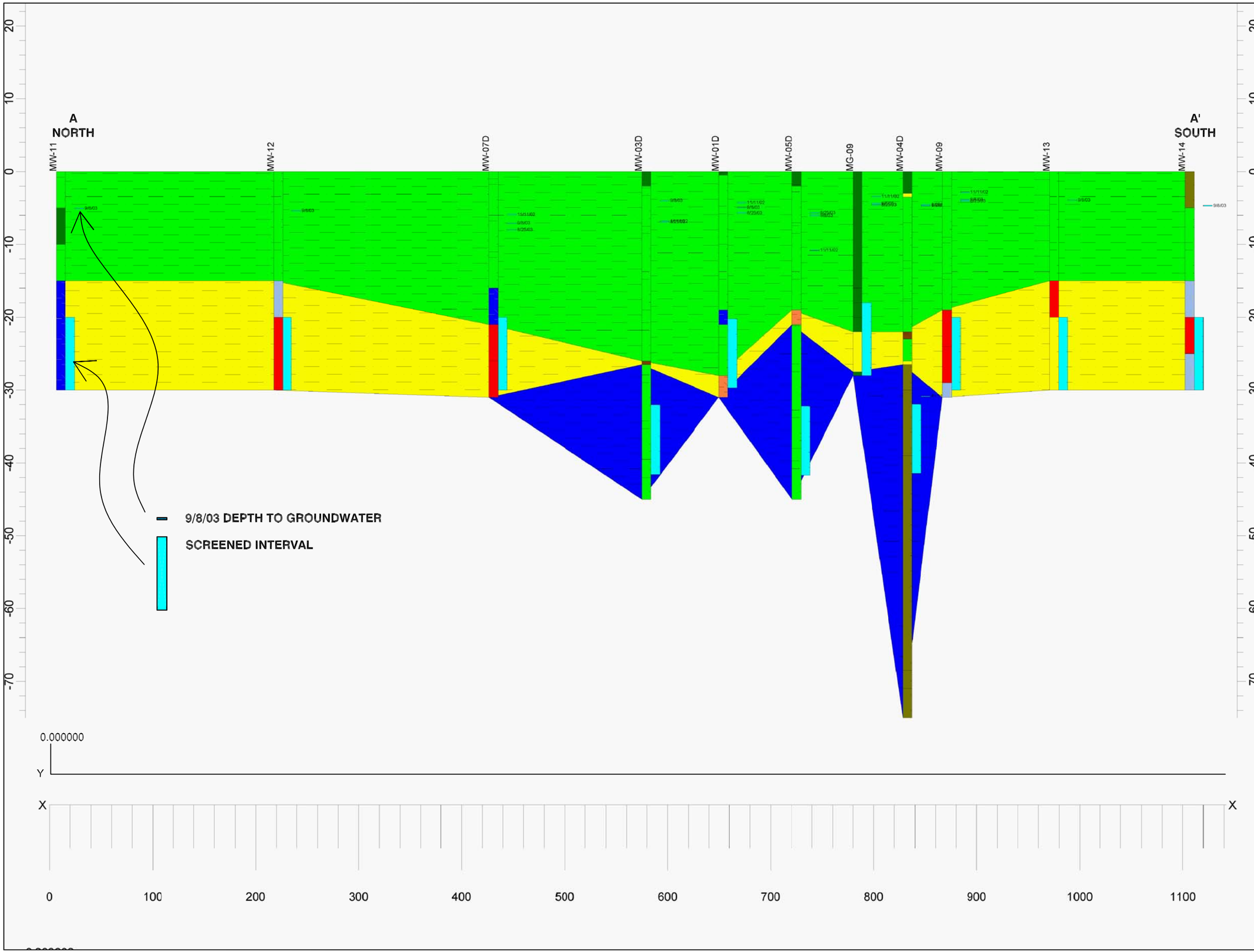
Figure 4
Base Map X-Sections A-A' & B-B'
2002/2003 Samples

Nike SL-10 Launch Area
Groundwater Feasibility Study
RI/FS/PP/ROD Project

PLEXUS SCIENTIFIC

Drawn by: WWM
Date: 6-14-06

Project No: 8032-08C



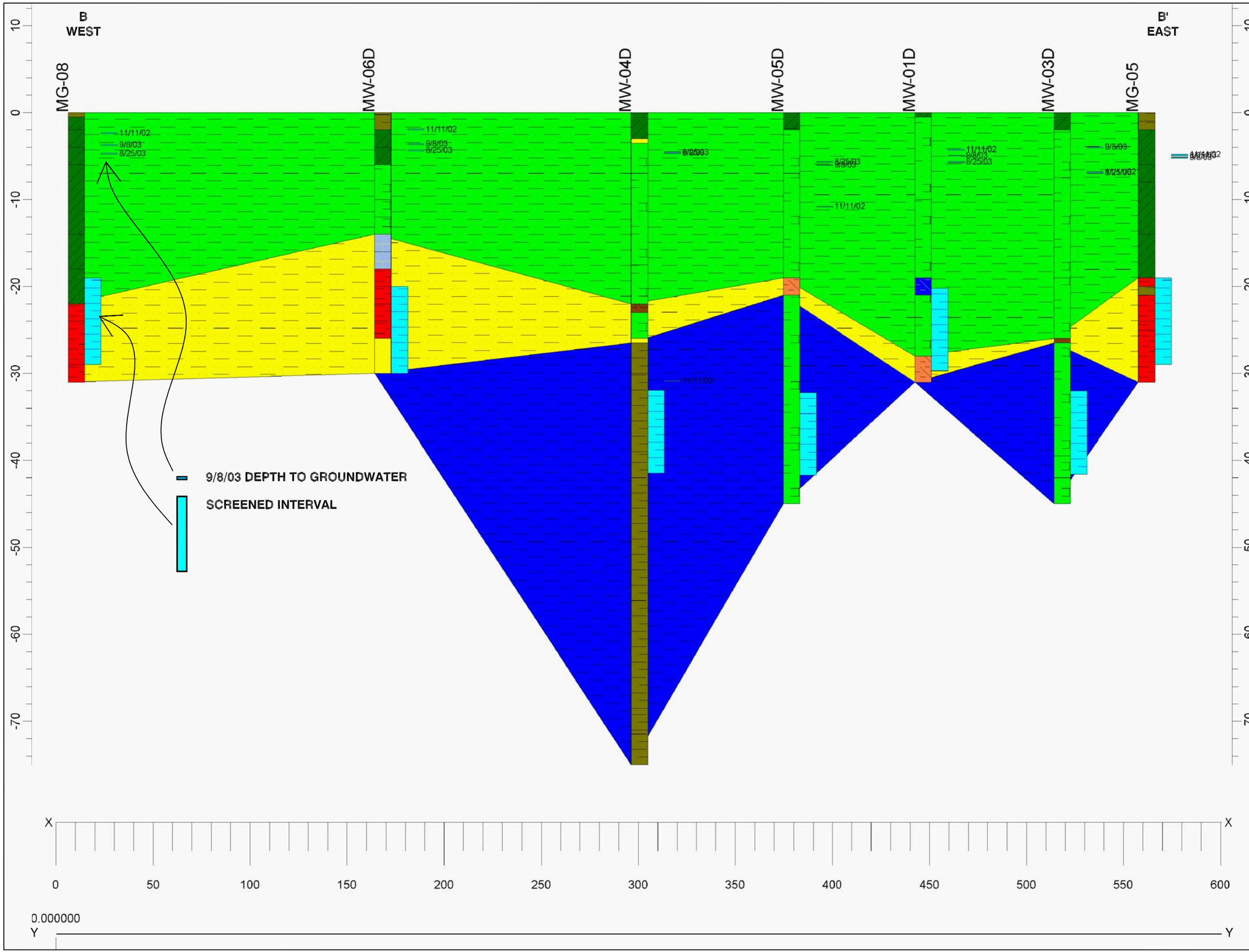
STRAT LEGEND	LITHOLOGY LEGEND
Overlying Silt-Clay	Clay
Sandy Silt	Clay/Silt
Underlying Silt-Clay	Sandy Clay
	Clayey Sand
	Silty Sand
	Gravel
	Silt
	Sand
	Sandy Silt

Figure 5
X-Section A-A' North to South
2002/2003 Samples

Nike SL-10 Launch Area
Groundwater Feasibility Study
RI/FS/PP/ROD Project

Drawn by: WWM
Date: 6-14-06

Project No: 8032-08C



STRAT LEGEND	LITHOLOGY LEGEND
Overlying Silt-Clay	Clay
Sandy Silt	Clay/Silt
Underlying Silt-Clay	Sandy Clay
	Clayey Sand
	Silty Sand
	Gravel
	Silt
	Sand
	Sandy Silt

Figure 6
X-Section B-B' West to East
2002/2003 Samples

Nike SL-10 Launch Area
Groundwater Feasbility Study
RI/FS/PP/ROD Project

PLEXUS

Drawn by: WWM
Date: 6-14-06

Project No.: 8032-08C

1.3.1.4.3 Hydraulic Conductivity

Several slug tests have been performed at the site, the reported coefficients of permeability (k) are as follows:

Well No.	k, coefficient of permeability (centimeters per second (cm/sec))
MG-1	6.13×10^{-4}
MG-2	6.54×10^{-6}
MG-3	2.43×10^{-4}
MG-4	6.42×10^{-5}
MW-01D	4.52×10^{-3}
MW-02D	1.74×10^{-3}
MW-09	6.99×10^{-3}

Law interpreted the base of the uppermost groundwater producing zone to be approximately 45 feet bgs. A sample of silty clay (underlying clay/silt unit) collected by Law from boring IW-01 from 45 to 47 feet bgs had a vertical hydraulic conductivity of 2.3 x 10^{-8} cm/sec, based on a falling head permeability test. Geotechnical engineers generally regard material of 10^{-7} cm/sec permeability or less to be relatively impermeable (Law 2002). This material is typical of an aquitard or aquiclude.

The K values for the deeper wells MW-01D, MW-02D and MW-09 fall in the range of values expected for sandy silt to clean sand (Freeze and Cherry 1979). The sandy silt unit has higher conductivities than the overlying clay/silt (MG-1, MG-2, MG-3 and MG-4) and much higher conductivities than the one value provided by Law (Law 2002) for the underlying clay/silt.

Law estimated that the sandy silt material at the site has a porosity of 0.20 or 20% (Law 2002). Freeze and Cherry give a range of values for porosity from sand at 25% to 50% to silt at 35% to 50% to clay at 40% to 70% (Freeze and Cherry 1979, p 37). Fetter (1988) gives a porosity range for glacial till from 10% to 20%. Well-sorted sediments in general have lower porosities.

1.3.2 Site History

Nike Site SL-10 was acquired by the DoD between 1959 and 1962 for the operation of Nike Hercules surface-to-air guided missile firing and control. During operation, DoD maintained 145 acres of land for housing, launch, line of sight, and sewer/water easements. The site was deactivated on August 16, 1968, and declared surplus by the General Services Administration (GSA) on January 21, 1970. The Launch Area and Control Area of 20 and 19 acres, respectively, were conveyed to the Madison County Board of Supervisors between 1971 and 1972, and the remainder of the property was released to the original property owners. The site is currently used by the County Highway Department for equipment and materials storage, and by the County Sheriff's Department for a firing range. The former ready building at the Launch Area was converted into a home, where a resident caretaker resided. The ready building is now used for storage and the well used by the resident caretaker has been abandoned.

USACE has conducted 4 Site Investigations at the former missile base. The first was performed in 1987-88 by EEI under contract to the St. Louis District. EEI installed and

sampled 4 monitoring wells, sampled soil from the well borings, and sampled the residence well on-site (EEI 1988). The second investigation was performed in 1992 by SEC Donohue, under contract to the Buffalo District. SEC Donohue installed 5 monitoring wells, sampled groundwater in four of the new wells, the four previously installed wells, and the residence well, and collected soil samples from 4 well borings and 3 additional soil borings (SEC Donohue 1992). The third investigation was conducted in 1994 by ARDL, also under contract to the Buffalo District. ARDL collected groundwater samples from 8 monitoring wells, the residence well, and 40 soil borings, and soil samples from the 40 soil borings (ARDL 1994).

In June of 1995, Environmental Science and Engineering, Inc. (ESE), conducted a Baseline Risk Assessment (BRA) under contract to the USACE Buffalo District. ESE determined the constituents of concern, assessed the exposure pathways and contaminant toxicity, and characterized the risks to humans and the environment (ESE 1995). The data used in this BRA was not validated and according to current USACE policy the data can not be used in the preparation of a risk assessment. The BRA was not up dated for the RI.

In July of 1995 the on-site residence was vacated. On February 6, 1996, the on-site residential well was permanently closed. Currently, the site is used only for equipment storage, and does not have a source of water. There are no plans to use the site for anything other than equipment storage (Dickman 1996).

The USACE Buffalo District prepared a draft of this FS report in 1996 (USACE 1996). The recommended remedial option was dual-phase extraction. The proposed system consisted of extraction of groundwater and soil gas, treatment, venting of the soil gas, and re-injection of groundwater into the aquifer. Law completed a pilot-scale study of a dual-phase system in 1999. Law installed 2 extraction wells, a re-injection well, and 5 pairs of nested wells (Law 2002). The system did not work well and was not put into operation.

Plexus completed a Preliminary Assessment of the SL-10 site including the Control Area in 2004 (Plexus 2004). Plexus completed a RI in 2005. During the RI 12 additional groundwater monitoring wells were installed; one well was abandoned; and 20 temporary wells were installed, sampled and abandoned. A HHRA was completed using only the validated groundwater data from the RI (Plexus 2005).

1.3.3 Nature and Extent of Contamination

Groundwater samples were collected from 31 monitoring wells, 20 temporary wells, the residence well, and many soil borings over the course of the site investigations and RI. Several VOCs, including 1,1-dichloroethene (1,1-DCE), 1,2- dichloroethene (1,2-DCE), tetrachloroethene (PCE), 1,1,2-trichloroethane (1,1,2-TCA), and trichloroethene (TCE), were detected in multiple groundwater samples at concentrations greater than Illinois Class I Groundwater Levels, confirming the existence of VOC contamination at the site. Appendix A presents a tabulation of the groundwater data from the SL-10 Launch Area. Table 1 gives certain physical and chemical properties of these contaminants.

Table 1: Physical and Chemical Properties of Contaminants of Concern

Contaminant	Specific Weight	Water Solubility (mg/L)	Octanol/Water Partition Coeff.	Organic Carbon Coeff.	Vapor Pressure (mm Hg)	Henry's Law Constant (atm- m^3/mole)
1,1-DCE	1.2129	2250	2.13	65	600	$3.4x10^{-2}$
1,2-DCE (total)	1.27	3500.0 - 6300.0	2.09	49-59	200.0-320.0	6.5 - $7.6x10^{-3}$
1,1,2-TCA	1.4416	4500	2.5	56	30	$1.2x10^{-3}$
TCE	1.4649	1100	2.38	126	57.9	$9.1x10^{-3}$

An estimated plume boundary for TCE and its daughter products is shown in Figure 7. It appears from the analytical data that the VOC contamination covers an area in the eastern portion of the site from the vicinity of MW-13 north to near MW-11. Figures 8, 9 and 10 are a base map and two cross-sections showing the estimated vertical extent of the TCE contamination in the subsurface. The VOC plume that is in excess of the Maximum Contaminant Limit (MCLs) is roughly 500 feet long by 125 feet wide and 15 feet thick. The assumed porosity of the site soils is 20%. Based on these estimates that site plume may contain as much as 5,300 m^3 (1.4 million gallons) of water that is contaminated in excess of the MCLs for various VOCs.

The exact source of this contamination is unknown. Since the highest levels of groundwater contamination are near the former missile assembly and test building, it could be surmised that the contamination is a result of the use of solvents (which often contain VOCs) to clean equipment. However, this conjecture has not been confirmed.

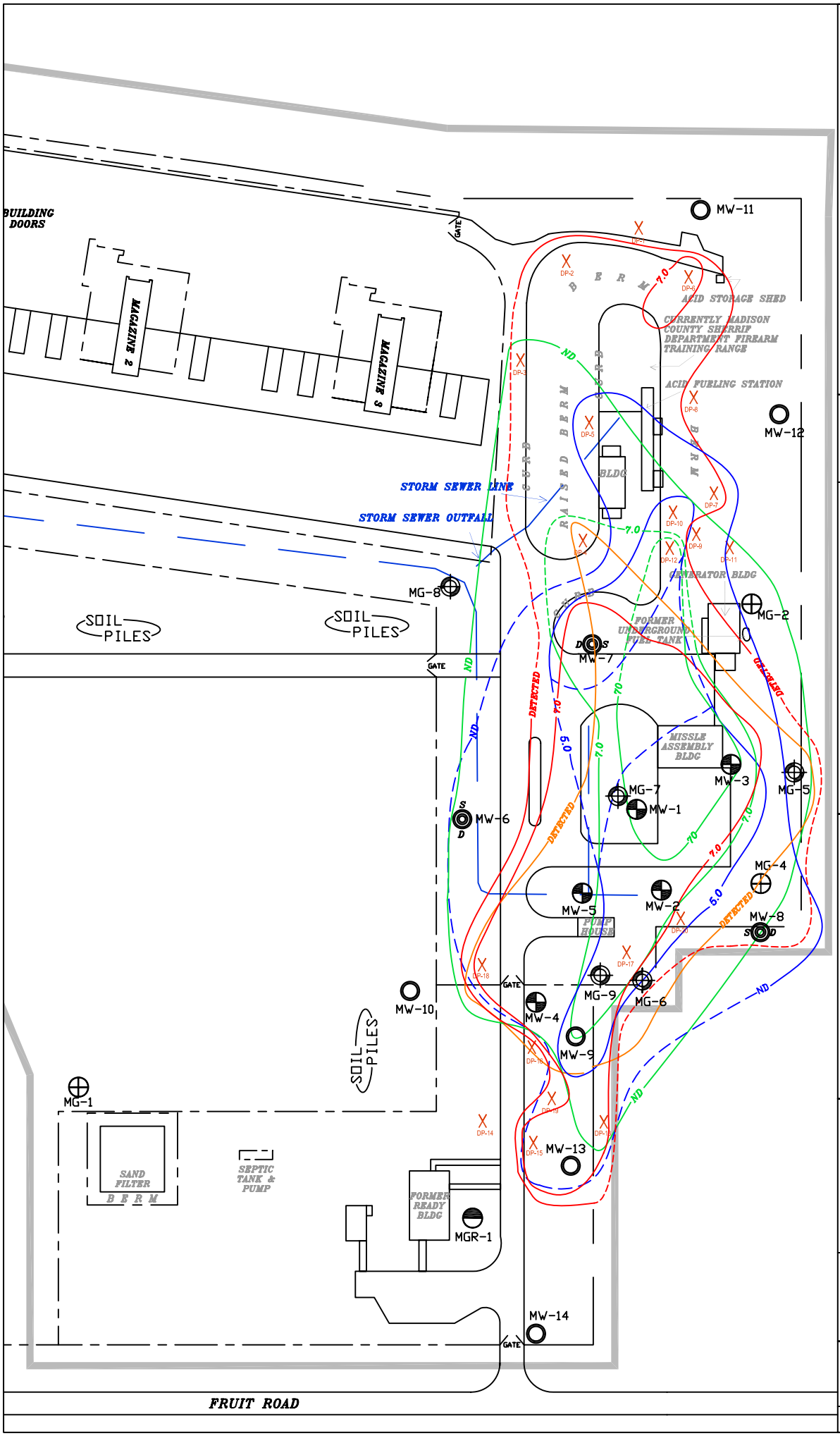
1.3.4 Contaminant Fate and Transport

1.3.4.1 Potential Routes of Migration

The primary route of migration for the contamination at Nike Site SL-10 is through the groundwater. The sandy silt unit located between overlying clay/silt and underlying clay/silt units at the site could potentially act as a preferential migration path for the groundwater, since it has a higher hydraulic conductivity than the clay layers.

1.3.4.2 Contaminant Persistence

The primary factor affecting persistence of VOCs in groundwater is biodegradation. Studies have shown that under anaerobic conditions, trichloroethene can be degraded to dichloroethene and then to vinyl chloride. This process is also referred to as natural attenuation. 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE and low levels of vinyl chloride have been detected in groundwater at the site indicating that natural attenuation of TCE is taking place via anaerobic degradation.



NOTE: MCL for TCE is 5 ug/L
NOTE: MCL for CIS-1,2-DCE is 70 ug/L
NOTE: MCL for 1,1-DCE is 7 ug/L
NOTE: MCL for TRANS-1,2-DCE is 100 ug/L

INFERRED ISOCONCENTRATION LINE

APPROXIMATE ISOCONCENTRATION LINE

DETECTED — LINE INDICATING AREA OF DETECTED 1,1-DEC IN GROUNDWATER

DETECTED — LINE INDICATING AREA OF DETECTED TRANS 1,1-DCE IN ug/L GROUNDWATER

TCE
1,1-DCE
TRANS-1,2-DCE
CIS-1,2-DCE

DP-1 DIRECT PUSH TEMPORARY WELLS (PLEXUS 2003)
MW-9 SINGLE MONITORING WELLS (PLEXUS 2002)
MW-6 NESTED PAIRS MONITORING WELLS (PLEXUS 2002)
MG-1 MONITORING WELL 1-4 (ENVIRODYNE 1998)
MG-5 MONITORING WELL 5-9 (SEC DONOHUE 1992)
MW-1 MONITORING WELL (NESTED PAIR) 1-5 (LAW 2002)
MGR-1 FORMER WATER SUPPLY WELL
S SHALLOW
D DEEP

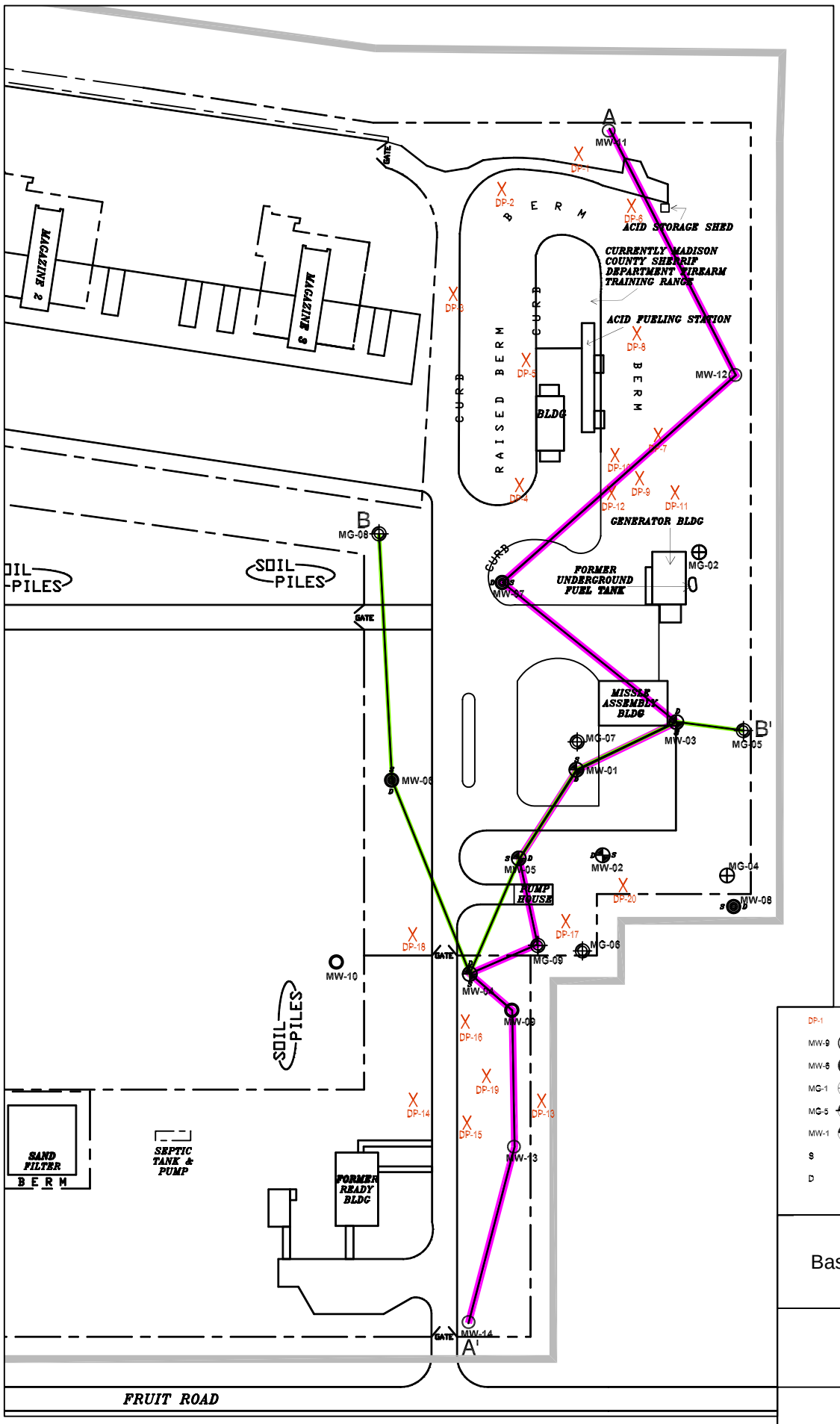
FIGURE 7
TCE AND DAUGHTER PRODUCTS ISOCONCENTRATIONS IN GROUNDWATER

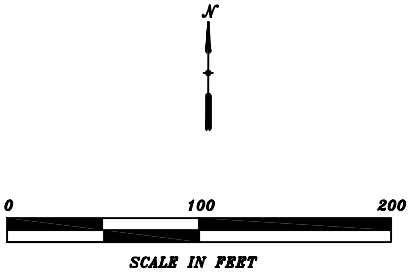
NIKE SL-10
LAUNCH AREA GROUNDWATER

RI/FS/PP/ROD
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE

PLEXUS

DRAWN BY: PEC
DATE: 06/13/06
CHECKED BY: XXX
DATE: XXX
PROJECT NO. 8032-008





B-B'

A-A'

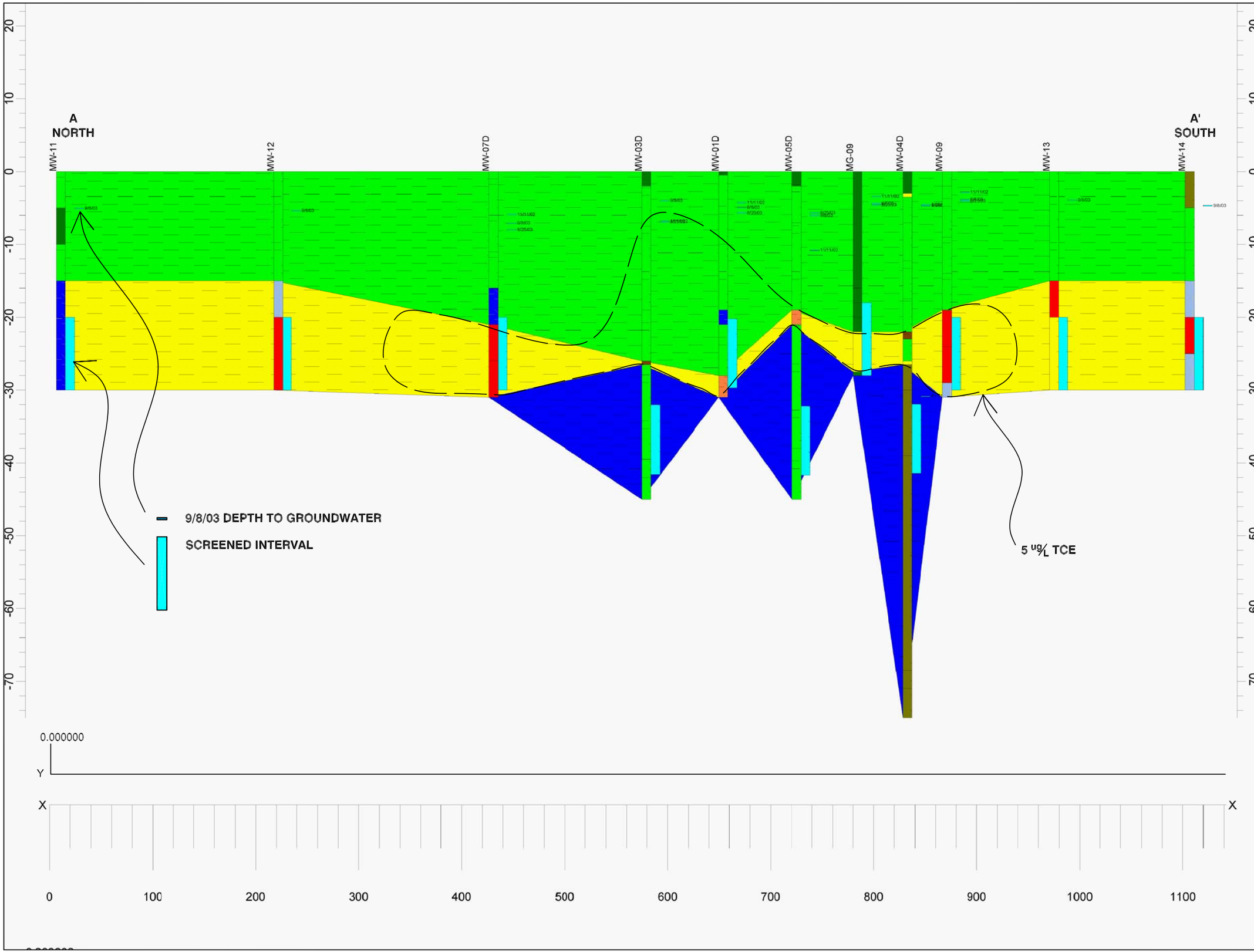
DP-1	DIRECT PUSH TEMPORARY WELLS (PLEXUS 2003)
MW-9	SINGLE MONITORING WELLS (PLEXUS 2002, 2003)
MW-8	NESTED PAIRS MONITORING WELLS (PLEXUS 2002)
MG-1	MONITORING WELL 1-4 (ENVIRODYNE 1998)
MG-5	MONITORING WELL 5-9 (SEC DONOHUE 1992)
MW-1	MONITORING WELL (NESTED PAIR) 1-5 (LAW 2002)
S	SHALLOW
D	DEEP

Figure 8
Base Map X-Sections A-A' & B-B'
2002/2003 Samples

Nike SL-10
Launch Area Groundwater
Feasibility Study

PLEXUS SCIENTIFIC

DRAWN BY: WVM
DATE: 10/13/2003
CHECKED BY: XXX
DATE: XXX
PROJECT NO. 8032-008



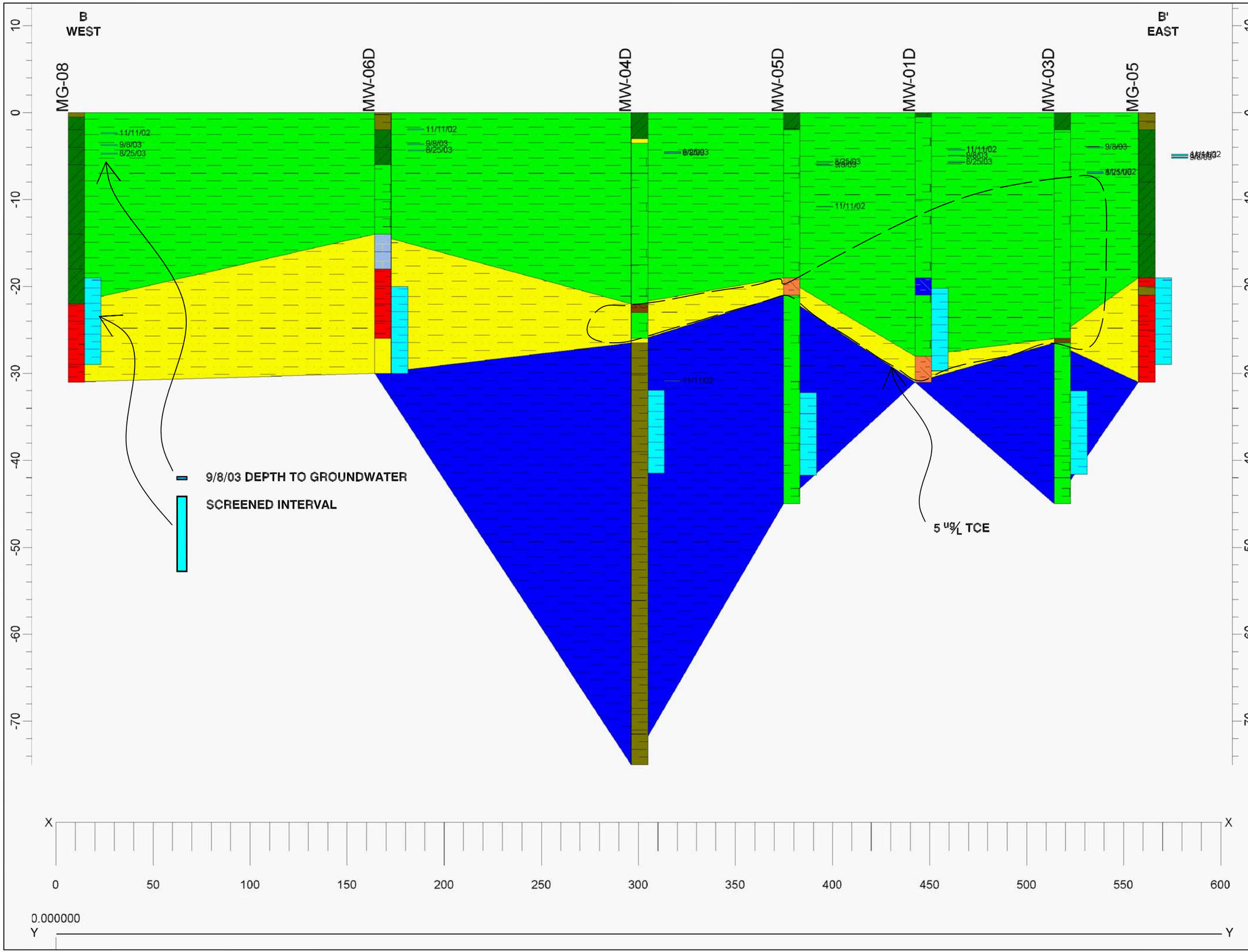
STRAT LEGEND	LITHOLOGY LEGEND
Overlying Silt-Clay	Clay
Sandy Silt	Clay/Silt
Underlying Silt-Clay	Sandy Clay
	Clayey Sand
	Silty Sand
	Gravel
	Silt
	Sand
	Sandy Silt

Figure 9
TCE Isoconcentration X-Section A-A'
2002/2003 Samples

Nike SL-10 Launch Area
Groundwater Feasibility Study
RI/FS/PP/ROD

PLEXUS

DRAWN BY: WWH
DATE: 10/29/2003
CHECKED BY: XXX
DATE: XXX
PROJECT NO. 8032-003



STRAT LEGEND	LITHOLOGY LEGEND
Overlying Silt-Clay	Clay
Sandy Silt	Clay/Silt
Underlying Silt-Clay	Sandy Clay
	Clayey Sand
	Silty Sand
	Gravel
	Silt
	Sand
	Sandy Silt

Figure 10
TCE Isoconcentration X-Section B-B'
2002/2003 Samples

Nike SL-10 Launch Area
Groundwater Feasibility Study
RI/FS/PP/ROD

PLEXUS

DRAWN BY: WVH
DATE: 10/29/2003
CHECKED BY: XXX
DATE: XXX
PROJECT NO. 8032-069

1.3.4.3 Contaminant Migration

As stated above, the primary constituents of concern for Nike Site SL-10 are VOCs. These contaminants are generally soluble in water (see Table 1) and as such are expected to be present in solution in the groundwater. The low organic carbon partition coefficients (K_{oc}) indicate that the contaminants would not strongly adsorb to organic materials. Based on their solubility and K_{oc} values, the contaminants are expected to be fairly mobile in the aquatic environment. However, the Henry's Law constants for these contaminants are all greater than 1.0×10^{-3} atm-m^3/mole, indicating that these contaminants would tend to volatilize from water if exposed to air.

1.3.5 Risk Assessment

The HHRA prepared, as part of the RI used, a residential scenario for an adult and a child living at the site and utilizing site water for drinking, bathing and other domestic uses. The water used in this scenario comes from the plume.

The BRA, in 1996 using data that had not been validated, identified two receptors for the groundwater contamination, the on-site residential well and an unnamed tributary of Silver Creek located to the southwest of the site. The BRA determined travel times to these receptors and future concentrations for each contaminant of concern. Travel times for the organic contaminants ranged from 8 to 240 years to travel the 90 feet from the source to the on-site well and from 190 to 5400 years to travel the 2000 feet from the source to the unnamed tributary. Using these travel times and the upper 95 percent confidence levels and mean concentrations of the contaminants of concern, the BRA predicted the future contaminant concentrations at the residential well and the unnamed tributary. Table 2 lists the contaminant travel times and predicted concentrations. The BRA then used these predicted concentrations and the current concentrations to determine the current and future risks to human health and the environment associated with the contaminated groundwater. The BRA concluded that there are no potential unacceptable environmental or human health risks associated with future contaminant concentrations in the unnamed tributary. The BRA also concluded that unacceptable potential carcinogenic health risks associated with future contaminant concentrations in the on-site residential well do exist. These risks were related to ingestion of drinking water and inhalation of vapors during showering and were primarily due to future groundwater concentrations of 1,1-dichloroethene in the residential well. However, since the on-site residential well has been decommissioned, these health risks no longer exist.

Table 2: Contaminant Travel Times and Predicted Concentrations

Contaminant of Concern	Residential Well			Unnamed Tributary			Illinois Class I (M/L)
	Travel Time (yrs)	Concentration (µg/L)		Travel Time (yrs)	Concentration (µg/L)		
		UCL 95	Mean		UCL 95	Mean	
1,1-DCE	16	50.9	29.0	360	4.50	2.56	7
1,2-trans DCE	15	11.1	4.39	330	0.980	0.389	100
1,2-DCE (total)	15	32.6	14.4	330	2.88	1.27	70
1,1,2-TCA	14	4.71	2.43	310	0.416	0.215	5
TCE	29	69.7	40.1	650	6.16	3.55	5

1.3.6 Focused Risk Assessment

Although the risk to the on-site residential well has been eliminated, other potential receptors do exist. Figure 11 shows a map of the area surrounding Nike Site SL-10. Southwest of the site, there are two residences, R1 and R2. Residence R1 is approximately 1500 feet distant from the contaminant plume, and R2 is approximately 1750 feet distant. These two residences currently receive their water supply from private groundwater wells. Following the same methodology used in the BRA (ESE 1995), the total potential carcinogenic health risks were determined for R1 and R2. The calculations were performed using the unvalidated data from the environmental investigations conducted prior to 1995. Appendix B gives the detailed calculations for determining the health risks. Table 3 gives the potential carcinogenic risks based on the reasonable maximum exposure (RME) and the reasonable average exposure (RAE), as well as the travel times to the residences. It can be seen from this table that RME cancer risks for both residences exceed the acceptable range of $1x10^{-6}$ to $1x10^{-4}$. Table 3 also shows that the primary contributor to the carcinogenic health risk are the future concentrations of 1,1-DCE in the residence wells. By working backwards, it was determined that an acceptable carcinogenic risk of less than $1x10^{-4}$ would first occur at a distance of 2200 feet from the current contamination plume. A 2200 foot radius around Nike Site SL-10 is shown in Figure 11. The only down gradient residences that fall within this radius are the previously identified R1 and R2. Therefore, these are the only receptors potentially threatened by the contaminant plume. As shown in Table 3, the travel times for 1,1-dichloroethene to reach wells R1 and R2 are 267 and 311 years, respectively, indicating that potential risks should not occur in the near future.

It seems very unlikely that the plume which appears to be contained on the site would migrate to either of these residences at concentrations above the Class I groundwater standards. It is unknown if the residences use municipal water, well water or a combination. There is a municipal water line that runs along Fruit Road between the houses (Plexus 2004). If the houses use well water and if there was

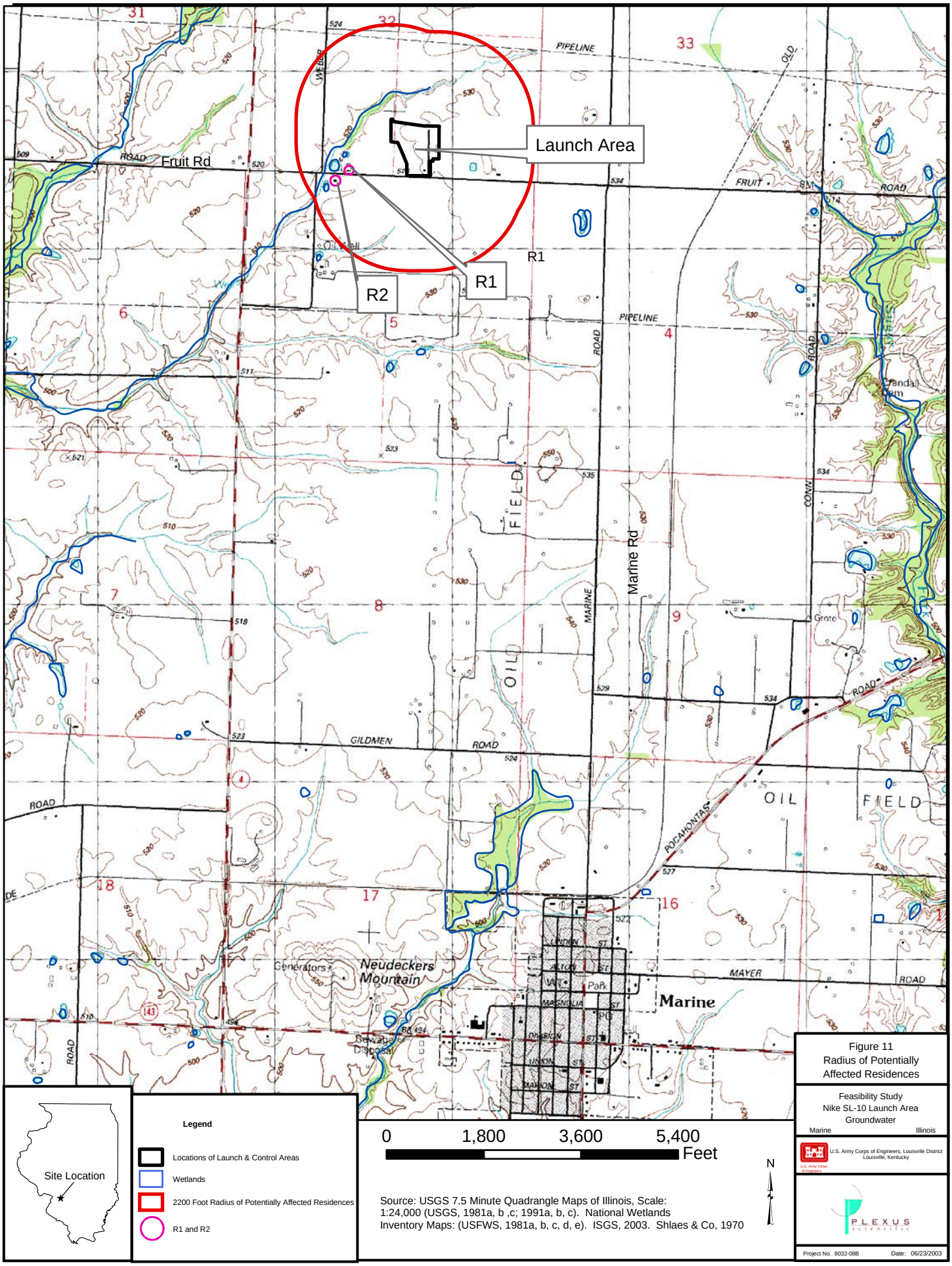
any indication that the contamination was going to impact the groundwater around these residential wells the residences could be switched to municipal water.

As with the BRA, there is overall a moderate potential for overestimation of potential human health risks, based on the conservative methodology and assumptions used in this analysis.

The data used in this Focused Risk Assessment was not validated and therefore according to current USACE policy is not usable in a risk assessment. This Focused Risk Assessment was retained in the FS to show the possible risk to off site receptors that was not a scenario evaluated in the HHRA.

Table 3: Future Carcinogenic Health Risks

Contaminant	Residence R1			Residence R2		
	Cancer Risk (RME)	Cancer Risk (RAE)	Travel Time (years)	Cancer Risk (RME)	Cancer Risk (RAE)	Travel Time (years)
Benzene	2.13E-7	1.55E-8	331	1.84E-7	1.34E-8	386
1,1-DCE	1.35E-4	1.04E-5	267	1.17E-4	9.01 E-6	311
PCE	2.66E-7	1.72E-8	1351	2.3E-7	1.49E-8	1576
1,1,2-TCA	7.72E-7	5.10E-8	233	6.68E-7	4.39E-8	272
TCE	1.43E-6	1.20E-7	487	1.49E-6	1.04E-7	568
TOTAL	1.38E-4	1.06E-5	-	1.20E-4	9.19E-6	-



Source: USGS 7.5 Minute Quadrangle Maps of Illinois, Scale: 1:24,000 (USGS, 1981a, b ,c; 1991a, b, c). National Wetlands Inventory Maps: (USFWS, 1981a, b, c, d, e). ISGS, 2003. Shlaes & Co, 1970

Figure 11
Radius of Potentially Affected Residences

Feasibility Study
Nike SL-10 Launch Area
Groundwater

Marine Illinois

U.S. Army Corps of Engineers, Louisville District
Louisville, Kentucky

PLEXUS scientific

Project No. 8032-088 Date: 06/23/2003

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 Introduction

Before remedial action alternatives can be evaluated, the remedial technologies that make up the alternatives must be screened for applicability to the site under investigation. The steps that precede the remedial action alternative evaluation are the following:

- Remedial action objectives (RAOs) must be specified for the contaminants and media of interest
- Applicable or Relevant and Appropriate Requirements (ARARs) must be established for the project
- General response actions (GRAs) that may be taken to satisfy the remedial objectives must be identified for all media of interest
- Remedial action technology types and process options must be identified and screened for applicability to the site of interest
- The process options that are applicable are assembled into remedial action alternatives.

This section identifies and screens remedial technologies using the process outlined in USEPA Remedial Investigation/Feasibility Study (RI/FS) guidance and the NCP (USEPA, 1988 and 1990). Technologies were identified to attain the RAOs and to correspond to the categories of general response actions described in Section 2.4 below. Demonstrated performance of each technology for site contaminants and conditions was considered during technology identification. The result is a list of potential remedial technologies that are screened based on their effectiveness, implementability and cost. The purpose of the screening is to produce an inventory of suitable technologies that can be assembled into candidate remedial alternatives capable of mitigating actual or potential risks at the Nike SL-10 Launch Area. An extensive list of potential technologies representing a range of general response actions (i.e., no action, limited actions, containment, treatment, and removal) was considered to develop the candidate remedial alternatives. This process is consistent with USEPA guidance.

The remaining subsections of Section 2.0 cover the first 4 steps listed above, while Section 3.0 covers the development of the remedial action alternatives.

2.2 Remedial Action Objectives

RAOs are statements that define the extent to which sites require cleanup to meet the objectives of protecting human health and the environment. RAOs reflect the contaminants of concern, exposure routes and receptors, and acceptable contaminant concentrations for each medium of concern. RAOs are classified as either general or specific. General RAOs can be applied to all CERCLA sites; specific RAOs reflect site-specific and media-specific conditions.

Once developed, RAOs can be expressed numerically as preliminary cleanup goals. Preliminary cleanup goals are the chemical concentrations, in this case in groundwater, that achieve the level of protection specified by the RAOs. The preliminary cleanup goals provide a basis for delineating the extent and volume of contaminated media that

is necessary when remedial alternatives are being evaluated and compared within the FS process. Preliminary cleanup goals should not be considered final remediation goals or cleanup levels to be achieved by remedial action. Specific uses for preliminary cleanup goals include: (1) to identify target areas that require remediation; (2) to identify minimum detection limits for analytical methods to verify that contaminant concentrations protective of human health and the environment have been attained after remediation; (3) to provide "look-up" tables for use in the field to rapidly evaluate analytical data collected during remedial action; and (4) to verify that residual contamination achieves RAOs.

2.2.1 General RAOs

The general RAOs include:

- Protect human health and the environment by reducing the risk of potential exposure to contaminants
- Expedite site cleanup and restoration
- Use permanent solutions to the extent possible
- Consider innovative technologies to reduce the duration and cost of remedial actions
- Restore the site to the extent possible to support existing land uses
- Achieve compliance with ARARs
- Be compatible with other actions
- Be flexible enough to respond to reuse priorities and changes in reuse priorities.

2.2.2 Specific RAOs

The RAOs for the groundwater contamination at Nike Site SL-10 are the following:

- To reduce the risk to human health by preventing current or future ingestion of groundwater having VOC contaminant concentrations greater than ARARs
- To reduce the risk to the environment by restoring the aquifer groundwater to VOC contaminant concentrations below ARARs.

A general discussion of ARARs and a discussion of the ARARs for Nike Site SL-10 are given in Section 2.3.

2.3 Applicable or Relevant and Appropriate Requirements

Under the CERCLA statute, two mandates establish the underlying legal and regulatory requirements for CERCLA actions. CERCLA §121(d)(1) requires remedial actions to attain a degree of cleanup that assures protection of human health and the environment [42 U.S.C. §9621(d)(1)]. This CERCLA requirement is implemented through means of a risk assessment which, based on site-specific exposures, identifies contaminant exposure pathways that present either a current or potential future unacceptable risk. When such a risk is identified, remedial or removal action is required to address the unacceptable risk. Second, CERCLA §121 (d)(2)(A) requires that on-site remedial actions must meet the standards and criteria that are otherwise legally applicable to the substance, pollutant, or contaminant or that are relevant and appropriate under the circumstances [42 U.S.C. §9621(d)(2)(A)]. The compliance with ARARs mandate arises under CERCLA §121(d)(2)(A) when an on-site remedial action is required.

2.3.1 Identification and Application of ARARs

Requirements of CERCLA, SARA and the NCP state that ARARs are to be identified during the development of remedial alternatives. ARARs are federal and state human-health and environmental requirements used to:

1. Evaluate the appropriate extent of site cleanup
2. Define and formulate remedial action alternatives
3. Govern implementation and operation of the selected action.

To properly consider ARARs and to clarify their function in remedial response processes, the NCP defines two ARAR categories: (1) applicable requirements, and (2) relevant and appropriate requirements. In addition, the NCP identifies a third category of guidance, termed “information to be considered” (TBC). These definitions are discussed briefly in the following paragraphs.

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site. An example of an applicable requirement is the use of MCL drinking water standards for a site where groundwater contamination has affected a public water supply.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site, address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site. There is discretion in this determination in that it is possible for only part of a requirement to be considered relevant and appropriate, the rest being dismissed if judged not to be relevant and appropriate in a given case. For example, MCLs for drinking water would be relevant and appropriate requirements at a site where groundwater contamination could affect a potential, rather than actual, drinking water source.

Information to be considered consists of non-promulgated advisories or guidance issued by the federal or state government that are not legally binding, and do not have the status of ARARs. However, if there are no specific ARARs for a chemical or site condition, or if existing ARARs are not deemed sufficiently protective, then guidance or advisory criteria should be identified and used to confirm protection of human health and the environment.

Because of their site-specific nature, identification of ARARs require evaluation of federal, state, and local environmental and health regulations regarding chemicals of concern (COCs), site characteristics, and proposed remedial alternatives. Requirements that pertain to the remedial response at a CERCLA site can be categorized in three distinct areas:

Chemical-specific ARARs are typically health- or risk-based numerical values or methodologies that establish site-specific acceptable chemical concentrations or

amounts. These values are used to develop quantitative action levels or preliminary remediation goals (PRGs).

Location-specific ARARs involve restrictions established for specific substances or activities based solely on their location.

Action-specific ARARs involve performance, design, or other action-specific requirements and are generally technology or activity-based.

2.3.2 Chemical Specific ARARs

Chemical-specific ARARs are numerical values or procedures that, when applied to a specific site, establish numerical limits for individual chemicals or groups of chemicals. These ARARs will govern the extent of site remediation by providing either actual cleanup levels or the basis for calculating such levels. The chemical-specific ARARs that have been considered are presented in Table 4.

Groundwater. In the groundwater media, the Illinois Environmental Protection Agency (IEPA) Class I groundwater standards will be used as appropriate, to develop remedial alternatives.

2.3.3 Location-Specific ARARs

Location-specific ARARs set restrictions on the concentrations of hazardous substances or the performance of activities solely because they are in special locations. These ARARs set restrictions relative to special locations such as wetlands, floodplains, sensitive ecosystems, and historical or archeological sites, and provide a basis for assessing existing site conditions. The location-specific ARARs that have been considered are presented in Table 5.

2.3.4 Action-Specific ARARs

Action-specific ARARs, unlike chemical or location-specific ARARs, are technology or activity based limitations that direct how remedial actions are conducted. The applicability of this set of requirements is directly related to the particular remedial activities selected for the site. Evaluation of action-specific ARARs is one criterion for assessing the feasibility and effectiveness of proposed remedial alternatives. The action-specific ARARs that have been considered are presented in Table 6.

2.3.5 Other Regulatory Considerations

Although there are several laws and regulations related to worker safety, (e.g., under the Occupational Safety and Health Administration [OSHA]) and transportation (e.g., under the Department of Transportation [DOT]), these are not environmental laws and therefore are not cited as ARARs. The remedial actions would however be conducted in accordance with OSHA standards (e.g., Safety and Health Standards; 29 Code of Federal Regulation [CFR] 1910) and DOT requirements (e.g., Hazardous Materials Transportation Regulations; 49 CFR 173 Subpart I) and any other appropriate health and safety regulation. These later regulations and rules that will be considered during remediation are presented in Table 7.

Table 4: Chemical-Specific ARARs, Criteria, Advisories, and Guidance

Feasibility Study
Nike SL-10 Launch Area
Marine, Illinois

Media	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
Groundwater				
Federal	Safe Drinking Water Act (SDWA)	Relevant and Appropriate	The SDWA establishes both Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs). MCLs are enforceable standards that apply to specified contaminants that the United States Environmental Protection Agency (USEPA) has determined to adversely affect human health when above certain levels. MCLs are set as close as feasible to MCLGs (feasibility in this determination takes both technology and cost considerations into account). MCLGs are non-enforceable, health-based goals that have been established at levels where no known or anticipated adverse effects on human health can occur, and still allow an adequate margin of safety.	The remedial action alternatives will provide a reduction in groundwater contaminant concentrations in accordance with these requirements.
State	State of Illinois, Illinois Administrative Code (IAC) Groundwater Quality Regulations Title 35: Environmental Protection, Subtitle F: Public Water Supplies, Chapter 1: Pollution Control Board, Part 620, Groundwater Quality, Section 620.210 Class I: Potable Resource Groundwater Section 620.410 Groundwater Quality Standards for Class I: Potable Resource Groundwater (a through e).	Relevant and Appropriate	Groundwater quality standards have been promulgated for several common organic and inorganic contaminants. These levels regulate the concentration of contaminants in groundwater. USEPA has delegated to the State authority for primacy on groundwater issues in the State.	The remedial action alternatives will provide a reduction in groundwater contaminant concentrations in accordance with these requirements.
	(35 IAC 742) Tiered Approach to Corrective Action Objectives (TACO)	Relevant and Appropriate	TACO provides look-up tables of contaminant concentration information sufficient for the purposes of a screening risk assessment. The tables in TACO present	The remedial action alternatives will provide a reduction in groundwater

Table 4: Chemical-Specific ARARs, Criteria, Advisories, and Guidance

Feasibility Study
Nike SL-10 Launch Area
Marine, Illinois

Media	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
			acceptable concentrations under various exposure scenarios. These acceptable contaminant concentrations are individually calculated using methodologies consistent with USEPA's Risk Assessment Guidance for Superfund (RAGS). The TACO tables are also consistent with the available Federal Soil Screening Levels (SSLs).	contaminant concentrations in accordance with these requirements.

Notes:
ARAR = Applicable or Relevant and Appropriate Requirement
IAC = Illinois Administrative Code
MCL = Maximum Contaminant Limit
MCLG = Maximum Contaminant Limit Goal
RAGS = Risk Assessment Guidance for Superfund
SDWA = Safe Drinking Water Act
TACO = Tiered Approach to Corrective Action Objectives
SSL = Soil Screening Levels

Table 5: Location-Specific ARARs, Criteria, Advisories, and Guidance

Feasibility Study
Nike SL-10 Launch Area
Marine, Illinois

Media	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
Wetland/Floodplains				
Federal	Floodplain Management Executive Order No. 11988 (40 CFR Part 6, App. A)	To Be Considered	Requires federal agencies to evaluate the potential adverse effects associated with direct and indirect development of a floodplain. Under this order, federal agencies are required to avoid long-term and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid support of floodplain development wherever there is a practicable alternative.	Remedial action alternatives will be designed and implemented to minimize adverse impacts on the floodplains. If adverse impacts cannot be avoided, appropriate actions will be taken to restore the floodplain.
	Protection of Wetlands Executive Order No. 11990 (40 CFR Part 6, App. A)	Applicable, if remedial actions are preformed within wetlands.	Under this Order, federal agencies are required to minimize the destruction, loss, or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. If remediation is required within wetland areas, and no practical alternative exists, potential harm must be minimized and action taken to restore natural and beneficial values.	Remedial action alternatives will be designed and implemented to minimize adverse impacts on the wetlands. If adverse impacts cannot be avoided appropriate actions will be taken to restore the natural and beneficial values of the wetlands.
Other Natural Resources				
Federal	National Historic Preservation Act (16 USC 470, et seq.)	Applicable	This act requires that actions be taken to preserve historic properties, recover and preserve artifacts, and minimize harm to National Historic Landmarks.	It is not anticipated that historic properties or artifacts are located within areas where remedial action activities will be conducted. However, if historic properties or artifacts are encountered during the remedial actions, efforts will be taken to recover and preserve the artifacts and minimize harm to the historic properties in accordance with these requirements.

Notes: ARAR = Applicable or Relevant and Appropriate Requirement
CFR = Code of Federal Regulation
USC = U.S. Code

Table 6: Potential Action-Specific ARARs, Criteria, Advisories, and Guidance

Feasibility Study
Nike SL-10 Launch Area
Marine, Illinois

Media	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
Surface Water				
Federal	Clean Water Act (CWA) National Pollutant Discharge Elimination System (NPDES) (40 CFR Parts 122, 125, 131, and 136)	Applicable	This rule requires permits for the discharge of pollutants from any point source into U.S. waters.	If ground water is extracted and treated at the site prior to discharge to surface water the effluent will meet discharge limitations, monitoring requirements, and best management practices.
Groundwater				
Federal	Use of Monitored Natural Attenuation (MNA) at Superfund, Resource Conservation and Recovery Act (RCRA) Corrective Action, and Underground Storage Tank Sites, USEPA Office of Solid Waste and Emergency Response (OSWER) Directive 9200.4-17P, April 1999.	To Be Considered	This directive provides guidance regarding the use of monitored natural attenuation for the remediation of contaminated groundwater at sites regulated under OSWER programs.	The FS evaluation of natural attenuation as a remedy meets USEPA policy by assessing the protectiveness of human health and the reasonableness of the remedial timeframe in comparison with remedial alternatives and by presenting the efficacy of natural attenuation through site characterization. A performance monitoring program will be implemented to meet the objectives of the directive.
Waste Material				
Federal	RCRA Identification and Listing of Hazardous Waste; Toxicity Characteristic (40 CFR Part 261.24)	Applicable	This requirement defines those wastes that are subject to regulation as hazardous waste under 40 CFR Parts 124 and 264.	Analytical results will be evaluated against the criteria and definitions of hazardous waste. The criteria and definition of hazardous waste will be referred to and utilized in development of alternatives and during removal actions.

Table 7: Potential Action-Specific ARARs, Criteria, Advisories, and Guidance

Feasibility Study
Nike SL-10 Launch Area
Marine, Illinois

Media	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
Federal (cont.)	RCRA Standards Applicable to Generators of Hazardous Waste (40 CFR Part 262)	Applicable	These standards govern storage, labeling, accumulation times, and disposal of hazardous waste.	Any hazardous waste generated during removal action activities will be managed in accordance with these standards.
	RCRA Container Storage Requirements (40 CFR Part 264, Subpart I)	Applicable	These requirements apply to owners and operators of facilities that use container storage to store hazardous waste.	If containers are used to store materials that are hazardous wastes, the containers will be managed according to these rules.
	RCRA Land Disposal Restrictions pertaining to Universal Treatment Standards (UTS) (40 CFR Part 268.48)	Applicable	The UTS identifies the hazardous constituents, along with the non-wastewater and wastewater treatment standard levels, that are used to regulate most prohibited hazardous wastes with numerical limits.	As a minimum, the UTS will be met in establishing treatment levels necessary for disposal in hazardous waste landfills or discharge to surface water.
	RCRA Miscellaneous Units Requirements (40 CFR Part 264, Subpart X)	Applicable	These requirements apply to owners and operators of facilities that treat, store, or dispose of hazardous waste in miscellaneous units.	If miscellaneous units are used to store materials that are hazardous wastes, the units will be managed according to these requirements.
	RCRA Tanks Systems Requirements (40 CFR Part 264, Subpart J)	Applicable	These requirements apply to owners and operators of facilities that use tank systems for storing or treating hazardous waste.	If tank systems are used to store materials that are hazardous wastes, the tank systems will be managed according to these requirements.
	USEPA OSWER Publication 9345.3 - 03 FS, January 1992	To Be Considered	Management of IDW must ensure protection of human health and the environment.	IDW that may be produced from well installation and groundwater sampling will comply with ARARs.

Notes:
ARAR = Applicable or Relevant and Appropriate Requirement
MNA = Monitored Natural Attenuation
OSWER = Office of Solid Waste and Emergency Response
UTS = Universal Treatment Standards
CWA = Clean Water Act
NPDES = National Pollution Discharge Elimination System
RCRA = Resource Conservation and Recovery Act

The federal and state objectives for the primary contaminants of concern are given in Table 8, as well as the maximum measured concentration for the Nike SL-10 Launch Area.

Table 8: Federal and State Groundwater Standards

Compound	Federal MCL (µg/L)	Illinois Class I (µg/L)	Illinois Class II (µg/L)	Maximum Measured (µg/L)
1,1-Dichloroethene	-	7	35	329
cis-1,2-Dichloroethene	70	70	200	461
trans-1,2-Dichloroethene	100	100	500	120.0*
1,1,2-Trichloroethane	5	5	50	293
Trichloroethene	5	5	25	1390
Vinyl chloride	2	2	10	2.76

*Total 1,2-Dichloroethene

2.4 General Response Actions

GRAs describe the broad range of actions that will satisfy the RAOs. GRAs may include no-action, limited actions, disposal, treatment, or a combination of these. Similar to RAOs, GRAs are medium-specific.

Except for the no-action alternative, each GRA can be achieved by several remedial technologies. In this context, the following definitions apply:

- Remedial technologies are defined as the general categories of remedies under a GRA. For example, pump and treat is one of the remedial technologies under the GRA of ex-situ treatment.
- Process options are specific categories of remedies within each remedial technology. The process options are used to implement each remedial technology. For example, the remedial technology of pump and treat could be implemented using one of several types of treatment options (e.g., in dual phase extraction). Process options in some cases may be useful in some aspect of site remediation without necessarily satisfying an RAO. In many cases more than one process option would be required to satisfy an RAO. For example a groundwater treatment train might require a granular carbon filter to remove organics, a chemical reduction step to remove some inorganics and an ion exchange filter to remove other inorganics.

The first step in determining remedial alternatives is to look at GRAs that could mitigate the contamination problem. GRAs for groundwater contamination are:

- No action
- Institutional controls
- MNA
- Disposal (Collection and Discharge)
- Treatment.

The no-action GRA cannot satisfy RAOs and is used solely for comparison. Institutional controls are actions that limit exposure to contaminated material without actually treating the contamination. Institutional controls are potentially applicable for contaminated groundwater sites. MNA would monitor the contamination as it is degraded naturally. The MNA response is feasible for the groundwater contamination. The disposal response simply means disposing of the contaminated material (Collection and Discharge), which is feasible for contaminated groundwater if combined with other treatment. The treatment response involves restoring the contaminated media to an acceptable level of contamination, as dictated by ARARs. The treatment response is also feasible for groundwater contamination.

2.5 Identification of Technologies and Process Options

Following the development of GRAs, potential remedial technologies and process options for implementing the GRAs are identified. A universe of technology types and process options is available to implement the GRAs. Potentially applicable technology types and process options were identified from various sources, including references developed specifically for application to CERCLA sites, Internet searches, vendor-supplied information, standard engineering texts and others. The purpose of drawing on these sources is to ensure that applicable technologies and process options are not overlooked early in the FS process. Table 9 identifies applicable remedial technologies and associated process options for each GRA for groundwater. Table 10 describes the technologies and process options identified.

Following the identification process, two steps are performed:

- Technology process options are screened based on effectiveness, implementability and relative cost.
- Representative process options are selected.

These steps are described in the following sections. The significance of innovative technologies and presumptive remedies is also discussed.

2.6 Technology Screening

Process options for each technology are screened using the criteria of effectiveness, implementability and relative cost, which are described below.

The evaluation of process options for remediation of the groundwater are shown on Figure 12. Technologies and process options that are eliminated on the basis of effectiveness, implementability, and/or cost are represented with an X through the process option box on this figure. Table 11 summarizes the technologies and process options retained after screening.

2.6.1 Effectiveness

Specific process options are evaluated by considering the following factors:

1. The potential effectiveness of a process option to address the estimated areas or volumes of contaminated media and meet the goals identified in the general and/or specific RAOs.
2. The potential impacts to human health and the environment during the construction and implementation phases.

3. How reliable and proven the process is with respect to the types of contamination and site conditions that will be encountered.

Table 9: Potential Remedial Technologies for Groundwater

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

General Response Action	Remedial Technology	Process Option
No action	No Action. Not applicable	**No Action.** Not applicable
Limited action	Natural attenuation	**Monitored Natural Attenuation**
	Access and use restrictions	Land use restrictions Permits
Containment	Capping	Soil cover system Clay and soil cap Synthetic membrane Asphalt cap Concrete cap **Engineered cap (multi-layer)** Sprayed asphalt Chemical sealants/stabilizers
	Vertical barriers	Soil-bentonite slurry wall Cement-bentonite slurry wall Vibrating beam Grout curtain Sheet piling Ground freezing
	Horizontal barriers	Grout injection Liners Block displacement Ground freezing
	Encapsulation	Total encapsulation
In-situ treatment	Physical stripping (VOCs)	Air sparging Recirculation wells
	Chemical oxidation (VOCs)	Ozone Fenton's reagent Potassium permanganate
	Thermal enhancement (VOCs)	Electrical resistive heating (3 phase/6 phase) Steam/hot water/hot air injection Radio-frequency heating

Table 9: Potential Remedial Technologies for Groundwater

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

General Response Action	Remedial Technology	Process Option
In-situ treatment (cont.)	Biological treatment (VOCs)	**Enhanced bioremediation** Phytoremediation
	Passive treatment walls	Zero-valent iron permeable reactive barrier
Collection	Extraction	Interceptor trenches **Extraction wells** Dual-phase extraction Enhanced removal French drains
Ex-situ treatment	Physical/chemical treatment	**Granular activated carbon** (GAC) adsorption Air stripping Phase separation Ultraviolet oxidation Evaporative ponds Reverse osmosis Liquid/liquid extraction Distillation Freeze crystallization Supercritical extraction Supercritical water oxidation
	Thermal	Incineration Wet air oxidation
	Off-site treatment	Town of Marine POTW RCRA treatment facility
Discharge	On-site discharge	**Surface drainage** Re-injection
	Off-site discharge	Town of Marine POTW
	Reuse	Industrial, agricultural

Notes: **Bold** indicates a representative process option.

Table 10: Description of Groundwater Process Options

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

General Response Action/ Technology	Description of Process Options
No action None	**No Action**. No actions taken to reduce risk or monitor groundwater.
Limited action Natural attenuation	**Monitored Natural Attenuation.** Demonstrate through groundwater sampling, contaminant trend analysis, mass balance calculations and modeling that loss of contaminants is occurring and that contaminant degradation and natural physical processes (biological degradation, diffusion and dispersion) may reduce contaminant concentrations to acceptable levels.
Institutional controls	Land use restrictions. Through community zoning ordinances, restrict numerous parcels of land within a given area to a specific land use (e.g., commercial/industrial). With legal instruments of property transfer (e.g., deed, easements, etc.), prohibit use of groundwater underlying and immediately down gradient of the site. Permits. Permitting requirements for reuse. Permits are issued to regulate use of land/groundwater.
Containment Capping	Soil cover system. Placement of soil to reduce surface water infiltration and prevent contact with contaminated soil/groundwater. Clay and soil cap. Placement of clay and soil to prevent exposure to contaminated soil/groundwater. The clay will limit the infiltration of surface water. Synthetic membrane. Placement of a synthetic membrane to prevent exposure to contaminated soil/groundwater. The membrane will limit the infiltration of surface water. Asphalt cap. Placement of an asphalt cap to prevent exposure to contaminated soil/groundwater. The asphalt will limit the infiltration of surface water. Concrete cap. Placement of a concrete cap to prevent exposure to contaminated soil/groundwater. The concrete will limit the infiltration of surface water. **Engineered cap.** Placement of low-permeability material to prevent exposure to contaminated soil/groundwater and leaching of soil contaminants.
Vertical barriers	Soil-bentonite slurry wall. Trench is excavated around contaminated area and backfilled with soil-bentonite slurry. Cement-bentonite slurry wall. Trench is excavated around contaminated area and backfilled with cement-bentonite slurry. Vibrating beam. Vibrator force is used to advance a steel beam into the ground. Bentonite or cement slurry is injected as the beam is withdrawn. Grout curtain. Grout is pressure-injected around the contaminated area boundary in regular overlapping pattern of drilled holes. Sheet piling. Sheet pile is driven around the contaminated area boundary. Ground freezing. Coolant is circulated through refrigeration pipes to freeze the ground for seepage control.

Table 10: Description of Groundwater Process Options

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

General Response Action/ Technology	Description of Process Options
Horizontal barriers	Grout injection. Grout is pressure-injected through closely spaced drilled holes to form a horizontal barrier to downward contaminant migration. Liners. Liners placed in pits to restrict the vertical transport or leaching of contaminants from soil or wastes. Block displacement. Controlled injection of slurry in notched injection holes produces a horizontal barrier beneath contamination. Used in conjunction with vertical barriers to encapsulate a block of soil/groundwater. Ground freezing. Coolant is circulated through refrigeration pipes to freeze the ground for seepage control. Produces a horizontal barrier beneath the contamination.
Encapsulation	Total encapsulation. Combines horizontal and vertical barriers with a cap.
In-situ treatment Physical stripping	Air sparging. Removes VOCs from groundwater and saturated soil by forcing air into the saturated zone and inducing air flow through the soil matrix. Volatile contaminants partition to the air stream. Typically combined with soil vapor extraction (SVE) to collect contaminated vapor prior to reaching the ground surface. Recirculation wells. Utilizes a vertical groundwater circulation cell constructed with a single well casing with an upper and lower well screen. Contaminated groundwater enters into the well through one screen, is treated by air stripping within the upper well casing, and is discharged through the other well screen. Hydraulic heads and flows are controlled so that groundwater may pass through the well/treatment system several times before being released to the regional groundwater flow system.
Chemical oxidation	Ozone. Ozone is a highly reactive gas that is typically generated on site. It is injected through injection wells into the aquifer. In contrast to other types of chemical oxidants, ozone does not typically create organic residuals that remain in the aquifer after treatment. Ozone is an extremely powerful oxidant and it non-selectively oxidizes compounds dissolved in groundwater. Fenton's reagent. Fenton's reaction uses hydroxyl radicals produced from the mixing of hydrogen peroxide and a catalyst (usually iron-based) to break down organic contaminant chemical bonds. An acid is usually added to the contaminated groundwater, prior to addition of the hydrogen peroxide and catalyst, to lower groundwater pH and facilitate the reaction. Hydrogen peroxide and the catalyst are then delivered to the subsurface separately to prevent generation of hydroxyl radicals prior to contact with contaminated groundwater. The products of the reaction with chlorinated solvents are carbon dioxide, water and chloride ions. Potassium permanganate. Potassium permanganate is mixed with water and injected into the subsurface. The solution breaks down organic contaminants into carbon dioxide, manganese dioxide and chloride ions. The treatment process is often facilitated by extraction of contaminated groundwater down gradient of the treatment zone, mixing of the solution, and re-injection of the solution up gradient of the treatment zone.

Table 10: Description of Groundwater Process Options

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

General Response Action/ Technology	Description of Process Options
Thermal enhancement	Electric resistance heating. Process uses conventional electricity for resistive heating of soil and groundwater. Voltage gradient causes an electrical current to flow through soil and groundwater between electrodes. Resistance causes temperature to rise to the boiling point of water, stripping VOCs and semi-volatile organic compounds (SVOCs) from pore spaces. Steam/hot water/hot air injection. Steam/hot water/hot air is forced into the subsurface through injection wells to vaporize VOCs and SVOCs. Vaporized components rise to the unsaturated zone where they can be removed with an off-gas collection system and treated, if necessary. Radio frequency (RF) heating. Electromagnetic (EM) energy is introduced to the subsurface through the use of radio waves emitted through transmitters located in wells in the treatment area. The energy heats up the aquifer materials and volatilizes the VOCs. Vapors are recovered with typical vapor extraction systems. The efficiency of RE heating is adversely affected by the continued presence of water in the treatment zone.
Biological treatment	**Enhanced bioremediation.** Organic and inorganic nutrients are added to the groundwater using a matrix of injection wells to promote anaerobic biodegradation resulting in dechlorination of chlorinated compounds. For degradation of TCE, lactic acid would be injected and metabolized by indigenous anaerobic bacteria to produce hydrogen. Phytoremediation. Uses naturally occurring or genetically engineered vegetation to clean up or contain contaminated environmental media. Poplars would be a candidate species for phytoremediation in the area.
Passive treatment walls	Zero-valent iron permeable reactive barrier. A permeable wall is constructed using granular zero-valent iron. The iron is placed in the ground by trenching, injection, augering or other method. Chlorinated VOCs (dissolved-phase) are degraded abiotically (dechlorinated) as they pass through the wall by transfer of electrons from the iron to the VOCs.
Collection Extraction	Interceptor trenches. Trenches, drains, and piping are used to passively collect (i.e., gravity flow) groundwater. **Extraction wells.** Installed to collect groundwater through pumping. Wells are typically installed using augers in unconsolidated soils. Wells in bedrock are installed by coring the rock. A screen is placed at the desired depth in the well and covered with a filter pack. The remaining annulus is filled, typically with grout or bentonite. Typically a pump is used to extract contaminated groundwater from the screened interval. Dual-phase extraction. A high-vacuum system is applied to simultaneously remove liquid (groundwater) and gas (i.e. soil vapor) from low-permeability or heterogeneous formations. Enhanced removal. A surfactant is added to the aquifer to enhance the recovery of organics that are adhering to the aquifer matrix. The groundwater, surfactant and contaminants are pumped from the aquifer through extraction wells.
Ex-situ treatment Physical/chemical	**Granular activated carbon.** Activated carbon adsorption is a physical separation process in which contaminants are removed from groundwater or air by sorption (i.e., the attraction and accumulation of one substance on another). Contaminants are removed by sorption onto available granular-activated carbon sites that are periodically regenerated. Air stripping. Removes VOC and high-vapor pressure SVOCs from extracted groundwater by contacting contaminated water with large volumes of air. Contaminants are transferred from liquid phase to gas phase. Off-gas may require further treatment to meet air regulations.

Table 10: Description of Groundwater Process Options

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

General Response Action/ Technology	Description of Process Options
Physical/chemical (cont.)	Phase separation. An oil-water separator or a coalesing plate filter can be used to separate NAPL from dissolved groundwater contamination. Ultraviolet oxidation. Oxidation involves destroying VOCs in groundwater by changing the oxidation state of target contaminants. Types of oxidation include ultraviolet light, ozone, peroxide, and other chemical oxidants such as potassium permanganate. The simultaneous application of UV radiation and chemical oxidants also is commonly employed. Evaporation ponds. Groundwater is allowed to evaporate in open ponds. Reverse osmosis: Soluble materials will be concentrated by applying a high pressure gradient across a semi-permeable membrane, and reversing the osmotic driving force. Concentrated waste streams will require proper handling, treatment, or disposal. Liquid/liquid extraction: Two liquids which are mutually soluble may be separated by adding a third liquid which is a solvent for one of the original components, but is insoluble in and immiscible with the other. Distillation: Evaporation followed by condensation. Freeze crystallization: Separation of water from solutions including hazardous wastes by cooling the solution until ice crystals begin to form. Super critical extraction: Use of super critical carbon dioxide to extract organics from aqueous streams. Super critical water oxidation: Contaminated water pressurized and heated to super critical conditions to oxidize organic constituents.
Thermal	Wet air oxidation: Organic materials are broken down at high temperatures and pressures. Incineration: Combustion of organics at high temperatures.
Off site treatment	Off-site Town of Marine POTW. Transport untreated groundwater to the Town of Marine POTW for treatment. RCRA treatment facility: Extracted water shipped to a RCRA treatment/disposal facility.
Discharge On-site Discharge	**Surface Drainage.** Discharge treated groundwater to surface drainage. Re-injection. Re-inject treated groundwater meeting IEPA discharge limits outside the limits of contamination. Surface Water. Discharge treated groundwater meeting NPDES permit limits into a nearby surface-water body.
Off-site Discharge	Town of Marine POTW. Transport treated groundwater to the Town of Marine POTW.

Notes: IEPA = Illinois Environmental Protection Agency; POTW = publicly owned treatment works; SVOC = semi-volatile organic compound; VOC = volatile organic compound; NPDES = National Pollutant Discharge Elimination System; RCRA = Resource Conservation and Recovery Act; TCE = trichloroethene

Bold indicates representative process options.

2.6.2 Implementability

Implementability refers to the administrative or institutional aspects of using a technology or process. Considered under this criterion are factors such as the ability to obtain necessary permits; the availability and capacity of treatment, storage, and disposal services; and the availability of the equipment and workers to implement the technology.

2.6.3 Relative Cost

Cost plays a limited role in the screening of process options. Relative capital plus operations and maintenance costs are used rather than detailed estimates. The costs for each process option are evaluated on the basis of engineering judgment as high, medium, or low relative to the other process options in the same technology type.

2.6.4 Selection of Representative Process Options

Following evaluations for the criteria of effectiveness, implementability and cost, processes are chosen to represent the range of process options within a remedial technology type. The representative process options are selected by considering those process options that are the most well-established, proven, and reliable over a range of site conditions, and that satisfy general and/or specific RAOs. One or more representative process options are selected for each technology type to simplify the subsequent development and evaluation of alternatives. More than one process option may be selected for a technology type if the processes are sufficiently different in their performance that one would not adequately represent the other. The selection of representative process options provides more flexibility in the future, when the selected remedial action is designed. The specific process to be used at a particular location may not be selected until the remedial design phase.

The final remedies are not limited to these process options. These process options are considered representative of the technologies in the GRA grouping after consideration of effectiveness, implementability, and cost. Some categories may not have a representative process option and, conversely, some may have more than one representative process option. The representative process options may be used in conjunction with other response actions. Furthermore, implementation of some process options by themselves would not satisfy the RAOs.

Figure 12: Evaluation of Groundwater Remediation Technologies and Process Options

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Groundwater General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
No Action	None	None	Ineffective. Does not achieve remedial action objectives.	May be implemented at sites with regulatory agency acceptance.	None. No actions implemented.
Limited Action	Natural Attenuation	Monitored Natural Attenuation	Effective and reliable at verifying contaminant degradation, or lack thereof. Does not actively remediate contamination, but relies on natural physical, chemical, and biological processes.	May be implemented on a site-specific basis with regulatory agency acceptance.	Low capital, low maintenance.
	Institutional controls	Land Use Restrictions	Effectiveness depends on continued future implementation. Does not remediate contamination by itself.	Implementable	Low capital, low maintenance.
		Permits	Effectiveness depends on continued future implementation. Does not remediate contamination by itself.	Implementable	Low capital, low maintenance
	Environmental monitoring	Groundwater sampling	Does not lower contamination, but is effective in determining the condition of the aquifer.	Easily implemented. Some wells already installed.	Low capital, low to moderate maintenance
		Vadose zone monitoring	Effective at evaluating whether contamination is migrating in the soil vapor. Does not remediate contamination by itself.	Implementable.	Low capital, low maintenance
Containment	Capping	Soil cover system	Relatively ineffective and unreliable. May not sufficiently reduce infiltration of precipitation because native soils are semi-permeable. Eliminates the direct exposure pathway. Does not reduce the intrinsic toxicity or volume of contamination. Capping without treatment is ineffective in the long term.	Implementable, depending on size of area to be capped. Restricts future land use. Long-term liability is relatively high because untreated wastes remain in place.	Low capital, moderate to high maintenance.
		Clay and soil cap	Moderately effective at reducing precipitation infiltration and leaching of contaminants to groundwater. Eliminates the direct exposure pathway. Does not reduce the intrinsic toxicity or volume of contamination. Clay is susceptible to cracking if desiccated. Capping without treatment is ineffective in the long term.	Implementable, depending on size of area to be capped. Restricts future land use. Long-term liability is relatively high because untreated wastes remain in place.	Low to moderate capital, moderate to high maintenance.
		Synthetic membrane	Moderately effective at reducing precipitation infiltration and leaching of contaminants to groundwater. Eliminates the direct exposure pathway. Does not reduce the intrinsic toxicity or volume of contamination. Liner is susceptible to damage. Capping without treatment is ineffective in the long term.	Implementable, depending on size of area to be capped. Restricts future land use. Long-term liability is relatively high because untreated wastes remain in place.	Low to moderate capital, high maintenance.
		Asphalt cap	Moderately effective at reducing precipitation infiltration and leaching of contaminants to groundwater. Eliminates the direct exposure pathway. Does not reduce the intrinsic toxicity or volume of contamination. Susceptible to weathering and cracking. Capping without treatment is ineffective in the long term.	Implementable, depending on size of area to be capped. Restricts future land use. Long-term liability is relatively high because untreated wastes remain in place.	Low to moderate capital, moderate to high maintenance.

Figure 12: Evaluation of Groundwater Remediation Technologies and Process Options

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Groundwater General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
	Vertical barriers	Concrete cap	Moderately effective at reducing precipitation infiltration and leaching of contaminants to groundwater. Eliminates the direct exposure pathway. Does not reduce the intrinsic toxicity or volume of contamination. Susceptible to weathering and cracking. Capping without treatment is ineffective in the long term.	Implementable, depending on size of area to be capped. Restricts future land use. Long-term liability is relatively high because untreated wastes remain in place.	Low to moderate capital, moderate to high maintenance.
		Engineered cap (multi-layer)	Most effective of capping process options at reducing precipitation infiltration and leaching of contaminants to groundwater. Eliminates the direct exposure pathway. Does not reduce the intrinsic toxicity or volume of contamination. Least susceptible to cracking.	Implementable, but may preclude many future beneficial uses of the land under restriction. Most rigorous of the capping process options. Satisfies RCRA technical requirements to cap construction. Long-term liability is relatively high because untreated wastes remain in place.	Moderate to high capital, low maintenance.
		Soil-bentonite slurry wall	Would limit lateral migration of groundwater if it could be effectively installed to 30 + feet. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable, depending on size of area to be walled. Restricts future land use. Long-term liability is relatively high because untreated wastes remain in place.	High capital, low maintenance.
		Cement-bentonite slurry wall	Would limit lateral migration of groundwater if it could be effectively installed to 30 + feet. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable, depending on size of area to be walled. Restricts future land use. Long-term liability is relatively high because untreated wastes remain in place.	High capital, low maintenance.
		Vibrating beam	Would limit lateral migration of groundwater if it could be effectively installed to 30 + feet. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable, depending on size of area to be grouted. Restricts future land use. Long-term liability is relatively high because untreated wastes remain in place.	High capital, low maintenance.
		Grout curtain	Would limit lateral migration of groundwater if it could be effectively installed to 30 + feet. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable, depending on length of grout curtain. Restricts future land use. Long-term liability is relatively high because untreated wastes remain in place.	High capital, low maintenance.
		Sheet piling	Would limit lateral migration of groundwater if it could be effectively installed to 30 + feet. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable, depending on length of sheet pile barrier required. Restricts future land use. Long-term liability is relatively high because untreated wastes remain in place.	High capital, low maintenance.
		Ground freezing	Would limit lateral migration of groundwater if it could be effectively installed to 30 + feet. Does not reduce the intrinsic toxicity or volume of contamination. Temporary measure.	Implementable, could only be sustained temporarily.	High capital, high maintenance.
	Horizontal barriers	~~Grout injection~~	Horizontal barrier beneath groundwater contamination not necessary because of the presence of impermeable underlying silt/clay layer. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable, but not necessary.	High capital, low maintenance.
		~~Liners~~	Horizontal barrier beneath groundwater contamination not necessary because of the presence of impermeable underlying silt/clay layer. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable, but not necessary.	High capital, low maintenance.
		~~Block displacement~~	Horizontal barrier beneath groundwater contamination not necessary because of the presence of impermeable underlying silt/clay layer. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable, but not necessary.	High capital, low maintenance.
		~~Ground freezing~~	Horizontal barrier beneath groundwater contamination not necessary because of the presence of impermeable underlying silt/clay layer. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable, but not necessary.	High capital, low maintenance.

Figure 12: Evaluation of Groundwater Remediation Technologies and Process Options

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Groundwater General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
	Encapsulation	~~Total encapsulation~~	Horizontal barrier beneath groundwater contamination not necessary because of the presence of impermeable underlying silt/clay layer. Could be achieved by tying grout curtain into underlying silt/clay layer.	Implementable, but not necessary.	High capital, low maintenance.
	Surface controls	Surface sealings	Effective for some shot-term applications when used in conjunction with other technologies. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable.	Low to moderate capital, moderate maintenance.
		Grading	Effective for some short-term applications when used in conjunction with other technologies. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable.	Low to moderate capital, low maintenance.
		Soil stabilization	Effective for some short-term applications when used in conjunction with other technologies. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable.	Low to moderate capital, low to moderate maintenance.
		Revegetation	Effective when used in conjunction with other technologies. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable.	Low capital, low to moderate maintenance.
		Diversion and collection system	Effective when used in conjunction with other technologies. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable.	Low to moderate capital, low to moderate maintenance.
	Sediment control barriers	Curtain barriers	Effective for some short-term applications when used in conjunction with other technologies. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable, but may adversely affect wetlands habitat. Will require coordination and approval of regulatory agencies.	Low to moderate capital & maintenance.
		Cofferdams	Effective for some short-term applications when used in conjunction with other technologies. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable, but may adversely affect wetlands habitat. Will require coordination and approval of regulatory agencies.	Moderate to high capital, low maintenance.
		Bottom seals	Effective for some short-term applications. Reduces contaminant mobility. Does not reduce the intrinsic toxicity or volume of contamination. Clay seal is susceptible to damage from flowing water. Susceptible to cracking if desiccated.	Implementable, but may adversely affect wetlands habitat. Will require coordination and approval of regulatory agencies.	Moderate capital, moderate maintenance
		Sandbags	Effective for some short-term applications when used in conjunction with other technologies. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable, but may adversely affect wetlands habitat. Will require coordination and approval of regulatory agencies.	Low capital, low maintenance.
	Dust and vapor suppression	Water	Effective for some short-term applications when used in conjunction with other technologies. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable.	Low capital moderate maintenance.

Figure 12: Evaluation of Groundwater Remediation Technologies and Process Options

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Groundwater General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
		Organic agents/polymers/foam	Effective for some short-term applications when used in conjunction with other technologies. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable.	Moderate capital, low maintenance.
		Membranes/tarps	Effective for some short-term applications when used in conjunction with other technologies. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable.	Moderate to high capital, moderate maintenance.
		Hygroscopic agents	Effective for some short-term applications when used in conjunction with other technologies. Does not reduce the intrinsic toxicity or volume of contamination.	Implementable.	Moderate capital, low maintenance.
	In-situ physical stripping	Air sparging	Potentially effective on VOCs. Thin vadose zone may limit effectiveness of SVE to collect off gas.	Implementable.	Moderate to high capital, and maintenance.
		Recirculation wells	Potentially effective on VOCs.	Implementable	Moderate to high capital, and maintenance.
	In-situ chemical oxidation	Ozone	Potentially effective on VOCs.	Implementable.	Moderate to high capital, and maintenance.
		Fenton's agent	Potentially effective on organics.	Implementable	Moderate to high capital, and maintenance.
		Potassium permanganate	Potentially effective on organics.	Implementable.	Moderate to high capital, and maintenance.
In-situ treatment	In-situ thermal enhancement	Electrical resistance heating	Potentially effective on organics.	Implementable.	High capital and maintenance.
		Steam/hot air injection	Potentially effective on organics.	Implementable.	High capital and maintenance.
		Radio frequency heating	Potentially effective on organics.	Implementable.	High capital and maintenance.

Figure 12: Evaluation of Groundwater Remediation Technologies and Process Options

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Groundwater General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
	In-situ biological treatment	Enhanced bioremediation	Potentially effective for organics.	Implementable.	Low to moderate capital and maintenance.
		~~Phytoremediation~~	Not effective in deep groundwater	Not implementable at the site.	Low capital and maintenance.
	Passive treatment walls	Zero valent iron permeable reactive barrier	Potentially effective for dechlorinating solvents. Precipitation of metals may foul the barrier.	Would only be implementable for shallow groundwater. Difficult to establish below excavation depth.	High capital low maintenance.
Collection	Extraction	Interceptor trenches	Would only be effective for shallow groundwater.	Implementable.	High capital low to moderate maintenance
		Extraction wells	Effective and well-established technology.	Implementable	Moderate capital and maintenance
		Dual-phase extraction	Would be effective for removing VOCs vapors from the vadose zone. Would be effective at containing the groundwater plume(s).	Implementable	Moderate capital high maintenance.
		Enhanced removal	Would be effective on organics. Could be useful in conjunction with other ex-situ processes.	Implementable. Regulators will have to approve injection of surfactant into the aquifer.	Moderate capital and maintenance
		~~French drains~~	Not effective contamination too deep	Not implementable the groundwater is too shallow.	Moderate capital and low maintenance
Ex-situ Treatment	Physical/chemical treatment	Activated carbon	Effective on site COCs. Would require regeneration.	Implementable.	High capital and high maintenance.
		Air stripping	Proven technology to remove VOCs. Can be accomplished by using air stripping tower or shallow tray aeration.	Commercially available. Might need off-gas treatment.	Moderate capital and maintenance.
		Phase separation	Effective for removing NAPL from groundwater with dissolved contaminants. Useful as part of an ex-situ treatment train.	Implementable.	Low capital and maintenance.
		Ultraviolet oxidation	Effective for organics. Intermediates might be hazardous. Useful as part of an ex-situ treatment train.	Implementable.	High capital and moderate maintenance.
		Evaporate ponds	Would be effective for COCs at the site. VOCs would evaporate.	Implementable. The regulatory community would have difficulty approving evaporation ponds in the area of the site. Difficult to permit.	Low capital and maintenance.

Figure 12: Evaluation of Groundwater Remediation Technologies and Process Options

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Nike SL-10 Launch Area Groundwater
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Groundwater General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
		Reverse osmosis	Effective on site COCs. Useful as part of an ex-situ treatment train.	Implementable.	Moderate to high capital and maintenance costs.
		Liquid/liquid extraction	Effective on site COCs. Useful as part of an ex-situ treatment train.	Implementable.	Moderate capital and maintenance.
		~~Distillation~~	Ineffective at the concentrations of VOCs found in groundwater.	Implementable.	Moderate capital and maintenance.
		~~Freeze crystallization~~	Ineffective on low levels of contamination.	Implementable.	High capital and moderate maintenance.
		Super critical extraction	Effective on all organic compounds.	Implementable.	High capital & maintenance.
		Super critical water oxidation	Effective on all organic compounds.	Implementable.	High capital & maintenance.
	Thermal	~~Incineration~~	Ineffective too much water to evaporate off.	Not implementable	High capital & maintenance.
		Wet air oxidation	Effective on organic compounds.	Implementable.	High capital & maintenance.
	Off-site treatment	Town of Marine POTW	Effective to remove extracted water from site. Must meet pretreatment standards of the POTW and have a permit.	Implementable. POTW may not have the capacity to take the water.	High capital, low maintenance.
		RCRA treatment facility	Effective for removal of extracted water from site. Facility must be able to treat contamination.	Implementable. Facility must have the capacity.	High capital & maintenance.
Discharge	On-site discharge	Discharge to surface	Effective for disposal of treated water from site. Must have a discharge permit. Water may need adjustment prior to discharge.	Implementable.	High capital, low maintenance.
		Re-injection	Effective for disposal of treated groundwater. Must have a permit and regulatory approval. May be difficult to get the recharge needed. .	Implementable. Regulatory approval required.	Moderate capital and maintenance.
	Off-site discharge	Town of Marine POTW	Effective to dispose of treated water from site. Must meet pretreatment standards of the POTW and have a permit.	Implementable. POTW may not have the capacity to take the water.	High capital, low maintenance.

Table 11: Screening Summary of Groundwater Technologies and Process Options

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

General Response Action/Technology	Process Option	Representative Process Options	Retained Process Options	Eliminated Process Options
No action				
Not Applicable	No action	X	X	
Limited action				
Natural attenuation	Monitored Natural Attenuation	X	X	
Institutional controls	Land use restrictions		X	
	Permits		X	
Containment				
Capping	Soil cover system		X	
	Clay and soil cap		X	
	Synthetic membrane		X	
	Asphalt cap		X	
	Concrete cap		X	
	Engineered cap	X	X	
Vertical barriers	Soil-bentonite slurry wall		X	
	Cement-bentonite slurry wall		X	
	Vibrating beam		X	
	Grout curtain		X	
	Sheet piling		X	
	Ground freezing		X	
Horizontal barriers	Grout injection			X
	Liners			X
	Block displacement			X
	Ground freezing			X
Encapsulation	Total encapsulation			X
In-situ Treatment				
Physical stripping	Air Sparging		X	
	Recirculation Wells		X	

Table 11: Screening Summary of Groundwater Technologies and Process Options

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

General Response Action/Technology	Process Option	Representative Process Options	Retained Process Options	Eliminated Process Options
Chemical oxidation	Ozone		X	
	Fenton's Reagent		X	
	Potassium Permanganate		X	
Chemical reduction	Electrical Resistive Heating		X	
	Steam/Hot Air Injection		X	
	Radio Frequency Heating		X	
Biological treatment	Enhanced Bioremediation	X	X	
	Phytoremediation			X
Passive treatment walls	Zero-Valent Iron Permeable Reactive Barrier		X	
Collection				
Extraction	Interceptor Trenches		X	
	Extraction Wells	X	X	
	Dual-Phase Extraction		X	
	Enhanced removal		X	
	French drains			X
Ex-situ Treatment				
Physical/chemical treatment	Activated Carbon	X	X	
	Air Stripping		X	
	Phase Separation		X	
	Ultraviolet Oxidation		X	
	Evaporative ponds		X	
	Reverse osmosis		X	
	Liquid/liquid extraction			X
	Distillation			X
	Freeze crystallization			X
	Super critical extraction		X	
	Super critical water oxidation		X	
Thermal	Incineration			X
	Wet air oxidation		X	

Table 11: Screening Summary of Groundwater Technologies and Process Options

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

General Response Action/Technology	Process Option	Representative Process Options	Retained Process Options	Eliminated Process Options
Off-site treatment	Town of Marine POTW		X	
	RCRA treatment facility		X	
Discharge				
On-site discharge	Discharge to surface drainage	X	X	
	Re-injection		X	
Off-site discharge	Town of Marine POTW		X	

2.6.4.1 Groundwater

Table 8 presents a list of groundwater GRAs, remedial technologies and process options. Table 9 presents a description of the groundwater process options. Figure 12 presents an evaluation of the groundwater process options against the criteria of effectiveness, implementability, and cost. Table 10 is a screening summary of the groundwater technologies and process options. The only contaminants of concern in the groundwater at the site are VOCs. All of the retained treatment processes will potentially work well for the VOC contaminant group. Representative process options are outlined in bold on the tables and figures.

Representative process options to be evaluated include no action (required), 2 limited action treatment process options, a containment treatment process, an in situ treatment process, a collection treatment process, an ex situ treatment process and a discharge treatment process (Table 10). These remedial technologies are retained either because they are required (no action) or because they meet the criteria of effectiveness, implementability and cost for the general site conditions and contaminants (Figure 12).

2.6.4.1.1 No Action

The no-action process option represents leaving the site as it is; it is intended only for comparison to other alternatives. No-action is required for consideration by the NCP, but will not be implemented because the option does not satisfy the RAOs.

2.6.4.1.2 Limited Action

MNA: Under the Limited Action GRA MNA is 1 of 2 representative process options. Natural attenuation of organic contaminants in groundwater takes place over long periods of time. The concentrations and sources of contaminants would have a profound impact on the amount of time required for the groundwater contamination to degrade to RAOs. For evaluation purposes the time frame for natural attenuation has been set at 50 years. This time frame was selected since natural attenuation has been active at the site for roughly 35 years and has not met the RAOs. 50-years was also selected because estimating beyond 50 year is not recommended by EPA (USEPA 2000). Natural attenuation is a combination of biological, chemical and physical processes that combine to reduce the volume, toxicity and mobility of contaminants. Bacteria will degrade organics in the groundwater by using them as chemical energy sources. Some bacteria will release enzymes that will degrade contaminants. Chemical processes will breakdown organics slowly over time. Physical processes of adsorption, volatilization, dissolution, precipitation, advection, dispersion, and diffusion will combine to reduce the volume, toxicity, and mobility of contaminants in the groundwater.

Through MNA, samples of the groundwater will be collected periodically to assess the concentration of contaminants. The trend in contaminant concentrations will be monitored. If the concentrations of contaminants are decreasing in the contaminated area then attenuation is proceeding. If concentrations are rising then there is a residual source of contamination that is contributing contamination to the groundwater. The lateral and vertical extent of contamination will have to be monitored in the area to assess whether the plume is stable, growing, or shrinking.

Advantages of MNA:

- The natural groundwater system is not disturbed
- No chemicals or heat are added to the groundwater
- The groundwater is not pumped
- The option is relatively inexpensive, while being protective of human health and the environment
- It can be used as a polishing step following some more active remedial action
- Can be used as an interim step to monitor long-term fate and transport issues in the groundwater.

Limitation of MNA:

- Does not actively reduce the volume, toxicity or mobility of the contaminated groundwater
- Will not be as rapid as other remedial options
- Will require on going monitoring for the life of the remediation
- Will limit the potential uses of the groundwater and site.

Institutional Controls: As stated above, the institutional control general response action usually does not involve actual treatment of contamination, but rather uses other methods to limit exposure to the contamination. Institutional control technology types for groundwater include: land use restrictions, permits, and alternate water supplies.

The land use restrictions involve preventing human contact with the contaminated groundwater. The land use restriction process options can be physical in nature, such as installation of fencing and warning signs surrounding the contaminated area, or they can be legal, such as imposing deed restrictions on future uses of the contaminated site. Permits could be used to restrict the areas where groundwater supply wells could be installed in the area. Land use restricts and permits could be applicable technology types at the site. Institutional controls can be a component of any groundwater remedy at the site.

The alternate water supply technology type involves providing a source of water to users other than the contaminated groundwater. Alternative water supply process options include: installing an aboveground water storage tank that would require filling from an outside source, or tying the residential water supply into a municipal water system. The cost to continuously fill the aboveground tank over an extended period of time would be high, and it would not be very convenient for the residents using the tank, especially if it were to run out before it was refilled. Therefore the aboveground tank option will not be considered further. The municipal tie in process option would involve running a pipeline from an existing water supply distribution system to any affected residences. This process is potentially applicable to the Nike SL-10 Launch Area.

The following lists the advantages and limitations of Institutional Controls:

Advantages:

- They are less costly than capping, or in situ or ex situ treatment in the short term.
- They can protect human health and the environment if controls are properly enforced.

Limitations:

- They may not fully comply with ARARs if implemented alone.
- They do not reduce toxicity, mobility, or the volume of contamination.
- They may be difficult to enforce.

2.6.4.1.3 Containment

Engineered Cap: The surface over the contaminated groundwater is covered with a cap to limit exposure pathways to human and ecological receptors, and reduce infiltration of precipitation. A typical engineered cap is composed of a foundation layer consisting of clean soil or consolidated waste, a low-permeability soil layer or a membrane liner, a layer of topsoil, and drainage control as required. Construction of a cap may also include biotic barriers; gas collection features; erosion control measures; and subsurface cap completion, which may support land use (e.g., material storage area, parking lot). For example, an innovative cap design might incorporate a soil vapor collection system, provide for thermal destruction of the contaminated soil gas, and maximize reuse potential by utilizing the site for outdoor storage. In addition, land-use restrictions will be necessary to prevent damage to the cap and to prevent the creation of exposure pathways.

Advantages of an engineered cap:

- In the short term, it is typically not as costly as some treatment technologies.
- It is protective of human health and the environment.
- It reduces the mobility of contaminants as long as the cap integrity is maintained.

Limitations of an engineered cap:

- It does not reduce the volume or toxicity of contamination.
- Long-term liability is relatively high because untreated wastes remain in place.
- It requires costly periodic inspection and maintenance.
- It will restrict many beneficial land uses.
- It will require monitoring to ensure long-term plume stability in the groundwater.

2.6.4.1.4 In Situ Treatment

Enhanced Bioremediation: Enhanced bioremediation at the site could take many forms for treatment of organic compounds in the groundwater. For the chlorinated solvent plume at the site the amendments could take the form of hydrogen release compound (HRC) or the addition of a carbon source to the groundwater like molasses. These amendments would increase the rate of dehalogenation, the stripping of chloride ions from the chlorinated solvent molecules. These amendments would ramp up the anaerobic degradation of these compounds. The daughter products of dehalogenation of the solvents can be toxic. One of the daughter products, vinyl chloride can be generated by the anaerobic process, but is degraded by an aerobic process. Some caution will have to be exercised in design of the remedial program to limit the build up of daughter products in the groundwater.

Advantages of enhanced bioremediation:

- Does not require pumping of the groundwater.

- The injection of amendments can disturb the groundwater, but not as much as pumping the groundwater.
- Fairly benign chemicals are used in the process.
- Does not require discharge of the groundwater.
- Accepted processes with proven record of effectiveness.

Limitations of enhanced bioremediation:

- Not as rapid as some other treatment options.
- May disturb the hydraulic conditions in the subsurface.
- Does require injection of chemicals into the groundwater, which can be contentious in some jurisdictions.
- Will require ongoing application of amendments and extensive monitoring during implementation.

The time frame for enhanced bioremediation would be on the order of 5 years to remediate the VOCs in the groundwater at the site to below the MCLs. This time frame is based on experience at other sites and the number of injections anticipated at the site.

2.6.4.1.5 Collection

Extraction Wells: Extraction wells would be installed around the site to contain the groundwater plume and pump the contaminated groundwater to the surface. Extraction wells would be combined with various ex-situ treatment trains.

Advantages of extraction wells:

- Can remove contaminated groundwater from the subsurface and transport it to the surface for treatment.
- When combined with other technologies like a pump and treat system extraction wells have been shown to be effective at containing contaminant plumes.
- Wells can be installed quickly.

Limitations of extraction wells:

- A relatively expensive option.
- Will disturb the hydraulic conditions in the subsurface.
- Even when combined with other technologies like pump and treat systems extraction wells have been shown to be ineffective at remediation of contaminant plumes.
- Discharge of treated water can be problematic.
- Process infrastructure can interfere with site reuse.
- Wells will ultimately have to be abandoned.

2.6.4.1.6 Ex-Situ Treatment

Granular Activated Carbon: Carbon adsorption involves the removal of soluble contaminants from an aqueous or gaseous waste stream through binding of the contaminants to the surface of a solid activated carbon adsorbent. The most commonly used adsorbent for groundwater remediation is granular activated carbon (GAC), used in a moving or fixed bed reactor through which the waste stream is passed in direct contact with the carbon. The carbon must be replaced or regenerated and reused

periodically once it has reached its capacity. GAC systems can be used to treat aqueous or vapor waste streams. Aqueous phase GAC could be used either in groundwater pump and treat projects or in point of use treatment, where the groundwater is only treated immediately before use by a GAC filter installed on a supply well. Vapor phase GAC could be used as secondary treatment for the vapor phase from an air stripper.

At the Nike SL-10 Launch Area, extracted contaminated groundwater would be run through GAC filters to remove contaminants prior to discharge or re-injection.

Advantages of GAC:

- Readily available
- Proven technology
- Effective on site COCs.

Limitation of GAC:

- Relatively expensive
- Carbon needs to be regenerated periodically
- Systems require frequent O&M or on site operator.

For evaluation purposes the time frame for pump and treat has been set at 50 years. This time frame was selected due to experience at many sites. The tendency of pump and treat is to remove some product but to quickly reach a point where the system operates and removes small amounts of product from the aquifer without affecting the concentration within the plume level or making it decrease. 50-years was also selected because estimating beyond 50 year is not recommended by USEPA (USEPA 2000).

2.6.4.1.7 Discharge

On-Site Discharge: is the representative discharge process option following groundwater treatment.

On-site discharge of treated groundwater at the Nike SL-10 Launch Area would be achieved by discharging the water to one or more of the existing drainage ditches or drains on site. The water would ultimately drain into Silver Creek and then to Mississippi River. The site does not currently have a discharge permit. Initial permitting issues would need to be addressed and discharge limits would need to be met.

Advantages of discharge to surface water:

- Water has been demonstrated not to infiltrate into the surface at the site.
- Since the injection well constructed for the pilot test failed to accept the water from the treatment system as quickly as it was generated, discharge to surface runoff would be a better option.
- Existing infrastructure could be reused to facilitate discharge.

Limitation of discharge to surface water:

- New permit required.
- Local residents and regulators may be concerned about discharge to the surface.
- May require additional treatment of groundwater prior to release.
- Could create ecological concerns.

3.0 DEVELOPMENT OF ALTERNATIVES

The representative options screened in Section 2.6 were assembled into 4 remedial alternatives. In the following subsections a conceptual approach for each alternative is developed to allow for comparison. Following conceptual development, remedial alternatives are screened with respect to the criteria of effectiveness, implementability and cost to meet the requirements of CERCLA, and the NCP. The objective of this alternative screening step is to eliminate impractical alternatives or higher cost alternatives (i.e., order of magnitude cost differences) that provide little or no increase in effectiveness or implementability over their lower-cost counterparts.

An engineered (multi-layer) cap alternative has not been prepared at this time. Several containment remedial technologies are feasible at the site and should be kept in mind if the alternatives developed are found to be unworkable at some point in the future.

3.1 Groundwater Alternatives

The areas with groundwater contamination have been identified. Figure 7 is a presentation of the areas where groundwater contamination has been detected at the site and the regulation exceeded. The following four alternatives have been identified for remediation of groundwater at the Nike SL-10 Launch Area and have been developed in this FS:

- Alternative GW-1: No Action
- Alternative GW-2: Groundwater Monitored Natural Attenuation
- Alternative GW-3: In-Situ Treatment
- Alternative GW-4: Groundwater Collection/Treatment/Discharge

The alternatives are intended to address VOC contamination in groundwater at the site.

The assembly of representative process options into remedial alternatives is shown in Table 11. Detailed descriptions and the conceptual designs for all of the alternatives are provided in the following sections.

3.1.1 Alternative GW-1: No Action

The No Action alternative does not include any remedial action components to reduce or control potential risks from contaminated site groundwater. The No Action alternative will not be evaluated according to screening criteria; it will pass through screening to be evaluated during the detailed analysis as a baseline for comparison with other retained alternatives (USEPA 1988).

3.1.2 Alternative GW-2: Monitored Natural Attenuation

Groundwater monitoring would be conducted as part of Alternative GW-2 to evaluate the effectiveness of natural attenuation processes at reducing contaminant concentrations in site groundwater. Groundwater sampling would be conducted at monitoring wells in the vicinity of the delineated VOC-contamination. The monitoring wells would be selected to surround the known groundwater contamination. This would include wells up gradient of the site on the east, northeast and southeast sides of the property and wells down gradient of the site on the south and southwest sides of the property. Representative wells would have to be selected within the areas of groundwater contamination to monitor the contamination over time. The groundwater

would have to be monitored for contaminants of concern (COCs) at the site and for parameters that can be used to gauge the subsurface conditions that impact the rate of attenuation.

A *Long-Term Monitoring Plan* for the Nike SL-10 Launch Area site will have to be developed to detail the wells and monitoring points to be used, the appropriate tests to be run on the samples, validation of data, the frequency of monitoring and other parameters that will be required.

Institutional controls on the use of the site and groundwater in the vicinity would have to be in place during the MNA process.

3.1.3 Alternative GW-3: In-Situ Treatment

This alternative would use enhanced bioremediation to dechlorinate the solvent in the groundwater generating non toxic daughter products. A hydrogen or carbon source would be released into the groundwater through wells in the plume (Figure 13). The added hydrogen or carbon would increase anaerobic bacterial activity that would strip chloride ions from the solvents following the pattern shown in Figure 14 or a similar chemical pathway.

Existing monitoring wells could potentially be used for releasing the chemicals but new wells would likely be required. Monitoring of groundwater within and outside of the plume would be necessary to gauge the rate of the remediation, when/whether another treatment was needed and whether the plume was migrating.

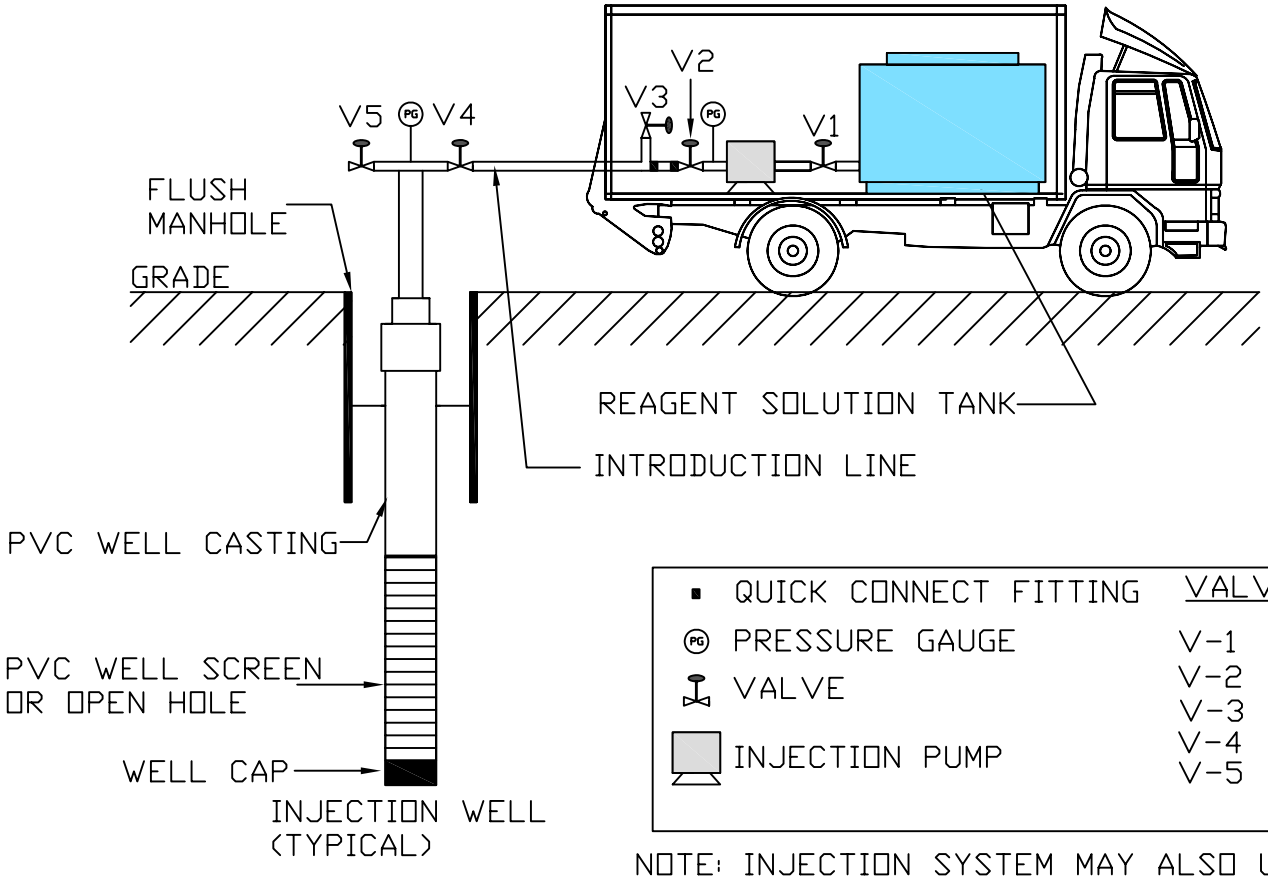
3.1.4 Alternative GW-4: Groundwater Collection/Treatment/Discharge

This alternative provides collection of groundwater contamination with extraction wells, treatment of groundwater and discharge of treated groundwater. In general, this alternative provides ex situ treatment, and site wide hydraulic containment, and prevents the transport of contamination off the Nike SL-10 Launch Area site.

Law as part of their pilot study installed 2 extraction wells on the site (Figure 2, RW-1 and RW-1A) (Law 2002). One or more additional extraction wells would have to be installed using conventional methods to capture and contain the plume. The existing on site trailer located at the extraction wells is outfitted with carbon vessels for water and vapor filtration. This system could potentially be used for treatment of the extracted groundwater. Discharge to one of the nearby drainage ditches would require a permit from the state. The pumps used in the wells would need to be able to operate at very low flow rates.

Groundwater extracted from the wells would be pumped to the treatment facility through buried forcemain installed below the frost line. This would be done to reduce interference with on site activities, weather effects, and damage to the system from heavy equipment operated on the site by the county. Instrumentation and control wiring would be installed in the trenches along with the forcemain.

Instrumentation provided with treatment system components would include water-level controls that would respond to abnormally high or low levels in vessels, which could result from overflows or ruptures. The controls would shut down extraction-well pumps and/or treatment facility pumps, as required, in the event of equipment failure.



▪ QUICK CONNECT FITTING	VALVE	FUNCTION
PG PRESSURE GAUGE	V-1	TANK ISOLATION
VALVE	V-2	PUMP ISOLATION
	V-3	PRESSURE RELIEF
INJECTION PUMP	V-4	FLOW CONTROL
	V-5	MANUAL PRESSURE RELIEF

NOTE: INJECTION SYSTEM MAY ALSO UTILIZE SKID AND/OR TRAILER-MOUNTED EQUIPMENT

FIGURE 13

SCHEMATIC OF THE INJECTION SYSTEM

NIKE SL-10

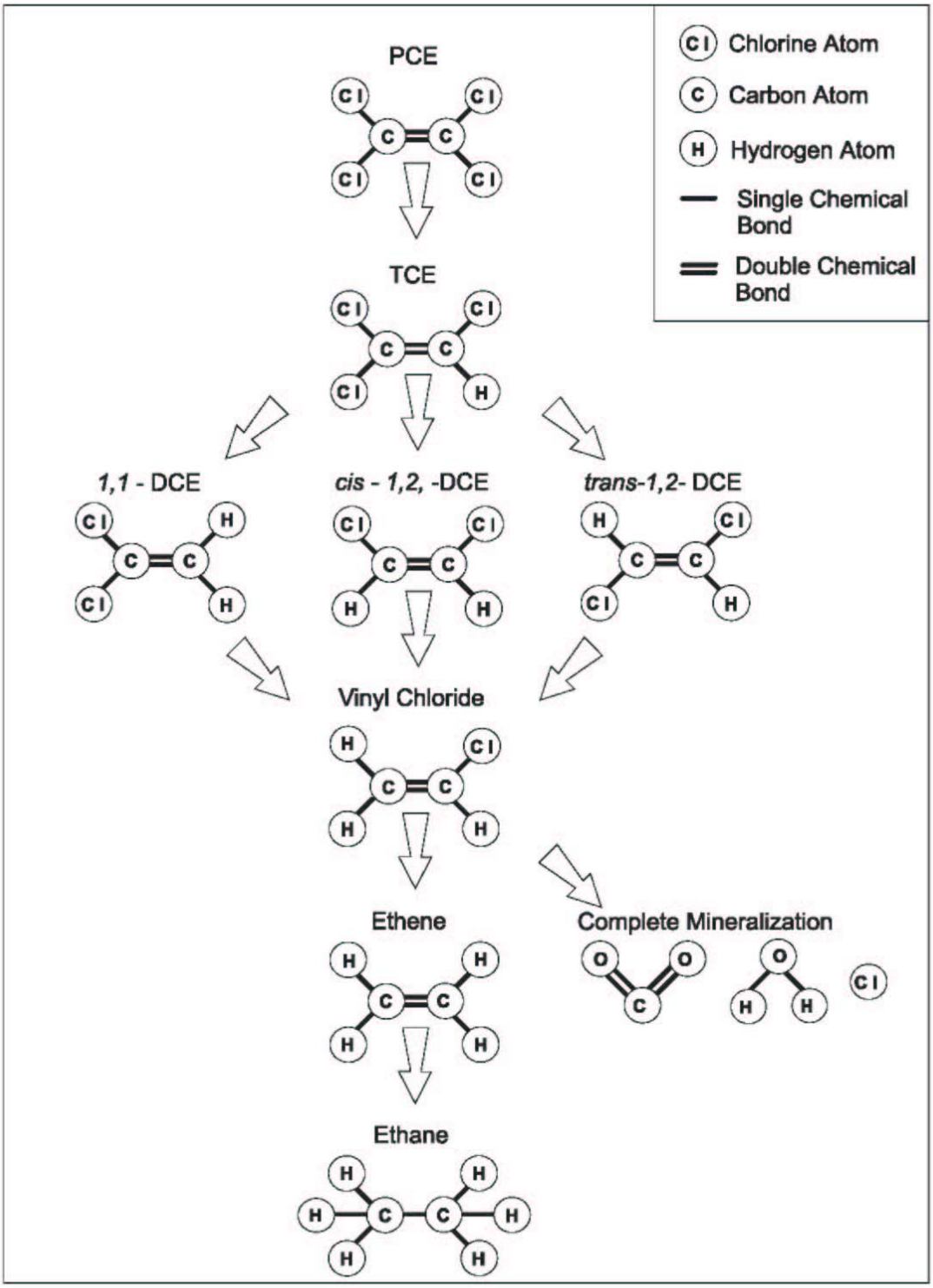
LAUNCH AREA GROUNDWATER

RI/FS/PP/ROD

U.S. ARMY ENGINEER DISTRICT, LOUISVILLE

PLEXUS scientific

PROJECT NO.	FILE NO.
8032-008	FIGURE 13



Source: EPA 1998

Figure 14

Pathway Illustrating
Reductive Dehalogenation of Chlorinated Ethenes

3.1.4.1.1 Site Wide Groundwater Organics Treatment

Based on the technology screening presented in Section 2.6, granular activated carbon filtration is considered for general site wide groundwater treatment:

GAC is capable of high removal efficiencies for a range of VOCs, including chlorinated compounds. The filtration system will be designed to treat the anticipated flow of impacted groundwater. The concentrations of TCE detected in site groundwater range as high as 1,390 µg/L. Influent concentrations ranging from 420 to 616 µg/L were detected on the pilot system. It is likely that the contaminant concentration in the extracted water will drop off over time to a lower more stable level as the system treats the water close to the wells. The GAC will need to be regenerated as the carbon becomes saturated with contaminants. The frequency of regeneration will vary with contaminant levels and flow rates.

An equipment layout plan for the trailer used by Law during the dual phase extraction pilot test, a system schematic for the system Law designed, and an extraction well schematic (Law 2002) are presented in Figures 15, 16, and 17. The pilot test treatment system used a pulsed operation flow rate of 1.8 gallons per minute. Law's system had an injection well that did not accept treated water quickly enough to keep up with the system (i.e. less than 1.8 gallons per minute). Law proposed a series of infiltration galleries to infiltrate the treated water. The infiltration galleries were not installed. Infiltration galleries could potentially work as a way to dispose of treated water.

3.1.4.1.2 Treated Groundwater Discharge

The discharge representative process option used in Alternative GW-4 is discharge to surface drainage at the site that would drain through ditches on adjacent property and into an unnamed tributary of Silver Creek and ultimately to the Mississippi River. Treated groundwater will be discharged under permit to the drainage ditches. There is no current discharge permit for the Nike SL-10 Launch Area site. Initial permitting issues would need to be addressed and discharge limits would need to be met, however, no subsequent costs would be incurred during the system operation. An alternative to this approach would be to pipe the water to a sanitary sewer main and dispose of the water to a local publicly owned treatment works (POTW). There would be additional costs associated with disposal to the POTW.

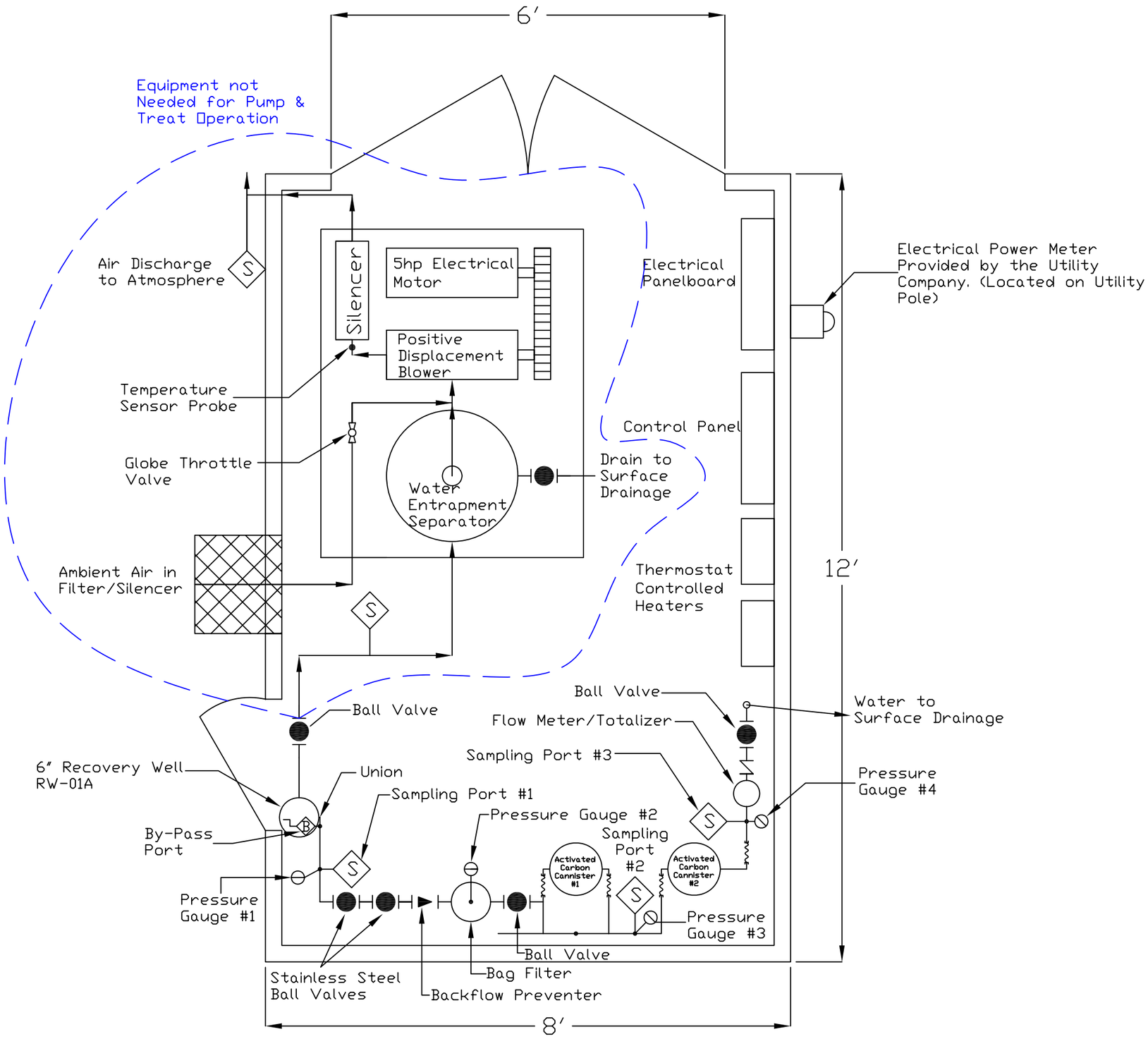


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FIGURE 15

EQUIPMENT LAYOUT PLAN

NIKE SL-10

LAUNCH AREA GROUNDWATER

RI/FS/PP/ROD

U.S. ARMY ENGINEER DISTRICT, LOUISVILLE

REPLICATED FROM LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC., LOUISVILLE KENTUCKY DRAWINGS, (LAW 2002)

PLEXUS SCIENTIFIC

PROJECT NO. 0032-008

FILE NO. FIGURE 15

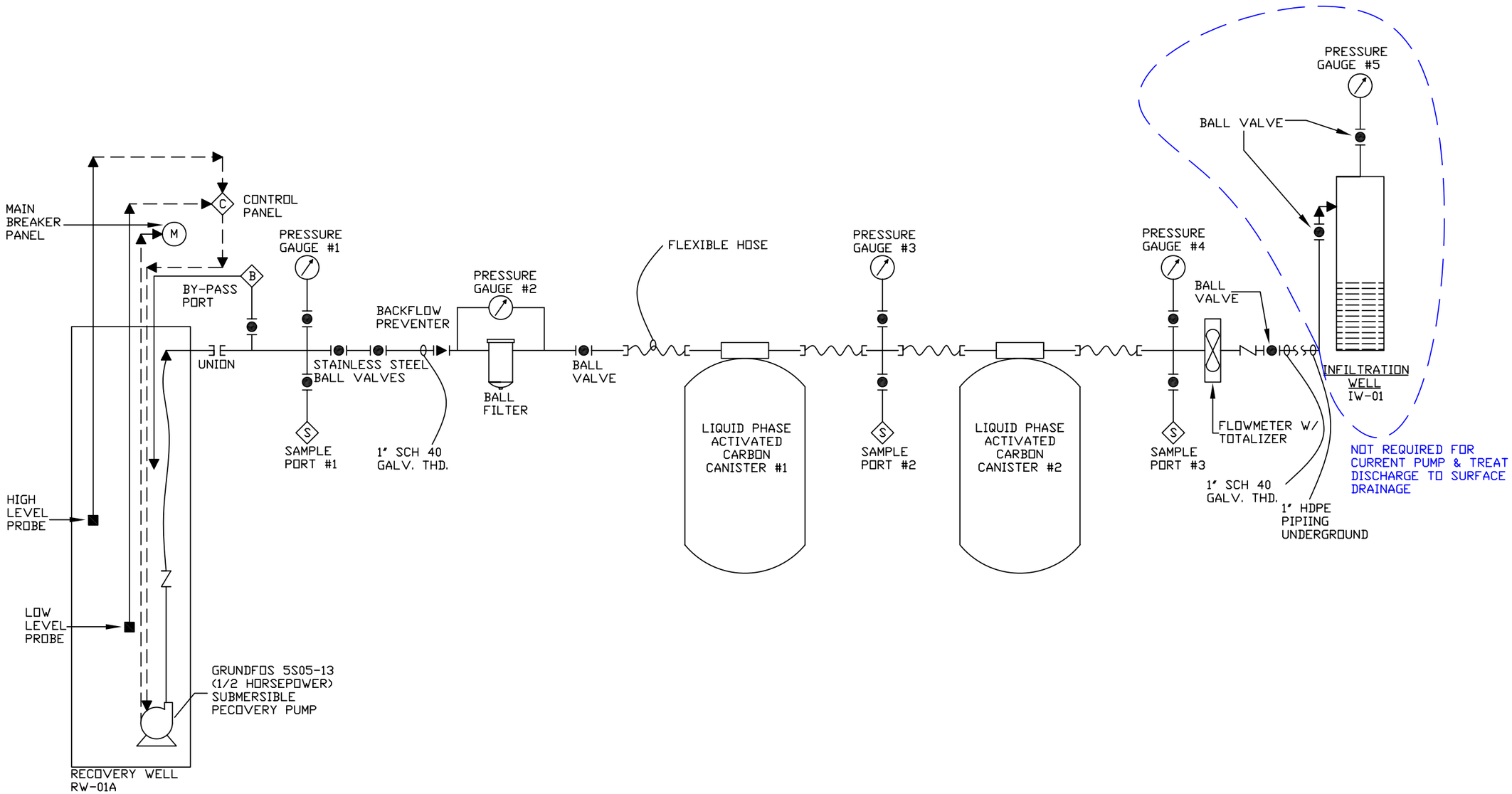

FIGURE 16

GROUND WATER RECOVERY SYSTEM SCHEMATIC

NIKE SL-10

LAUNCH AREA GROUNDWATER

RI/FS/PP/RDD

U.S. ARMY ENGINEER DISTRICT, LOUISVILLE

REPLICATED FROM LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC., LOUISVILLE KENTUCKY DRAWINGS, (LAW 2002)

PLEXUS scientific

PROJECT NO.	FILE NO.
0032-008	FIGURE 16

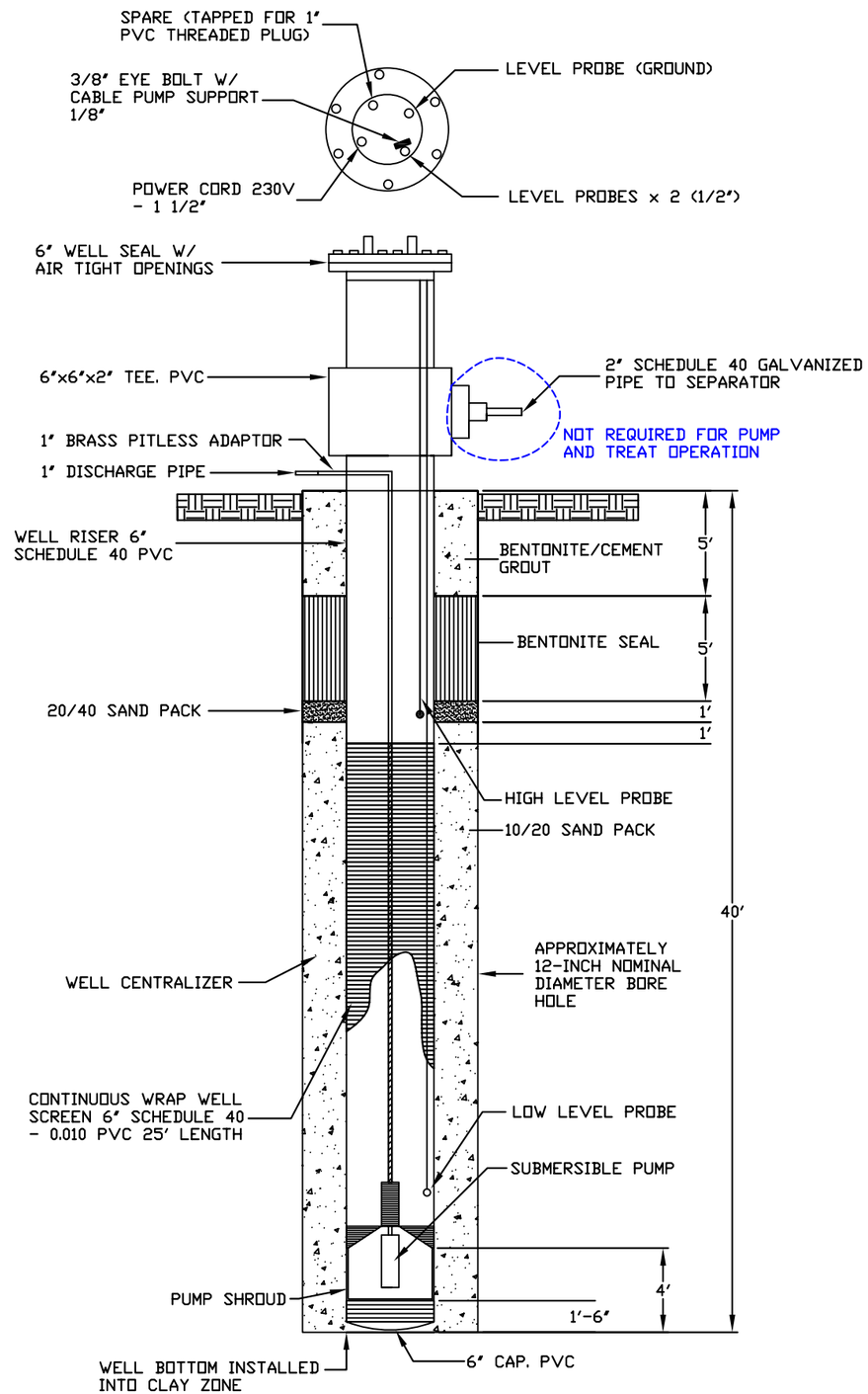

FIGURE 17

RECOVERY WELL DETAIL

NIKE SL-10

LAUNCH AREA GROUNDWATER

RI/FS/PP/ROD

U.S. ARMY ENGINEER DISTRICT, LOUISVILLE

REPLICATED FROM LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC., LOUISVILLE KENTUCKY DRAWINGS, (LAW 2002)

PLEXUS SCIENTIFIC

PROJECT NO.	FILE NO.
8032-008	FIGURE 17

4.0 DETAILED ANALYSIS OF ALTERNATIVES

The purpose of this section is to provide decision-makers with sufficient information to evaluate remedial alternatives and select an appropriate alternative for groundwater remediation. This section compares each alternative against criteria for suitability. The nine CERCLA evaluation criteria include:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume Through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

The NCP [40 CFR Section 300.430(e)(9)(iii)] categorizes these nine criteria into three groups: (1) threshold criteria, (2) primary balancing criteria, and (3) modifying criteria. Each type of criteria has its own weight when it is evaluated. Threshold criteria are requirements that each alternative must meet to be eligible for selection as the preferred alternative, and include overall protection of human health and the environment, and compliance with ARARs.

Primary balancing criteria are used to weigh effectiveness and cost tradeoffs among alternatives. The primary balancing criteria include long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. The primary balancing criteria represent the main technical criteria upon which the alternatives evaluation is based.

Modifying criteria include state acceptance and community acceptance, and may be used to modify aspects of the preferred alternative. Modifying criteria are generally evaluated after public comment on the FS and the Proposed Plan. Accordingly, only the seven threshold and primary balancing criteria are in the detailed analysis phase. The following sections provide descriptions of the first seven evaluation criteria.

4.1 Description of Evaluation Criteria

4.1.1 Criterion 1—Overall Protection of Human Health and the Environment

This evaluation criterion assesses how each alternative provides and maintains adequate protection of human health and the environment. Alternatives are assessed to determine whether they can adequately protect human health and the environment from unacceptable risks posed by contaminants present at the site, in both the short- and long-term. This criterion is also used to evaluate how risks would be eliminated, reduced, or controlled through treatment, engineering, institutional controls, or other remedial activities. The considerations evaluated during the analysis of each alternative for overall protection of human health and the environment are presented in Table 12.

Table 12: Criterion 1—Overall Protection of Human Health and the Environment

Analysis Factor	Considerations
Human Health Protection	Likelihood that the alternative reduces risk to human health as a result of exposure to contaminants in site media by direct contact, ingestion, or inhalation.
Environmental Protection	Likelihood that the alternative reduces the threat to unaffected groundwater/soil/surface water by minimizing migration of contaminants.
	Likelihood that the alternative reduces risk to ecological receptors.

4.1.2 Criterion 2—Compliance with ARARs

This evaluation criterion is used to determine if each alternative would attain federal and state ARARs, or whether invoking waivers to specific ARARs is adequately justified. Other information, such as advisories, criteria, or guidance, is considered where appropriate during the ARARs analysis. The considerations evaluated during the analysis of the ARARs applicable to each alternative are presented in Table 13. Potential action-, location-, and chemical-specific ARARs for the alternatives presented in this FS are identified in Section 2.3.

Table 13: Criterion 2—Compliance with ARARs

Analysis Factor	Considerations
Chemical-Specific ARARs	Likelihood that the alternative will achieve compliance with chemical-specific ARARs within a reasonable period of time.
	If it appears that compliance with chemical-specific ARARs will not be achieved, then evaluation of whether a waiver is appropriate.
Location-Specific ARARs	Determination of whether any location-specific ARARs (e.g., preservation of wetlands) apply to the alternative.
	Likelihood that the alternative will achieve compliance with the location-specific ARAR.
	Evaluation of whether a waiver is appropriate if the location-specific ARAR cannot be met.
Action-Specific ARARs	Likelihood that the alternative will achieve compliance with action-specific ARARs (e.g., hazardous waste treatment regulations).
	Evaluation of whether a waiver is appropriate if the action-specific ARAR cannot be met.
Other Criteria and Guidance	Likelihood that the alternative will achieve compliance with other criteria, such as risk-based criteria.

4.1.3 Criterion 3—Long-Term Effectiveness and Permanence

This evaluation criterion addresses the long-term effectiveness and permanence of maintaining the protection of human health and the environment after implementing the remedial action imposed by the alternative. The primary components of this criterion are the magnitude of residual risk remaining at the site after remedial objectives have been met and the extent and effectiveness of controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The considerations evaluated during the analysis of each alternative for long-term effectiveness and permanence are presented in Table 14. The components addressed for each alternative are described in more detail in the following subsections.

Table 14: Criterion 3—Long-Term Effectiveness and Permanence

Analysis Factor	Considerations
Magnitude of Residual Risks	Identity of remaining risks (risks from treatment residuals) as well as risks from untreated residual contamination.
	Magnitude of the remaining risks.
Adequacy and Reliability of Controls	Likelihood that the technologies will meet required process efficiencies or performance specifications.
	Type and degree of long-term management required.
	Long-term monitoring requirements.
	Operation and maintenance (O&M) functions that must be performed.
	Difficulties and uncertainties associated with long-term O&M functions.
	Potential need for technical components replacement.
	Magnitude of threats or risks should the remedial action need replacement.
	Degree of confidence that controls can adequately handle potential problems.
	Uncertainties associated with land disposal of residuals and untreated wastes.

4.1.3.1 Magnitude of Residual Risk

The magnitude of residual risk at the end of remedial activities is measured by numerical standards such as cancer risk levels, or the volume or concentration of contaminants remaining on the site. The characteristics of the residuals remaining on site are also evaluated, considering their volume, toxicity, mobility, and propensity to bioaccumulate.

4.1.3.2 Adequacy and Reliability of Controls

The adequacy and reliability of controls that are used to either manage treatment residuals or untreated materials that remain at the site after attaining preliminary cleanup goals are evaluated. This criterion includes an assessment of containment systems and institutional controls to evaluate the degree of confidence that they adequately handle potential problems and provide sufficient protection. The criterion also addresses long-term reliability, the need for long-term management and monitoring of the site, and the potential need to replace technical components of the alternative.

4.1.4 Criterion 4—Reduction of Toxicity, Mobility, or Volume through Treatment

This evaluation criterion addresses the anticipated performance of the alternative's treatment technologies in permanently and significantly reducing toxicity, mobility, and/or volume of hazardous materials at the site. The NCP prefers remedial actions where treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media. The considerations evaluated during the analysis of each alternative for reduction of toxicity, mobility or volume of contaminants present is presented in Table 15.

Table 15: Criterion 4—Reduction of Toxicity, Mobility, or Volume Through Treatment

Analysis Factor	Considerations
Treatment process and remedy	Likelihood that the treatment process addresses the principal threat.
	Special requirements for the treatment process.
Amount of hazardous material destroyed or treated	Portion (mass) of contaminant that is destroyed.
	Portion (mass) of contaminant that is treated.
Reduction in toxicity, mobility, or volume	Extent that the total mass of contaminants is reduced.
	Extent that the mobility of contaminants is reduced.
	Extent that the volume of contaminants is reduced.
Irreversibility of treatment	Extent that the effects of the treatment are irreversible.
Type and quantity of treatment residual	Residuals that will remain.
	Quantities and characteristics of the residuals.
	Risk posed by the treatment residuals.
Statutory preference for treatment as a principal element	Extent to which the scope of the action covers the principal threats.
	Extent to which the scope of the action reduces the inherent hazards posed by the principal threats at the site.

4.1.5 Criterion 5—Short-term Effectiveness

This evaluation criterion considers the effect of each alternative on the protection of human health and the environment during the construction and implementation process. The short-term effectiveness evaluation only addresses protection prior to meeting the RAO. The considerations evaluated during the analysis of each alternative for short-term effectiveness are presented in Table 16.

Table 16: Criterion 5—Short-Term Effectiveness

Analysis Factors	Considerations
Protection of the community during the remedial action	Risks to the community that must be addressed.
	How the risks will be addressed and mitigated.
	Remaining risks that cannot be readily controlled.
Protection of workers during remedial actions	Risks to the workers that must be addressed.
	How the risks will be addressed and mitigated.
	Remaining risks that cannot be readily controlled.
Environmental Impacts	Environmental impacts that are expected with the construction and implementation of the alternative.
	Mitigation measures that are available and their reliability to minimize potential impacts.
	Impacts that cannot be avoided, should the alternative be implemented.
Time until remedial action objectives are achieved	Time to achieve protection against the threats being addressed.
	Time until any remaining threats are addressed.
	Time until RAOs are achieved.

4.1.6 Criterion 6—Implementability

This criterion evaluates the technical feasibility and administrative feasibility (i.e., the ease or difficulty) of implementing each alternative and the availability of required services and materials during its implementation. The considerations evaluated during the analysis of each alternative for implementability are presented in Table 17.

Table 17: Criterion 6—Implementability

Analysis Factors	Considerations
Technical Feasibility	
Ability to construct and operate the technology	Difficulties associated with the construction.
	Uncertainties associated with the construction.
Reliability of the technology	Likelihood that technical problems will lead to schedule delays.
Ease of undertaking additional remedial action	Likely future remedial actions that may be anticipated.
	Difficulty implementing additional remedial actions.
Monitoring considerations	Migration or exposure pathways that cannot be monitored adequately.
	Risks of exposure, should the monitoring be insufficient to detect failure.
Administrative Feasibility	
Coordination with other agencies	Steps required to coordinate with regulatory agencies.
	Steps required to establish long-term or future coordination among agencies.
	Ease of obtaining permits for off site activities, if required.
Availability of Services and Materials	
Availability of treatment, storage capacity, and disposal services	Availability of adequate treatment, storage capacity, and disposal services.
	Additional capacity that is necessary.
	Whether lack of capacity prevents implementation.
	Additional provisions required to ensure that additional capacity is available.
Availability of necessary equipment and specialists	Availability of adequate equipment and specialists.
	Additional equipment or specialists that are required.
	Whether there is a lack of equipment or specialists.
	Additional provisions required to ensure that equipment and specialists are available.
Availability of prospective technologies	Whether technologies under consideration are generally available and sufficiently demonstrated.
	Further field applications needed to demonstrate that the technologies may be used full-scale to treat the waste at the site.
	When technology should be available for full-scale use.
	Whether more than one vendor will be available to provide a competitive bid.

4.1.7 Criterion 7—Cost

This criterion evaluates the cost of implementing each alternative. The cost of an alternative encompasses all engineering, construction, and operation and maintenance (O&M) costs incurred over the life of the project. The assessment against this criterion is based on the estimated present worth of these costs for each alternative. Present worth is used to estimate expenditures such as construction and O&M that occur over different lengths of time. This allows costs for remedial alternatives to be compared by discounting all costs to the year that the alternative is implemented.

4.2 CERCLA Criteria Analysis – Groundwater

4.2.1 Alternative GW-1: No Action

4.2.1.1 Overall Protection of Human Health and the Environment

The No Action alternative does not reduce the risk to human health or the environment, as it does not treat the groundwater and allows the contaminant plume to migrate unchecked.

4.2.1.2 Compliance with ARARs

The No Action alternative does not affect the contamination levels in the groundwater at the site. Natural attenuation of the contaminants would proceed, but no monitoring of groundwater contaminant concentrations would take place. Groundwater contaminated above the IEPA Class I groundwater goal would be allowed to migrate unchecked. No effort would be made to comply with ARARs.

4.2.1.3 Long-Term Effectiveness

This alternative does not provide for any treatment of the site contamination, so long-term human health and environmental risks would remain as they are currently. The VOCs would continue to migrate through the groundwater.

4.2.1.4 Reduction of Toxicity, Mobility, or Volume

Since no remedial action is implemented with this alternative, there would be no reduction of contaminant toxicity, mobility, or volume.

4.2.1.5 Short-Term Effectiveness

Because no remedial action will be taken under Alternative GW-1, no short-term risks to the community or to workers as a result of implementing the action will occur. Similarly, no environmental impact from construction activities will occur.

4.2.1.6 Implementability

No technology factors are evaluated (ability to construct or operate the technology, availability and reliability of the technology or specialists, etc.) under Alternative GW-1. There are no impediments to implementing future remedial actions.

4.2.1.7 Cost

There are no costs associated with Alternative GW-1.

4.2.2 Alternative GW-2: Groundwater Monitoring and Natural Attenuation

4.2.2.1 Overall Protection of Human Health and the Environment

Under Alternative GW-2, the contaminated groundwater will remain in place. The contaminants will degrade slowly over time by natural processes in the aquifer. The groundwater will be monitored until these natural processed achieve the RAOs.

Exposure to the groundwater would be limited by institutional controls. Ecological exposure at points where groundwater mixes with surface waters would not be limited. The rate and volume of mixing of groundwater with surface water at the site are not known in detail, but are suspected to be small.

Human health and the environment will be protected through the isolation of the waste. Institutional controls could be used to limit access to the site.

Contaminants from the site will take many years to reach surface water or down gradient wells and will be attenuated during transport by natural chemical, physical and biological processes. It is anticipated that the groundwater contaminants will be difficult to detect by the time they mix with surface waters or reach down gradient wells.

4.2.2.2 Compliance with ARARs

Alternative GW-2 will comply with ARARs for VOCs that make up the site groundwater contamination. The groundwater contamination will be monitored in place to confirm compliance with relevant and appropriate IEPA objectives.

4.2.2.3 Long-Term Effectiveness

Under Alternative GW-2, the groundwater contamination at the site will remain in place and VOCs will slowly degrade over time. The contaminants in groundwater will remain; however, access to the contaminated groundwater could be limited by land use restriction. As long as the restrictions are maintained, the use of the site is not altered, and the groundwater is not used for potable purposes the residual risk will be acceptable.

The ultimate effectiveness of monitored natural attenuation at reducing the migration of contaminants to surface water is uncertain. Some infiltration of surface water will likely continue at the site and groundwater will move to the site from up gradient sources. The movement of groundwater in the aquifer will be a function of a number of parameters, including hydraulic conductivity, duration and intensity of rainfall, slope of the ground surface, and presence and location of undetected defects.

For MNA to be effective over the long-term, continued monitoring of the groundwater and soil management practices will be required. If contaminated groundwater is found to present an eminent danger of contaminating surface water at unacceptable concentrations, or if the contaminated groundwater is to be put to beneficial use, these alternatives could potentially result in exposure to contaminated groundwater. Because contaminated groundwater will remain in place, monitoring, land use restrictions, and access restrictions (e.g. soil management plan) will be required until the groundwater meets the RAOs.

Institutional controls at the site, are susceptible to changes in political jurisdiction, legal interpretations, and enforcement, and would be required in perpetuity. Therefore, long-term reliability on institutional controls to prevent exposure to contaminated groundwater is unknown.

4.2.2.4 Reduction of Toxicity, Mobility, or Volume

Under Alternative GW-2, contaminated groundwater at the site will be monitored in place while organic contaminants naturally degrade. The east side of the launch area is underlain by shallow groundwater contamination with chlorinated solvents (Figure 7). Under Alternative GW-2, the total volume of contaminated groundwater would be remediated through natural attenuation. The toxicity, mobility, and volume of contamination groundwater at the site will decrease over time as the chlorinated solvents are dechlorinated through natural processes. Daughter products will be produced as the primary contaminants degrade and ultimately the resulting chemicals will be environmentally benign. Petroleum hydrocarbons will be metabolized by bacterial ultimately yielding carbon dioxide and water.

The proposed treatment methods will be irreversible. A summary of the toxicity, mobility, and volume reduction achieved through natural attenuation and the type of residuals produced is provided in Table 18.

Table 18: Summary of Toxicity, Mobility, and Volume Reduction Achieved by Groundwater Natural Attenuation and Residuals Produced

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine Illinois

Treatment	Toxicity	Mobility	Volume	Treatment Residuals
Monitored natural attenuation	Reduced – chlorinated solvents will be degraded in groundwater through natural processes over a long period of time.	Reduced – Contaminants are degraded in the groundwater so fewer contaminants are left to mobilize.	Reduced – Contaminants are degraded to none toxic residuals in the groundwater.	Daughter products at interim stages and ultimately no toxic residuals.

4.2.2.5 Short-Term Effectiveness

If additional groundwater monitoring points are required, some potential short-term exposures to workers could occur during well installation. Personnel performing the monitoring may also potentially be exposed to contaminated groundwater during subsequent monitoring events. Even with these potential exposures to monitoring personnel, Alternative GW-2 would be very effective in the short term.

4.2.2.6 Implementability

No unusual difficulties in performing long term monitoring of natural attenuation at the Nike SL-10 Launch Area are anticipated.

Coordination with IEPA will be required to properly implement this alternative. Negotiations with the agency to determine the nature and timing of groundwater monitoring will be necessary. The long-term monitoring plan and soil management plans will benefit from review by and discussion with the IEPA.

4.2.2.7 Cost

The cost of Alternative GW-2 is summarized in Table 19.

Table 19: Summary of Costs for Alternative GW-2

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine Illinois

	Residential
Annual Operations by Fiscal Year (year)	**Total ($1,000s)**
01	$188
02	$30
03	$30
04	$30
05	$44
06	$30
07	$30
08 through 50	$1,455
Total Alternative GW-2 Costs	$1,837
Average Annual Outlay [a]	$37
Total Alternative GW-2 Present Worth Cost	$631

4.2.3 Alternative GW-3: In-Situ Treatment

4.2.3.1 Overall Protection of Human Health and the Environment

Under Alternative GW-3, the contaminated groundwater will be treated in place. An enhanced bioremediation system will be installed at the site to treat groundwater contaminated with chlorinated solvents. Amendments will be added to the groundwater to release hydrogen or carbon into the contaminant plume. The bacteria in the groundwater will use the amendments to increase anaerobic degradation of the chlorinated solvents by stripping chloride ions from the solvent molecules.

The groundwater will be monitored to evaluate the rate of the degradation. Additional amendments to the groundwater will be applied as needed based on the results of the monitoring.

Residual contamination in the aquifer at the site will be allowed to attenuate naturally and will be monitored as it degrades. The residual groundwater contamination will be monitored until the RAOs are achieved.

As discussed previously, exposure to the groundwater would be limited by land use restrictions (Section 2.6.4.1.2), which would reduce the risk to human health. Ecological exposure at points where groundwater mixes with surface waters would not be limited. The rate and volume of mixing of groundwater with surface water at the site are not known in detail, but are suspected to be small. Direct exposure to groundwater and soil vapor would exist for construction workers excavating soil at the site. Worker protection would take the form of a soil management plan for the property and ongoing monitoring for compliance with the plan.

Human health and the environment will be protected through the treatment and isolation of the waste. Institutional controls will be used to control access to the site.

4.2.3.2 Compliance with ARARs

Alternative GW-3 will comply with ARARs. The groundwater contamination will be treated in-situ and residual contamination will be monitored in place to confirm compliance with relevant and appropriate IEPA goals.

4.2.3.3 Long-Term Effectiveness

Under Alternative GW-3, the groundwater contamination at the site will be treated in-situ and residual contamination remaining in place will slowly degrade over time. Most of the contaminant volume will be removed through treatment. The removal of the organic contaminants will be irreversible. Access restriction will limit exposure to the remaining residual contaminants in groundwater. The use of the property should be monitored and if the property is to be used for residential purposes of if groundwater from the site is to be used for potable purposes another remedial alternative will have to be used to increase the rate of the remediation. As long as the access restrictions are maintained, and the use of the property does not change the residual risk will be acceptable.

The ultimate effectiveness of in-situ treatment of the groundwater at reducing the migration of contaminants to surface water is uncertain. The possibility will remain that the residual contamination in the groundwater could migrate to surface waters. The enhanced bioremediation could have an effect on the transport of water in the aquifer and may result in the mobilization of residual contaminants possibly toward contact with surface water.

As discussed previously, for monitored natural attenuation of the residuals to be effective over the long-term, continued monitoring of the groundwater and soil management practices will be required. If contaminated groundwater is found to present an eminent danger of contaminating surface water at unacceptable concentrations, or if the groundwater is to be put to beneficial use, these alternatives could potentially result in exposure to contaminated groundwater. Because contaminated groundwater will remain in place, monitoring, land use restrictions, and access restrictions (e.g. soil management plan) will be required until the groundwater meets the RAOs.

Institutional controls at the site, are susceptible to changes in political jurisdiction, legal interpretations, and enforcement, and would be required in perpetuity. Therefore, long-term reliability on institutional controls to prevent exposure to contaminated groundwater is unknown.

4.2.3.4 Reduction of Toxicity, Mobility, or Volume

Under Alternative GW-3, contaminated groundwater at the site will be treated in place. Organic contaminants will be removed from the aquifer. The toxicity, mobility and volume of organics will thus be eliminated from groundwater at the site. The amount of residual in the aquifer will not be known until the treatment is complete. The residual will be monitored as it degrades until the RAOs are met.

The proposed treatment methods will be irreversible. A summary of the toxicity, mobility, and volume reduction achieved through the enhanced bioremediation and the type of treatment residuals produced is provided in Table 20.

Table 20: Summary of Toxicity, Mobility, and Volume Reduction Achieved by Groundwater Treatment Technologies and Treatment Residuals Produced

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine Illinois

Treatment	Toxicity	Mobility	Volume	Treatment Residuals
Enhanced bioremediation	Reduced – organic compounds will be removed from the aquifer by this process.	Reduced – Organic contaminants are removed from the aquifer.	Reduced – Organic contaminants are removed from the aquifer.	Residual dissolved organic contaminants and possible daughter products will remain in the aquifer.

4.2.3.5 Short-Term Effectiveness

Injection wells may be required in the VOC plume, some potential short-term exposures to workers could occur during well installation. System operators will potentially be exposed to contaminated groundwater during treatment.

Personnel performing the monitoring may also potentially be exposed to contaminated groundwater during subsequent monitoring events.

4.2.3.6 Implementability

Alternative GW-3 is readily implementable. The enhanced bioremediation system will not require a lot of on site infrastructure. Some injection wells may be required, but for the most part the existing wells can be used for injection and monitoring. Permitting will have to be researched and all necessary permits will have to be obtained.

Coordination with IEPA will be required to properly implement this alternative. Negotiations with the agency to determine the nature and timing of groundwater monitoring will be necessary. The long-term monitoring plan and soil management plans will benefit from review by and discussion with the IEPA.

Groundwater monitoring will be conducted on residual contamination following treatment. There is minimal risk of exposure to contaminated groundwater if the monitoring fails to detect contaminant migration because the groundwater is not used for drinking water.

4.2.3.7 Cost

The cost of Alternative GW-3 is summarized in Table 21.

Table 21: Summary of Costs for Alternative GW-3

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine Illinois

	Residential
Annual Operations by Fiscal Year (year)	**Total ($1,000s)**
01	$228
02	$145
03	$145
04	$119
05	$212
06	$0
07	$0
08 through 50	$0
Total Alternative GW-3 Costs	$849
Average Annual Outlay [a]	$17
Total Alternative GW-3 Present Worth Cost	$701

4.2.4 Alternative GW-4: Groundwater Collection/Treatment/Discharge

4.2.4.1 Overall Protection of Human Health and the Environment

Under Alternative GW-4, the contaminated groundwater will be treated ex-situ. Extraction wells will remove groundwater from the aquifer. The water will be treated through GAC filtration. The GAC filter will remove the organic contaminants. The treated water will be amended if necessary and discharged to the surface drainage at the site. This system will collect enough of the site groundwater to contain the contaminant plume. This system would be protective of human health and the environment because it would prevent the migration of the contaminated groundwater from the site.

As discussed previously, exposure to the groundwater would be limited by access restrictions and restrictions on the use of groundwater at the site, which would reduce the risk to human health. Ecological exposure to the contaminants in the groundwater would be limited by the containment of the plume(s) on the site. Direct exposure to groundwater and soil vapor would exist for construction workers excavating soil at the site. Worker protection would take the form of a soil management plan for the property and ongoing monitoring for compliance with the plan.

Human health and the environment will be protected through the treatment and containment of the contamination.

4.2.4.2 Compliance with ARARs

Alternative GW-4 will comply with ARARs. The groundwater contamination will be treated ex-situ and residual contamination will be contained on site to confirm compliance with relevant and appropriate IEPA goals.

4.2.4.3 Long-Term Effectiveness

Under Alternative GW-4, the groundwater contamination at the site will be treated ex-situ and contaminant plume(s) will be contained by the pump and treat system. Some of the contaminant volume will be removed through treatment. The removal of the organic contaminants will be irreversible. Land use restriction will limit exposure to the remaining residual contaminants in groundwater. As long as the restrictions are maintained, the residual risk will be acceptable.

The ultimate effectiveness of ex-situ treatment of the groundwater at reducing the migration of contaminants to surface water is uncertain. The possibility will remain that the residual contamination in the groundwater could migrate to surface waters. The pump and treat system will have an effect on the transport of water in the aquifer and may result in the mobilization of contaminants possibly toward contact with surface water though this is unlikely. If contaminated groundwater is found to present an eminent danger of contaminating surface water at unacceptable concentrations or if the groundwater is to be put to beneficial use these alternatives could potentially result in exposure to contaminated groundwater. Because contaminated groundwater will remain in place, monitoring, land use restrictions, and access restrictions (e.g. soil management plan) will be required until the groundwater meets the RAOs.

Institutional controls at the site are susceptible to changes in political jurisdiction, legal interpretations, and enforcement, and would be required in perpetuity. Therefore, long-term reliability on institutional controls to prevent exposure to contaminated groundwater is unknown.

4.2.4.4 Reduction of Toxicity, Mobility, or Volume

Under Alternative GW-4, contaminated groundwater at the site will be treated and discharged. Organic contaminants will be removed from the aquifer. The toxicity, mobility and volume of organics will thus be eliminated from groundwater at the site. Treatment will continue until an asymptotic recovery curve is achieved (i.e. continued extraction is not reducing the concentration of the contaminants in the aquifer), or until it is determined that the plume can degrade naturally without any additional treatment and will not leave the property. Periodically, at five-year reviews, alternative methods of remediation that will reduce treatment times or costs will be considered.

The proposed treatment methods will be irreversible. A summary of the toxicity, mobility, and volume reduction achieved through the various treatment technologies that may be applied and the type of treatment residuals produced is provided in Table 22.

Table 22: Summary of Toxicity, Mobility, and Volume Reduction Achieved by Groundwater Treatment Technologies and Treatment Residuals Produced

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine Illinois

Treatment	Toxicity	Mobility	Volume	Treatment Residuals
Activated carbon	Reduced – organic compounds will be removed from the aquifer by this process.	Reduced – Organic contaminants are removed from the aquifer.	Reduced – Organic contaminants are removed from the aquifer.	The activated carbon will require regeneration periodically.

4.2.4.5 Short- Term Effectiveness

Extraction wells will have to be installed as part of the pump and treat systems, some potential short-term exposure to workers could occur during well installation. A treatment plant will have to be designed and built. Construction may generate dust and runoff. System operators will potentially be exposed to contaminated groundwater during treatment. Personnel performing the monitoring may also potentially be exposed to contaminated groundwater during monitoring events.

4.2.4.6 Implementability

Pump and treat technology is reliable and the equipment is readily available. Activated carbon will require regeneration periodically. Permitting will have to be researched and all necessary permits will have to be obtained.

Coordination with IEPA will be required to properly implement this alternative. Negotiations with the agency to determine the nature and timing of groundwater monitoring will be necessary. The long-term monitoring plan and soil management plans will benefit from review by and discussion with the IEPA.

Groundwater monitoring will be conducted to assess changes in the contaminant plume(s). There is minimal risk of exposure to contaminated groundwater if the monitoring fails to detect contaminant migration because the groundwater is not used for drinking water.

4.2.4.7 Cost

The cost of Alternative GW-4 is summarized in Table 23.

Table 23: Summary of Costs for Alternative GW-4

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine Illinois

	Residential
Annual Operations by Fiscal Year (year)	**Total ($1,000s)**
01	$514
02	$121

Table 23: Summary of Costs for Alternative GW-4

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine Illinois

	Residential
Annual Operations by Fiscal Year (year)	**Total ($1,000s)**
03	$121
04	$121
05	$142
06	$121
07	$121
08 through 50	$5,565
Total Alternative GW-4 Costs	$6,826
Average Annual Outlay [a]	$137
Total Alternative GW-4 Present Worth Cost	$2,103

4.3 Comparative Analysis

This section provides a comparative analysis of the relative performance of each alternative in relation to the seven CERCLA evaluation criteria. An analysis of the groundwater alternatives performance against the seven criteria is presented in Table 24.

4.3.1 Overall Protection of Human Health and the Environment

Alternative GW-1 would not reduce the risk to human health because exposure to contaminants in groundwater through direct contact, ingestion, and/or inhalation would be possible, and the risk of impacting the environment remains because the migration of contamination to uncontaminated groundwater, soil, and surface water is not eliminated. In Alternative GW-2, natural attenuation would take place slowly over time; exposure to contaminated groundwater could pose a risk to human health and the environment because the contaminants are left in place for many years. The 2 remaining alternatives, GW-3 (enhanced bioremediation) and GW-4 (pump and treat), both reduce the risks to human health and the environment through treatment of the contaminated groundwater.

4.3.2 Compliance With ARARs

All alternatives will comply with potentially applicable action-, location-, and chemical-specific ARARs with the exception of Alternative GW-1 because ARARs requiring cleanup of wastes that pose a risk to human health and the environment have not been met. In addition, ARARs related to management of wastes that will remain in place at areas where releases of wastes have occurred have also not been met for Alternative GW-1.

Table 24: Ranking of Groundwater alternatives

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine Illinois

Alternative Ranking	Criterion 1	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7 [a]
1[b]	Alternative 3	Alternative 3	Alternative 3	Alternative 1	Alternative 1	Alternative 1
2	Alternative 4	Alternative 4	Alternative 4	Alternative 2	Alternative 2	Alternative 2
3	Alternative 2	Alternative 2	Alternative 2	Alternative 3	Alternative 3	Alternative 3
4	Alternative 1	Alternative 1	Alternative 1	Alternative 4	Alternative 4	Alternative 4

[a] Criteria 7 is ranked by the Total Cost (50-years – present worth) as presented in Table 25.

[b] A ranking of one "1" denotes that a particular Alternative most fully meets the corresponding criteria.

Note: Criterion 2 is not reported in this table because all Alternatives comply with ARARs with the exception of Alternative I; therefore the ranking format presented in this table does not apply to this particular criteria.

Criterion 1 – Overall Protection of Human Health and the Environment
Criterion 2 – Compliance with ARARs
Criterion 3 – Long-Term Effectiveness and Performance
Criterion 4 – Reduction of Toxicity, Mobility, or Volume through Treatment
Criterion 5 – Short-Term Effectiveness
Criterion 6 – Implementability
Criterion 7 – Cost

Alternative GW-1 – No-Action
Alternative GW-2 – Monitored Natural Attenuation
Alternative GW-3– In-Situ Treatment
Alternative GW-4 – Groundwater Collection/Treatment/Discharge

4.3.3 Long-Term Effectiveness

There are no controls implemented to manage untreated wastes and risks that remain at the areas of contamination for Alternative GW-1, therefore, the criterion for long-term effectiveness and permanence is not met. In Alternatives GW-2 and GW-3, long-term effectiveness and permanence also depend on proper maintenance of long-term monitoring that would be implemented as part of the Alternative. Treatment of groundwater in Alternative GW-3 and GW-4 provides long-term effectiveness in protecting human health and the environment and meets the criterion for long-term effectiveness and permanence because contaminants are physically removed from the source area. Alternative GW-3 would be the more protective of the two because it removes more source material from the aquifer quickly.

4.3.4 Reduction of Toxicity. Mobility, or Volume

Alternative GW-1 will not reduce contaminant toxicity, mobility, and volume through treatment because no treatment technologies are employed. Alternative GW-2 will reduce the toxicity and volume of organic compounds that are subject to natural degradation. The potential for migration of contaminants under GW-2 is unaffected. However, the mobility of the contaminants will be monitored so that measures can be taken if necessary to capture mobile contaminants.

Alternatives GW-3 and GW-4 will significantly reduce contaminant toxicity, mobility, and volume through treatment. The treatment technologies used on the groundwater are irreversible, and these Alternatives meet the statutory preference for treatment. In the case of GW-3 residual contamination will be monitored, as in Alternative GW-2, over time to confirm that the contaminants are not moving toward a location were exposure would be possible. Large amounts of organic contaminants are removed from the aquifer quickly in Alternative GW-3. Alternative GW-4 will contain the contaminant plume on site and prevent migration. Alternatives GW-3 and GW-4 both have advantages when it comes to reducing toxicity, mobility, and volume of contaminants. Alternative GW-3 would be slightly more advantageous because of the rapidity of treatment.

4.3.5 Short-Term Effectiveness

Because no remedial action will be taken under Alternative GW-1, no environmental impacts will occur, and no short-term risks to the community or to workers as a result of implementing the action will occur. MW-2 would create very little potential for short-term exposure to contaminated groundwater. In Alternatives GW-3 and GW-4, the initial phases of implementation may pose potential short-term exposures to the community and workers. Controls and mitigation activities would be implemented to minimize these potential exposures and to minimize the impact to environmentally sensitive areas.

4.3.6 Implementability

All alternatives are implementable; all technologies can be constructed and operated; and materials, equipment, and vendors are readily available.

There are no impediments to implementing future remedial actions for Alternative GW-1. In regard to Alternative GW-2, natural attenuation is already underway in the groundwater at the site. Therefore, Alternatives GW-3 and GW-4 would be the most

disruptive to site activities because routine maintenance and repairs to the system may restrict the activities at the site. Alternative GW-3 would be completed quickly and would not require a plant at the site over a long period of years, as would be the case with Alternative GW-4. If the trailer from the pilot test can be reused for alternative GW-4 this will limit the amount of activity required to install the pump and treat system. Alternative GW-3 would be more disruptive in the short term, but would be completed more quickly than Alternative GW-4.

4.3.7 Cost

The estimated costs for implementing Alternatives GW-1 through GW-4 are presented in Table 25. Alternatives GW-1 through GW-4 are ranked according to cost in Table 24. Detailed cost calculations are presented in Appendix C.

4.4 Recommended Remedial Alternative

At this stage in the Feasibility Study, it is too early to recommend a remedial alternative, as the alternatives have not been analyzed for state or community acceptance. This draft Feasibility Study will be submitted for state and public review. Once all comments on the draft have been received, the Feasibility Study will be modified to incorporate the state and community concerns, and a Proposed Plan will be prepared presenting the recommended remedial action.

Table 25: Summary of Groundwater Alternative Cost Estimates

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine Illinois

Alternatives	Alternative GW-1 No-Action ($ million)	Alternative GW-2 Monitored Natural Attenuation ($ million)	Alternative GW-3 In-Situ Treatment ($ million)	Alternative GW-4 Groundwater Collection/ Treatment/Discharge ($ million)
Average Annual Outlay Costs[a]	0	$0.041	$0.017	$0.137
Total Cost (50 years – straight cost)	0	$2.049	$0.849	$6.825
Total Cost (50 years – present worth)[b]	0	$0.691	$0.701	$2.102

[a]The Average Annual Outlay Costs include capital costs.

[b]The present worth over 50 years of annual costs is based on a 7 percent discount rate.

5.0 REFERENCES

American Society for Testing and Materials (ASTM). 1995. "Cleanup Criteria for Contaminated Soil and Groundwater"; ASTM DS 64, Philadelphia; 1995.

Applied Research and Development Laboatory (ARDL), Inc. 1994. "Phase II Contamination Evaluation Report, Former Nike Site SL-10, /Marine, Illinois"; prepared for U.S. Army Corps of Engineers, Buffalo District, Buffalo, NY; September 1994. Contract No. DACW 49-93-0009.

Dickman, Michael. 1996. "Personal Phone Communication with Michael Dickman, Superintendent of Maintenance, Madison County Highway Department"; April 1996.

Envirodyne Engineers, Inc. (EEI). 1988. "Contamination Evaluation, Former Nike Missile Site SL-10, Marine, Illinois"; prepared for U.S. Army Corps of Engineers Buffalo District, Buffalo, NY; May 1988. Contract No. DACA 87-86-D-0045.

Environmental Cost Handling Options and Solutions (ECHOS). 2006. Environmental Remediation Cost Data – Assemblies. Azimuth Group, Ltd.

ECHOS. 2006. Environmental Remediation Cost Data – Unit Price. Azimuth Group, Ltd.

Environmental Science and Engineering, Inc. (ESE). 1995. "Baseline Risk Assessment Report, Nike Missile Site SL-10"; prepared for U.S. Army Corps of Engineers, Buffalo District, Buffalo, NY; June 1995.

Fetter, C.W. 1988. *Applied Hydrogeology*, Columbia, OH: Merrill Publishing Company.

Freeze, R.A. and J.A. Cherry. 1979. *Groundwater*. Englewood, NJ. Prentice Hall.

Illinois Department of Natural Resources (IDNR). Natural History Survey. 1996. Available at www.isgs.uiuc.edu/nsdihome/browse/statewide/quat96b.gif.

IDNR. Natural History Survey. 1997. Available at www.isgs.uiuc.edu/nsdihome/browse/statewide/bedgoeb.gif.

Illinois State Geological Survey (ISGS). 1999. "Pleistocene Glaciations in Illinois." www.isgs.uiuc.edu/tours/outliers/pleist-G.htm. June 17.

King, Phillip B. 1977. *The Evolution of North America*. Princeton, NJ. Princeton University Press.

Law Engineering and Environmental Services, Inc. (Law). 2002. "Final Report, Pilot-Scale Treatability Study, Former Nike Missile SL-10 Launch Area, Marine, Illinois." February.

Plexus Scientific Corporation (Plexus). 2004. "Former Nike Site SL-10, Marine, Madison County, Illinois, Preliminary Assessment, Final." September 2004.

Plexus. 2005. "Nike SL-10 Launch Area Groundwater, Remedial Investigation/ Feasibility Study/Proposed Plan/Record of Decision Project, Marine, Illinois, Remedial Investigation Report, Final." November 2005.

SEC Donohue, Inc. (SEC Donohue). 1992. "Contamination Evaluation, Former Nike Site SL-10, Marine, Illinois"; prepared for U.S. Army Corps of Engineers, Buffalo District, Buffalo, NY; October 1992. Contract No. DACA41-90-D-0002.

U.S. Army Corps of Engineers (USACE). 1996. Draft Feasibility Study, Former Nike Missile Site SL-10 Launch Area, Marine, Illinois, August.

U.S. DOD, 1994. "Remediation Technologies Screening Matrix and Reference Guide"; DOD Environmental Technology Transfer Committee, EPA/542/B-94/013; October 1994.

U.S. Environmental Protection Agency (USEPA). 1985. "Guidance on Feasibility Studies Under CERCLA"; U.S. Environmental Protection Agency, EPA/540/G-85/003; June 1985.

USEPA. 1988. "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final"; U.S. Environmental Protection Agency, EPA/540/G-89/004; October 1988.

USEPA. 1990. “National Oil and Hazardous Substances Pollution Contingency Plan.” 40 CFR Part 300. March 1990.

USEPA. 1995. "Vendor Information System for Innovative Treatment Technologies, Version 4.0"; U.S. Environmental Protection Agency, 1995.

USEPA. 1998. “Technical Protocol for Evaluation Natural Attenuation of Chlorinated Solvents in Groundwater,” EPA/600/R-98/128. September.

USEPA. 2000. “A Guide to Developing and Documenting Cost Estimates During the Feasibility Study.” EPA 540-R-00-002, OSWER 9355.0-75. July.

APPENDIX A: Nike SL-10 Launch Area Groundwater Data Tables

November 2002 Data

	MCL	Illinois Class I[1]	MG-2	LQ	VQ	MG-5	LQ	VQ	MG-9	LQ	VQ	MW-1D	LQ	VQ	MW-2D	LQ	VQ	MW-3S	LQ	VQ	MW-103S	LQ	VQ	MW-5S	LQ	VQ	MW-6S	LQ	VQ	MW-106S	LQ	VQ	MW-6D	LQ	VQ	MW-106D	LQ	VQ	MW-7S	LQ
Units	ug/L	ug/L	ug/L			ug/L			ug/L			ug/L			ug/L			ug/L			ug/L			ug/L			ug/L						ug/L						ug/L	
VOCs (8260B)																					NA																			
acetone		700	<10			<10			<10		UJ c	<20			<13		UJ c	<13		UJ c				<10			<10			<10			<10			<10			<10	
benzene	5	5	<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
bromodichloromethane	80**	0.2	**<1.0**			**<1.0**			**<1.0**			**<2.0**			**<1.3**			**<1.3**						**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**	
bromoform	80**	1	<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
bromomethane		9.8	<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
2-butanone			<10			<10			<10			<20			<13			<13						<10			<10			<10			<10			<10			<10	
carbon disulfide		700	<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
carbon tetrachloride	5	5	<1.0			<1.0			<1.0			<2.0		UJ c	<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
chlorobenzene	100	100	<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
chloroethane			<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
chloroform	80**	0.2	**<1.0**			**<1.0**			**<1.0**			**<2.0**			**<1.3**			**<1.3**						**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**	
chloromethane			<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
cyclohexane			<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<2.0			<1.3		UJ c	<1.3		UJ c				<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0	
dibromochloromehtane	80**	0.2	**<1.0**			**<1.0**			**<1.0**			**<2.0**			**<1.3**			**<1.3**						**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**	
1,2-dibromo-3-chloro-propane	0.2	0.2	**<2.0**			**<2.0**			**<2.0**		UJ c	**<4.0**		UJ c	**<2.7**		UJ c	**<2.7**		UJ c				**<2.0**			**<2.0**			**<2.0**			**<2.0**			**<2.0**			**<2.0**	
1,2-dibromomethane		0.05	**<1.0**			**<1.0**			**<1.0**			**<2.0**			**<1.3**			**<1.3**						**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**	
1,2-dichlorobenzene	600	600	<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
1,3-dichlorobenzene			<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
1,4-dichlorobenzene	75	75	<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
dichlorodifluoromethane			<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
1,1-dichloroethane		700	<1.0			<1.0			6.9			14			42			7.4						0.68	J		<1.0			<1.0			0.96	J		0.87	J		0.33	J
1,2-dichloroethane	5	5	<1.0			<1.0			1.2			2.5			8.3			5.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
1,1-dichloroethene	7	7	<1.0			0.45	J		110			27			160			16						3.9			<1.0			<1.0			<1.0			<1.0			<1.0	
cis-1,2-dichloroethene	70	70	0.75	J		3.8			9.1			140			53			82						<1.0			0.8	J		0.88	J		2.8			2.8			<1.0	
trans-1,2-dichloroethene	100	100	<1.0			1.4			12			27			24			11						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
1,2-dichloropropane	5	5	<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
cis-1,3-dichloropropane			<1.0			<1.0			<1.0		UJ c	<2.0		UJ c	<1.3		UJ c	<1.3		UJ c				<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
trans-1,3-dichloropropane			<1.0			<1.0			<1.0		UJ c	<2.0		UJ c	<1.3		UJ c	<1.3		UJ c				<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
ethylbenzene	700	700	<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
2-hexanone			<10			<10			<10			<20			<13			<13						<10		UJ c	<10			<10			<10			<10			<10	
isopropylbenzene			<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<2.0		UJ c	<1.3		UJ c	<1.3		UJ c				<1.0			<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0	
methyl acetate			<1.0			<1.0			<10		UJ c	<2.0		UJ c	<1.3		UJ c	<1.3		UJ c				<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
methylene chloride	5	5	<1.0		B z	<1.0		B z	<1.0		B z	<2.0		B,z	<1.3		B,z	<1.3		Bz				<1.0			<1.0		B z	<1.0			<1.0		B,z	<1.0		B,z	<1.0	
methylcyclohexane			<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<2.0			<1.3		UJ c	<1.3		UJ c				<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0	
4-methyl-2-pentanone			<10			<10			<10			<20			<13			<13						<10			<10			<10			<10			<10			<10	
methyl tert-butyl ether			<5.0			<5.0			<5.0			<10			<1.3			<1.3						<5.0			<5.0			<5.0			<5.0			<5.0			<5.0	
styrene	100	100	<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
1,1,2,2-tertachloroethane			<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
tetrachloroethene (PCE)	5	5	<1.0			<1.0			0.96	J		<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
toluene	1000	NA	<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			0.74	J		0.75	J		0.42	J		0.43	J		<1.0	
1,2,4-trichloro-benzene	70	70	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<2.0			<1.3		UJ c	<1.3		UJ c				<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0	
1,1,1-trichloroethane	200	200	<1.0			<1.0			1.6			<2.0			<1.3			0.56	J					<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
1,1,2-trichloroethane	5	5	<1.0			<1.0			4.9			9.7	J		70			48						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
trichloroethene (TCE)	5	5	<1.0			<1.0			77			170			190			200						<1.0			<1.0			<1.0			0.58	J		0.52	J		<1.0	
trichlorofluoromethane			<1.0			<1.0			<1.0		UJ c	<2.0			<1.3		UJ c	<1.3		UJ c				<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
1,1,2-trichloro-1,2,2-trifluoroethane			<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
vinyl chloride	2	2	<1.0			<1.0			0.66	J		1.4	J		1.8			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
xylenes (total)	10000	10000	<1.0			<1.0			<1.0			<2.0			<1.3			<1.3						<1.0			<1.0			<1.0			<1.0			<1.0			<1.0	
TOC (mg/L)			0.9	B		NA			0.9	B		2			1			0.8	B		1			0.7	B		NA			NA			NA			NA			NA	
Metals																					NA									NA										
arsenic	As	10	50	**<12.0**			2.4	B		**<12.0**			4.0	B		2.9	B		**<12.0**						2.9	B		2.7	B		**<12.0**			5.3	B		6.9	B		**<12.0**	
cadmium	Cd	5	5	**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**			0.31		B				**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**	
lead*	Pb	15	7.5	**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**						**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**	
selenium	Se	50	50	<10.0			<10.0			<10.0			<10.0			<10.0			<10.0						<10.0			<10.0			<10.0			<10.0			<10.0			<10.0	
thallium	Tl	2	2	**<15.0**			6.4	B		**<15.0**			**<15.0**			**<15.0**			**<15.0**						5.9	B		**<15.0**			**<15.0**			**<15.0**			6.4	B		**<15.0**	
																					NA																			
silver	Ag	SS=100	50	<20.0			<20.0			1.1	B		<20.0			<20.0			<20.0						<20.0			1.0	B		<20.0			<20.0			<20.0			0.99	B
aluminum	Al	SS = 50 to 200		**<200**			**<200**			**<200**			**<200**			**<200**			**<200**						**<200**			**<200**			**<200**			**<200**			**<200**			**<200**	
barium	Ba	2000	2000	79.6			93.1			95.7			96.7			112			74.7						119			62.2			60.0			75.3			86.9			97.4	
beryllium	Be	4	4	**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**						**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**	
calcium	Ca			38400			59400			72400			84100			73400			50700						51700			73200			70900			63500			73600			50900	
cobalt	Co			<20.0		B z	<20.0			<20.0		B	<20.0		B z	<20.0		B	<20.0						<20.0			<20.0		B	<20.0		B	<20.0			<20.0		B	<20.0	
chromium	Cr	100	100	<20.0			<20.0			<20.0			<20.0			<20.0			<20.0						<20.0			<20.0			<20.0			<20.0			<20.0			<20.0	
copper*	Cu	1300	650	8.2	B		2.5	B		3.8	B		3.6	B		4.2	B		3.6	B					5.8	B		6.9	B		6.2	B		3.1	B		3.6	B		4.9	B
iron	Fe	SS=300	5000	<1000			1630			552	B		390	B		216	B		<1000						<1000			<1000			<1000			619	B		637	B		<1000	
potassium	K			<5000		B z	<5000		B z	<5000		B	895	B J		791	B J		<5000		B				<5000		B	<5000		B	<5000		B	<5000		B	739	B J		<5000	
magnesium	Mg			19500			25200			31100			34500			28000			23500						24700			35000			34000			26400			30700			25100	
manganese	Mn	SS = 50	150	2.7	B		57.7			235			188			86.9	B		1.6	B					7.0	B		19.5	B		18.9	B		216			251			1340	
sodium	Na			75000			43800			56500			73400			68800			60800						61100			35400			33900			35500			40500			54900	
nickel	Ni		100	<20.0			<20.0			<20.0			4.5	B		<20.0			<20.0						3.0	B		2.9	B		3.0	B		<20.0			<20.0			12.8	
antimony	Sb	6	6	**<100**			**<100**			**<100**			**<100**			**<100**			**<100**						**<100**			**<100**			**<100**			**<100**			**<100**			**<100**	
vanadium	V		49	0.74	B		<20.0			<20.0			<20.0			0.87	B		0.8	B					<20.0			1.0	B		<20.0			<20.0			<20.0			0.85	B
zinc	Zn		5000	<100			<100			<100			<100			<100			<100						<100			14.5	B		<100			<100			<100			<100	
Mercury	Hg	2	2	<0.50			<0.50			<0.50			<0.50			<0.50			<0.50			NA			<0.50			<0.50			<0.50			<0.50			<0.50			<0.50	

MCL = Maximum Contaminant Level *MCL action level
highlight indicates above the MCL, EPA Secondary Drinking Water Standards and/or the State of Illinois Class I Remedial Objective
NA = not analyzed
"<" = below the detection limit
RL = reporting limit
SS = EPA Secondary drinking water standard
VOC = volatile organic compound
TOC = total organic carbon
[1] The Illinois Class I standard referenced is from Section 742. Appendix B, Table E: Tier 1, Groundwater Remedial Objectives for the Groundwater Component of the Groundwater Ingestion Route, Class I Groundwater.

For several metals the reporting limit of the method was higher than the regulatory standard used for comparison.
Those results that are reported as less than the reporting limit, which were higher than the relevant standard are in **bold**.
Analytical results for sample numbers over 100 i.e. MW-103S are duplicate analysis of other samples in this case MW-3S.
TB stands for trip blank and FB stands for field blank.

Inorganics
LQ = data qualifiers assigned by the laboratory
B = Estimated Result. Result is less than reporting limit.
E = Matrix interference
J = Method Blank Contamination. The associated method blank contains the target analyte at a reportable level.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

VQ = data qualifiers assigned by the data verifier.
B = The analyte was not detected substantially above the level reported in laboratory or field blanks.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample quantitation limit.
However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
c = Calibration failure.
z = Laboratory storage blank contamination

Organics
LQ = data qualifiers assigned by the laboratory
J = Estimated result. Result is less than reporting limit.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

VQ = data qualifiers assigned by the data verifier.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
R = The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample quantitation limit.
However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
c = Calibration failure; poor or unstable response.
m = MS/MSD recovery failure.

September 2003 Data

	MCL	Illinois Class I[1]	VQ	MW-7D	LQ	VQ	MW-8S	LQ	VQ	MW-8D	LQ	VQ	MW-9	LQ	VQ	MW-10	LQ	VQ	FB-01	LQ	VQ	TB-01	LQ	VQ	MW-11	LQ	VQ	MW-110	LQ	VQ	MW-12	LQ	VQ	MW-13	LQ	VQ	MW-14	LQ	VQ	TB-10	LQ	VQ
Units	ug/L	ug/L		ug/L			ug/L			ug/L			ug/L			ug/L			ug/L			ug/L			ug/L			ug/L			ug/L			ug/L			ug/L			ug/L		
VOCs (8260B)																																										
acetone		700		<10			<10			<10			<10			<10			1.8	J		<10	J		<10		R r	<10		R r	8.4	J	J r	<10		R r	<10		R r	<10		R r
benzene	5	5		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
bromodichloromethane	80**	0.2		**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**		
bromoform	80**	1		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
bromomethane		9.8		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
2-butanone				<10			<10			<10			<10			<10			<10			<10			<10			<10			1.4	J		<10			<10			0.56	J	
carbon disulfide		700		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
carbon tetrachloride	5	5		<1.0			<1.0			<1.0			<1.0		UJ c	<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
chlorobenzene	100	100		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
chloroethane				<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
chloroform	80**	0.2		**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			0.27	J	
chloromethane				<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
cyclohexane			UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
dibromochloromehtane	80**	0.2		**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**		
1,2-dibromo-3-chloro-propane	0.2	0.2		**<2.0**			**<2.0**			**<2.0**			**<1.0**		UJ c	**<2.0**			**<2.0**			**<2.0**			**<2.0**			**<2.0**			**<2.0**			**<2.0**			**<2.0**			**<2.0**		
1,2-dibromomethane		0.05		**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**			**<1.0**		
1,2-dichlorobenzene	600	600		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
1,3-dichlorobenzene				<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
1,4-dichlorobenzene	75	75		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
dichlorodifluoromethane				<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
1,1-dichloroethane		700		5.1			<1.0			<1.0			6.2			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			0.92	J		<1.0			<1.0		
1,2-dichloroethane	5	5		1.7			<1.0			<1.0			0.82	J		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
1,1-dichloroethene	7	7		7			2.9			0.81	J		85			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			11			<1.0			<1.0		
cis-1,2-dichloroethene	70	70		23			<1.0			<1.0			6.4			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
trans-1,2-dichloroethene	100	100		<1.0			<1.0			<1.0			16			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
1,2-dichloropropane	5	5		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
cis-1,3-dichloropropane				<1.0			<1.0			<1.0			<1.0		UJ c	<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
trans-1,3-dichloropropane				<1.0			<1.0			<1.0			<1.0		UJ c	<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
ethylbenzene	700	700		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
2-hexanone				<10			<10			<10			<10			<1.0			<1.0			<1.0			<10			<10			<10			<10			<10			<10		
isopropylbenzene			UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
methyl acetate				<1.0			<10			<10			<10		UJ c	<10			<10			<10			<10			<10			<10			<10			<10			<10		
methylene chloride	5	5	B,z	<1.0			<1.0		B,z	<1.0		B,z	<1.0		B,z	<1.0		B,z	<1.0		B,z	<1.0		B,z	<1.0			<1.0			<1.0			<1.0			<1.0			1.1		
methylcyclohexane			UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
4-methyl-2-pentanone				<10			<10			<10			<10			<10			<10			<10			<10			<10			<10			<10			<10			<10		
methyl tert-butyl ether				<5.0			<5.0			<5.0			<5.0			<5.0			<5.0			<5.0			<5.0			<5.0			<5.0			<5.0			<5.0			<5.0		
styrene	100	100		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
1,1,2,2-tertachloroethane				<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
tetrachloroethene (PCE)	5	5		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
toluene	1000	NA		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
1,2,4-trichloro-benzene	70	70	UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0		UJ c	<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
1,1,1-trichloroethane	200	200		<1.0			<1.0			0.39	J		0.52	J		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
1,1,2-trichloroethane	5	5		0.41	J		<1.0			<1.0			2.6			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
trichloroethene (TCE)	5	5		8.6			1.9			0.57		J	46			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			3.2			<1.0			<1.0		
trichlorofluoromethane				<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
1,1,2-trichloro-1,2,2-trifluoroethane				<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
vinyl chloride	2	2		0.62	J		<1.0			<1.0			0.55	J		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
xylenes (total)	10000	10000		<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0			<1.0		
TOC (mg/L)				NA			0.8	B		0.8	B		2			0.7	B		NA			NA			NA			NA			NA			NA			NA			NA		
Metals																			NA			NA																		NA		
arsenic	As	10	50	**<12.0**			3.2	B		4.2	B		6.9	B		8.9	B								**<12.0**			**<12.0**			3.2	B		3.2	B		10.9	B				
cadmium	Cd	5	5	**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**									**<10.0**			**<10.0**			0.65	B		**<10.0**			**<10.0**					
lead*	Pb	15	7.5	**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**									**<10.0**			**<10.0**			2.8	B		**<10.0**			**<10.0**					
selenium	Se	50	50	<10.0			<10.0			<10.0			<10.0			<10.0									<10.0			<10.0			<10.0			<10.0			<10.0					
thallium	Tl	2	2	**<15.0**			**<15.0**			6.9	B		6.4	B		5.5	B								**<15.0**			**<15.0**			**<15.0**			**<15.0**			6.1	B				
																			NA			NA																		NA		
silver	Ag	SS=100	50	<20.0			<20.0			<20.0			<20.0			<20.0									<20.0			<20.0			<20.0			<20.0			<20.0					
aluminum	Al	SS = 50 to 200		**<200**			**<200**			**<200**			**<200**			**<200**									75.1	B	J c	87.0	B	J c	134	B	J c	56.3	B	J c	167	B	J c			
barium	Ba	2000	2000	98.4			66			81.9			124			107									73.5			74.8			175			131			102					
beryllium	Be	4	4	**<10.0**			**<10.0**			**<10.0**			**<10.0**			**<10.0**									<10.0			<10.0			<10.0			<10.0			<10.0					
calcium	Ca			77500			54300			72500			76700			67400									61800			63100			62100			67200			63800					
cobalt	Co			<20.0	B	B	<20.0		B z	<20.0		B,z	<20.0			<20.0		B z							<20.0			<20.0			1.4	B		<20.0			<20.0					
chromium	Cr	100	100	<20.0			<20.0			<20.0			<20.0			<20.0									<20.0			<20.0			<20.0			<20.0			<20.0					
copper*	Cu	1300	650	2.4	B		4.6	B		3.6	B		2.8	B		4.6	B								<10.0			<10.0			2.4	B		<10.0			2.1	B				
iron	Fe	SS=300	5000	129	B		<1000			49.6	B		1730			305	B								167	B		165	B		86.8	B		945	B		768	B				
potassium	K			1210	B J		<5000		B z	1160	B J		1450	B J E	J s	1010	B J								1580	B J E	J s	1540	B J	J s	18500	J	J s	2730	B J	J s	2340	B J	J s			
magnesium	Mg			31700			25500			30600			34600			28100									26500			27200			34500			31100			26300					
manganese	Mn	SS = 50	150	217			7.6	B		433			161			319									152			152			220			895			235					
sodium	Na			46500			66000			44800			49200			30200									31100			31700			52200			49400			38800					
nickel	Ni		100	<20.0			<20.0			<20.0			<20.0			<20.0									<20.0			<20.0			<20.0			<20.0			<20.0					
antimony	Sb	6	6	**<100**			**<100**			**<100**			**<100**			**<100**									**<100**			**<100**			**<100**			**<100**			**<100**					
vanadium	V		49	<20.0			1.4	B		<20.0			<20.0			<20.0									<20.0			<20.0			<20.0			<20.0			<20.0					
zinc	Zn		5000	<100			<100			<100			<100			<100									<100			<100			18.8	B		<100			44.1	B				
																																								NA		
Mercury	Hg	2	2	<0.50			<0.50			<0.50			<0.50			<0.50			NA			NA			<0.5			<0.5			<0.5			<0.5			<0.5					

MCL = Maximum Contaminant Level *MCL action level
highlight indicates above the MCL, EPA Secondary Drinking Water Standards and/or the State of Illinois Class I Remedial Objective
NA = not analyzed
"<" = below the detection limit
RL = reporting limit
SS = EPA Secondary drinking water standard
VOC = volatile organic compound
TOC = total organic carbon

For several metals the reporting limit of the method was higher than the regulatory standard used for comparison.
Those results that are reported as less than the reporting limit, which were higher than the relevant standard are in **bold**.
Analytical results for sample numbers over 100 i.e. MW-103S are duplicate analysis of other samples in this case MW-3S.
TB stands for trip blank and FB stands for field blank.

[1] The Illinois Class I standard referenced is from Section 742. Appendix B, Table E: Tier 1, Groundwater Remedial Objectives for the Groundwater Component of the Groundwater Ingestion Route, Class I Groundwater.

Inorganics
LQ = data qualifiers assigned by the laboratory
B = Estimated Result. Result is less than reporting limit.
J = Method Blank Contamination. The associated method blank contains the target analyte at a reportable level.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
E = Matrix interference.

VQ = data qualifiers assigned by the data verifier.
B = The analyte was not detected substantially above the level reported in laboratory or field blanks.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample quantitation limit.
However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
c = Calibration failure.
k = laboratory duplicate imprecision
m = MS/MSD recovery failure
o = calibration blank contamination
s = serial dilution failure

Organics
LQ = data qualifiers assigned by the laboratory
J = Estimated result. Result is less than reporting limit.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

VQ = data qualifiers assigned by the data verifier.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
R = The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample quantitation limit.
However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
c = Calibration failure; poor or unstable response.
m = MS/MSD recovery failure.
r = linearity failure in initial calibration

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	EEI 1988							
Well # / Boring #			MG-1	MG-1 split	MG-2	MG-3	MG-4	MGR-1	MGR-2 **	MGR-3
Sampling Date			06/17/87	06/17/87	06/17/87	06/17/87	06/17/87	11/18/87	11/18/87	11/18/87
Units	ug/L	ug/L	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
VOCs (only detected compounds)										
1,1-DCA		700	<0.8	1.2	6.5	2.5	86	<0.8	<0.8	<0.8
1,1-DCE	7	7	<1.9	<1.9	4.5	2.1	**329**	<1.9	<1.9	<1.9
1,2-DCE (total)			NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-DCE	70	70	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-DCE	100	100	<1.5	<1.5	69.4	<1.5	22	<1.5	<1.5	<1.5
1,1,1-TCA	200	200	<1.2	<1.2	4	<1.2	**203**	<1.2	<1.2	<1.2
1,1,2-TCA	5	5	<1.6	<1.6	<1.6	<1.6	<16	<1.6	<1.6	<1.6
PCE	5	5	<1.5	<1.5	<1.5	<1.5	<15	<1.5	<1.5	<1.5
TCE	5	5	<1.3	<1.3	3	4.9	**423**	<1.3	<1.3	<1.3
vinyl chloride	2	2	<1.2	<1.2	<1.2	<1.2	<12	<1.2	<1.2	<1.2
benzene	5	5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<0.5	<0.5
toluene	1000	1000	<1.0	1.4	<1.0	1.6	<10	<1.0	<1.0	<1.0
ethylbenzene	700	700	<0.4	<0.4	<0.4	<0.4	<4	<0.4	<0.4	<0.4
xylene	10000	10000	NA	NA	NA	NA	NA	NA	NA	NA
acetone		700	NA	NA	NA	NA	NA	NA	NA	NA
bromoform	80*	1	<3.2	<3.2	<3.2	<3.2	<32	<3.2	<3.2	<3.2
bromodichloromethane	80*	0.2	NA	NA	NA	NA	NA	NA	NA	NA
bromomethane			NA	NA	NA	NA	NA	NA	NA	NA
carbon disulfide		700	NA	NA	NA	NA	NA	NA	NA	NA
chloroform	80*	0.2	<0.8	<0.8	<0.8	<0.8	<8	<0.8	<0.8	<0.8
methylene chloride	5	5	**6.5**	**11.6**	**7.7**	**8.2**	<16	<1.6	2.3	1.2
styrene	100	100	NA	NA	NA	NA	NA	NA	NA	NA
SVOCs (only detected compounds)										
naphthalene		140	NA	NA	NA	NA	NA	NA	NA	NA
diethylphthalate		5600	NA	NA	NA	NA	NA	NA	NA	NA
di-n-butylphthalate		700	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	6	6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides (only detected compounds)										
heptachlor		0.4	NA	NA	NA	NA	NA	NA	NA	NA
dieldrin		9	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE			NA	NA	NA	NA	NA	NA	NA	NA
Metals (total)										
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	<3.1	<3.1	3.7	**12.8**	<3.1	NA	NA	NA
barium	2000	2000	121	116	157	214	307	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	<1	<1	<1	<1	<1	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	7	6	18	35	36	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	<8	<8	**8**	**20**	**18**	3.7	<2.1	<2.1
magnesium			NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	<0.2	<0.2	<0.2	<0.2	<0.2	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	<2	<2	<2	<2	<2	NA	NA	NA
silver	SS=100	50	<1.4	<1.4	<1.4	<1.4	<1.4	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA
cyanide		200	NA	NA	NA	NA	NA	NA	NA	NA
Metals (dissolved)										
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons*			<1000	<1000	<1000	<1000	<1000	NA	NA	NA
Total PCBs	0.5	0.5	<1.8	<1.8	<1.8	<1.8	<9	NA	NA	NA

MCL=maximum contaminant level (USEPA drinking water standards)
IL Class I = Illinois Class I Groundwater Remediation Objectives
Section 742 Appendix B: Tier 1 Tables and Illustrations
Table E: Tier 1 Groundwater Remedial Objectives for the
Groundwater Component of the Groundwater Ingestion Route
SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
* Total recoverable petroleum hydrocarbons, method not specified.
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	SEC Donohue 1992					
Well # / Boring #			MG-1	MG-2	MG-3	MG-4	MG-4 (QCRP)	MG-4 (QARP)
Sampling Date			03/21/92	03/21/92	03/21/92	03/21/92	03/21/92	03/21/92
Units	ug/L	ug/L	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
VOCs (only detected compounds)								
1,1-DCA		700	0.59	1.4	<0.1	48	42	39
1,1-DCE	7	7	<0.3	<0.3	<0.3	**167**	**164**	**130**
1,2-DCE (total)			NA	NA	NA	NA	NA	NA
cis-1,2-DCE	70	70	NA	NA	NA	NA	NA	NA
trans-1,2-DCE	100	100	<0.2	<0.2	<0.2	<2.0	<1.0	<2.0
1,1,1-TCA	200	200	<0.2	<0.2	<0.2	41	38	33
1,1,2-TCA	5	5	<0.2	<0.2	<0.2	<2.0	<1.0	<2.0
PCE	5	5	<0.4	<0.4	<0.4	<4.0	2.4	2
TCE	5	5	3	1.9	1.9	**159**	**172**	**140**
vinyl chloride	2	2	<0.2	<0.2	<0.2	<0.2	<1.5	<0.2
benzene	5	5	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1
toluene	1000	1000	<0.1	<0.1	<0.1	<1.0	<0.5	<2.0
ethylbenzene	700	700	<0.3	<0.3	<0.3	<3.0	2	2.1
xylene	10000	10000	NA	NA	NA	NA	NA	NA
acetone		700	NA	NA	NA	NA	NA	NA
bromoform	80*	1	<0.3	<0.3	<0.3	<3.0	<1.5	<2.0
bromodichloromethane	80*	0.2	<0.1	<0.1	<0.1	<1.0	<0.5	<2.0
bromomethane			<0.3	<0.3	<0.3	<0.3	<1.0	<0.3
carbon disulfide		700	NA	NA	NA	NA	NA	NA
chloroform	80*	0.2	<0.1	<0.1	<0.1	<0.1	<0.5	<2.0
methylene chloride	5	5	<0.2	<0.2	<0.2	<2.0	<1.0	<2.0
styrene	100	100	NA	NA	NA	NA	NA	NA
SVOCs (only detected compounds)								
naphthalene		140	NA	NA	NA	NA	NA	NA
diethylphthalate		5600	NA	NA	NA	NA	NA	NA
di-n-butylphthalate		700	NA	NA	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	6	6	NA	NA	NA	NA	NA	NA
Pesticides (only detected compounds)								
heptachlor		0.4	NA	NA	NA	NA	NA	NA
dieldrin		9	NA	NA	NA	NA	NA	NA
4,4'-DDE			NA	NA	NA	NA	NA	NA
Metals (total)								
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	<4	<4	<4	**8**	6	**12.9**
magnesium			NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA
cyanide		200	NA	NA	NA	NA	NA	NA
Metals (dissolved)								
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons*			<1200	<1200	<1200	1300	1400	<1000
Total PCBs	0.5	0.5	NA	NA	NA	NA	NA	NA

MCL=maximum contaminant level (USEPA drinking water standards)
IL Class I = Illinois Class I Groundwater Remediation Objectives
Section 742 Appendix B: Tier 1 Tables and Illustrations
Table E: Tier 1 Groundwater Remedial Objectives for the
Groundwater Component of the Groundwater Ingestion Route
SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
* Total recoverable petroleum hydrocarbons, method not specified.
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	SEC Donohue 1992 (cont.)						
Well # / Boring #			MG-5	MG-5 (QCRP)	MG-5 (QARP)	MG-7	MG-8	MG-9	MGR-1
Sampling Date			03/22/92	03/22/92	03/22/92	03/21/92	03/21/92	03/21/92	03/22/92
Units	ug/L	ug/L	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
VOCs (only detected compounds)									
1,1-DCA		700	<0.1	<0.1	<2.0	34	2.7	8.3	<0.1
1,1-DCE	7	7	<0.3	<0.3	<2.0	**90**	<0.3	**178**	<0.3
1,2-DCE (total)			NA	NA	NA	NA	NA	NA	NA
cis-1,2-DCE	70	70	NA	NA	NA	NA	NA	NA	NA
trans-1,2-DCE	100	100	<0.2	<0.2	<2.0	6	<0.2	<0.2	<0.2
1,1,1-TCA	200	200	<0.2	<0.2	<2.0	8.3	<0.2	9.5	<0.2
1,1,2-TCA	5	5	<0.2	<0.2	<2.0	**33**	<0.2	<0.2	<0.2
PCE	5	5	<0.4	<0.4	<2.0	<0.4	<0.4	<0.4	<0.4
TCE	5	5	3.3	2.75	1.9	**300**	3.1	**100**	<0.3
vinyl chloride	2	2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
benzene	5	5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
toluene	1000	1000	<0.1	<0.1	<2.0	<0.1	<0.1	<0.1	<0.1
ethylbenzene	700	700	<0.3	<0.3	<2.0	<0.3	<0.3	<0.3	<0.3
xylene	10000	10000	NA	NA	NA	NA	NA	NA	NA
acetone		700	NA	NA	NA	NA	NA	NA	NA
bromoform	80*	1	<0.3	<0.3	<2.0	<0.3	<0.3	<0.3	**2.2**
bromodichloromethane	80*	0.2	<0.1	<0.1	<2.0	<0.1	<0.1	<0.1	**4.1**
bromomethane			<0.3	<0.3	<0.1	<0.3	<0.3	<0.3	<0.3
carbon disulfide		700	NA	NA	NA	NA	NA	NA	NA
chloroform	80*	0.2	<0.1	<0.1	<2.0	**0.33**	<0.1	<0.1	**4**
methylene chloride	5	5	<0.2	<0.2	<2.0	<0.2	<0.2	<0.2	<0.2
styrene	100	100	NA	NA	NA	NA	NA	NA	NA
SVOCs (only detected compounds)									
naphthalene		140	NA	NA	NA	NA	NA	NA	NA
diethylphthalate		5600	NA	NA	NA	NA	NA	NA	NA
di-n-butylphthalate		700	NA	NA	NA	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	6	6	NA	NA	NA	NA	NA	NA	NA
Pesticides (only detected compounds)									
heptachlor		0.4	NA	NA	NA	NA	NA	NA	NA
dieldrin		9	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE			NA	NA	NA	NA	NA	NA	NA
Metals (total)									
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	<4	<4	3.9	6	**15**	<4	6
magnesium			NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA
cyanide		200	NA	NA	NA	NA	NA	NA	NA
Metals (dissolved)									
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons*			<1200	<1200	<1000	<1200	<1200	<1200	<1200
Total PCBs	0.5	0.5	NA	NA	NA	NA	NA	NA	NA

MCL=maximum contaminant level (USEPA drinking water standards)
IL Class I = Illinois Class I Groundwater Remediation Objectives
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Table E: Tier 1 Groundwater Remedial Objectives for the
Groundwater Component of the Groundwater Ingestion Route
SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
* Total recoverable petroleum hydrocarbons, method not specified.
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.

Appendix A

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	ARDL 1994 Groundwater Monitoring Well Samples																					
Well # / Boring #			MG-1	LQ	MG-2	LQ	MG-3	LQ	MG-4	LQ	MG-5	LQ	MG-7	LQ	MG-8	LQ	MG-9	LQ	MGR-1	LQ	MGR-1 Dup	LQ
Sampling Date			6/9&10/94		6/9&10/94		6/9&10/94		6/9&10/94		6/9&10/94		6/9&10/94		6/9&10/94		6/9&10/94		6/9&10/94		6/9&10/94	
Units	ug/L	ug/L	ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l	
VOCs (only detected compounds)																						
1,1-DCA		700	<5	U	<5	U	<5	U	54		2	J	27		<5	U	10		<5	U	<5	U
1,1-DCE	7	7	<5	U	<5	U	<5	U	**140**		<5	U	**58**		<5	U	**130**		<5	U	<5	U
1,2-DCE (total)			<5	U	2	J	<5	U	53		33		120		<5	U	6		<5	U	<5	U
cis-1,2-DCE	70	70	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
trans-1,2-DCE	100	100	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
1,1,1-TCA	200	200	<5	U	<5	U	<5	U	43		<5	U	<25	U	<5	U	<5	U	<5	U	<5	U
1,1,2-TCA	5	5	<5	U	<5	U	<5	U	<5	U	<5	U	**30**		<5	U	<5	U	<5	U	<5	U
PCE	5	5	<5	U	<5	U	<5	U	8		<5	U	<25	U	<5	U	<5	U	<5	U	<5	U
TCE	5	5	<5	U	<5	U	<5	U	**140**		32		**260**		<5	U	**83**		<5	U	<5	U
vinyl chloride	2	2	<10	U	<10	U	<10	U	<10	U	<10	U	<50	U	<10	U	<10	U	<10	U	<10	U
benzene	5	5	<5	U	<5	U	<5	U	2	J	<5	U	<25	U	<5	U	<5	U	<5	U	<5	U
toluene	1000	1000	<5	U	<5	U	<5	U	<5	U	<5	U	<25	U	<5	U	<5	U	2	J	4	J
ethylbenzene	700	700	<5	U	<5	U	<5	U	4	J	<5	U	<25	U	<5	U	<5	U	<5	U	<5	U
xylene	10000	10000	<5	U	<5	U	<5	U	2	J	<5	U	<25	U	<5	U	<5	U	<5	U	4	J
acetone		700	<100	U	<100	U	22	J	<100	U	<100	U	<500	U	<100	U	<100	U	<100	U	<100	U
bromoform	80*	1	<5	U	<5	U	<5	U	<5	U	<5	U	<25	U	<5	U	<5	U	<5	U	<5	U
bromodichloromethane	80*	0.2	<5	U	<5	U	<5	U	<5	U	<5	U	<25	U	<5	U	<5	U	<5	U	<5	U
bromomethane			<10	U	<10	U	<10	U	<10	U	<10	U	<50	U	<10	U	<10	U	<10	U	<10	U
carbon disulfide		700	<100	U	<100	U	<100	U	12	J	<100	U	<500	U	<100	U	<100	U	<100	U	<100	U
chloroform	80*	0.2	<5	U	<5	U	<5	U	<5	U	<5	U	<25	U	<5	U	<5	U	<5	U	<5	U
methylene chloride	5	5	2	J	2	J	<5	U	3	J	<5	U	<25	U	<5	U	<5	U	2	J	<5	U
styrene	100	100	<5	U	<5	U	<5	U	<5	U	<5	U	<25	U	<5	U	<5	U	<5	U	<5	U
SVOCs (only detected compounds)																						
naphthalene		140	<10	U	<10	U	<10	U	21		<10	U	<10	U	<10	U	<10	U	<10	U	<10	U
diethylphthalate		5600	1	JB	2	JB	<10	U	<10	U	<10	U	2	JB	<10	U	2	JB	2	JB	2	JB
di-n-butylphthalate		700	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U
bis(2-ethylhexyl)phthalate	6	6	<10	U	3	JB	<10	U	2	J	1	J	4	J	<10	U	<10	U	**140**		<10	U
Pesticides (only detected compounds)																						
heptachlor		0.4	<0.03	U	<0.03	U	<0.03	U	<0.03	U	<0.03	U	<0.03	U	<0.03	U	<0.03	U	<0.03	U	0.03	
dieldrin		9	<0.02	U	<0.02	U	0.03		<0.02	U	<0.02	U	<0.02	U	<0.02	U	<0.02	U	0.03		0.03	
4,4'-DDE			<0.04	U	<0.04	U	0.04		<0.04	U	<0.04	U	<0.04	U	<0.04	U	<0.04	U	0.04		<0.04	U
Metals (total)																						
aluminum	SS=50 to 200		2920		2430		24100		11400		5820		84700		54200		10200		<100	U	<100	U
antimony	6	6	<30.0	U	<30.0	U	<30.0	U	<30.0	U	<30.0	U	<30.0	U	<30.0	U	<30.0	U	<30.0	U	<30.0	U
arsenic	10	50	<1.0	U	2.4	B	2.6	B	6.6	B	<1.0	U	**10.1**		**12.3**		<1.0	U	<1.0	U	<1.0	U
barium	2000	2000	181	B	220		275		225		111	B	588		591		161	B	65.5	B	57.1	B
beryllium	4	4	<1.0	U	<1.0	U	1.8	B	<1.0	U	<1.0	U	**6.2**		**4.2**	B	<1.0	U	<1.0	U	<1.0	U
cadmium	5	5	<5.0	U	<5.0	U	<5.0	U	**5.8**		<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U
calcium			65700		43000		40200		48300		86600		512000		427000		135000		69600		67200	
chromium	100	100	**211**		43.3		44.3		33	B	9.5	B	**131**		76.9		15.6		<5.0	U	<5.0	U
cobalt			<5.0	U	18.7	B	32.7	B	6.6	B	<5.0	U	66.1		47.9	B	7.2	B	<5.0	U	<5.0	U
copper	AL=1300	650	11.3	B	<5.0	U	35.5		21.3		25.8		156		60.1		15.3	B	<5.0	U	<5.0	U
iron	SS=300	5000	4440		**12100**		**32400**		**19100**		**10900**		**135000**		**82200**		**19800**		<75.0	U	76.3	B
lead	AL=15	7.5	<5.0	U	**23.8**		**36.8**		**41.9**		**10.4**		**106**		**45.8**		**10.8**	B	<5.0	U	<5.0	U
magnesium			30800		21200		20500		24100		37300		223000		161000		58500		26800		26200	
manganese	SS=50	150	**349**		**639**		**2590**		**3360**		**265**		**3440**		**3180**		**744**		25.4		51	
mercury	2	2	<0.20	U	<0.20	U	<0.20	U	<0.20	U	<0.20	U	0.21		<0.20	U	<0.20	U	<0.20	U	<0.20	U
nickel		100	31.8	B	23.4	B	32.4	B	<20.0	U	<20.0	U	**129**		71.7		<20.0	U	<20.0	U	<20.0	U
potassium			<2000	U	<2000	U	4430	B	<2000	U	<2000	U	15300		10700		3300	B	<2000	U	<2000	U
selenium	50	50	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U
silver	SS=100	50	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U
sodium			117000		71300		82700		102000		43000		60400		39900		53300		28700		27300	
thallium	2	2	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U
vanadium		49	8.6	B	19.6	B	**57.4**		26.7	B	11.7	B	**164**		**99.7**		23.1	B	<5.0	U	<5.0	U
zinc	SS=5000	5000	33.7		77.4		157		618		50.1		386		244		84.5		<5.0	U	<5.0	U
cyanide		200	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U
Metals (dissolved)																						
aluminum	SS=50 to 200		<100	U	<100	U	<100	U	<100	U	<100	U	<100	U	<100	U	<100	U	<100	U	<100	U
antimony	6	6	<30.0	U	<30.0	U	<30.0	U	<30.0	U	<30.0	U	<30.0	U	<30.0	U	<30.0	U	<30.0	U	<30.0	U
arsenic	10	50	<1.0	U	<1.0	U	<1.0	U	3.3	B	<1.0	U	1.4	B	<1.0	U	1.3	B	<1.0	U	<1.0	U
barium	2000	2000	182	B	106	B	121	B	172	B	159	B	272		195	B	203		90.7	B	90.7	B
beryllium	4	4	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U
cadmium	5	5	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U
calcium			73200		47600		33100		51200		72300		94700		84100		88400		76800		78700	
chromium	100	100	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U
cobalt			<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U
copper	AL=1300	650	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U
iron	SS=300	5000	<75.0	U	<75.0	U	<75.0	U	3480		1190	U	128	U	<75.0	U	386	U	<75.0	U	<75.0	U
lead	AL=15	7.5	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U
magnesium			32300		22600		13800		23200		29500		37500		32800		35900		28900		29300	
manganese	SS=50	150	**317**		28.9		114		**3560**		120		**329**		**466**		**339**		24.9		24.1	
mercury	2	2	<0.20	U	<0.20	U	<0.20	U	<0.20	U	<0.20	U	<0.20	U	<0.20	U	<0.20	U	<0.20	U	<0.20	U
nickel		100	<20.0	U	<20.0	U	<20.0	U	<20.0	U	<20.0	U	<20.0	U	<20.0	U	<20.0	U	<20.0	U	<20.0	U
potassium			<2000	U	<2000	U	<2000	U	<2000	U	<2000	U	<2000	U	<2000	U	<2000	U	<2000	U	<2000	U
selenium	50	50	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	3.6	B	<1.0	U	<1.0	U
silver	SS=100	50	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U
sodium			128000		76600		87500		109000		45700		62700		39300		55100		29300		29800	
thallium	2	2	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U	<1.0	U
vanadium		49	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U	<5.0	U
zinc	SS=5000	5000	38.8		24.9		66.4		53.5		42.6		58.8		49.2		43.7		15.4	B	11.4	B
Petroleum Hydrocarbons[a]			NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Total PCBs	0.5	0.5	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	

MCL=maximum contaminant level (USEPA drinking water standards)
IL Class I = Illinois Class I Groundwater Remediation Objectives
Section 742 Appendix B: Tier 1 Tables and Illustrations
Table E: Tier 1 Groundwater Remedial Objectives for the
Groundwater Component of the Groundwater Ingestion Route
SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.
LQ = laboratory data qualifiers.

Organics:
J = Estimated result. Result less than reporting limit.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
B = Method blank contamination. The associated method blank contains the target analyte at a reportable level.

Inorganics:
B = Estimated result. Result is less than reporting limit.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	ARDL 1994 Soil Boring Groundwater Grab Samples											
Well # / Boring #			SB-1 LQ	SB-2 LQ	SB-3 LQ	SB-4 LQ	SB-5 LQ	SB-6 LQ	SB-7 LQ	SB-8 LQ	SB-9 LQ	SB-10 LQ	SB-11 LQ	SB-12 LQ
Sampling Date			07/13/94	07/13/94	07/13/94	07/13/94	07/13/94	07/14/94	07/14/94	07/14/94	07/14/94	07/14/94	07/25/94	07/25/94
Units	ug/L	ug/L	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
VOCs (only detected compounds)														
1,1-DCA		700	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	11	4 J	<10 U
1,1-DCE	7	7	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	7 J	<10 U	20
1,2-DCE (total)			<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	4 J	11	10	<10 U	62
cis-1,2-DCE	70	70	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-DCE	100	100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1-TCA	200	200	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	6 J
1,1,2-TCA	5	5	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
PCE	5	5	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
TCE	5	5	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	6 J	<10 U	100
vinyl chloride	2	2	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
benzene	5	5	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
toluene	1000	1000	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
ethylbenzene	700	700	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
xylene	10000	10000	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
acetone		700	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
bromoform	80*	1	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
bromodichloromethane	80*	0.2	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
bromomethane			<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
carbon disulfide		700	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
chloroform	80*	0.2	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
methylene chloride	5	5	8 JB	8 JB	10 JB	10 JB	9 JB	<10 U	<10 U	<10 U	5 JB	4 JB	<10 U	<10 U
styrene	100	100	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
SVOCs (only detected compounds)														
naphthalene		140	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
diethylphthalate		5600	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
di-n-butylphthalate		700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	6	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides (only detected compounds)														
heptachlor		0.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
dieldrin		9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals (total)														
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cyanide		200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals (dissolved)														
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons[a]			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	0.5	0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

MCL=maximum contaminant level (USEPA drinking water standards)
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AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.
LQ = laboratory data qualifiers.

Organics:
J = Estimated result. Result less than reporting limit.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
B = Method blank contamination. The associated method blank contains the target analyte at a reportable level.
JB = Data quantitation is estimated as possibly biased high based upon blank data.

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	ARDL 1994 Soil Boring Groundwater Grab Samples (cont.)												
Well # / Boring #			SB-13 LQ	SB-14 LQ	SB-15 LQ	SB-16 LQ	SB-17 LQ	SB-18 LQ	SB-19 LQ	SB-20 LQ	SB-21 LQ	SB-22 LQ	SB-23 LQ	SB-24 LQ	SB-25 LQ
Sampling Date			07/25/94	07/25/94	07/26/94	07/26/94	07/26/94	07/26/94	07/26/94	07/26/94	07/27/94	07/27/94	07/27/94	07/27/94	07/27/94
Units	ug/L	ug/L	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
VOCs (only detected compounds)															
1,1-DCA		700	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	<5 U
1,1-DCE	7	7	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	<5 U
1,2-DCE (total)			<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	**8**
cis-1,2-DCE	70	70	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-DCE	100	100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1-TCA	200	200	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	<5 U
1,1,2-TCA	5	5	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	<5 U
PCE	5	5	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	<5 U
TCE	5	5	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	<5 U
vinyl chloride	2	2	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
benzene	5	5	<10 U	<10 U	**2** J	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	<5 U
toluene	1000	1000	<10 U	<10 U	**6** J	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	**2** J	<5 U	<5 U	<5 U
ethylbenzene	700	700	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	<5 U
xylene	10000	10000	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	<5 U
acetone		700	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<100 U	<100 U	<100 U	<100 U	<100 U
bromoform	80*	1	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	<5 U
bromodichloromethane	80*	0.2	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	<5 U
bromomethane			<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U
carbon disulfide		700	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<100 U	<100 U	<100 U	<100 U	<100 U
chloroform	80*	0.2	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	<5 U
methylene chloride	5	5	<10 U	<10 U	**7** J	**13**	**4** J	**9** J	**8** J	**6** J	**12** B	**8** B	**9** B	**14** B	**15** B
styrene	100	100	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5 U	<5 U	<5 U	<5 U	<5 U
SVOCs (only detected compounds)															
naphthalene		140	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
diethylphthalate		5600	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
di-n-butylphthalate		700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	6	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides (only detected compounds)															
heptachlor		0.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
dieldrin		9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals (total)															
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cyanide		200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals (dissolved)															
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons[a]			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	0.5	0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

MCL=maximum contaminant level (USEPA drinking water standards)
IL Class I = Illinois Class I Groundwater Remediation Objectives
Section 742 Appendix B: Tier 1 Tables and Illustrations
Table E: Tier 1 Groundwater Remedial Objectives for the
Groundwater Component of the Groundwater Ingestion Route
SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.
LQ = laboratory data qualifiers.

Organics:
J = Estimated result. Result less than reporting limit.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
B = Method blank contamination. The associated method blank contains the target analyte at a reportable level.

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	ARDL 1994 Confirmation Soil Boring Groundwater Grab Samples																			
Well # / Boring #			SBC01	LQ	SBC02	LQ	SBC03	LQ	SBC04	LQ	SBC05	LQ	SBC06	LQ	SBC07	LQ	SBC07RE	LQ	SBC08	LQ
Sampling Date			07/27/94		07/27/94		07/27/94		07/27/94		07/28/94		07/28/94		07/28/94		07/28/94		07/28/94	
Units	ug/L	ug/L	ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l	
VOCs (only detected compounds)																				
1,1-DCA		700	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
1,1-DCE	7	7	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
1,2-DCE (total)			<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
cis-1,2-DCE	70	70	NA		NA		NA		NA		NA		NA		NA		NA		NA	
trans-1,2-DCE	100	100	NA		NA		NA		NA		NA		NA		NA		NA		NA	
1,1,1-TCA	200	200	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
1,1,2-TCA	5	5	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
PCE	5	5	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
TCE	5	5	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
vinyl chloride	2	2	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
benzene	5	5	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
toluene	1000	1000	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
ethylbenzene	700	700	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
xylene	10000	10000	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
acetone		700	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
bromoform	80*	1	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
bromodichloromethane	80*	0.2	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
bromomethane			<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
carbon disulfide		700	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
chloroform	80*	0.2	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
methylene chloride	5	5	**12**		<10	U	<10	U	<10	U	<10	U	**6**	JB	<10	U	NA		<10	U
styrene	100	100	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	NA		<10	U
SVOCs (only detected compounds)																				
naphthalene		140	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U
diethylphthalate		5600	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U
di-n-butylphthalate		700	<10	U	<10	U	<10	U	<10	U	<10	U	5	J B	2	J B	2	J B	4	J B
bis(2-ethylhexyl)phthalate	6	6	<10	U	**9**	J	<10	U	**80**		2	J	<10	U	<10	U	<10	U	<10	U
Pesticides (only detected compounds)																				
heptachlor		0.4	<0.05	U	<0.05	U	<0.05	U	<0.05	U	<0.05	U	<0.05	U	<0.05	U	NA		<0.05	U
dieldrin		9	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	NA		<0.10	U
4,4'-DDE			<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	NA		<0.10	U
Metals (total)																				
aluminum	SS=50 to 200		NA		NA		NA		NA		NA		NA		NA		NA		NA	
antimony	6	6	NA		NA		NA		NA		NA		NA		NA		NA		NA	
arsenic	10	50	NA		NA		NA		NA		NA		NA		NA		NA		NA	
barium	2000	2000	NA		NA		NA		NA		NA		NA		NA		NA		NA	
beryllium	4	4	NA		NA		NA		NA		NA		NA		NA		NA		NA	
cadmium	5	5	NA		NA		NA		NA		NA		NA		NA		NA		NA	
calcium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
chromium	100	100	NA		NA		NA		NA		NA		NA		NA		NA		NA	
cobalt			NA		NA		NA		NA		NA		NA		NA		NA		NA	
copper	AL=1300	650	NA		NA		NA		NA		NA		NA		NA		NA		NA	
iron	SS=300	5000	NA		NA		NA		NA		NA		NA		NA		NA		NA	
lead	AL=15	7.5	NA		NA		NA		NA		NA		NA		NA		NA		NA	
magnesium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
manganese	SS=50	150	NA		NA		NA		NA		NA		NA		NA		NA		NA	
mercury	2	2	NA		NA		NA		NA		NA		NA		NA		NA		NA	
nickel		100	NA		NA		NA		NA		NA		NA		NA		NA		NA	
potassium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
selenium	50	50	NA		NA		NA		NA		NA		NA		NA		NA		NA	
silver	SS=100	50	NA		NA		NA		NA		NA		NA		NA		NA		NA	
sodium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
thallium	2	2	NA		NA		NA		NA		NA		NA		NA		NA		NA	
vanadium		49	NA		NA		NA		NA		NA		NA		NA		NA		NA	
zinc	SS=5000	5000	NA		NA		NA		NA		NA		NA		NA		NA		NA	
cyanide		200	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Metals (dissolved)																				
aluminum	SS=50 to 200		NA		NA		NA		NA		NA		NA		NA		NA		NA	
antimony	6	6	NA		NA		NA		NA		NA		NA		NA		NA		NA	
arsenic	10	50	NA		NA		NA		NA		NA		NA		NA		NA		NA	
barium	2000	2000	NA		NA		NA		NA		NA		NA		NA		NA		NA	
beryllium	4	4	NA		NA		NA		NA		NA		NA		NA		NA		NA	
cadmium	5	5	NA		NA		NA		NA		NA		NA		NA		NA		NA	
calcium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
chromium	100	100	NA		NA		NA		NA		NA		NA		NA		NA		NA	
cobalt			NA		NA		NA		NA		NA		NA		NA		NA		NA	
copper	AL=1300	650	NA		NA		NA		NA		NA		NA		NA		NA		NA	
iron	SS=300	5000	NA		NA		NA		NA		NA		NA		NA		NA		NA	
lead	AL=15	7.5	NA		NA		NA		NA		NA		NA		NA		NA		NA	
magnesium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
manganese	SS=50	150	NA		NA		NA		NA		NA		NA		NA		NA		NA	
mercury	2	2	NA		NA		NA		NA		NA		NA		NA		NA		NA	
nickel		100	NA		NA		NA		NA		NA		NA		NA		NA		NA	
potassium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
selenium	50	50	NA		NA		NA		NA		NA		NA		NA		NA		NA	
silver	SS=100	50	NA		NA		NA		NA		NA		NA		NA		NA		NA	
sodium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
thallium	2	2	NA		NA		NA		NA		NA		NA		NA		NA		NA	
vanadium		49	NA		NA		NA		NA		NA		NA		NA		NA		NA	
zinc	SS=5000	5000	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Petroleum Hydrocarbons*			NA		NA		NA		NA		NA		NA		NA		NA		NA	
Total PCBs	0.5	0.5	NA		NA		NA		NA		NA		NA		NA		NA		NA	

MCL=maximum contaminant level (USEPA drinking water standards)
IL Class I = Illinois Class I Groundwater Remediation Objectives
Section 742 Appendix B: Tier 1 Tables and Illustrations
Table E: Tier 1 Groundwater Remedial Objectives for the
Groundwater Component of the Groundwater Ingestion Route
SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.
LQ = laboratory data qualifiers.

Organics:
J = Estimated result. Result less than reporting limit.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
B = Method blank contamination. The associated method blank contains the target analyte at a reportable level.
JB = Data quantitation is estimated as possibly biased high based upon blank data.

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	ARDL 1994 Confirmation Soil Boring Groundwater Grab Samples (cont.)																			
Well # / Boring #			SBC08A	LQ	SBC09	LQ	SBC10	LQ	SBC10RE	LQ	SBC11	LQ	SBC12	LQ	SBC13	LQ	SBC14	LQ	SBC15	LQ
Sampling Date			07/28/94		07/28/94		07/28/94		07/28/94		07/28/94		07/29/94		07/29/94		07/29/94		07/29/94	
Units	ug/L	ug/L	ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l	
VOCs (only detected compounds)																				
1,1-DCA		700	<10	U	6	J	<10	U	NA		11		<10	U	<10	U	<10	U	<10	U
1,1-DCE	7	7	<10	U	<10	U	<10	U	NA		**18**		<10	U	<10	U	<10	U	<10	U
1,2-DCE (total)			<10	U	<10	U	<10	U	NA		9	J	<10	U	<10	U	<10	U	<10	U
cis-1,2-DCE	70	70	NA		NA		NA		NA		NA		NA		NA		NA		NA	
trans-1,2-DCE	100	100	NA		NA		NA		NA		NA		NA		NA		NA		NA	
1,1,1-TCA	200	200	<10	U	<10	U	<10	U	NA		<10	U	<10	U	<10	U	<10	U	<10	U
1,1,2-TCA	5	5	<10	U	<10	U	<10	U	NA		**28**		<10	U	<10	U	<10	U	<10	U
PCE	5	5	<10	U	<10	U	<10	U	NA		<10	U	<10	U	<10	U	<10	U	<10	U
TCE	5	5	<10	U	<10	U	<10	U	NA		**10**		<10	U	<10	U	<10	U	<10	U
vinyl chloride	2	2	<10	U	<10	U	<10	U	NA		<10	U	<10	U	<10	U	<10	U	<10	U
benzene	5	5	<10	U	<10	U	<10	U	NA		<10	U	<10	U	<10	U	<10	U	<10	U
toluene	1000	1000	<10	U	<10	U	<10	U	NA		<10	U	<10	U	<10	U	<10	U	<10	U
ethylbenzene	700	700	<10	U	<10	U	<10	U	NA		<10	U	<10	U	<10	U	<10	U	<10	U
xylene	10000	10000	<10	U	<10	U	<10	U	NA		<10	U	<10	U	<10	U	<10	U	<10	U
acetone		700	<10	U	<10	U	<10	U	NA		<10	U	<10	U	<10	U	<10	U	<10	U
bromoform	80*	1	<10	U	<10	U	<10	U	NA		<10	U	<10	U	<10	U	<10	U	<10	U
bromodichloromethane	80*	0.2	<10	U	<10	U	<10	U	NA		**8**	J	<10	U	<10	U	<10	U	<10	U
bromomethane			<10	U	<10	U	<10	U	NA		<10	U	<10	U	<10	U	<10	U	<10	U
carbon disulfide		700	<10	U	<10	U	<10	U	NA		<10	U	<10	U	<10	U	<10	U	<10	U
chloroform	80*	0.2	<10	U	<10	U	<10	U	NA		<10	U	<10	U	<10	U	<10	U	<10	U
methylene chloride	5	5	<10	U	**8**	JB	**10**	JB	NA		**9**	JB	**9**	JB	**8**	JB	**10**	JB	**7**	JB
styrene	100	100	<10	U	<10	U	<10	U	NA		<10	U	<10	U	6	J	<10	U	<10	U
SVOCs (only detected compounds)																				
naphthalene		140	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U
diethylphthalate		5600	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U	<10	U
di-n-butylphthalate		700	5	J B	2	J B	<10	U	<10	U	4	J B	3	JB	2	JB	1	JB	2	JB
bis(2-ethylhexyl)phthalate	6	6	<10	U	2	J	2	J	2	J	3	J	<10	U	<10	U	<10	U	<10	U
Pesticides (only detected compounds)																				
heptachlor		0.4	<0.05	U	<0.05	U	<0.05	U	<0.05	U	<0.05	U	<0.05	U	<0.05	U	<0.05	U	<0.05	U
dieldrin		9	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U
4,4'-DDE			<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U	<0.10	U
Metals (total)																				
aluminum	SS=50 to 200		NA		NA		NA		NA		NA		NA		NA		NA		NA	
antimony	6	6	NA		NA		NA		NA		NA		NA		NA		NA		NA	
arsenic	10	50	NA		NA		NA		NA		NA		NA		NA		NA		NA	
barium	2000	2000	NA		NA		NA		NA		NA		NA		NA		NA		NA	
beryllium	4	4	NA		NA		NA		NA		NA		NA		NA		NA		NA	
cadmium	5	5	NA		NA		NA		NA		NA		NA		NA		NA		NA	
calcium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
chromium	100	100	NA		NA		NA		NA		NA		NA		NA		NA		NA	
cobalt			NA		NA		NA		NA		NA		NA		NA		NA		NA	
copper	AL=1300	650	NA		NA		NA		NA		NA		NA		NA		NA		NA	
iron	SS=300	5000	NA		NA		NA		NA		NA		NA		NA		NA		NA	
lead	AL=15	7.5	NA		NA		NA		NA		NA		NA		NA		NA		NA	
magnesium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
manganese	SS=50	150	NA		NA		NA		NA		NA		NA		NA		NA		NA	
mercury	2	2	NA		NA		NA		NA		NA		NA		NA		NA		NA	
nickel		100	NA		NA		NA		NA		NA		NA		NA		NA		NA	
potassium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
selenium	50	50	NA		NA		NA		NA		NA		NA		NA		NA		NA	
silver	SS=100	50	NA		NA		NA		NA		NA		NA		NA		NA		NA	
sodium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
thallium	2	2	NA		NA		NA		NA		NA		NA		NA		NA		NA	
vanadium		49	NA		NA		NA		NA		NA		NA		NA		NA		NA	
zinc	SS=5000	5000	NA		NA		NA		NA		NA		NA		NA		NA		NA	
cyanide		200	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Metals (dissolved)																				
aluminum	SS=50 to 200		NA		NA		NA		NA		NA		NA		NA		NA		NA	
antimony	6	6	NA		NA		NA		NA		NA		NA		NA		NA		NA	
arsenic	10	50	NA		NA		NA		NA		NA		NA		NA		NA		NA	
barium	2000	2000	NA		NA		NA		NA		NA		NA		NA		NA		NA	
beryllium	4	4	NA		NA		NA		NA		NA		NA		NA		NA		NA	
cadmium	5	5	NA		NA		NA		NA		NA		NA		NA		NA		NA	
calcium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
chromium	100	100	NA		NA		NA		NA		NA		NA		NA		NA		NA	
cobalt			NA		NA		NA		NA		NA		NA		NA		NA		NA	
copper	AL=1300	650	NA		NA		NA		NA		NA		NA		NA		NA		NA	
iron	SS=300	5000	NA		NA		NA		NA		NA		NA		NA		NA		NA	
lead	AL=15	7.5	NA		NA		NA		NA		NA		NA		NA		NA		NA	
magnesium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
manganese	SS=50	150	NA		NA		NA		NA		NA		NA		NA		NA		NA	
mercury	2	2	NA		NA		NA		NA		NA		NA		NA		NA		NA	
nickel		100	NA		NA		NA		NA		NA		NA		NA		NA		NA	
potassium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
selenium	50	50	NA		NA		NA		NA		NA		NA		NA		NA		NA	
silver	SS=100	50	NA		NA		NA		NA		NA		NA		NA		NA		NA	
sodium			NA		NA		NA		NA		NA		NA		NA		NA		NA	
thallium	2	2	NA		NA		NA		NA		NA		NA		NA		NA		NA	
vanadium		49	NA		NA		NA		NA		NA		NA		NA		NA		NA	
zinc	SS=5000	5000	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Petroleum Hydrocarbons*			NA		NA		NA		NA		NA		NA		NA		NA		NA	
Total PCBs	0.5	0.5	NA		NA		NA		NA		NA		NA		NA		NA		NA	

MCL=maximum contaminant level (USEPA drinking water standards)
IL Class I = Illinois Class I Groundwater Remediation Objectives
Section 742 Appendix B: Tier 1 Tables and Illustrations
Table E: Tier 1 Groundwater Remedial Objectives for the
Groundwater Component of the Groundwater Ingestion Route
SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.
LQ = laboratory data qualifiers.

Organics:
J = Estimated result. Result less than reporting limit.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
B = Method blank contamination. The associated method blank contains the target analyte at a reportable level.
JB = Data quantitation is estimated as possibly biased high based upon blank data.

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	Law 2002								
Well # / Boring #			RW-01 13' VQ	RW-01 23' VQ	IW-01 10-11' VQ	IW-01 22' VQ	IW-10 47' VQ	MW-01 20' VQ	MW-01 31' VQ	MW-02 18' VQ	MW-02 30.5' VQ
Sampling Date			03/17/98	03/17/98	03/27/98	03/27/98	03/27/98	03/17/98	03/18/98	03/19/98	03/19/98
Units	ug/L	ug/L	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
VOCs (only detected compounds)											
1,1-DCA		700	1.34	19.6	<0.500	2.22	<0.500	<0.500	14.0	3.15	1.32
1,1-DCE	7	7	2.23	**51.8**	<0.500	1.56	<0.500	2.01	**19.5**	**20.0**	1.82
1,2-DCE (total)			NA	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-DCE	70	70	1.17	51.8	<0.500	17.3	1.59	2.16	45.6	1.32	1.45
trans-1,2-DCE	100	100	<0.500	42.9	<0.500	<0.500	<0.500	<0.500	12.4	<0.500	<0.500
1,1,1-TCA	200	200	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
1,1,2-TCA	5	5	1.26	**34.4**	<1.00	<1.00	<1.00	1.36	**24.1**	4.18	**13.0**
PCE	5	5	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
TCE	5	5	**7.15**	**74.5**	<0.500	2.54	<0.500	**8.06**	**76.7**	**7.22**	4.82
vinyl chloride	2	2	<2.00	**2.72**	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
benzene	5	5	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
toluene	1000	1000	2.09	1.15	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
ethylbenzene	700	700	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
xylene	10000	10000	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
acetone		700	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	7.79
bromoform	80*	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
bromodichloromethane	80*	0.2	<0.500 JL	<0.500 JL	<0.500 JL	<0.500 JL	<0.500 JL	<0.500 JL	<0.500 JL	<0.500 JL	<0.500 JL
bromomethane			<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
carbon disulfide		700	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
chloroform	80*	0.2	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
methylene chloride	5	5	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
styrene	100	100	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
SVOCs (only detected compounds)											
naphthalene		140	NA	NA	NA	NA	NA	NA	NA	NA	NA
diethylphthalate		5600	NA	NA	NA	NA	NA	NA	NA	NA	NA
di-n-butylphthalate		700	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	6	6	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides (only detected compounds)											
heptachlor		0.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
dieldrin		9	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE			NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals (total)											
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA	NA
cyanide		200	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals (dissolved)											
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons[a]			NA	NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	0.5	0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA

MCL=maximum contaminant level (USEPA drinking water standards)
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Groundwater Component of the Groundwater Ingestion Route
SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.
VQ = laboratory data qualifiers.

Organics:
JL = data quantification is estimated as possibly biased low based upon QC data.

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	Law 2002 (cont.)																	
Well # / Boring #			MW-03 19-20'	VQ	MW-03 45-47'	VQ	MW-04 12.5'	VQ	MW-04 32'	VQ	MW-04 76-77'	VQ	MW-05 19-20'	VQ	MW-05 19-20' Dup	VQ	MW-05 25-27'	VQ
Sampling Date			04/02/98		04/02/98		03/24/98		03/24/98		03/25/98		04/03/98		04/03/98		04/03/98	
Units	ug/L	ug/L	ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l	
VOCs (only detected compounds)																		
1,1-DCA		700	43.5		4.65		<0.500	JL	3.01	JL	<0.500		1.77		1.73		<0.500	
1,1-DCE	7	7	**63.8**		2.67		<0.500	JL	**33.9**	JL	3.35		**10.6**		**9.73**		1.82	
1,2-DCE (total)			NA		NA		NA	JL	NA	JL	NA		NA		NA		NA	
cis-1,2-DCE	70	70	**404**		41.6		<0.500	JL	1.81	JL	<0.500		<0.500		<0.500		<0.500	
trans-1,2-DCE	100	100	8.49		1.72		<0.500	JL	<0.500	JL	<0.500		<0.500		<0.500		<0.500	
1,1,1-TCA	200	200	5.11		<0.500		<0.500	JL	<0.500	JL	<0.500		<0.500		<0.500		<0.500	
1,1,2-TCA	5	5	**222**		**27.8**		<1.00	JL	<1.00	JL	<1.00		<1.00		<1.00		<1.00	
PCE	5	5	1.21		<0.500		<0.500	JL	<0.500	JL	<0.500		<0.500		<0.500		<0.500	
TCE	5	5	**1380**		**78.5**		<0.500	JL	**26.8**	JL	2.37		1.2		<0.500		<0.500	
vinyl chloride	2	2	<2.00		<2.00		<2.00	JL	<2.00	JL	<2.00		<2.00		<2.00		<2.00	
benzene	5	5	<0.500		<0.500		<0.500	JL	<0.500	JL	1.17		<0.500		<0.500		<0.500	
toluene	1000	1000	<0.500		<0.500		<0.500	JL	<0.500	JL	<0.500		<0.500		<0.500		<0.500	
ethylbenzene	700	700	<0.500		<0.500		<0.500	JL	<0.500	JL	<0.500		<0.500		<0.500		<0.500	
xylene	10000	10000	<1.00		<1.00		<1.00	JL	<1.00	JL	<1.00		<1.00		<1.00		<1.00	
acetone		700	<5.00		<5.00		<5.00	JL	<5.00	JL	<5.00		<5.00		<5.00		<5.00	
bromoform	80*	1	<1.00		<1.00		<1.00	JL	<1.00	JL	<1.00		<1.00		<1.00		<1.00	
bromodichloromethane	80*	0.2	<0.500	JL	<0.500	JL	<0.500	JL	<0.500	JL	<0.500	JL	<0.500	JL	<0.500		<0.500	JL
bromomethane			79.3		<2.00		<2.00	JL	<2.00	JL	<2.00		<2.00		<2.00		<2.00	
carbon disulfide		700	<1.00		1.89		<1.00	JL	<1.00	JL	<1.00		<1.00		<1.00		<1.00	
chloroform	80*	0.2	<0.500		<0.500		<0.500	JL	<0.500	JL	**15.8**		<0.500		<0.500		<0.500	
methylene chloride	5	5	<2.00		<2.00		<2.00	JL	<2.00	JL	<2.00		<2.00		<2.00		<2.00	
styrene	100	100	<0.500		<0.500		<0.500	JL	<0.500	JL	<0.500		<0.500		<0.500		<0.500	
SVOCs (only detected compounds)																		
naphthalene		140	NA		NA		NA		NA		NA		NA		NA		NA	
diethylphthalate		5600	NA		NA		NA		NA		NA		NA		NA		NA	
di-n-butylphthalate		700	NA		NA		NA		NA		NA		NA		NA		NA	
bis(2-ethylhexyl)phthalate	6	6	NA		NA		NA		NA		NA		NA		NA		NA	
Pesticides (only detected compounds)																		
heptachlor		0.4	NA		NA		NA		NA		NA		NA		NA		NA	
dieldrin		9	NA		NA		NA		NA		NA		NA		NA		NA	
4,4'-DDE			NA		NA		NA		NA		NA		NA		NA		NA	
Metals (total)																		
aluminum	SS=50 to 200		NA		NA		NA		NA		NA		NA		NA		NA	
antimony	6	6	NA		NA		NA		NA		NA		NA		NA		NA	
arsenic	10	50	NA		NA		NA		NA		NA		NA		NA		NA	
barium	2000	2000	NA		NA		NA		NA		NA		NA		NA		NA	
beryllium	4	4	NA		NA		NA		NA		NA		NA		NA		NA	
cadmium	5	5	NA		NA		NA		NA		NA		NA		NA		NA	
calcium			NA		NA		NA		NA		NA		NA		NA		NA	
chromium	100	100	NA		NA		NA		NA		NA		NA		NA		NA	
cobalt			NA		NA		NA		NA		NA		NA		NA		NA	
copper	AL=1300	650	NA		NA		NA		NA		NA		NA		NA		NA	
iron	SS=300	5000	NA		NA		NA		NA		NA		NA		NA		NA	
lead	AL=15	7.5	NA		NA		NA		NA		NA		NA		NA		NA	
magnesium			NA		NA		NA		NA		NA		NA		NA		NA	
manganese	SS=50	150	NA		NA		NA		NA		NA		NA		NA		NA	
mercury	2	2	NA		NA		NA		NA		NA		NA		NA		NA	
nickel		100	NA		NA		NA		NA		NA		NA		NA		NA	
potassium			NA		NA		NA		NA		NA		NA		NA		NA	
selenium	50	50	NA		NA		NA		NA		NA		NA		NA		NA	
silver	SS=100	50	NA		NA		NA		NA		NA		NA		NA		NA	
sodium			NA		NA		NA		NA		NA		NA		NA		NA	
thallium	2	2	NA		NA		NA		NA		NA		NA		NA		NA	
vanadium		49	NA		NA		NA		NA		NA		NA		NA		NA	
zinc	SS=5000	5000	NA		NA		NA		NA		NA		NA		NA		NA	
cyanide		200	NA		NA		NA		NA		NA		NA		NA		NA	
Metals (dissolved)																		
aluminum	SS=50 to 200		NA		NA		NA		NA		NA		NA		NA		NA	
antimony	6	6	NA		NA		NA		NA		NA		NA		NA		NA	
arsenic	10	50	NA		NA		NA		NA		NA		NA		NA		NA	
barium	2000	2000	NA		NA		NA		NA		NA		NA		NA		NA	
beryllium	4	4	NA		NA		NA		NA		NA		NA		NA		NA	
cadmium	5	5	NA		NA		NA		NA		NA		NA		NA		NA	
calcium			NA		NA		NA		NA		NA		NA		NA		NA	
chromium	100	100	NA		NA		NA		NA		NA		NA		NA		NA	
cobalt			NA		NA		NA		NA		NA		NA		NA		NA	
copper	AL=1300	650	NA		NA		NA		NA		NA		NA		NA		NA	
iron	SS=300	5000	NA		NA		NA		NA		NA		NA		NA		NA	
lead	AL=15	7.5	NA		NA		NA		NA		NA		NA		NA		NA	
magnesium			NA		NA		NA		NA		NA		NA		NA		NA	
manganese	SS=50	150	NA		NA		NA		NA		NA		NA		NA		NA	
mercury	2	2	NA		NA		NA		NA		NA		NA		NA		NA	
nickel		100	NA		NA		NA		NA		NA		NA		NA		NA	
potassium			NA		NA		NA		NA		NA		NA		NA		NA	
selenium	50	50	NA		NA		NA		NA		NA		NA		NA		NA	
silver	SS=100	50	NA		NA		NA		NA		NA		NA		NA		NA	
sodium			NA		NA		NA		NA		NA		NA		NA		NA	
thallium	2	2	NA		NA		NA		NA		NA		NA		NA		NA	
vanadium		49	NA		NA		NA		NA		NA		NA		NA		NA	
zinc	SS=5000	5000	NA		NA		NA		NA		NA		NA		NA		NA	
Petroleum Hydrocarbons*			NA		NA		NA		NA		NA		NA		NA		NA	
Total PCBs	0.5	0.5	NA		NA		NA		NA		NA		NA		NA		NA	

MCL=maximum contaminant level (USEPA drinking water standards)
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SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.
VQ = laboratory data qualifiers.

Organics:
JL = data quantification is estimated as possibly biased low based upon QC data.

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
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RI/FS/PP/ROD Project

	MCL	IL Class I	Law 2002 (cont.)							
Well # / Boring #			MG-4	MG-5	MG-7	MG-8	MG-9	MW-01 D	MW-02 D	MW-02 S
Sampling Date			08/04/98	08/04/98	08/04/98	08/04/98	08/04/98	08/04/98	08/04/98	08/04/98
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
VOCs (only detected compounds)										
1,1-DCA		700	4.99	<0.500	23.7	1.9	12.1	23.2	47.8	17.1
1,1-DCE	7	7	**7.74**	<0.500	**34.6**	<0.500	**76.3**	**48.5**	**166**	**92.9**
1,2-DCE (total)			NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-DCE	70	70	11.7	5.48	**146**	3.93	11.2	**107**	44.0	7.67
trans-1,2-DCE	100	100	<0.500	2.12	9.4	<0.500	15.7	6.04	14.6	1.43
1,1,1-TCA	200	200	2.01	<0.500	2.66	<0.500	<0.500	2.74	3.52	1.74
1,1,2-TCA	5	5	<1.0	<1.00	**26.6**	<1.00	**20.7**	**32.6**	**92.8**	**30.9**
PCE	5	5	1.11	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
TCE	5	5	**14.9**	1.93	**357**	1.6	**45.1**	**285**	**217**	**59.8**
vinyl chloride	2	2	<2.00	<2.00	<2.00	<2.00	**2.21**	<2.00	<2.00	<2.00
benzene	5	5	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
toluene	1000	1000	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
ethylbenzene	700	700	1.09	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
xylene	10000	10000	1.09	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
acetone		700	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
bromoform	80*	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
bromodichloromethane	80*	0.2	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
bromomethane			<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
carbon disulfide		700	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
chloroform	80*	0.2	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
methylene chloride	5	5	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
styrene	100	100	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
SVOCs (only detected compounds)										
naphthalene		140	NA	NA	NA	NA	NA	NA	NA	NA
diethylphthalate		5600	NA	NA	NA	NA	NA	NA	NA	NA
di-n-butylphthalate		700	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	6	6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides (only detected compounds)										
heptachlor		0.4	NA	NA	NA	NA	NA	NA	NA	NA
dieldrin		9	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE			NA	NA	NA	NA	NA	NA	NA	NA
Metals (total)										
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA
cyanide		200	NA	NA	NA	NA	NA	NA	NA	NA
Metals (dissolved)										
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons[a]			NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	0.5	0.5	NA	NA	NA	NA	NA	NA	NA	NA

MCL=maximum contaminant level (USEPA drinking water standards)
IL Class I = Illinois Class I Groundwater Remediation Objectives
Section 742 Appendix B: Tier 1 Tables and Illustrations
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Groundwater Component of the Groundwater Ingestion Route
SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	Law 2002 (cont.)						
Well # / Boring #			MW-03 D	MW-03 S	Duplicate	MW-04D	MW-04 S	MW-05 D	MW-05 S
Sampling Date			08/04/98	08/04/98	08/04/98	08/04/98	08/04/98	08/04/98	08/04/98
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
VOCs (only detected compounds)									
1,1-DCA		700	<0.500	38.3	36.2	<0.500	<0.500	<0.500	<0.500
1,1-DCE	7	7	<0.500	**61.6**	**51.3**	<0.500	<0.500	<0.500	<0.500
1,2-DCE (total)			NA	NA	NA	NA	NA	NA	NA
cis-1,2-DCE	70	70	4.14	**392**	**400**	<0.500	<0.500	<0.500	<0.500
trans-1,2-DCE	100	100	<0.500	11.2	13.8	<0.500	<0.500	<0.500	<0.500
1,1,1-TCA	200	200	<0.500	6.39	5.83	<0.500	<0.500	<0.500	<0.500
1,1,2-TCA	5	5	1.58	**282**	**293**	<1.00	<1.00	<1.00	<1.00
PCE	5	5	<0.500	1.41	1.14	<0.500	<0.500	<0.500	<0.500
TCE	5	5	4.86	**1390**	**1390**	<0.500	<0.500	<0.500	<0.500
vinyl chloride	2	2	<2.00	**2.76**	**2.68**	<2.00	<2.00	<2.00	<2.00
benzene	5	5	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
toluene	1000	1000	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
ethylbenzene	700	700	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
xylene	10000	10000	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
acetone		700	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
bromoform	80*	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
bromodichloromethane	80*	0.2	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
bromomethane			<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
carbon disulfide		700	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
chloroform	80*	0.2	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
methylene chloride	5	5	<2.00	<2.00	<2.00	2.81	<2.00	<2.00	<2.00
styrene	100	100	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
SVOCs (only detected compounds)									
naphthalene		140	NA	NA	NA	NA	NA	NA	NA
diethylphthalate		5600	NA	NA	NA	NA	NA	NA	NA
di-n-butylphthalate		700	NA	NA	NA	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	6	6	NA	NA	NA	NA	NA	NA	NA
Pesticides (only detected compounds)									
heptachlor		0.4	NA	NA	NA	NA	NA	NA	NA
dieldrin		9	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE			NA	NA	NA	NA	NA	NA	NA
Metals (total)									
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA
cyanide		200	NA	NA	NA	NA	NA	NA	NA
Metals (dissolved)									
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons*			NA	NA	NA	NA	NA	NA	NA
Total PCBs	0.5	0.5	NA	NA	NA	NA	NA	NA	NA

MCL=maximum contaminant level (USEPA drinking water standards)
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SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	Law 2002 (cont.)							
Well # / Boring #			MG-4	MG-5	MG-8	MG-9	MW-01 D	MW-01 S	MW-02 D	MW-02 S
Sampling Date			10/01/98	10/01/98	10/02/98	10/01/98	10/01/98	10/01/98	10/01/98	10/01/98
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
VOCs (only detected compounds)										
1,1-DCA		700	6.62	<0.500	2.86	13.3	20.7	20.7	47.8	25.4
1,1-DCE	7	7	**15.2**	<0.500	<0.500	**86.5**	**48**	**43.8**	**210**	**131**
1,2-DCE (total)			NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-DCE	70	70	15.2	5.49	6.87	15.1	**130**	**146**	42.8	13.6
trans-1,2-DCE	100	100	23.9	1.74	<0.500	19.8	5.56	<10.0	14	2.31
1,1,1-TCA	200	200	2.27	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	2.4
1,1,2-TCA	5	5	<1.00	<1.00	<1.00	**24**	**28.4**	**21.1**	**105**	**55.6**
PCE	5	5	1.07	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
TCE	5	5	**21.1**	<0.500	2.8	**57.1**	**294**	**321**	**233**	**102**
vinyl chloride	2	2	<2.00	<2.00	<2.00	**2.32**	<10.0	<40.0	<10.0	<4.00
benzene	5	5	<0.500	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
toluene	1000	1000	<0.500	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
ethylbenzene	700	700	<0.500	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
xylene	10000	10000	<1.00	<1.00	<1.00	<1.00	<5.00	<20.0	<5.00	<2.00
acetone		700	<5.00	<5.00	<5.00	<5.00	<25.0	<100	<25.0	<10.0
bromoform	80*	1	<1.00	<1.00	<1.00	<1.00	<5.00	<20.0	<5.00	<2.00
bromodichloromethane	80*	0.2	<0.500	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
bromomethane			<2.00	<2.00	<2.00	<2.00	<10.0	<40.0	<10.0	<4.00
carbon disulfide		700	4.17	20.2	8.00	9.87	8.49	<20.0	<5.00	7.06
chloroform	80*	0.2	<0.500	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
methylene chloride	5	5	<2.00	<2.00	<2.00	<2.00	<10.0	<40.0	<10.0	<4.00
styrene	100	100	<0.500	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
SVOCs (only detected compounds)										
naphthalene		140	NA	NA	NA	NA	NA	NA	NA	NA
diethylphthalate		5600	NA	NA	NA	NA	NA	NA	NA	NA
di-n-butylphthalate		700	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	6	6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides (only detected compounds)										
heptachlor		0.4	NA	NA	NA	NA	NA	NA	NA	NA
dieldrin		9	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE			NA	NA	NA	NA	NA	NA	NA	NA
Metals (total)										
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA
cyanide		200	NA	NA	NA	NA	NA	NA	NA	NA
Metals (dissolved)										
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons[a]			NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	0.5	0.5	NA	NA	NA	NA	NA	NA	NA	NA

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AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.

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Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	Law 2002 (cont.)						
Well # / Boring #			MW-03 D	MW-03 S	Duplicate	MW-04 D	MW-04 S	MW-05 D	MW-05 S
Sampling Date			10/01/98	10/01/98	10/01/98	10/01/98	10/01/98	10/01/98	10/01/98
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
VOCs (only detected compounds)									
1,1-DCA		700	<0.500	38.0	30.6	<0.500	<0.500	<0.500	<0.500
1,1-DCE	7	7	<0.500	**75.3**	**56.3**	<0.500	<0.500	<0.500	<0.500
1,2-DCE (total)			NA	NA	NA	NA	NA	NA	NA
cis-1,2-DCE	70	70	4.05	**461**	**394**	<0.500	<0.500	<0.500	<0.500
trans-1,2-DCE	100	100	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
1,1,1-TCA	200	200	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
1,1,2-TCA	5	5	<1.00	**258**	**275**	<1.00	<1.00	<1.00	<1.00
PCE	5	5	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
TCE	5	5	3.5	**1330**	**1210**	<0.500	<0.500	<0.500	<0.500
vinyl chloride	2	2	<2.0	<40.0	<40.0	<2.00	<2.00	<2.00	<2.00
benzene	5	5	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
toluene	1000	1000	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
ethylbenzene	700	700	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
xylene	10000	10000	<1.00	<20.0	<20.0	<1.00	<1.00	<1.00	<1.00
acetone		700	<5.00	<100	<100	<5.00	<5.00	<5.00	<5.00
bromoform	80*	1	<1.00	<20.0	<20.0	<1.00	<1.00	<1.00	<1.00
bromodichloromethane	80*	0.2	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
bromomethane			<2.00	<40.0	<40.0	<2.00	<2.00	<2.00	<2.00
carbon disulfide		700	1.42	77.4	31.3	4.92	<1.00	5.02	3.37
chloroform	80*	0.2	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
methylene chloride	5	5	<2.00	<40.0	<40.0	<2.00	<2.00	<2.00	<2.00
styrene	100	100	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
SVOCs (only detected compounds)									
naphthalene		140	NA	NA	NA	NA	NA	NA	NA
diethylphthalate		5600	NA	NA	NA	NA	NA	NA	NA
di-n-butylphthalate		700	NA	NA	NA	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	6	6	NA	NA	NA	NA	NA	NA	NA
Pesticides (only detected compounds)									
heptachlor		0.4	NA	NA	NA	NA	NA	NA	NA
dieldrin		9	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE			NA	NA	NA	NA	NA	NA	NA
Metals (total)									
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA
cyanide		200	NA	NA	NA	NA	NA	NA	NA
Metals (dissolved)									
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons*			NA	NA	NA	NA	NA	NA	NA
Total PCBs	0.5	0.5	NA	NA	NA	NA	NA	NA	NA

MCL=maximum contaminant level (USEPA drinking water standards)
IL Class I = Illinois Class I Groundwater Remediation Objectives
Section 742 Appendix B: Tier 1 Tables and Illustrations
Table E: Tier 1 Groundwater Remedial Objectives for the Groundwater Component of the Groundwater Ingestion Route
SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	Law 2002 (cont.)							
Well # / Boring #			MG-4	MG-5	MG-8	MG-9	MW-01 D	MW-01 S	MW-02 D	MW-02 S
Sampling Date			12/02/98	12/02/98	12/02/98	12/02/98	12/02/98	12/02/98	12/02/98	12/02/98
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
VOCs (only detected compounds)										
1,1-DCA		700	6.69	<0.500	2.81	14.8	18.0	<10.0	46.2	19.7
1,1-DCE	7	7	**15.5**	<0.500	1.06	**98**	**36.6**	**35.1**	**204**	**92.3**
1,2-DCE (total)			NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-DCE	70	70	23.2	7.14	6.86	18.7	**126**	**157**	42.1	10.2
trans-1,2-DCE	100	100	<0.500	1.85	<0.500	26.1	<2.50	<10.0	14.3	2.34
1,1,1-TCA	200	200	2.2	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
1,1,2-TCA	5	5	1.69	<1.00	<1.00	**23.1**	**25.0**	<20.0	**113**	**47.4**
PCE	5	5	1.36	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
TCE	5	5	**20.8**	<0.500	3.02	**55.2**	**283**	**330**	**244**	**79.8**
vinyl chloride	2	2	<2.00	<2.00	<2.00	**2.61**	<10.0	<40.0	<10.0	<4.00
benzene	5	5	<0.500	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
toluene	1000	1000	<0.500	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
ethylbenzene	700	700	<0.500	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
xylene	10000	10000	<1.00	<1.00	<1.00	<1.00	<5.00	<20.0	<5.00	<2.00
acetone		700	<5.00	<5.00	<5.00	<5.00	<25.0	<100	<25.0	<10.0
bromoform	80*	1	<1.00	<1.00	<1.00	<1.00	<5.00	<20.0	<5.00	<2.00
bromodichloromethane	80*	0.2	<0.500	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
bromomethane			<2.00	<2.00	<2.00	<2.00	<10.0	<40.0	<10.0	<4.00
carbon disulfide		700	1.70	2.9	<1.00	<1.00	<5.00	<20.0	<5.00	4.07
chloroform	80*	0.2	<0.500	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
methylene chloride	5	5	<2.00	<2.00	<2.00	<2.00	<10.0	<40.0	<10.0	<4.00
styrene	100	100	<0.500	<0.500	<0.500	<0.500	<2.50	<10.0	<2.50	<1.00
SVOCs (only detected compounds)										
naphthalene		140	NA	NA	NA	NA	NA	NA	NA	NA
diethylphthalate		5600	NA	NA	NA	NA	NA	NA	NA	NA
di-n-butylphthalate		700	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	6	6	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides (only detected compounds)										
heptachlor		0.4	NA	NA	NA	NA	NA	NA	NA	NA
dieldrin		9	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE			NA	NA	NA	NA	NA	NA	NA	NA
Metals (total)										
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA
cyanide		200	NA	NA	NA	NA	NA	NA	NA	NA
Metals (dissolved)										
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons*			NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	0.5	0.5	NA	NA	NA	NA	NA	NA	NA	NA

MCL=maximum contaminant level (USEPA drinking water standards)
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Groundwater Component of the Groundwater Ingestion Route
SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.

Groundwater Sample Analytical Results from Previous Investigations - Summary Table
Feasibility Study, Nike SL-10 Launch Area
Groundwater
RI/FS/PP/ROD Project

	MCL	IL Class I	Law 2002 (cont.)						
Well # / Boring #			MW-03 D	MW-03 S	Duplicate	MW-04 D	MW-04S	MW-05 D	MW-05 S
Sampling Date			12/02/98	12/02/98	12/02/98	12/02/98	12/02/98	12/02/98	12/02/98
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
VOCs (only detected compounds)									
1,1-DCA		700	<0.500	32.5	28.5	<0.500	<0.500	<0.500	<0.500
1,1-DCE	7	7	<0.500	**61.9**	**48.1**	<0.500	<0.500	<0.500	<0.500
1,2-DCE (total)			NA	NA	NA	NA	NA	NA	NA
cis-1,2-DCE	70	70	2.43	**402**	**365**	<0.500	<0.500	<0.500	<0.500
trans-1,2-DCE	100	100	1.32	20.3	<10.0	<0.500	<0.500	<0.500	<0.500
1,1,1-TCA	200	200	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
1,1,2-TCA	5	5	<1.00	**229**	**250**	<1.00	<1.00	<1.00	<1.00
PCE	5	5	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
TCE	5	5	1.63	**1160**	**1100**	<0.500	<0.500	<0.500	<0.500
vinyl chloride	2	2	<2.00	<40	<40	<2.00	<2.00	<2.00	<2.00
benzene	5	5	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
toluene	1000	1000	<0.500	<10.0	<10.0	1.07	<0.500	<0.500	<0.500
ethylbenzene	700	700	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
xylene	10000	10000	<1.00	<20.0	<20.0	<1.00	<1.00	<1.00	<1.00
acetone		700	<5.00	<100	<100	<5.00	<5.00	<5.00	<5.00
bromoform	80*	1	<1.00	<20.0	<20.0	<1.00	<1.00	<1.00	<1.00
bromodichloromethane	80*	0.2	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
bromomethane			<2.00	<40.0	<40.0	<2.00	<2.00	<2.00	<2.00
carbon disulfide		700	<1.00	<20.0	<20.0	<1.00	5.47	<1.00	5.93
chloroform	80*	0.2	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
methylene chloride	5	5	<2.00	<40.0	<40.0	<2.00	<2.00	<2.00	<2.00
styrene	100	100	<0.500	<10.0	<10.0	<0.500	<0.500	<0.500	<0.500
SVOCs (only detected compounds)									
naphthalene		140	NA	NA	NA	NA	NA	NA	NA
diethylphthalate		5600	NA	NA	NA	NA	NA	NA	NA
di-n-butylphthalate		700	NA	NA	NA	NA	NA	NA	NA
bis(2-ethylhexyl)phthalate	6	6	NA	NA	NA	NA	NA	NA	NA
Pesticides (only detected compounds)									
heptachlor		0.4	NA	NA	NA	NA	NA	NA	NA
dieldrin		9	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE			NA	NA	NA	NA	NA	NA	NA
Metals (total)									
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA
cyanide		200	NA	NA	NA	NA	NA	NA	NA
Metals (dissolved)									
aluminum	SS=50 to 200		NA	NA	NA	NA	NA	NA	NA
antimony	6	6	NA	NA	NA	NA	NA	NA	NA
arsenic	10	50	NA	NA	NA	NA	NA	NA	NA
barium	2000	2000	NA	NA	NA	NA	NA	NA	NA
beryllium	4	4	NA	NA	NA	NA	NA	NA	NA
cadmium	5	5	NA	NA	NA	NA	NA	NA	NA
calcium			NA	NA	NA	NA	NA	NA	NA
chromium	100	100	NA	NA	NA	NA	NA	NA	NA
cobalt			NA	NA	NA	NA	NA	NA	NA
copper	AL=1300	650	NA	NA	NA	NA	NA	NA	NA
iron	SS=300	5000	NA	NA	NA	NA	NA	NA	NA
lead	AL=15	7.5	NA	NA	NA	NA	NA	NA	NA
magnesium			NA	NA	NA	NA	NA	NA	NA
manganese	SS=50	150	NA	NA	NA	NA	NA	NA	NA
mercury	2	2	NA	NA	NA	NA	NA	NA	NA
nickel		100	NA	NA	NA	NA	NA	NA	NA
potassium			NA	NA	NA	NA	NA	NA	NA
selenium	50	50	NA	NA	NA	NA	NA	NA	NA
silver	SS=100	50	NA	NA	NA	NA	NA	NA	NA
sodium			NA	NA	NA	NA	NA	NA	NA
thallium	2	2	NA	NA	NA	NA	NA	NA	NA
vanadium		49	NA	NA	NA	NA	NA	NA	NA
zinc	SS=5000	5000	NA	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons*			NA	NA	NA	NA	NA	NA	NA
Total PCBs	0.5	0.5	NA	NA	NA	NA	NA	NA	NA

MCL=maximum contaminant level (USEPA drinking water standards)
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SS = USEPA Secondary Drinking Water Standard
AL = USEPA Drinking Water Action Level
* Total trihalomethanes MCL is 80 ug/kg

NA = not analyzed
yellow highlight indicates compound detected
"<" = compound not detected above detection limit
Bold indicates exceedance of a MCL or State Remedial Objective.

APPENDIX B: Focused Risk Assessment Tables

FUTURE VAPOR INHALATION - CARCINOGENIC RISK - WELL R1, X = 1500 FT

Contaminant	Upper 95% Source Conc. (mg/L)	Mean Source Conc. (mg/L)	Upper 95% Well Conc. (mg/L)	Mean Well Conc. (mg/L)	Upper 95% Air Conc. (mg/m^3)	Mean Air Conc. (mg/m^3)	Estimated Daily Intake (mg/kg/day) RME	Estimated Daily Intake (mg/kg/day) RAE	Cancer Slope Factor (CSF) (mg/kg/day)^-	Excess Lifetime Cancer Risk RME	Excess Lifetime Cancer Risk RAE
Benzene	4.78E-03	2.73E-03	2.91E-04	1.66E-04	5.29E-03	3.02E-03	3.73E-06	3.19E-07	2.90E-02	1.08E-07	9.26E-09
1,1-DCA	2.57E-02	1.48E-02	1.56E-03	9.00E-04	2.84E-02	1.64E-02	2.00E-05	1.73E-06		0.00E+00	0.00E+00
1,1-DCE	9.78E-02	5.57E-02	5.95E-03	3.39E-03	1.08E-01	6.16E-02	7.62E-05	6.51E-06	1.20E+00	9.15E-05	7.81E-06
1,2-trans-DCA	2.13E-02	8.45E-03	1.29E-03	5.14E-04	2.36E-02	9.35E-03	1.66E-05	9.88E-07		0.00E+00	0.00E+00
1,2-DCA total	6.26E-02	2.77E-02	3.81E-03	1.68E-03	6.93E-02	3.06E-02	4.88E-05	3.24E-06		0.00E+00	0.00E+00
PCE	6.08E-03	3.77E-03	3.70E-04	2.29E-04	6.73E-03	4.17E-03	4.74E-06	4.41E-07	2.00E-03	9.48E-09	8.82E-10
1,1,1-TCA	3.79E-02	1.66E-02	2.30E-03	1.01E-03	4.19E-02	1.84E-02	2.95E-05	1.94E-06		0.00E+00	0.00E+00
1,1,2- TCA	9.05E-03	4.67E-03	5.50E-04	2.84E-04	1.00E-02	5.17E-03	7.05E-06	5.46E-07	5.60E-02	3.95E-07	3.06E-08
TCE	1.34E-01	7.71E-02	8.15E-03	4.69E-03	1.48E-01	8.53E-02	1.04E-04	9.01E-06	6.00E-03	6.27E-07	5.41E-08
									TOTAL	9.26E-05	7.91E-06

	RME	RAE
IR = 'Inhalation rate (m^3/hour)	0.6	0.6
ET = 'Exposure time (hours/day)	0.2	0.2
EF = 'Exposure frequency (days/year)	350	175
ED = 'Exposure duration (years)	30	9
BW = 'Body weight (kg)	70	70
AT = 'Averaging time (days)	365	365
YL = Years per lifetime (years)	70	70

EDI = AIR CONCENTRATION*IR*ET*EF*ED/(BW*AT*YL)

FUTURE DRINKING WATER INGESTION - CARCINOGENIC RISK - WELL R1, X = 1500 FT

Contaminant	Upper 95% Source Conc. (mg/L)	Mean Source Conc. (mg/L)	Upper 95% Well Conc. (mg/L)	Mean Well Conc. (mg/L)	Estimated Daily Intake (mg/kg/day) RME	Estimated Daily Intake (mg/kg/day) RAE	Cancer Slope Factor (CSF) (mg/kg/day)^-	Excess Lifetime Cancer Risk RME	Excess Lifetime Cancer Risk RAE
Benzene	4.78E-03	2.73E-03	2.91E-04	1.66E-04	3.41E-06	2.05E-07	2.90E-02	9.89E-08	5.93E-09
1,1-DCA	2.57E-02	1.48E-02	1.56E-03	9.00E-04	1.83E-05	1.11E-06		0.00E+00	0.00E+00
1,1-DCE	9.78E-02	5.57E-02	5.95E-03	3.39E-03	6.98E-05	4.17E-06	6.00E-01	4.19E-05	2.50E-06
1,2-trans-DC	2.13E-02	8.45E-03	1.29E-03	5.14E-04	1.52E-05	6.33E-07		0.00E+00	0.00E+00
1,2-DCA total	6.26E-02	2.77E-02	3.81E-03	1.68E-03	4.47E-05	2.08E-06		0.00E+00	0.00E+00
PCE	6.08E-03	3.77E-03	3.70E-04	2.29E-04	4.34E-06	2.83E-07	5.20E-02	2.26E-07	1.47E-08
1,1,1-TCA	3.79E-02	1.66E-02	2.30E-03	1.01E-03	2.71E-05	1.24E-06		0.00E+00	0.00E+00
1,1,2- TCA	9.05E-03	4.67E-03	5.50E-04	2.84E-04	6.46E-06	3.50E-07	5.70E-02	3.68E-07	2.00E-08
TCE	1.34E-01	7.71E-02	8.15E-03	4.69E-03	9.56E-05	5.78E-06	1.10E-02	1.05E-06	6.36E-08
							TOTAL	4.36E-05	2.61E-06

	RME	RAE
IR = Ingestion rate (L/day)	2	1.4
EF = Exposure frequency (days/year)	350	175
ED = Exposure duration (years)	30	9
BW = Body weight (kg)	70	70
AT = Averaging time (days/lifetime)	25550	25550

EDI = Conc.*IR*EF*ED/(BW*AT*YL)

FUTURE DERMAL ADSORPTION - CARCINOGENIC RISK - WELL R1, X = 1500 FT

Contaminant	Upper 95% Source Conc. (mg/L)	Mean Source Conc. (mg/L)	Upper 95% Well Conc. (mg/L)	Mean Well Conc. (mg/L)	Dermal Permeability Constant (cm/hour)	Estimated Daily Intake (mg/kg/day) RME	Estimated Daily Intake (mg/kg/day) RAE	Cancer Slope Factor (CSF) (mg/kg/day)^-	Excess Lifetime Cancer Risk RME	Excess Lifetime Cancer Risk RAE
Benzene	4.78E-03	2.73E-03	2.91E-04	1.66E-04	2.10E-02	2.04E-07	9.94E-09	2.90E-02	5.92E-09	2.88E-10
1,1-DCA	2.57E-02	1.48E-02	1.56E-03	9.00E-04	8.90E-03	4.65E-07	2.28E-08		0.00E+00	0.00E+00
1,1-DCE	9.78E-02	5.57E-02	5.95E-03	3.39E-03	1.60E-02	3.18E-06	1.55E-07	6.00E-01	1.91E-06	9.27E-08
1,2-trans-DC	2.13E-02	8.45E-03	1.29E-03	5.14E-04	1.00E-02	4.33E-07	1.47E-08		0.00E+00	0.00E+00
1,2-DCA total	6.26E-02	2.77E-02	3.81E-03	1.68E-03	1.00E-02	1.27E-06	4.80E-08		0.00E+00	0.00E+00
PCE	6.08E-03	3.77E-03	3.70E-04	2.29E-04	4.80E-02	5.94E-07	3.14E-08	5.20E-02	3.09E-08	1.63E-09
1,1,1-TCA	3.79E-02	1.66E-02	2.30E-03	1.01E-03	1.70E-02	1.31E-06	4.89E-08		0.00E+00	0.00E+00
1,1,2- TCA	9.05E-03	4.67E-03	5.50E-04	2.84E-04	8.40E-03	1.55E-07	6.80E-09	5.70E-02	8.81E-09	3.88E-10
TCE	1.34E-01	7.71E-02	8.15E-03	4.69E-03	1.60E-02	4.36E-06	2.14E-07	1.10E-02	4.80E-08	2.35E-09
								TOTAL	2.00E-06	9.74E-08

	RME	RAE
CF = Conversion factor (L/cm^3)	1.00E-03	1.00E-03
SA = Skin surface area (cm^2)	22800	19400
ET = Exposure time (hours/day)	0.25	0.167
EF = Exposure frequency (days/year)	350	175
ED = Exposure duration (years)	30	9
BW = Body weight (kg)	70	70
AT = Averaging time (days)	365	365
YL = Years per lifetime (years)	70	70

EDI = Conc.*PC*CF*SA*ET*EF*ED/(BW*AT*YL)

FUTURE VAPOR INHALATION - CARCINOGENIC - WELL R2, X = 1750 FT

Contaminant	Upper 95% Source Conc. (mg/L)	Mean Source Conc. (mg/L)	Upper 95% Well Conc. (mg/L)	Mean Well Conc. (mg/L)	Upper 95% Air Conc. (mg/m^3)	Mean Air Conc. (mg/m^3)	Estimated Daily Intake (mg/kg/day) RME	Estimated Daily Intake (mg/kg/day) RAE	Cancer Slope Factor (CSF) (mg/kg/day)^-	Excess Lifetime Cancer Risk RME	Excess Lifetime Cancer Risk RAE
Benzene	4.78E-03	2.73E-03	2.51E-04	1.43E-04	4.57E-03	2.61E-03	3.22E-06	2.76E-07	2.90E-02	9.34E-08	8.00E-09
1,1-DCA	2.57E-02	1.48E-02	1.35E-03	7.78E-04	2.46E-02	1.42E-02	1.73E-05	1.50E-06		0.00E+00	0.00E+00
1,1-DCE	9.78E-02	5.57E-02	5.14E-03	2.93E-03	9.36E-02	5.33E-02	6.59E-05	5.63E-06	1.20E+00	7.91E-05	6.76E-06
1,2-trans-DCA	2.13E-02	8.45E-03	1.12E-03	4.44E-04	2.04E-02	8.08E-03	1.44E-05	8.54E-07		0.00E+00	0.00E+00
1,2-DCA total	6.26E-02	2.77E-02	3.29E-03	1.46E-03	5.99E-02	2.65E-02	4.22E-05	2.80E-06		0.00E+00	0.00E+00
PCE	6.08E-03	3.77E-03	3.20E-04	1.98E-04	5.82E-03	3.61E-03	4.10E-06	3.81E-07	2.00E-03	8.20E-09	7.62E-10
1,1,1-TCA	3.79E-02	1.66E-02	1.99E-03	8.73E-04	3.63E-02	1.59E-02	2.55E-05	1.68E-06		0.00E+00	0.00E+00
1,1,2- TCA	9.05E-03	4.67E-03	4.76E-04	2.45E-04	8.66E-03	4.47E-03	6.10E-06	4.72E-07	5.60E-02	3.42E-07	2.64E-08
TCE	1.34E-01	7.71E-02	7.04E-03	4.05E-03	1.28E-01	7.38E-02	9.03E-05	7.79E-06	6.00E-03	5.42E-07	4.68E-08
									TOTAL	8.01E-05	6.84E-06

	RME	RAE
IR = 'Inhalation rate (m^3/hour)	0.6	0.6
ET = 'Exposure time (hours/day)	0.2	0.2
EF = 'Exposure frequency (days/year)	350	175
ED = 'Exposure duration (years)	30	9
BW = 'Body weight (kg)	70	70
AT = 'Averaging time (days)	365	365
YL = Years per lifetime (years)	70	70

EDI = AIR CONCENTRATION*IR*ET*EF*ED/(BW*AT*YL)

FUTURE DRINKING WATER INGESTION - CARCINOGENIC RISK - WELL R2, X = 1750 FT

Contaminant	Upper 95% Source Conc. (mg/L)	Mean Source Conc. (mg/L)	Upper 95% Well Conc. (mg/L)	Mean Well Conc. (mg/L)	Estimated Daily Intake (mg/kg/day) RME	Estimated Daily Intake (mg/kg/day) RAE	Cancer Slope Factor (CSF) (mg/kg/day)^-	Excess Lifetime Cancer Risk RME	Excess Lifetime Cancer Risk RAE
Benzene	4.78E-03	2.73E-03	2.51E-04	1.43E-04	2.95E-06	1.77E-07	2.90E-02	8.56E-08	5.13E-09
1,1-DCA	2.57E-02	1.48E-02	1.35E-03	7.78E-04	1.59E-05	9.59E-07		0.00E+00	0.00E+00
1,1-DCE	9.78E-02	5.57E-02	5.14E-03	2.93E-03	6.04E-05	3.61E-06	6.00E-01	3.62E-05	2.17E-06
1,2-trans-DC	2.13E-02	8.45E-03	1.12E-03	4.44E-04	1.31E-05	5.48E-07		0.00E+00	0.00E+00
1,2-DCA total	6.26E-02	2.77E-02	3.29E-03	1.46E-03	3.86E-05	1.80E-06		0.00E+00	0.00E+00
PCE	6.08E-03	3.77E-03	3.20E-04	1.98E-04	3.75E-06	2.44E-07	5.20E-02	1.95E-07	1.27E-08
1,1,1-TCA	3.79E-02	1.66E-02	1.99E-03	8.73E-04	2.34E-05	1.08E-06		0.00E+00	0.00E+00
1,1,2- TCA	9.05E-03	4.67E-03	4.76E-04	2.45E-04	5.59E-06	3.03E-07	5.70E-02	3.18E-07	1.72E-08
TCE	1.34E-01	7.71E-02	7.04E-03	4.05E-03	8.27E-05	5.00E-06	1.10E-02	9.10E-07	5.50E-08
							TOTAL	3.77E-05	2.26E-06

	RME	RAE
IR = Ingestion rate (L/day)	2	1.4
EF = Exposure frequency (days/year)	350	175
ED = Exposure duration (years)	30	9
BW = Body weight (kg)	70	70
AT = Averaging time (days/lifetime)	25550	25550

EDI = Conc.*IR*EF*ED/(BW*AT*YL)

FUTURE DERMAL ADSORPTION - CARCINOGENIC RISK - WELL R2, X = 1750 FT

Contaminant	Upper 95% Source Conc. (mg/L)	Mean Source Conc. (mg/L)	Upper 95% Well Conc. (mg/L)	Mean Well Conc. (mg/L)	Dermal Permeability Constant (cm/hour)	Estimated Daily Intake (mg/kg/day) RME	Estimated Daily Intake (mg/kg/day) RAE	Cancer Slope Factor (CSF) (mg/kg/day)^-	Excess Lifetime Cancer Risk RME	Excess Lifetime Cancer Risk RAE
Benzene	4.78E-03	2.73E-03	2.51E-04	1.43E-04	2.10E-02	1.77E-07	8.60E-09	2.90E-02	5.12E-09	2.49E-10
1,1-DCA	2.57E-02	1.48E-02	1.35E-03	7.78E-04	8.90E-03	4.02E-07	1.98E-08		0.00E+00	0.00E+00
1,1-DCE	9.78E-02	5.57E-02	5.14E-03	2.93E-03	1.60E-02	2.75E-06	1.34E-07	6.00E-01	1.65E-06	8.02E-08
1,2-trans-DC	2.13E-02	8.45E-03	1.12E-03	4.44E-04	1.00E-02	3.75E-07	1.27E-08		0.00E+00	0.00E+00
1,2-DCA total	6.26E-02	2.77E-02	3.29E-03	1.46E-03	1.00E-02	1.10E-06	4.15E-08		0.00E+00	0.00E+00
PCE	6.08E-03	3.77E-03	3.20E-04	1.98E-04	4.80E-02	5.13E-07	2.71E-08	5.20E-02	2.67E-08	1.41E-09
1,1,1-TCA	3.79E-02	1.66E-02	1.99E-03	8.73E-04	1.70E-02	1.13E-06	4.23E-08		0.00E+00	0.00E+00
1,1,2- TCA	9.05E-03	4.67E-03	4.76E-04	2.45E-04	8.40E-03	1.34E-07	5.88E-09	5.70E-02	7.62E-09	3.35E-10
TCE	1.34E-01	7.71E-02	7.04E-03	4.05E-03	1.60E-02	3.77E-06	1.85E-07	1.10E-02	4.15E-08	2.03E-09
								TOTAL	1.73E-06	8.42E-08

	RME	RAE
CF = Conversion factor (L/cm^3)	1.00E-03	1.00E-03
SA = Skin surface area (cm^2)	22800	19400
ET = Exposure time (hours/day)	0.25	0.167
EF = Exposure frequency (days/year)	350	175
ED = Exposure duration (years)	30	9
BW = Body weight (kg)	70	70
AT = Averaging time (days)	365	365
YL = Years per lifetime (years)	70	70

EDI = Conc.*PC*CF*SA*ET*EF*ED/(BW*AT*YL)

FUTURE VAPOR INHALATION - CARCINOGENIC - X = 2200 FT

Contaminant	Upper 95% Source Conc. (mg/L)	Mean Source Conc. (mg/L)	Upper 95% Well Conc. (mg/L)	Mean Well Conc. (mg/L)	Upper 95% Air Conc. (mg/m^3)	Mean Air Conc. (mg/m^3)	Estimated Daily Intake (mg/kg/day) RME	Estimated Daily Intake (mg/kg/day) RAE	Cancer Slope Factor (CSF) (mg/kg/day)^-	Excess Lifetime Cancer Risk RME	Excess Lifetime Cancer Risk RAE
Benzene	4.78E-03	2.73E-03	2.02E-04	1.15E-04	3.68E-03	2.10E-03	2.59E-06	2.22E-07	2.90E-02	7.51E-08	6.44E-09
1,1-DCA	2.57E-02	1.48E-02	1.09E-03	6.26E-04	1.98E-02	1.14E-02	1.39E-05	1.20E-06		0.00E+00	0.00E+00
1,1-DCE	9.78E-02	5.57E-02	4.13E-03	2.35E-03	7.52E-02	4.28E-02	5.30E-05	4.53E-06	1.20E+00	6.36E-05	5.43E-06
1,2-trans-DCA	2.13E-02	8.45E-03	9.00E-04	3.57E-04	1.64E-02	6.50E-03	1.15E-05	6.87E-07		0.00E+00	0.00E+00
1,2-DCA total	6.26E-02	2.77E-02	2.65E-03	1.17E-03	4.82E-02	2.13E-02	3.39E-05	2.25E-06		0.00E+00	0.00E+00
PCE	6.08E-03	3.77E-03	2.57E-04	1.59E-04	4.68E-03	2.90E-03	3.29E-06	3.06E-07	2.00E-03	6.59E-09	6.13E-10
1,1,1-TCA	3.79E-02	1.66E-02	1.60E-03	7.02E-04	2.92E-02	1.28E-02	2.05E-05	1.35E-06		0.00E+00	0.00E+00
1,1,2- TCA	9.05E-03	4.67E-03	3.83E-04	1.97E-04	6.96E-03	3.59E-03	4.90E-06	3.80E-07	5.60E-02	2.75E-07	2.13E-08
TCE	1.34E-01	7.71E-02	5.66E-03	3.26E-03	1.03E-01	5.93E-02	7.26E-05	6.27E-06	6.00E-03	4.36E-07	3.76E-08
									TOTAL	6.44E-05	5.50E-06

	RME	RAE
IR = 'Inhalation rate (m^3/hour)	0.6	0.6
ET = 'Exposure time (hours/day)	0.2	0.2
EF = 'Exposure frequency (days/year)	350	175
ED = 'Exposure duration (years)	30	9
BW = 'Body weight (kg)	70	70
AT = 'Averaging time (days)	365	365
YL = Years per lifetime (years)	70	70

EDI = AIR CONCENTRATION*IR*ET*EF*ED/(BW*AT*YL)

FUTURE DRINKING WATER INGESTION - CARCINOGENIC RISK - X = 2200 FT

Contaminant	Upper 95% Source Conc. (mg/L)	Mean Source Conc. (mg/L)	Upper 95% Well Conc. (mg/L)	Mean Well Conc. (mg/L)	Estimated Daily Intake (mg/kg/day) RME	Estimated Daily Intake (mg/kg/day) RAE	Cancer Slope Factor (CSF) (mg/kg/day)^-	Excess Lifetime Cancer Risk RME	Excess Lifetime Cancer Risk RAE
Benzene	4.78E-03	2.73E-03	2.02E-04	1.15E-04	2.37E-06	1.42E-07	2.90E-02	6.88E-08	4.13E-09
1,1-DCA	2.57E-02	1.48E-02	1.09E-03	6.26E-04	1.28E-05	7.71E-07		0.00E+00	0.00E+00
1,1-DCE	9.78E-02	5.57E-02	4.13E-03	2.35E-03	4.85E-05	2.90E-06	6.00E-01	2.91E-05	1.74E-06
1,2-trans-DC	2.13E-02	8.45E-03	9.00E-04	3.57E-04	1.06E-05	4.40E-07		0.00E+00	0.00E+00
1,2-DCA total	6.26E-02	2.77E-02	2.65E-03	1.17E-03	3.11E-05	1.44E-06		0.00E+00	0.00E+00
PCE	6.08E-03	3.77E-03	2.57E-04	1.59E-04	3.02E-06	1.96E-07	5.20E-02	1.57E-07	1.02E-08
1,1,1-TCA	3.79E-02	1.66E-02	1.60E-03	7.02E-04	1.88E-05	8.65E-07		0.00E+00	0.00E+00
1,1,2- TCA	9.05E-03	4.67E-03	3.83E-04	1.97E-04	4.49E-06	2.43E-07	5.70E-02	2.56E-07	1.39E-08
TCE	1.34E-01	7.71E-02	5.66E-03	3.26E-03	6.65E-05	4.02E-06	1.10E-02	7.31E-07	4.42E-08
							TOTAL	3.03E-05	1.81E-06

	RME	RAE
IR = Ingestion rate (L/day)	2	1.4
EF = Exposure frequency (days/year)	350	175
ED = Exposure duration (years)	30	9
BW = Body weight (kg)	70	70
AT = Averaging time (days/lifetime)	25550	25550

EDI = Conc.*IR*EF*ED/(BW*AT*YL)

FUTURE DERMAL ADSORPTION - CARCINOGENIC RISK - X=2200 FT

Contaminant	Upper 95% Source Conc. (mg/L)	Mean Source Conc. (mg/L)	Upper 95% Well Conc. (mg/L)	Mean Well Conc. (mg/L)	Dermal Permeability Constant (cm/hour)	Estimated Daily Intake (mg/kg/day) RME	Estimated Daily Intake (mg/kg/day) RAE	Cancer Slope Factor (CSF) (mg/kg/day)^-	Excess Lifetime Cancer Risk RME	Excess Lifetime Cancer Risk RAE
Benzene	4.78E-03	2.73E-03	2.02E-04	1.15E-04	2.10E-02	1.42E-07	6.91E-09	2.90E-02	4.12E-09	2.00E-10
1,1-DCA	2.57E-02	1.48E-02	1.09E-03	6.26E-04	8.90E-03	3.24E-07	1.59E-08		0.00E+00	0.00E+00
1,1-DCE	9.78E-02	5.57E-02	4.13E-03	2.35E-03	1.60E-02	2.21E-06	1.07E-07	6.00E-01	1.33E-06	6.45E-08
1,2-trans-DC	2.13E-02	8.45E-03	9.00E-04	3.57E-04	1.00E-02	3.01E-07	1.02E-08		0.00E+00	0.00E+00
1,2-DCA total	6.26E-02	2.77E-02	2.65E-03	1.17E-03	1.00E-02	8.85E-07	3.34E-08		0.00E+00	0.00E+00
PCE	6.08E-03	3.77E-03	2.57E-04	1.59E-04	4.80E-02	4.13E-07	2.18E-08	5.20E-02	2.15E-08	1.13E-09
1,1,1-TCA	3.79E-02	1.66E-02	1.60E-03	7.02E-04	1.70E-02	9.11E-07	3.40E-08		0.00E+00	0.00E+00
1,1,2- TCA	9.05E-03	4.67E-03	3.83E-04	1.97E-04	8.40E-03	1.08E-07	4.73E-09	5.70E-02	6.13E-09	2.70E-10
TCE	1.34E-01	7.71E-02	5.66E-03	3.26E-03	1.60E-02	3.03E-06	1.49E-07	1.10E-02	3.34E-08	1.64E-09
								TOTAL	1.39E-06	6.77E-08

	RME	RAE
CF = Conversion factor (L/cm^3)	1.00E-03	1.00E-03
SA = Skin surface area (cm^2)	22800	19400
ET = Exposure time (hours/day)	0.25	0.167
EF = Exposure frequency (days/year)	350	175
ED = Exposure duration (years)	30	9
BW = Body weight (kg)	70	70
AT = Averaging time (days)	365	365
YL = Years per lifetime (years)	70	70

EDI = Conc.*PC*CF*SA*ET*EF*ED/(BW*AT*YL)

APPENDIX C: Detailed Alternative Cost Estimate

Appendix C

Remedial Cost Estimates

Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost estimates for 3 Groundwater Alternatives are presented in this Appendix. There are several Tables and Exhibits associated with each Alternative. A separator page has been placed between each of the alternatives with a description of the Tables and Exhibits presented for the alternative. The cost estimates were developed following EPA protocols presented in *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA July, 2000, [EPA 540-R-00-002, OSWER 9355.0-75]). Much of the unit cost information was drawn from Environmental Remediation Cost Data – Unit Price and Environmental Remediation Cost Data – Assemblies (both from ECHOS 2006).

Appendix C - Alternative Groundwater 2
Monitored Natural Attenuation

Exhibits

Exhibit C-GW 2-1 – Cost Estimate Summary – Alternative GW 2
Exhibit C-GW 2-2 – Cost Worksheet GW 2 – Capital Cost Sub-Element – Construction Activities: Mobilization/Demobilization
Exhibit C-GW 2-3 – Cost Worksheet GW 2 – Capital Cost Sub-Element – Construction Activities: Monitoring, Sampling, Testing, and Analysis
Exhibit C-GW 2-4 – Cost Worksheet GW 2 – Capital Cost Sub-Element – Construction Activities: Off-Site Treatment & Disposal
Exhibit C-GW 2-5 – Cost Worksheet GW 2 – Capital Cost Sub-Element – Institutional Controls
Exhibit C-GW 2-6 – Cost Worksheet GW 2 – O&M Monitoring, Sampling, Testing & Analysis
Exhibit C-GW 2-7 – Cost Worksheet GW 2 – O&M Off-Site Treatment & Disposal
Exhibit C-GW 2-8 – Cost Worksheet GW 2 – O&M Institutional Controls
Exhibit C-GW 2-9 – Cost Worksheet GW 2 – Periodic Cost Sub-Element – Five-Year Review
Exhibit C-GW 2-10 – Cost Worksheet GW 2 – Periodic Cost Sub-Element – Demobilization & Well Abandonment
Exhibit C-GW 2-11 – Cost Worksheet GW 2 – Periodic Cost Sub-Element – Institutional Controls

Tables

Table C-GW 2-1 – Capital Cost Element Checklist – Alternative GW 2 – MNA
Table C-GW 2-2 – O&M Cost Element Checklist – Alternative GW 2 – MNA
Table C-GW 2-3 – Periodic Cost Element Checklist – Alternative GW 2 – MNA

EXHIBIT C-GW 2-1
COST ESTIMATE SUMMARY - ALTERNATIVE GW-2

Alternative GW-2
Monitored Natural Attenuation

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Feasibility Study (-30% to +50%)
Base Year: 2006
Date: 6-23-06

Description: Alternative GW 2 - MNA consists of developing and executing a long term MNA groundwater monitoring plan. Groundwater will be sampled and analized quarterly for the first year and annually thereafter.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Mobilization / Demobilization	1	LS	$24,135	$24,135	
Monitoring, Sampling, Testing, and Analysis	1	LS	$83,394	$83,394	
Off-Site Treatment & Disposal	1	LS	$5,123	$5,123	
SUBTOTAL				$112,652	
Contingency	30%			$33,796	10% scope + 20% bid
SUBTOTAL				$146,448	
Project Management	5%			$7,322	
Remedial Design	8%			$11,716	
Construction Management	6%			$8,787	
Institutional Controls	1	LS	$13,644	$13,644	
SUBTOTAL				$187,917	
TOTAL CAPITAL COST				$187,917	

O&M COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Monitoring, Sampling, Testing, and Analysis	1	LS	$17,171	$17,171	
Off-Site Treatment/Disposal	1	LS	$512	$512	
SUBTOTAL				$17,683	
Contingency	30%			$5,305	10% scope + 20% bid
SUBTOTAL				$22,988	
Project Management	5%			$1,149	
Technical Support	10%			$2,299	
SUBTOTAL				$26,436	
Institutional Controls	1	LS	$3,078	$3,078	Annual site visit and plan update.
SUBTOTAL				$29,514	
TOTAL ANNUAL O&M COST				$29,514	

EXHIBIT C-GW 2-1
COST ESTIMATE SUMMARY - ALTERNATIVE GW-2

Alternative GW-2
Monitored Natural Attenuation

PERIODIC COSTS:

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5-Year Review	5	1	EA	$9,222	$9,222	
Update Institutional Control Plan	5	1	EA	$5,404	$5,404	
SUBTOTAL					$14,627	
5-Yr Rev	10	1	EA	$9,222	$9,222	
Update Institutional Control Plan	10	1	EA	$5,404	$5,404	
SUBTOTAL					$14,627	
5-Year Review	15	1	EA	$9,222	$9,222	
Update Institutional Control Plan	15	1	EA	$5,404	$5,404	
SUBTOTAL					$14,627	
5-Yr Rev	20	1	EA	$9,222	$9,222	
Update Institutional Control Plan	20	1	EA	$5,404	$5,404	
SUBTOTAL					$14,627	
5-Year Review	25	1	EA	$9,222	$9,222	
Update Institutional Control Plan	25	1	EA	$5,404	$5,404	
SUBTOTAL					$14,627	
5-Yr Rev	30	1	EA	$9,222	$9,222	
Update Institutional Control Plan	30	1	EA	$5,404	$5,404	
SUBTOTAL					$14,627	
5-Year Review	35	1	EA	$9,222	$9,222	
Update Institutional Control Plan	35	1	EA	$5,404	$5,404	
SUBTOTAL					$14,627	
5-Yr Rev	40	1	EA	$9,222	$9,222	
Update Institutional Control Plan	40	1	EA	$5,404	$5,404	
SUBTOTAL					$14,627	
5-Year Review	45	1	EA	$9,222	$9,222	
Update Institutional Control Plan	45	1	EA	$5,404	$5,404	
SUBTOTAL					$14,627	
5-Yr Rev	50	1	EA	$9,222	$9,222	
System Demob	50	1	EA	$42,902	$42,902	
Contingency (% of Sum)		25%			$10,725	% of construction activity
Project Mgt. (% of Sum + Cont.)		5%			$2,681	% of construction activity + contingency
Update Institutional Control Plan	50	1	EA	$5,404	$5,404	
SUBTOTAL					$70,936	
SUBTOTAL					$202,578	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
Capital Cost	1	$187,917	$187,917	1.000	$187,917	
Annual O&M Cost	2-50	$1,446,194	$29,514	13.767	$406,321	
Periodic Cost	5	$14,627	$14,627	0.7130	$10,429	
Periodic Cost	10	$14,627	$14,627	0.5080	$7,430	
Periodic Cost	15	$14,627	$14,627	0.3620	$5,295	
Periodic Cost	20	$14,627	$14,627	0.2580	$3,774	
Periodic Cost	25	$14,627	$14,627	0.1840	$2,691	
Periodic Cost	30	$14,627	$14,627	0.1310	$1,916	
Periodic Cost	35	$14,627	$14,627	0.0937	$1,371	
Periodic Cost	40	$14,627	$14,627	0.0668	$977	
Periodic Cost	45	$14,627	$14,627	0.0476	$696	
Periodic Cost	50	$70,936	$70,936	0.0339	$2,405	
		$1,836,689			$631,223	
TOTAL PRESENT VALUE OF ALTERNATIVE					$631,223	

EXHIBIT C-GW 2-2
COST WORKSHEET - ALTERNATIVE GW-2

Alternative GW-2 Monitored Natural Attenuation
Capital Cost Sub-Element
Construction Activity: Mobilization/Demobilization

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/23/06

Check by: _____
Date: _____

Work Statement:

The MNA alternative will require some planning documents and submittals.

Cost Analysis:

Mobilization/Demobilization

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Plans								
Senior Engineer	48	HR	$42.14			$42.14	$2,022.72	ECHOS
Field Technician	100	HR	$26.66			$26.66	$2,666.00	ECHOS
			ECHOS costs with Localization Factor (0.98):				$4,594.95	ECHOS
Computers, etc.	0	HR		$25.00		$25.00	$0.00	Plexus
Report Copying, etc.	1	LS	$1,000.00	$500.00	$500.00	$2,000.00	$2,000.00	Estimate
Other Non-Itemized Direct Costs	1	LS		$250.00	$250.00	$500.00	$500.00	Estimate
						Escalation (4340/3693):	$2,937.99	
Permitting								
Senior Engineer	8	HR	$42.14			$42.14	$337.12	ECHOS
Field Technician	12	HR	$26.66			$26.66	$319.92	ECHOS
			ECHOS costs with Localization Factor (0.98):				$643.90	ECHOS
Computers, etc.	0	HR		$25.00		$25.00	$0.00	Plexus
Report Copying, etc.	1	LS	$100.00	$100.00	$50.00	$250.00	$250.00	Estimate
Other Non-Itemized Direct Costs	1	LS		$50.00	$50.00	$100.00	$100.00	Estimate
						Escalation (4340/3693):	$411.32	
						Subtotal:	$8,588.15	
			Prime Contractor Overhead:			15%	$1,288.22	
						Subtotal:	$9,876.38	
			Prime Contractor Profit:			10%	$987.64	
			TOTAL ACTIVITY COST:				$10,864.02	

Source of Cost Data:

Plexus 2003 rates for CELRL contract
ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
Estimate based on experience

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	NA
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	ECHOS localization factor 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 2-3
COST WORKSHEET - ALTERNATIVE GW-2

Alternative GW-2 Monitored Natural Attenuation
Capital Cost Sub-Element
Construction Activity: Monitoring, Sampling, Testing and Analysis

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/23/06

Check by: _____
Date: _____

Work Statement:

A long term groundwater monitoring process will begin with sampling of on site wells. On-site analytical techniques will be used for some parameters and samples will be shipped to off-site laboratories for other parameters. During the initial year monitoring will take place quarterly, and annually thereafter.

Cost Analysis:

Monitoring, Sampling, Testing, and Analysis:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
On-Site Analysis (4 quarters)								
Fe^{+2} Hack Kit	1	EA				$47.30	$47.30	Hach
CO_2 Hack Kit	1	EA				$30.60	$30.60	Hach
pH, temperature, conductivity, O_2, and ORP using field monitor with flow thru cell, rental	4	WEEK				$300.00	$1,200.00	Pine
Laboratory Analysis (4 quarters)								
VOCs	50	EA				$130.00	$6,500.00	STL
	0	EA				$150.00	$0.00	STL
	0	EA				$150.00	$0.00	STL
	0	EA				$30.00	$0.00	STL
TOC	45	EA				$45.00	$2,025.00	STL
Filters, 0.45 micron field water filters.	0	EA				$11.75	$0.00	Pine
Shipping	4	LS				$250.00	$1,000.00	Estimate
Incidentials	4	LS				$500.00	$2,000.00	Estimate
PID Rental	4	WEEK				$150.00	$600.00	Pine
Drums	20	EA				$50.00	$1,000.00	Estimate
Monitoring Well Sampling	40	WELLS				$300.00	$12,000.00	Estimate
Data Validation	4	LS				$3,000.00	$12,000.00	Estimate
Per Diem	12	DAY				$125.00	$1,500.00	Estimate
						Escalation (4340/3693):	$46,893.74	
Report Preparation (1 report/quarter)								
Senior Engineer	0	HR	$42.12			$42.12	$0.00	ECHOS
Project Engineer	100	HR	$32.94			$32.94	$3,294.00	ECHOS
Field Technician	200	HR	$26.66			$26.66	$5,332.00	ECHOS
						ECHOS costs with Localization Factor (0.98):	$8,453.48	ECHOS
Computers, etc.	200	HR				$25.00	$5,000.00	Plexus
Report Copying, etc.	1	LS				$4,000.00	$4,000.00	Estimate
Groundwater Modeling	0	LS				$20,000.00	$0.00	Estimate
						Escalation (4340/3693):	$10,576.77	
						Subtotal:	$65,923.99	
						Prime Contractor Overhead: 15%	$9,888.60	
						Subtotal:	$75,812.59	
						Prime Contractor Profit: 10%	$7,581.26	
						TOTAL ACTIVITY COST:	$83,393.84	

Source of Cost Data:

Plexus 2003 rates for CELRL contract
Estimate based on experience
Laboratory cost from STL project rates
Rental rates from Pine Environmental
Test kit rates from Hach
ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.

EXHIBIT C-GW 2-3
COST WORKSHEET - ALTERNATIVE GW-2

Alternative GW-2 Monitored Natural Attenuation
Capital Cost Sub-Element
Construction Activity: Monitoring, Sampling, Testing and Analysis

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/23/06

Check by: _____
Date: _____

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	NA
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	ECHOS localization factor 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 2-4
COST WORKSHEET - ALTERNATIVE GW-2

Alternative GW-2 Monitored Natural Attenuation
Capital Cost Sub-Element
Construction Activity: Off-Site Treatment and Disposal

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/30/06

Check by: _____
Date: _____

Work Statement:

Purge water from the monitoring wells will need to be handled and disposed of.

Cost Analysis:

Off-Site Treatment and Disposal

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Drums for Purge Water, 55 Gallon DOT	20	EA			$50.00	$50.00	$1,000.00	Estimate
Transportation and Treatment	20	EA				$100.00	$2,000.00	Estimate
						Subtotal:	$3,000.00	
					Subcontractor Overhead:	25%	$750.00	
						Subtotal:	$3,750.00	
					Subcontractor Profit:	8%	$300.00	
						Subtotal:	$4,050.00	
					Prime Contractor Overhead:	15%	$607.50	
						Subtotal:	$4,657.50	
					Prime Contractor Profit:	10%	$465.75	
					TOTAL ACTIVITY COST:		$5,123.25	

Source of Cost Data:

Estimated based on previous experience at Plexus.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level D
☒	Escalation to Base Year	NA
☒	Area Cost Factor	NA
☒	Subcontractor Overhead and Profit	Calculated at 25% and 8%.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 2-5
COST WORKSHEET - ALTERNATIVE GW-2

Alternative GW-2 Monitored Natural Attenuation
Capital Cost Sub-Element
Institutional Controls

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/27/06

Check by: _____
Date: _____

Work Statement:

Institutional Control include preparing a plan to present the process of developing institutional controls and putting them into action. The Institutional Controls on the site could include restrictive covenants, zoning restrictions instituted through Madison County, property easements if needed, deed notices, advisories, and groundwater use restrictions. In addition, the site information database is to be updated and maintained. A similar cost element will be included with the other media remedial costs, duplication of costs will have to be resolved during detailed project cost analysis.

Cost Analysis:

Costs for Institutional Controls:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Senior Engineer	0	HR	$42.14			$42.14	$0.00	ECHOS
Environmental Attorney	40	HR	$50.00			$50.00	$2,000.00	Estimate
Project Engineer	40	HR	$32.94			$32.94	$1,317.60	ECHOS
Field Technician	32	HR	$26.66			$26.66	$853.12	ECHOS
			ECHOS costs with Localization Factor (0.98):				$4,087.31	ECHOS
Computers, etc.	0	HR				$25.00	$0.00	Plexus
Report Copying, etc.	1	LS				$5,000.00	$5,000.00	Estimate
Other Non-Itemized Direct Costs	1	LS				$200.00	$200.00	Estimate
Per Diem	4	DAY				$125.00	$500.00	Estimate
						Escalation (4340/3693):	$6,698.62	
						Subtotal:	$10,785.92	
						Prime Contractor Overhead: 15%	$1,617.89	
						SUBTOTAL:	$12,403.81	
						Prime Contractor Profit: 10%	$1,240.38	
						TOTAL UNIT COST:	$13,644.19	

Source of Cost Data:

Plexus 2003 rates for CELRL contract
Estimate based on experience
An attorney has been added to assist the contractor and the Army in negotiation with the City and State.
The hours for Engineering Support have been increased as well to cover meetings and negotiations.
ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Costs from 2003 CELRL rates, base year is 2006.
☒	Area Cost Factor	ECHOS localization factor 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 2-6
COST WORKSHEET - ALTERNATIVE GW-2

Alternative GW-2 Monitored Natural Attenuation

O&M: Monitoring, Sampling, Testing and Analysis

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/27/06

Check by: _____
Date: _____

Work Statement:

The site wells in the long term monitoring program will be sampled once annually.
On-site analytical techniques will be used for some parameters and samples will be shipped to off-site laboratories for other parameters.

Cost Analysis:

Monitoring, Sampling, Testing, and Analysis:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
On-Site Analysis (4 quarters)								
Fe^{+2} Hack Kit	1	EA				$47.30	$47.30	Hach
CO_2 Hack Kit	1	EA				$30.60	$30.60	Hach
pH, temperature, conductivity, O2, and ORP using field monitor with flow thru cell, rental	1	WEEK				$300.00	$300.00	Pine
Laboratory Analysis (4 quarters)								
VOCs	13	EA				$130.00	$1,690.00	STL
TAL metals filtered	0	EA				$150.00	$0.00	STL
TAL metals unfiltered	0	EA				$150.00	$0.00	STL
Hexavalent chromium	0	EA				$30.00	$0.00	STL
TOC	12	EA				$45.00	$540.00	STL
Filters, 0.45 micron field water filters.	0	EA				$11.75	$0.00	Pine
Shipping	1	LS				$250.00	$250.00	Estimate
Incidentials	1	LS				$250.00	$250.00	Estimate
PID Rental	1	WEEK				$150.00	$150.00	Pine
Drums	2	EA				$50.00	$100.00	Estimate
Monitoring Well Sampling	10	WELLS				$300.00	$3,000.00	Estimate
Data Validation	1	LS				$3,000.00	$3,000.00	Estimate
Per Diem	4	DAY				$125.00	$500.00	Estimate
						Escalation (4340/3693):	$10,905.92	
Report Preparation								
Senior Engineer	0	HR	$42.14			$42.14	$0.00	ECHOS
Project Engineer	16	HR	$32.94			$32.94	$527.04	ECHOS
Field Technician	40	HR	$26.66			$26.66	$1,066.40	ECHOS
			ECHOS costs with Localization Factor (0.98):				$1,561.57	ECHOS
Computers, etc.	0	HR				$25.00	$0.00	Plexus
Report Copying, etc.	1	LS				$1,000.00	$1,000.00	Estimate
Groundwater Modeling	0	LS				$20,000.00	$0.00	Estimate
						Escalation (4340/3693):	$1,106.31	
						Subtotal:	$13,573.80	
					Prime Contractor Overhead:	15%	$2,036.07	
						Subtotal:	$15,609.87	
					Prime Contractor Profit:	10%	$1,560.99	
					TOTAL ACTIVITY COST:		$17,170.86	

Source of Cost Data:

Plexus 2003 rates CELRL contract
ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.

EXHIBIT C-GW 2-6

COST WORKSHEET - ALTERNATIVE GW-2

Alternative GW-2 Monitored Natural Attenuation

O&M: Monitoring, Sampling, Testing and Analysis

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/27/06

Check by: _____
Date: _____

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level D
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 2-7
COST WORKSHEET - ALTERNATIVE GW-2

Alternative GW-2 Monitored Natural Attenuation

O&M: Off-Site Treatment and Disposal

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/27/06

Check by: _____
Date: _____

Work Statement:

Purge water from the monitoring wells will need to be handled and disposed of.

Cost Analysis:

Off-Site Treatment and Disposal

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Drums for Purge Water, 55 Gallon DOT	2	EA			$50.00	$50.00	$100.00	
Transportation and Treatment	2	EA				$100.00	$200.00	
						Subtotal:	$300.00	
				Subcontractor Overhead:		25%	$75.00	
						Subtotal:	$375.00	
				Subcontractor Profit:		8%	$30.00	
						Subtotal:	$405.00	
				Prime Contractor Overhead:		15%	$60.75	
						Subtotal:	$465.75	
				Prime Contractor Profit:		10%	$46.58	
				TOTAL ACTIVITY COST:			$512.33	

Source of Cost Data:

Estimated based on previous experience at Plexus.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level D
☒	Escalation to Base Year	NA
☒	Area Cost Factor	Rough estimate
☒	Subcontractor Overhead and Profit	Calculated at 25% and 8%.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 2-8
COST WORKSHEET - ALTERNATIVE GW-2

Alternative GW-2 Monitored Natural Attenuation

O&M: Institutional Controls

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/27/06

Check by: _____
Date: _____

Work Statement:

An annual inspection of the site for compliance with institutional controls will be required under the GW 2 - MNA Alternative.

Cost Analysis:

Annual Institutional Control Costs:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Project Manager	50	HR	$40.66			$40.66	$2,033.00	ECHOS
			ECHOS costs with Localization Factor (0.98):				$1,992.34	ECHOS
Per Diem	1	DAY				$125.00	$125.00	Plexus
ODCs/equipment	1	LS				$250.00	$250.00	Plexus
						Escalation (4340/3693):	$440.70	
						Subtotal:	$2,433.04	
						Prime Contractor Overhead: 15%	$364.96	
						SUBTOTAL:	$2,797.99	
						Prime Contractor Profit: 10%	$279.80	
						TOTAL UNIT COST:	$3,077.79	

Source of Cost Data:

Plexus 2003 CELRL project rates
ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level E
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 2-9
COST WORKSHEET - ALTERNATIVE GW-2

Alternative GW-2 Monitored Natural Attenuation

Periodic: 5-Year Review Report

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/27/06

Check by: _____
Date: _____

Work Statement:

Services to prepare required five-year review reports. The five-year review is designed to summarize the previous five-years of remedial work, evaluate progress, and suggest changes in remedial approach as appropriate.

Cost Analysis:

Costs per Five-Year Review:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Senior Engineer	8	HR	$42.14			$42.14	$337.12	ECHOS
Project Engineer	56	HR	$32.94			$32.94	$1,844.64	ECHOS
Field Technician	96	HR	$26.66			$26.66	$2,559.36	ECHOS
			ECHOS costs with Localization Factor (0.98):				$4,646.30	ECHOS
Computers, etc.	0	HR				$25.00	$0.00	Plexus
Report Copying, etc.	1	LS				$1,000.00	$1,000.00	Estimate
Other Non-Itemized Direct Costs	1	LS				$250.00	$250.00	Estimate
Per Diem	8	DAY				$125.00	$1,000.00	Plexus
					Escalation (4340/3693):		$2,644.19	
						Subtotal:	$7,290.49	
				Prime Contractor Overhead:		15%	$1,093.57	
						SUBTOTAL:	$8,384.06	
				Prime Contractor Profit:		10%	$838.41	
					TOTAL UNIT COST:		$9,222.47	

Source of Cost Data:

Plexus 2003 rates CELRL contract
ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Escalated by 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 2-10
COST WORKSHEET - ALTERNATIVE GW-2

Alternative GW-2 Monitored Natural Attenuation

Periodic: Demobilization & Well Abandonment

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/27/06

Check by: _____
Date: _____

Work Statement:

Following remedial activities demobilization from the site. All of the monitoring wells on the site will need to be abondoned.

Cost Analysis:

Costs Demobilization & Well Abandonment:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Senior Engineer	8	HR	$42.14			$42.14	$337.12	ECHOS
Project Engineer	80	HR	$32.94			$32.94	$2,635.20	ECHOS
Field Technician	96	HR	$26.66			$26.66	$2,559.36	ECHOS
			ECHOS costs with Localization Factor (0.98):				$5,421.05	ECHOS
Computers, etc.	0	HR				$25.00	$0.00	Plexus
Report Copying, etc.	1	LS				$1,000.00	$1,000.00	Plexus
Other Non-Itemized Direct Costs	1	LS				$500.00	$500.00	Plexus
Per Diem	20	DAY				$125.00	$2,500.00	Plexus
					Escalation (4340/3693):		$4,700.79	
*Well Abandonment	30	EA				$500.00	$15,000.00	Estimate
						Subtotal:	$25,121.83	
					Subcontractor Overhead:	25%	$6,280.46	
						Subtotal:	$31,402.29	
					Subcontractor Profit:	8%	$2,512.18	
						Subtotal:	$33,914.47	
					Prime Contractor Overhead:	15%	$5,087.17	
						SUBTOTAL:	$39,001.64	
					Prime Contractor Profit:	10%	$3,900.16	
						TOTAL UNIT COST:	$42,901.81	

Source of Cost Data:

Plexus 2003 rates CELRL Contract
ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Plexus 2003 rates escalated to 2006 base year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	Calculated using 25 % overhead and 8% profit.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 2-11
COST WORKSHEET - ALTERNATIVE GW-2

Alternative GW-2 Monitored Natural Attenuation

Periodic: Institutional Controls

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/27/06

Check by: _____
Date: _____

Work Statement:

The Institutional Control Plan will be updated in accordance with the findings of the annual inspections for compliance.

Cost Analysis:

Annual Institutional Control Costs:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Project Engineer	96	HR	$32.92			$32.92	$3,160.32	ECHOS
			ECHOS costs with Localization Factor (0.98):				$3,097.11	ECHOS
Per Diem	0	DAY				$125.00	$0.00	Plexus
ODCs/equipment	1	LS				$1,000.00	$1,000.00	Plexus
						Subtotal:	$1,000.00	
						Escalation (4340/3693):	$1,175.20	
						Subtotal:	$4,272.31	
						Prime Contractor Overhead: 15%	$640.85	
						SUBTOTAL:	$4,913.16	
						Prime Contractor Profit: 10%	$491.32	
						TOTAL UNIT COST:	$5,404.47	

Source of Cost Data:

Plexus 2003 rates CELRL contract

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level E
☒	Escalation to Base Year	Plexus 2003 rates CELRL contract escalated to 2006 base year
☒	Area Cost Factor	NA
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

TABLE C-GW 2-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-2 MNA

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
Construction Activities		
Mobilization/ Demobilization	Bringing equipment and personnel to the site (mobilization) or removing equipment and personnel (demobilization) for purposes of constructing or installing the remedial action. Includes setup/construction and/or removal of temporary facilities and utilities. Does not include mobilization or demobilization specific to construction or installing an on-site treatment facility.	☐ Construction Equipment ☒ Submittals/Implementation Plans ___ Air Monitoring Plan ___ Construction Quality Control Plan ___ Construction Schedule ___ Environmental Protection Plan ___ Materials Handling/Transportation/Disposal Plan ___ Permits ✓ Sampling and Analysis Plan ✓ Site Health and Safety Plan ___ Site Security Plan ✓ Site Work Plan ___ Storm Water Pollution Prevention Plan ✓ Training & Medical Certifications ☐ Temporary Facilities ___ Office Trailers ___ Storage Facilities ___ Security Fencing & Signs ___ Roads and Parking ___ Decontamination Facilities ☐ Temporary Utilities ☐ Temporary Relocation of Roads/Structures/Utilities ☒ Post-Construction Submittals ___ As-Built Drawings ___ O&M Manuals ✓ QA/QC Documentation ☐ Site Security Personnel ☐ ___ ☐ ___

TABLE C-GW 2-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-2 MNA

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Construction Activities			
Monitoring, Sampling, Testing, and Analysis	Sampling, testing, on- or off-site analysis, data management, and quality assurance/quality control. Includes monitoring to evaluate remedy performance and/or compliance with regulations.		Meteorological Monitoring
			Air Monitoring and Sampling
			Radiation Monitoring
		X	Health and Safety Monitoring
		X	Personnel Protective Equipment
		X	Monitoring Wells
			Geotechnical Instrumentation
			Soil Sampling
			Sediment Sampling
			Surface Water Sampling
		X	Groundwater Sampling
			Radioactive Waste Sampling
			Asbestos Sampling
		X	Laboratory Chemical Analysis
			On-Site Chemcial Analysis
			Radioactive Waste Analysis
			Geotechnical Testing
		X	Chemical Data Management
			Soil Vapor Sampling

TABLE C-GW 2-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-2 MNA

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
Construction Activities		
Site Work	Activities to establish the infrastructure necessary for the project (i.e., site preparation). Also includes permanent site improvements and restoration of areas or site features disturbed during site remediation. Site work is generally assumed to be "clean work," meaning that there is no contact with contaminated media or materials. Excludes all site work specific to constructing or installing an on-site treatment facility.	☐ Demolition ☐ Clearing and Grubbing ☐ Earthwork ___ Stripping ___ Stockpiling ___ Excavation ___ Borrow ___ Grading ___ Backfill ___ Topsoil ☐ Roads/Parking/Curbs/Walks ☐ Vegetation and Planting ___ Topsoil ___ Seeding/Mulch/Fertilizer ___ Sodding ___ Erosion Control Fabric ___ Shrubs/Trees/Ground Cover ☐ Fencing/Signs/Gates ☐ Utilities ___ Electrical ___ Telephone/Communications ___ Water/Sewer/Gas ☐ Storm Drainage/Subdrainage ☐ Sediment Barriers ☐ _____ ☐ _____
Surface Water Collection or Containment	Collection or containment of contaminated surface water. Excludes treatment, off-site transportation, or off-site treatment/ disposal of contaminanted surface water.	☐ Pumping ☐ Draining ☐ Channel/Waterway ☐ Berm/Dike ☐ Lagoon/Basin/Tank ☐ _____ ☐ _____

TABLE C-GW 2-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-2 MNA

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
Construction Activities		
Groundwater Extraction or Containment	Extraction or containment of contaminated groundwater. Excludes treatment, off-site transportation, or off-site treatment/disposal of contaminated groundwater.	☐ Extraction/Injection Wells ___ Vertical ___ Horizontal ☐ Extraction Trench ☐ Pumps ☐ Piping ☐ Lagoon/Basin/Tank ☐ Subsurface Drains ☐ Subsurface Barrier ___ Slurry Wall ___ Grout Curtain ___ Sheet Piling ☐ _____ ☐ _____
Gas/Vapor Collection/ Control	Collection or control of off-gas or air emissions from contaminated sources.	☐ Collection Well System ☐ Collection Trench System ☐ Collection System at Lagoon Cover ☐ Fugitive Dust Control ☐ Vapor/Gas Emission Control ☐ _____ ☐ _____
Soil Excavation	Excavation and handling of contaminated soil. Excludes treatment, off-site transportation, or off-site treatment/disposal of contaminated soil.	☐ Excavation ☐ Hauling ☐ Stockpiling ☐ _____ ☐ _____
Sediment / Sludge Removal or Containment	Removal or containment of contaminated sediment or sludge. Excludes treatment, off-site transportation, or off-site treatment/disposal of contaminated sediment or sludge.	☐ Excavation ☐ Dredging ☐ Vacuuming ☐ Lagoon/Basin/Tank ☐ _____ ☐ _____

TABLE C-GW 2-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-2 MNA

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Construction Activities			
Demolition and Removal	Demolition/removal of contaminated or hazardous materials or structures. Excludes treatment, off-site transportation, or off-site disposal of contaminated or hazardous materials or structures.		Drum Removal
			Tank Removal
			Piping Removal
			Structure Removal
			Asbestos Removal
			Contaminated Paint Removal
			Ordnance Removal and Destruction
Cap or Cover	Construction of a multi-layered cap or cover over contaminated materials or media (e.g., soil, sediment, sludge) to prevent or reduce exposure and minimize infiltration of surface water and production of leachate.		Subgrade Preparation
			Gas Collection Layer
			Low Permeability Clay Layer
			Bentonite
			Geosynthetic Clay Layer
			Geotextile
			Geomembrane
			Granular Drainage Layer
			Geonet
			Waste Placement (Cut/Fill)
			Protective Soil Layer
			Asphalt/Concrete Pavement
			Topsoil
			Erosion Control Fabric
			Seeding/Mulch/Fertilizer
On-Site Treatment	Construction or installation of a complete and usable on-site facility for treatment of contaminated media (e.g., soil, solids, sediment, sludge, surface water, groundwater), including in-situ and ex-situ techniques. Includes all mobilization and site work required for the treatment facility.		Mobilization/Demobilization
			Site Work
			Structures
			Process Equipment and Appurtenances
			Non-Process Equipment
			Startup and Testing
			Equipment Upgrade/Replacement

TABLE C-GW 2-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-2 MNA

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
Construction Activities		
Off-Site Treatment / Disposal	Final placement of contaminated media, material, or treatment residuals at off-site commercial facilities, such as solid or hazardous waste landills and incinerators, that charge fees to accept waste based on certain criteria.	[X] Material Handling/Loading [X] Transportation to Off-Site Facility [X] Treatment/Disposal Fees [ ] [ ]
Contingency	Costs added to cover unknown, unforeseen circumstances, or unanticipated conditions related to construction or installation of the remedial action.	[X] Scope Contingency [X] Bid Contingency
Project Management	Services to support construction or installation of remedial action not specific to remedial design or construction management.	[X] Planning [X] Community Relations [X] Bid/Contract Administration [X] Cost and Performance Reporting [X] Permitting [X] Legal [X] Construction Complete Report [ ] [ ]
Remedial Design	Services to design the remedial action, including pre-design activities to collect the necessary data.	[X] Field Data Collection and Analysis [ ] Design Survey [ ] Treatability Study ___ Bench-Scale ___ Pilot-Scale ___ Field-Scale [ ] Preliminary/Intermediate/Final Design ___ Design Analysis ___ Plans & Specifications ___ Construction Cost Estimate ___ Construction Schedule [ ] [ ]

TABLE C-GW 2-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-2 MNA

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Construction Activities			
Construction Management	Services to manage construction or installation of remedial action, excluding any similar services provided as part of construction activities.	☐	Submittal Review
		☐	Change Order Review
		☐	Design Modification
		☐	Construction Observation
		☐	Construction Survey
		☐	Construction Schedule Tracking
		☐	QA/QC Documentation
		☐	O&M Manual
		☐	Record Drawings
		☐	
		☐	
Institutional Controls	Non-engineering (i.e., administrative or legal) measures to reduce or minimize potential for exposure to site contamination or hazards (i.e., limit site access or restrict site access).	☒	Institutional Control Plans
		☒	Restrictive Covenants
		☒	Zoning
		☒	Property Easements
		☒	Deed Notice
		☒	Advisories
		☒	Groundwater Use Restrictions
		☒	Site Information Database
		☐	
		☐	

TABLE C-GW 2-2
O&M COST ELEMENT CHECKLIST - ALTERNATIVE GW-2 MNA

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
O&M Activities			
Monitoring, Sampling, Testing, and Analysis[1]	Sampling, testing, on- or off-site analysis, data management, and quality assurance/quality control during the O&M period. Can include monitoring to evaluate remedy performance/compliance with regulations, or monitoring to track migration of contaminant plume.		Meteorological Monitoring
			Air Monitoring and Sampling
			Radiation Monitoring
		X	Health and Safety Monitoring
		X	Personnel Protective Equipment
		X	Monitoring Wells
			Soil Sampling
			Sediment Sampling
			Surface Water Sampling
		X	Groundwater Sampling
			Process Water Sampling
			Process Air Sampling
		X	Laboratory Chemical Analysis
		X	On-Site Chemcial Analysis
		X	Chemical Data Management
Extraction Containment, or Treatment Systems[2]	Operation and maintenance of on-sitesystemsto extract, contain, or treat contaminated media (e.g., soil, sediment, sludge, surface water, or groundwater).		Operations Labor
			Maintenance Labor
			Equipment Upgrade/Replacement Repair
			Spare Parts
			Equipment Ownership/Rental/Lease
			Consumable Supplies
			Bulk Chemicals
			Raw/Process Materials
			Utilities

[1] Site Monitoring, performance monitoring, or compliance monitoring.

[2] Specify extraction, containment, or treatment system. Examples include groundwater extraction system, engineered cap or cover, soil vapor extraction system, groundwater treatment facility, etc.
More than one system may be associated with an individual alternative.

TABLE C-GW 2-2
O&M COST ELEMENT CHECKLIST - ALTERNATIVE GW-2 MNA

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
O&M Activities		
Off-Site Treatment / Disposal	Treatment and/or disposal of wastes generated during operations and maintenance (e.g., on-site treatment residuals, monitoring wastes) at off-site commercial facilities, such as solid or hazardous waste landfills and incinerators.	[X] Material Handling/Loading [X] Transportation to Off-Site Facility [X] Treatment/Disposal Fees [ ] [ ]
Contingency	Costs to cover unknowns, unforeseen circumstances, or unanticipated conditions associated with annual O&M of the remedial action.	[X] Scope Contingency [X] Bid Contingency
Professional/Technical Services		
Project Management	Services to manage O&M activities not specific to technical support listed below.	[X] Planning [ ] Community Relations [ ] Cost and Performance Reporting [ ] Permitting [ ] Legal [ ] [ ]
Technical Support	Services to monitor, evaluate, and report progress of remedial actions.	[ ] O&M Manual Updates [ ] O&M Oversight [X] Progress Reports [ ] [ ]
Institutional Controls	Annual update or maintenance of non-engineering measures to reduce or minimize potential for exposure to site contaminants or hazards.	[X] Institutional Control Plans [X] Restrictive Covenants [X] Zoning [X] Property Easements [X] Deed Notice [X] Advisories [X] Groundwater Use Restrictions [X] Site Information Database [ ] [ ]

TABLE C-GW 2-3
PERIODIC COST ELEMENT CHECKLIST - ALTERNATIVE GW-2 MNA

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Construction/O&M Activities			
Remedy Failure or Replacement	Construction activities to replace an installation remedy or key components of the remedy.	☐	Mobilization/Demobilization
		☐	Site Work
		☐	Structures
		☐	Process Equipment and Appurtenances
		☐	Non-Process Equipment
		☐	Startup and Testing
		☐	
		☐	
Demobilization of On-Site Extraction, Containment, or Treatment Systems[1]	Construction activity to dismantle or take down extraction, containment, or treatment facility or equipment upon completion of remedial action.	☐	Demolition and Removal
		☒	Well Abondonment
		☐	
		☐	
Contingency	Costs to cover unknowns, unforeseen circumstances, or unanticipated conditions associated with Construction /O&M activities.	☒	Scope Contingency
		☒	Bid Contingency

[1] Specify extraction, containment, or treatment system. Examples include groundwater extraction systems, soil vapor extraction system, groundwater treatment facility, etc. More than one system may be associated with an individual alternative.

Professional/Technical Services			
Five Year Review	Services to prepare five-year review reports (if hazardous substances, pollutants, or contaminants remain on-site above levels that allow for unrestricted use and unlimited exposure.	☒	Site Visit
		☒	Field Data Collection
		☒	Data Review and Analysis
		☒	Report Preparation
		☐	
		☐	

TABLE C-GW 2-3
PERIODIC COST ELEMENT CHECKLIST - ALTERNATIVE GW-2 MNA

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Professional/Technical Services (cont.)			
Groundwater Performance Optimization Study	Services to analyze and optimize on-going groundwater pump and treat systems.		Site Visit
			Field Data Collection
			Data Review and Analysis
			Report Preparation
Remedial Action Report	Services to prepare remedial action report upon completion of remedial action.	X	Site Visit
		X	Field Data Collection
		X	Data Review and Analysis
		X	Report Preparation
Institutional Controls	Periodic update or maintenance of non-engineering measures to reduce or minimize potential for exposure to site contaminants or hazards.	X	Institutional Control Plans
		X	Restrictive Covenants
		X	Zoning
		X	Property Easements
		X	Deed Notice
		X	Advisories
		X	Groundwater Use Restrictions
		X	Site Information Database

Appendix C - Alternative GW 3
In-Situ Treatment

Exhibits

Exhibit C-GW 3-1 – Cost Estimate Summary – Alternative GW 3
Exhibit C-GW 3-2 – Cost Worksheet GW 3 – Capital Cost Sub-Element – Construction Activities: Mobilization/Demobilization
Exhibit C-GW 3-3 – Cost Worksheet GW 3 – Capital Cost Sub-Element – Construction Activities: System Installation
Exhibit C-GW 3-4 – Cost Worksheet GW 3 – Capital Cost Sub-Element – Institutional Controls
Exhibit C-GW 3-5 – Cost Worksheet GW 3 – O&M Cost Sub-Element – Soluble Substrate Injection
Exhibit C-GW 3-6 – Cost Worksheet GW 3 – O&M Cost Sub-Element – Monitoring, Sampling, Testing, and Analysis
Exhibit C-GW 3-7 – Cost Worksheet GW 3 – O&M Cost Sub-Element – Off-Site Treatment and Disposal
Exhibit C-GW 3-8 – Cost Worksheet GW 3 – O&M Cost Sub-Element – Institutional Controls
Exhibit C-GW 3-9 – Cost Worksheet GW 3 – Periodic Cost Sub-Element – Five-Year Review
Exhibit C-GW 3-10 – Cost Worksheet GW 3 – Periodic Cost Sub-Element – Demobilization & Well Abandonment
Exhibit C-GW 3-11 – Cost Worksheet GW 3 – Periodic Cost Sub-Element – Institutional Controls

Tables

Table C-GW 3-1 – Capital Cost Element Checklist – Alternative GW 3 – In-Situ Treatment
Table C-GW 3-2 – O&M Cost Element Checklist – Alternative GW 3 – In-Situ Treatment
Table C-GW 3-3 – Periodic Cost Element Checklist – Alternative GW 3 – In-Situ Treatment

EXHIBIT C-GW 3-1
COST ESTIMATE SUMMARY - ALTERNATIVE GW-3

Alternative GW-3
In-Situ Treatment

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006
Date: 07-18-06

Description: Alternative GW-3 In-Situ Treatment consists of injecting a soluble carbon source into the contaminant plume to increase the activity of the anaerobic bacteria in the groundwater and degrade the VOCs in the groundwater. There are 3 annaul injections of substrate anticipated and 5 years of quarterly monitoring to gauge progress of the remediation.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Construction Activities					
Mobilization/Demobilization	1	LS	$9,529	$9,529	Planning Doc's and submittals
System Installation	1	LS	$41,784	$41,784	Wells & process equipment
SUBTOTAL				$51,313	
SUBTOTAL				$51,313	
Contingency	30%			$15,394	10% scope + 20% bid
SUBTOTAL				$66,707	
Project Management	5%			$2,566	
Remedial Design	8%			$4,105	
Construction Management	6%			$3,079	
Institutional Controls					
Institutional Controls Plan	1	EA	$12,459	$12,459	
SUBTOTAL				$22,209	
TOTAL CAPITAL COST				$88,916	

EXHIBIT C-GW 3-1
COST ESTIMATE SUMMARY - ALTERNATIVE GW-3

Alternative GW-3
In-Situ Treatment

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006
Date: 07-18-06

Description: Alternative GW-3 In-Situ Treatment consists of injecting a soluble carbon source into the contaminant plume to increase the activity of the anaerobic bacteria in the groundwater and degrade the VOCs in the groundwater. There are 3 annaul injections of substrate anticipated and 5 years of quarterly monitoring to gauge progress of the remediation.

O&M COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
System O&M					
Soluble Substrate Injection	1	EA	$16,913	$16,913	Annual injection
Contingency	30%			$5,074	10% scope + 20% bid
SUBTOTAL				$21,987	
Project Management	5%			$1,099	
Technical Support	10%			$2,199	
SUBTOTAL				$3,298	
TOTAL ANNUAL O&M COST				$25,285	Cost for annual injection
SUBTOTAL FOR THREE YEARS OF INJECTION (X 3)				$75,856	
Site Monitoring					
Groundwater Sampling & Analysis	1	YR	$69,897	$69,897	4 Quarters - Sample 10 wells/qtr VOCs, & WQ
Off Site Treatment & Disposal	1	YR	$7,817	$7,817	
SUBTOTAL				$77,714	
Contingency	30%			$23,314	10% scope + 20% bid
SUBTOTAL				$101,028	
Project Management	5%			$5,051	
Technical Support	10%			$10,103	
Institutional Controls	1	LS	$3,078	$3,078	
SUBTOTAL				$18,232	
TOTAL ANNUAL O&M COST MONITORING				$119,260	Annual Monitoring Costs

EXHIBIT C-GW 3-1
COST ESTIMATE SUMMARY - ALTERNATIVE GW-3

Alternative GW-3
In-Situ Treatment

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006
Date: 07-18-06

Description: Alternative GW-3 In-Situ Treatment consists of injecting a soluble carbon source into the contaminant plume to increase the activity of the anaerobic bacteria in the groundwater and degrade the VOCs in the groundwater. There are 3 annaul injections of substrate anticipated and 5 years of quarterly monitoring to gauge progress of the remediation.

PERIODIC COSTS:

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
Five Year Review Report	5	1	EA	$9,222	$9,222	1 report at end of year 5
Demobilization and Well Abandonment	5	1	EA	$49,612	$49,612	Abandon 40 wells
Update Institutional Control Plan	5	1	EA	$2,800	$6,502	Update Plan
SUBTOTAL					$65,336	
Contingency (% of Sum)		30%			$19,601	% of construction activities
Project Mgt. (% of Sum + Cont.)		5%			$3,267	% of construction + contingency
TOTAL PERIODIC COST YEAR 5					$88,204	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
Capital Cost	1	$88,916	$88,916	0.935	$83,136	System installation
O&M Injection Cost	1-3	$75,856	$25,285	2.624	$66,348	3 Annual Injections
O&M Monitoring Cost	1-5	$596,300	$119,260	4.100	$488,966	5 Years of monitoring
Periodic Cost	5	$88,204	$88,204	0.7130	$62,889	5 Year Review/Well Abondonment
		$849,276			$701,340	
TOTAL PRESENT VALUE OF ALTERNATIVE					$701,340	

EXHIBIT C-GW 3-2
COST WORKSHEET - ALTERNATIVE GW-3

Alternative GW-3 In-Situ Treatment
Capital Cost Sub-Element
Construction Activity: Mobilization/Demobilization

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/27/06

Check by: _____
Date: _____

Work Statement:

The In-Situ alternative will require some planning documents and submittals.

Cost Analysis:

Mobilization/Demobilization

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Plans								
Senior Engineer	48	HR	$42.14			$42.14	$2,022.72	ECHOS
Field Technician	100	HR	$26.66			$26.66	$2,666.00	ECHOS
			ECHOS costs with Localization Factor (0.98):				$4,594.95	ECHOS
Computer, etc.	0	HR		$25.00		$25.00	$0.00	Plexus
Report Copying, etc.	1	LS	$1,000.00	$500.00	$500.00	$2,000.00	$2,000.00	Estimate
Other Non-Itemization Direct Cost	1	LS		$250.00	$250.00	$500.00	$500.00	Estimate
						Escalation (4340/3693):	$2,937.99	
						Subtotal:	$7,532.94	
						Prime Contractor Overhead: 15%	$1,129.94	
						Subtotal:	$8,662.88	
						Prime Contractor Profit: 10%	$866.29	
						TOTAL ACTIVITY COST:	$9,529.16	

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
Estimate based on experience

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	NA
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	ECHOS localization factor 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 3-3
COST WORKSHEET - ALTERNATIVE GW-3

Alternative GW-3 In-Situ Treatment
Capital Cost Sub-Element
Construction Activity: System Installation

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/27/06

Check by: _____
Date: _____

Work Statement:

Additional injection points as needed will be installed, assume ten. A tank and injection system will be assembled for batch injection of molasses solution.

Cost Analysis:

On-Site Treatment

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Mob/Demob								
Driller	1	LS				$1,000.00	$1,000.00	ESTCP
SiteWork								
Well Installation (10 ea 30-ft wells)	300	FT				$35.00	$10,500.00	ESTCP
Driller	100	HR	$75.00			$75.00	$7,500.00	ESTCP
Process Equipment and Appurtenances								
Batch injection equipment.	1	EA				$5,000.00	$5,000.00	ESTCP
						Subtotal:	$24,000.00	
						Escalation (4340/4168):	$24,990.40	
					Subcontractor Overhead:	25%	$6,247.60	
						Subtotal:	$6,247.60	
					Subcontractor Profit:	8%	$499.81	
						Subtotal:	$6,747.41	
						Subtotal:	$37,985.41	
					Prime Contractor Overhead:	15%	$5,697.81	
						Subtotal:	$43,683.22	
					Prime Contractor Profit:	10%	$3,798.54	
					TOTAL ACTIVITY COST:		$41,783.95	

Source of Cost Data:

Environmental Security Technology Certification Program (ESTCP). 2005. Cost Estimating Tool for Enhanced Anaerobic Bioremediation of Chlorinated Solvents, Version 3.1. April.
ESTCP. 2004. Principles and Practices of Enhanced Anaerobic Bioremediation of Chlorinated Solvents. August.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	NA
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	NA
☒	Subcontractor Overhead and Profit	25 % and 8 %
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 3-4
COST WORKSHEET - ALTERNATIVE GW-3

Alternative GW-3 In-Situ Treatment
Capital Cost Sub-Element
Institutional Controls

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/30/06

Check by: _____
Date: _____

Work Statement:

Institutional Control include preparing a plan to present the process of developing institutional controls and putting them into action. The Institutional Controls on the site could include restrictive covenants, zoning restrictions instituted through Madison County, property easements if needed, deed notices, advisories, and groundwater use restrictions. In addition, the site information database is to be updated and maintained. A similar cost element will be included with the other media remedial costs, duplication of costs will have to be resolved during detailed project cost analysis.

Cost Analysis:

Costs for Institutional Controls:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Environmental Attorney	40	HR	$50.00			$50.00	$2,000.00	Estimate
Senior Engineer	40	HR	$42.14			$42.14	$1,685.60	ECHOS
Secretarial/Administrative	32	HR	$15.86			$15.86	$507.52	ECHOS
			ECHOS costs with Localization Factor (0.98):				$2,149.26	ECHOS
Computers, etc.	0	HR				$25.00	$0.00	Plexus
Report Copying, etc.	1	LS				$5,000.00	$5,000.00	Estimate
Other Non-Itemized Direct Costs	1	LS				$200.00	$200.00	Estimate
Per Diem	4	DAY				$125.00	$500.00	Estimate
						Subtotal:	$9,849.26	
					Prime Contractor Overhead:	15%	$1,477.39	
						SUBTOTAL:	$11,326.65	
					Prime Contractor Profit:	10%	$1,132.66	
						TOTAL UNIT COST:	$12,459.31	

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
Estimate based on experience
An attorney has been added to assist the contractor and the Army in negotiation with the City and State.
The hours for Engineering Support have been increased as well to cover meetings and negotiations.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Costs from 2003 CELRL rates, base year is 2006.
☒	Area Cost Factor	ECHOS 2006 localization factor
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 3-5
COST WORKSHEET - ALTERNATIVE GW-3

Alternative GW-3 In-Situ Treatment

O&M: Soluble Substrate Injection

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/30/06

Check by: _____
Date: _____

Work Statement:

A solution of Soluble substrate (10% molasses) will be injected into 20 wells on site. The goal is to inject 750 gallons of solution at 5 gallons per minute into each well. The injection will take place annually unless on site testing indicates a more or less frequent injection will optomize degradation.

Cost Analysis:

Soluble Substrate Injection

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Molassess substratate	12500	LBS			$0.50	$0.50	$6,250.00	ESTCP
					Escalation (4340/4168):		$6,507.92	ESTCP
Labor for injection	80	HRS	$26.66			$26.66	$2,132.80	ECHOS
Truck	14	DAY		$74.67		$74.67	$1,045.38	ECHOS
Mileage	700	MI			$0.41	$0.41	$287.00	ECHOS
			ECHOS costs with Localization Factor (0.98):				$3,395.88	ECHOS
						Subtotal:	$9,903.79	
					Subcontractor Overhead:	25%	$2,475.95	
						Subtotal:	$12,379.74	
					Subcontractor Profit:	8%	$990.38	
						Subtotal:	$13,370.12	
					Prime Contractor Overhead:	15%	$2,005.52	
						Subtotal:	$15,375.64	
					Prime Contractor Profit:	10%	$1,537.56	
					TOTAL ACTIVITY COST:		$16,913.20	

Source of Cost Data:

Environmental Security Technology Certification Program (ESTCP). 2005. Cost Estimating Tool for Enhanced Anaerobic Bioremediation of Chlorinated Solvents, Version 3.1. April.
ESTCP. 2004. Principles and Practices of Enhanced Anaerobic Bioremediation of Chlorinated Solvents. August.
ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level D
☒	Escalation to Base Year	Base year is 2006.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	Calculated at 25% and 8%.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 3-6

COST WORKSHEET - ALTERNATIVE GW-3

Alternative GW-3 In-Situ Treatment

O&M: Monitoring, Sampling, Testing and Analysis

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/30/06

Check by: _____
Date: _____

Work Statement:

To monitor the progress of the enhanced bioremediation quarterly groundwater monitoring will be conducted. On-site analytical techniques will be used for some parameters and samples will be shipped to off-site laboratories for other parameters.

Cost Analysis:

Monitoring, Sampling, Testing, and Analysis:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
On-Site Analysis (4 quarters)								
Fe^{+2} Hack Kit	1	EA				$47.30	$47.30	Hach
CO_2 Hack Kit	1	EA				$30.60	$30.60	Hach
pH, temperature, conductivity, O2, and ORP using field monitor with flow thru cell, rental	4	WEEK				$300.00	$1,200.00	Pine
Laboratory Analysis (4 quarters)								
VOCs	55	EA				$130.00	$7,150.00	STL
TAL metals filtered	0	EA				$150.00	$0.00	STL
TAL metals unfiltered	0	EA				$150.00	$0.00	STL
Hexavalent chromium	0	EA				$30.00	$0.00	STL
TOC	50	EA				$45.00	$2,250.00	STL
Filters, 0.45 micron field water filters.	0	EA				$11.75	$0.00	Pine
Shipping	4	LS				$250.00	$1,000.00	Estimate
Incidentials	4	LS				$250.00	$1,000.00	Estimate
PID Rental	4	WEEK				$150.00	$600.00	Pine
Drums	15	EA				$50.00	$750.00	Estimate
						Subtotal:	$14,027.90	
Monitoring Well Sampling	40	WELLS				$300.00	$12,000.00	Estimate
Data Validation	4	LS				$3,000.00	$12,000.00	Estimate
Per Diem	16	DAY				$125.00	$2,000.00	Estimate
						Escalation (4340/3693):	$30,555.10	
Report Preparation								
Senior Engineer	0	HR	$42.14			$42.14	$0.00	ECHOS
Project Engineer	64	HR	$32.94			$32.94	$2,108.16	ECHOS
Field Technician	160	HR	$26.66			$26.66	$4,265.60	ECHOS
			ECHOS costs with Localization Factor (0.98):				$6,246.28	ECHOS
Computers, etc.	0	HR				$25.00	$0.00	Plexus
Report Copying, etc.	4	LS				$1,000.00	$4,000.00	Estimate
Groundwater Modeling	0	LS				$20,000.00	$0.00	Estimate
						Escalation (4340/3693):	$4,425.25	
						Subtotal:	$55,254.54	
					Prime Contractor Overhead:	15%	$8,288.18	
						Subtotal:	$63,542.72	
					Prime Contractor Profit:	10%	$6,354.27	
					TOTAL ACTIVITY COST:		$69,896.99	

EXHIBIT C-GW 3-6

COST WORKSHEET - ALTERNATIVE GW-3

Alternative GW-3 In-Situ Treatment

O&M: Monitoring, Sampling, Testing and Analysis

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/30/06

Check by: _____
Date: _____

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
Plexus 2003 rates CELRL contract

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level D
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 3-7
COST WORKSHEET - ALTERNATIVE GW-3

Alternative GW-3 In-Situ Treatment

O&M: Off-Site Treatment and Disposal

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/30/06

Check by: _____
Date: _____

Work Statement:

Purge water from the monitoring wells will need to be handled and disposed of.

Cost Analysis:

Off-Site Treatment and Disposal

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Drums for Purge Water, 55 Gallon DOT	15	EA			$95.00	$95.00	$1,425.00	ECHOS
Transportation/Treatment/Disposal	15	EA				$216.38	$3,245.70	ECHOS
					ECHOS costs with Localization Factor (0.98):		$4,577.29	
					Subcontractor Overhead:	25%	$1,144.32	
						Subtotal:	$5,721.61	
					Subcontractor Profit:	8%	$457.73	
						Subtotal:	$6,179.34	
					Prime Contractor Overhead:	15%	$926.90	
						Subtotal:	$7,106.24	
					Prime Contractor Profit:	10%	$710.62	
					TOTAL ACTIVITY COST:		$7,816.86	

Source of Cost Data:

Estimated based on previous experience at Plexus.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level D
☒	Escalation to Base Year	NA
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	Calculated at 25% and 8%.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 3-8
COST WORKSHEET - ALTERNATIVE GW-3

Alternative GW-3 In-Situ Treatment

O&M: Institutional Controls

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/30/06

Check by: _____
Date: _____

Work Statement:

An annual inspection of the site for compliance with institutional controls will be required under the GW 3 - In-Situ Treatment Alternative.

Cost Analysis:

Annual Institutional Control Costs:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Project Manager	50	HR	$40.66			$40.66	$2,033.00	ECHOS
			ECHOS costs with Localization Factor (0.98):				$1,992.34	ECHOS
Per Diem	1	DAY				$125.00	$125.00	Plexus
ODCs/equipment	1	LS				$250.00	$250.00	Plexus
						Escalation (4340/3693):	$440.70	
						Subtotal:	$2,433.04	
					Prime Contractor Overhead:	15%	$364.96	
						SUBTOTAL:	$2,797.99	
					Prime Contractor Profit:	10%	$279.80	
						TOTAL UNIT COST:	$3,077.79	

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
Plexus 2003 rates CELRL contract

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level E
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 3-9
COST WORKSHEET - ALTERNATIVE GW-3

Alternative GW-3 In-Situ Treatment

Periodic: 5-Year Review Report

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/30/06

Check by: _____
Date: _____

Work Statement:

Services to prepare required five-year review reports. The five-year review is designed to summarize the previous five-years of remedial work, evaluate progress, and suggest changes in remedial approach as appropriate.

Cost Analysis:

Costs per Five-Year Review:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Senior Engineer	8	HR	$42.14			$42.14	$337.12	ECHOS
Project Engineer	56	HR	$32.94			$32.94	$1,844.64	ECHOS
Field Technician	96	HR	$26.66			$26.66	$2,559.36	ECHOS
			ECHOS costs with Localization Factor (0.98):				$4,646.30	ECHOS
Computers, etc.	0	HR				$25.00	$0.00	Plexus
Report Copying, etc.	1	LS				$1,000.00	$1,000.00	Estimate
Other Non-Itemized Direct Costs	1	LS				$250.00	$250.00	Estimate
Per Diem	8	DAY				$125.00	$1,000.00	Plexus
					Escalation (4340/3693):		$2,644.19	
						Subtotal:	$7,290.49	
				Prime Contractor Overhead:		15%	$1,093.57	
						SUBTOTAL:	$8,384.06	
				Prime Contractor Profit:		10%	$838.41	
					TOTAL UNIT COST:		$9,222.47	

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
Plexus 2003 rates CELRL contract

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 3-10
COST WORKSHEET - ALTERNATIVE GW-3

Alternative GW-3 In-Situ Treatment

Periodic: Demobilization & Well Abandonment

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/30/06

Check by: _____
Date: _____

Work Statement:

Following remedial activities demobilization from the site. All of the monitoring wells on the site will need to be abondoned.

Cost Analysis:

Costs Demobilization & Well Abandonment:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Senior Engineer	8	HR	$42.14			$42.14	$337.12	ECHOS
Project Engineer	80	HR	$32.94			$32.94	$2,635.20	ECHOS
Field Technician	100	HR	$26.66			$26.66	$2,666.00	ECHOS
			ECHOS costs with Localization Factor (0.98):				$5,525.55	ECHOS
Computers, etc.	0	HR				$25.00	$0.00	Plexus
Report Copying, etc.	1	LS				$1,000.00	$1,000.00	Plexus
Other Non-Itemized Direct Costs	1	LS				$500.00	$500.00	Plexus
Per Diem	12	DAY				$125.00	$1,500.00	Plexus
					Escalation (4340/3693):		$3,525.59	
*Well Abandonment	40	EA				$500.00	$20,000.00	Estimate
						Subtotal:	$29,051.14	
					Subcontractor Overhead:	25%	$7,262.79	
						Subtotal:	$36,313.93	
					Subcontractor Profit:	8%	$2,905.11	
						Subtotal:	$39,219.04	
					Prime Contractor Overhead:	15%	$5,882.86	
						SUBTOTAL:	$45,101.90	
					Prime Contractor Profit:	10%	$4,510.19	
						TOTAL UNIT COST:	$49,612.09	

Source of Cost Data:

Plexus 2003 rates CELRL Contract
ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	Calculated using 25 % overhead and 8% profit.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 3-11
COST WORKSHEET - ALTERNATIVE GW-3

Alternative GW-3 In-Situ Treatment

Periodic: Institutional Controls

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/30/06

Check by: _____
Date: _____

Work Statement:

The Institutional Control Plan will be updated in accordance with the findings of the annual inspections for compliance.

Cost Analysis:

Annual Institutional Control Costs:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Senior Engineer	96	HR	$42.14			$42.14	$4,045.44	ECHOS
			ECHOS costs with Localization Factor (0.98):				$3,964.53	ECHOS
Per Diem	0	DAY				$125.00	$0.00	Plexus
ODCs/equipment	1	LS				$1,000.00	$1,000.00	Plexus
						Escalation (4340/3693):	$1,175.20	
						Subtotal:	$5,139.73	
						Prime Contractor Overhead: 15%	$770.96	
						SUBTOTAL:	$5,910.69	
						Prime Contractor Profit: 10%	$591.07	
						TOTAL UNIT COST:	$6,501.76	

Source of Cost Data:

Plexus 2003 rates CELRL contract
ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level E
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

TABLE C-GW 3-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-3 IN-SITU TREATMENT

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
Construction Activities		
Mobilization/ Demobilization	Bringing equipment and personnel to the site (mobilization) or removing equipment and personnel (demobilization) for purposes of constructing or installing the remedial action. Includes setup/construction and/or removal of temporary facilities and utilities. Does not include mobilization or demobilization specific to construction or installing an on-site treatment facility.	☐ Construction Equipment ☒ Submittals/Implementation Plans ___ Air Monitoring Plan ___ Construction Quality Control Plan ___ Construction Schedule ___ Environmental Protection Plan ✓ Materials Handling/Transportation/Disposal Plan ✓ Permits ✓ Sampling and Analysis Plan ✓ Site Health and Safety Plan ___ Site Security Plan ✓ Site Work Plan ___ Storm Water Pollution Prevention Plan ✓ Training & Medical Certifications ☐ Temporary Facilities ___ Office Trailers ___ Storage Facilities ___ Security Fencing & Signs ___ Roads and Parking ___ Decontamination Facilities ☐ Temporary Utilities ☐ Temporary Relocation of Roads/Structures/Utilities ☒ Post-Construction Submittals ✓ As-Built Drawings ___ O&M Manuals ✓ QA/QC Documentation ☐ Site Security Personnel ☐ ___ ☐ ___

TABLE C-GW 3-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-3 IN-SITU TREATMENT

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Construction Activities			
Monitoring, Sampling, Testing, and Analysis	Sampling, testing, on- or off-site analysis, data management, and quality assurance/quality control. Includes monitoring to evaluate remedy performance and/or compliance with regulations.		Meteorological Monitoring
			Air Monitoring and Sampling
			Radiation Monitoring
			Health and Safety Monitoring
			Personnel Protective Equipment
			Monitoring Wells
			Geotechnical Instrumentation
			Soil Sampling
			Sediment Sampling
			Surface Water Sampling
			Groundwater Sampling
			Radioactive Waste Sampling
			Asbestos Sampling
			Laboratory Chemical Analysis
			On-Site Chemcial Analysis
			Radioactive Waste Analysis
			Geotechnical Testing
			Chemical Data Management
			Soil Vapor Sampling

TABLE C-GW 3-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-3 IN-SITU TREATMENT

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
Construction Activities		
Site Work	Activities to establish the infrastructure necessary for the project (i.e., site preparation). Also includes permanent site improvements and restoration of areas or site features disturbed during site remediation. Site work is generally assumed to be "clean work," meaning that there is no contact with contaminated media or materials. Excludes all site work specific to constructing or installing an on-site treatment facility.	☐ Demolition ☐ Clearing and Grubbing ☐ Earthwork ___ Stripping ___ Stockpiling ___ Excavation ___ Borrow ___ Grading ___ Backfill ___ Topsoil ☐ Roads/Parking/Curbs/Walks ☐ Vegetation and Planting ___ Topsoil ___ Seeding/Mulch/Fertilizer ___ Sodding ___ Erosion Control Fabric ___ Shrubs/Trees/Ground Cover ☐ Fencing/Signs/Gates ☐ Utilities ___ Electrical ___ Telephone/Communications ___ Water/Sewer/Gas ☐ Storm Drainage/Subdrainage ☐ Sediment Barriers ☐ _____ ☐ _____
Surface Water Collection or Containment	Collection or containment of contaminated surface water. Excludes treatment, off-site transportation, or off-site treatment/ disposal of contaminanted surface water.	☐ Pumping ☐ Draining ☐ Channel/Waterway ☐ Berm/Dike ☐ Lagoon/Basin/Tank ☐ _____ ☐ _____

TABLE C-GW 3-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-3 IN-SITU TREATMENT

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
Construction Activities		
Groundwater Extraction or Containment	Extraction or containment of contaminated groundwater. Excludes treatment, off-site transportation, or off-site treatment/disposal of contaminated groundwater.	☐ Extraction/Injection Wells ___ Vertical ___ Horizontal ☐ Extraction Trench ☐ Pumps ☐ Piping ☐ Lagoon/Basin/Tank ☐ Subsurface Drains ☐ Subsurface Barrier ___ Slurry Wall ___ Grout Curtain ___ Sheet Piling ☐ _____ ☐ _____
Gas/Vapor Collection/ Control	Collection or control of off-gas or air emissions from contaminated sources.	☐ Collection Well System ☐ Collection Trench System ☐ Collection System at Lagoon Cover ☐ Fugitive Dust Control ☐ Vapor/Gas Emission Control ☐ _____ ☐ _____
Soil Excavation	Excavation and handling of contaminated soil. Excludes treatment, off-site transportation, or off-site treatment/disposal of contaminated soil.	☐ Excavation ☐ Hauling ☐ Stockpiling ☐ _____ ☐ _____
Sediment / Sludge Removal or Containment	Removal or containment of contaminated sediment or sludge. Excludes treatment, off-site transportation, or off-site treatment/disposal of contaminated sediment or sludge.	☐ Excavation ☐ Dredging ☐ Vacuuming ☐ Lagoon/Basin/Tank ☐ _____ ☐ _____

TABLE C-GW 3-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-3 IN-SITU TREATMENT

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Construction Activities			
Demolition and Removal	Demolition/removal of contaminated or hazardous materials or structures. Excludes treatment, off-site transportation, or off-site disposal of contaminated or hazardous materials or structures.	☐	Drum Removal
		☐	Tank Removal
		☐	Piping Removal
		☐	Structure Removal
		☐	Asbestos Removal
		☐	Contaminated Paint Removal
		☐	Ordnance Removal and Destruction
		☐	
		☐	
Cap or Cover	Construction of a multi-layered cap or cover over contaminated materials or media (e.g., soil, sediment, sludge) to prevent or reduce exposure and minimize infiltration of surface water and production of leachate.	☐	Subgrade Preparation
		☐	Gas Collection Layer
		☐	Low Permeability Clay Layer
		☐	Bentonite
		☐	Geosynthetic Clay Layer
		☐	Geotextile
		☐	Geomembrane
		☐	Granular Drainage Layer
		☐	Geonet
		☐	Waste Placement (Cut/Fill)
		☐	Protective Soil Layer
		☐	Asphalt/Concrete Pavement
		☐	Topsoil
		☐	Erosion Control Fabric
		☐	Seeding/Mulch/Fertilizer
		☐	
		☐	
On-Site Treatment	Construction or installation of a complete and usable on-site facility for treatment of contaminated media (e.g., soil, solids, sediment, sludge, surface water, groundwater), including in-situ and ex-situ techniques. Includes all mobilization and site work required for the treatment facility.	☒	Mobilization/Demobilization
		☒	Site Work
		☐	Structures
		☒	Process Equipment and Appurtenances
		☒	Non-Process Equipment
		☒	Startup and Testing
		☒	Equipment Upgrade/Replacement
		☐	
		☐	

TABLE C-GW 3-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-3 IN-SITU TREATMENT

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
Construction Activities		
Off-Site Treatment / Disposal	Final placement of contaminated media, material, or treatment residuals at off-site commercial facilities, such as solid or hazardous waste landills and incinerators, that charge fees to accept waste based on certain criteria.	☐ Material Handling/Loading ☐ Transportation to Off-Site Facility ☐ Treatment/Disposal Fees ☐ ☐
Contingency	Costs added to cover unknown, unforeseen circumstances, or unanticipated conditions related to construction or installation of the remedial action.	☒ Scope Contingency ☒ Bid Contingency
Project Management	Services to support construction or installation of remedial action not specific to remedial design or construction management.	☒ Planning ☒ Community Relations ☒ Bid/Contract Administration ☒ Cost and Performance Reporting ☒ Permitting ☒ Legal ☒ Construction Complete Report ☐ ☐
Remedial Design	Services to design the remedial action, including pre-design activities to collect the necessary data.	☒ Field Data Collection and Analysis ☒ Design Survey ☒ Treatability Study ___ Bench-Scale ___ Pilot-Scale ✓ Field-Scale ☒ Preliminary/Intermediate/Final Design ✓ Design Analysis ✓ Plans & Specifications ✓ Construction Cost Estimate ✓ Construction Schedule ☐ ☐

TABLE C-GW 3-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-3 IN-SITU TREATMENT

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Construction Activities			
Construction Management	Services to manage construction or installation of remedial action, excluding any similar services provided as part of construction activities.	☒	Submittal Review
		☒	Change Order Review
		☒	Design Modification
		☒	Construction Observation
		☒	Construction Survey
		☒	Construction Schedule Tracking
		☒	QA/QC Documentation
		☒	O&M Manual
		☒	Record Drawings
		☐	
		☐	
Institutional Controls	Non-engineering (i.e., administrative or legal) measures to reduce or minimize potential for exposure to site contamination or hazards (i.e., limit site access or restrict site access).	☒	Institutional Control Plans
		☒	Restrictive Covenants
		☒	Zoning
		☒	Property Easements
		☒	Deed Notice
		☒	Advisories
		☒	Groundwater Use Restrictions
		☒	Site Information Database
		☐	
		☐	

TABLE C-GW 3-2

O&M COST ELEMENT CHECKLIST - ALTERNATIVE GW-3 IN-SITU TREATMENT

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
O&M Activities			
Monitoring, Sampling, Testing, and Analysis[1]	Sampling, testing, on- or off-site analysis, data management, and quality assurance/quality control during the O&M period. Can include monitoring to evaluate remedy performance/compliance with regulations, or monitoring to track migration of contaminant plume.		Meteorological Monitoring
			Air Monitoring and Sampling
			Radiation Monitoring
		X	Health and Safety Monitoring
		X	Personnel Protective Equipment
		X	Monitoring Wells
			Soil Sampling
			Sediment Sampling
			Surface Water Sampling
		X	Groundwater Sampling
			Process Water Sampling
			Process Air Sampling
		X	Laboratory Chemical Analysis
		X	On-Site Chemcial Analysis
		X	Chemical Data Management
Extraction Containment, or Treatment Systems[2]	Operation and maintenance of on-sitesystemsto extract, contain, or treat contaminated media (e.g., soil, sediment, sludge, surface water, or groundwater).	X	Operations Labor
		X	Maintenance Labor
			Equipment Upgrade/Replacement Repair
			Spare Parts
			Equipment Ownership/Rental/Lease
		X	Consumable Supplies
		X	Bulk Chemicals
		X	Raw/Process Materials
			Utilities

[1] Site Monitoring, performance monitoring, or compliance monitoring.

[2] Specify extraction, containment, or treatment system. Examples include groundwater extraction system, engineered cap or cover, soil vapor extraction system, groundwater treatment facility, etc. More than one system may be associated with an individual alternative.

TABLE C-GW 3-2
O&M COST ELEMENT CHECKLIST - ALTERNATIVE GW-3 IN-SITU TREATMENT

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
O&M Activities			
Off-Site Treatment / Disposal	Treatment and/or disposal of wastes generated during operations and maintenance (e.g., on-site treatment residuals, monitoring wastes) at off-site commercial facilities, such as solid or hazardous waste landfills and incinerators.	☒	Material Handling/Loading
		☒	Transportation to Off-Site Facility
		☒	Treatment/Disposal Fees
		☐	
		☐	
Contingency	Costs to cover unknowns, unforeseen circumstances, or unanticipated conditions associated with annual O&M of the remedial action.	☒	Scope Contingency
		☒	Bid Contingency
Professional/Technical Services			
Project Management	Services to manage O&M activities not specific to technical support listed below.	☒	Planning
		☐	Community Relations
		☐	Cost and Performance Reporting
		☐	Permitting
		☐	Legal
		☐	
		☐	
Technical Support	Services to monitor, evaluate, and report progress of remedial actions.	☐	O&M Manual Updates
		☒	O&M Oversight
		☒	Progress Reports
		☐	
		☐	
Institutional Controls	Annual update or maintenance of non-engineering measures to reduce or minimize potential for exposure to site contaminants or hazards.	☒	Institutional Control Plans
		☒	Restrictive Covenants
		☒	Zoning
		☒	Property Easements
		☒	Deed Notice
		☒	Advisories
		☒	Groundwater Use Restrictions
		☒	Site Information Database
		☐	
		☐	

TABLE C-GW 3-3

PERIODIC COST ELEMENT CHECKLIST - ALTERNATIVE GW-3 IN-SITU TREATMENT

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Construction/O&M Activities			
Remedy Failure or Replacement	Construction activities to replace an installation remedy or key components of the remedy.	☐	Mobilization/Demobilization
		☐	Site Work
		☐	Structures
		☐	Process Equipment and Appurtenances
		☐	Non-Process Equipment
		☐	Startup and Testing
		☐	
		☐	
Demobilization of On-Site Extraction, Containment, or Treatment Systems[1]	Construction activity to dismantle or take down extraction, containment, or treatment facility or equipment upon completion of remedial action.	☐	Demolition and Removal
		☒	Well Abondonment
		☐	
		☐	
Contingency	Costs to cover unknowns, unforeseen circumstances, or unanticipated conditions associated with Construction /O&M activities.	☒	Scope Contingency
		☒	Bid Contingency

[1] Specify extraction, containment, or treatment system. Examples include groundwater extraction systems, soil vapor extraction system, groundwater treatment facility, etc. More than one system may be associated with an individual alternative.

Professional/Technical Services			
Five Year Review	Services to prepare five-year review reports (if hazardous substances, pollutants, or contaminants remain on-site above levels that allow for unrestricted use and unlimited exposure.	☒	Site Visit
		☒	Field Data Collection
		☒	Data Review and Analysis
		☒	Report Preparation
		☐	
		☐	

TABLE C-GW 3-3
PERIODIC COST ELEMENT CHECKLIST - ALTERNATIVE GW-3 IN-SITU TREATMENT

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Professional/Technical Services (cont.)			
Groundwater Performance Optimization Study	Services to analyze and optimize on-going groundwater pump and treat systems.	☐	Site Visit
		☐	Field Data Collection
		☐	Data Review and Analysis
		☐	Report Preparation
		☐	
		☐	
Remedial Acion Report	Services to prepare remedial action report upon completion of remedial action.	☒	Site Visit
		☒	Field Data Collection
		☒	Data Review and Analysis
		☒	Report Preparation
		☐	
		☐	
Institutional Controls	Periodic update or maintenance of non-engineering measures to reduce or minimize potential for exposure to site contaminants or hazards.	☒	Institutional Control Plans
		☒	Restrictive Covenants
		☒	Zoning
		☒	Property Easements
		☒	Deed Notice
		☒	Advisories
		☒	Groundwater Use Restrictions
		☒	Site Information Database
		☐	
		☐	

Appendix C - Alternative GW 4
Extraction, Treatment and Disposal

Exhibits

Exhibit C-GW 4-1 – Cost Estimate Summary – Alternative GW 4
Exhibit C-GW 4-2 – Cost Worksheet GW 4 – Capital Cost Sub-Element – Construction Activities: Mobilization/Demobilization
Exhibit C-GW 4-3 – Cost Worksheet GW 4 – Capital Cost Sub-Element – Construction Activities: Monitoring, Sampling, Testing, and Analysis
Exhibit C-GW 4-4 – Cost Worksheet GW 4 – Capital Cost Sub-Element – Construction Activities: Site Work
Exhibit C-GW 4-5 – Cost Worksheet GW 4 – Capital Cost Sub-Element – Construction Activities: On-Site Treatment
Exhibit C-GW 4-6 – Cost Worksheet GW 4 – Capital Cost Sub-Element – Off-Site Treatment/Disposal
Exhibit C-GW 4-7 – Cost Worksheet GW 4 – Capital Cost Sub-Element – Institutional Controls
Exhibit C-GW 4-8 – Cost Worksheet GW 4 – O&M Cost Sub-Element – Monitoring, Sampling, Testing, and Analysis
Exhibit C-GW 4-9 – Cost Worksheet GW 4 – O&M Cost Sub-Element – Extraction System
Exhibit C-GW 4-10 – Cost Worksheet GW 4 – O&M Cost Sub-Element – Off-Site Treatment and Disposal
Exhibit C-GW 4-11 – Cost Worksheet GW 4 – O&M Cost Sub-Element – Institutional Controls
Exhibit C-GW 4-12 – Cost Worksheet GW 4 – Periodic Cost Sub-Element – Site Work
Exhibit C-GW 4-13 – Cost Worksheet GW 4 – Periodic Cost Sub-Element – Mobilization/Demobilization
Exhibit C-GW 4-14 – Cost Worksheet GW 4 – Periodic Cost Sub-Element – Process Equipment and Appurtenances
Exhibit C-GW 4-15 – Cost Worksheet GW 4 – Periodic Cost Sub-Element – Startup and Testing
Exhibit C-GW 4-16 – Cost Worksheet GW 4 – Periodic Cost Sub-Element – Site Work
Exhibit C-GW 4-17 – Cost Worksheet GW 4 – Periodic Cost Sub-Element – 5-Year Review Report
Exhibit C-GW 4-18 – Cost Worksheet GW 4 – Periodic Cost Sub-Element – Institutional Controls

Tables

Table C-GW 4-1 – Capital Cost Element Checklist – Alternative GW 4 Extraction, Treatment and Disposal
Table C-GW 4-2 – O&M Cost Element Checklist – Alternative GW 4 – Extraction, Treatment and Disposal
Table C-GW 4-3 – Periodic Cost Element Checklist – Alternative GW 4 – Extraction, Treatment and Disposal

EXHIBIT C-GW 4-1
COST ESTIMATE SUMMARY - ALTERNATIVE GW-4

Alternative GW-4
Extraction, Treatment and Disposal

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006
Date: 07-24-06

Description: Alternative GW-4 Extraction, Treatment and Disposal is a pump and treat system for the contaminated groundwater plume at the site. The groundwater will be pumped from three wells in the plume to the existing treatment trailer filtered with granular activated carbon and discharged to surface drainages on site. It is expected that the pump and treat system will contain the groundwater plume and will require up to 50 years to remediate the contamination.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Construction Activities					
Mobilization/Demobilization	1	LS	$37,972	$37,972	Planning Doc's, submittals, equipment, & utilities
Groundwater Sampling & Analysis	1	LS	$69,798	$69,798	
Site Work	1	LS	$30,947	$30,947	
On-Site Treatment	1	LS	$113,060	$113,060	Equipment/well installation, startup and testing
Off-site Treatment and Disposal	1	LS	$3,695	$3,695	IDW disposal
SUBTOTAL				$255,472	
SUBTOTAL				$255,472	
Contingency	30%			$76,642	10% scope + 20% bid
SUBTOTAL				$332,114	
Project Management	5%			$12,774	
Remedial Design	8%			$20,438	
Construction Management	6%			$15,328	
Institutional Controls					
Institutional Controls Plan	1	EA	$12,459	$12,459	
SUBTOTAL				$60,999	
TOTAL CAPITAL COST				$393,113	

EXHIBIT C-GW 4-1
COST ESTIMATE SUMMARY - ALTERNATIVE GW-4

Alternative GW-4
Extraction, Treatment and Disposal

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006
Date: 07-24-06

Description: Alternative GW-4 Extraction, Treatment and Disposal is a pump and treat system for the contaminated groundwater plume at the site. The groundwater will be pumped from three wells in the plume to the existing treatment trailer filtered with granular activated carbon and discharged to surface drainages on site. It is expected that the pump and treat system will contain the groundwater plume and will require up to 50 years to remediate the contamination.

O&M COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
System O&M					
Extraction System	1	EA	$25,341	$25,341	
Contingency	30%			$7,602	10% scope + 20% bid
SUBTOTAL				$32,943	
Project Management	5%			$1,647	
Technical Support	10%			$3,294	
SUBTOTAL				$4,941	
TOTAL ANNUAL O&M COST				$37,885	Cost for annual injection
SUBTOTAL FOR THREE YEARS OF INJECTION (X 3)				$113,654	
Site Monitoring					
Groundwater Sampling & Analysis	1	YR	$70,936	$70,936	4 Quarters - Sample 10 wells/qtr VOCs, & WQ
Off Site Treatment & Disposal	1	YR	$7,817	$7,817	
SUBTOTAL				$78,753	
Contingency	30%			$23,626	10% scope + 20% bid
SUBTOTAL				$102,379	
Project Management	5%			$5,119	
Technical Support	10%			$10,238	
Institutional Controls	1	LS	$3,078	$3,078	
SUBTOTAL				$18,435	
TOTAL ANNUAL O&M COST MONITORING				$120,813	Annual Monitoring Costs

EXHIBIT C-GW 4-1
COST ESTIMATE SUMMARY - ALTERNATIVE GW-4

Alternative GW-4
Extraction, Treatment and Disposal

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006
Date: 07-24-06

Description: Alternative GW-4 Extraction, Treatment and Disposal is a pump and treat system for the contaminated groundwater plume at the site. The groundwater will be pumped from three wells in the plume to the existing treatment trailer filtered with granular activated carbon and discharged to surface drainages on site. It is expected that the pump and treat system will contain the groundwater plume and will require up to 50 years to remediate the contamination.

PERIODIC COSTS:

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
Five Year Review Report	5	1	EA	$9,222	$9,222	1 report every 5 years
Update Institutional Control Plan	5	1	EA	$6,502	$6,502	Update plan every 5 years
SUBTOTAL					$15,724	
Contingency (% of Sum)		30%			$4,717	% of construction activities
Project Mgt. (% of Sum + Cont.)		5%			$786	% of construction + contingency
TOTAL 5 YEAR PERIODIC COSTS					$21,228	
Process Equipment & Appurtenances	25	1	LS	$40,404	$40,404	1 time major system repair
Startup & Testing	25	1	LS	$13,396	$13,396	
SUBTOTAL					$53,800	
Contingency (% of Sum)		30%			$16,140	% of construction activities
Project Mgt. (% of Sum + Cont.)		5%			$2,690	% of construction + contingency
TOTAL MAJOR SYSTEM REPAIR YEAR 25					$72,630	
Demobilization and Well Abandonment	50	1	EA	$43,635	$43,635	Abandon 33 wells
Mobilization/Demobilization	50	1	LS	$4,559	$4,559	Dismantle System
Site Work	50	1	LS	$30,947	$30,947	Dismantle System
SUBTOTAL					$79,141	
Contingency (% of Sum)		30%			$23,742	% of construction activities
Project Mgt. (% of Sum + Cont.)		5%			$3,957	% of construction + contingency
TOTAL SYSTEM DISMANTEL & WELL ABANDONMENT YEAR 50					$106,840	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE	NOTES
Capital Cost	1	$393,113	$393,113	0.935	$367,561	System renovation & start up
O&M Monitoring Cost	1-50	$6,040,666	$120,813	13.801	$1,667,345	O&M for 50 years
Periodic	5	$21,228	$21,228	0.713	$15,135	5 Year Review & Institutional Control Update
Periodic	10	$21,228	$21,228	0.508	$10,784	5 Year Review & Institutional Control Update
Periodic	15	$21,228	$21,228	0.362	$7,684	5 Year Review & Institutional Control Update
Periodic	20	$21,228	$21,228	0.258	$5,477	5 Year Review & Institutional Control Update
Periodic	25	$21,228	$21,228	0.184	$3,906	5 Year Review & Institutional Control Update
Periodic: System Repair	25	$72,630	$72,630	0.184	$13,364	Major System Repair/Replacement
Periodic	30	$21,228	$21,228	0.131	$2,781	5 Year Review & Institutional Control Update
Periodic	35	$21,228	$21,228	0.0937	$1,989	5 Year Review & Institutional Control Update
Periodic	40	$21,228	$21,228	0.0668	$1,418	5 Year Review & Institutional Control Update
Periodic	45	$21,228	$21,228	0.0476	$1,010	5 Year Review & Institutional Control Update
Periodic	50	$21,228	$21,228	0.0339	$720	5 Year Review & Institutional Control Update
Periodic: Dismantle Sys	50	$106,840	$106,840	0.0339	$3,622	Dismantle System & Abandon Wells
		$6,825,526			$2,102,795	
TOTAL PRESENT VALUE OF ALTERNATIVE					$2,102,795	

EXHIBIT C-GW 4-2
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction Treatment and Disposal
Capital Cost Sub-Element
Construction Activity: Mobilization/Demobilization

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/06/06

Check by: _____
Date: _____

Work Statement:

Plans will be required to perform the Extraction, Treatment and Disposal alternative. Construction equipment will have to be mobilized to the site to dig trenches for the piping from the extraction wells to the system trailer.
Temporary utilities will have to be run to the system trailer to operate the system.
Post construction documentation including a O&M manual will be required (cost included in management fee).

Cost Analysis:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Plans								
Senior Engineer	12	HR	$42.14			$42.14	$505.68	ECHOS
Staff Engineer	120	HR	$28.40			$28.40	$3,408.00	ECHOS
QA/QC Officer	16	HR	$30.55			$30.55	$488.80	ECHOS
Secretarial/Administrative	80	HR	$15.86			$15.86	$1,268.80	ECHOS
Draftsman/CAD	80	HR	$18.28			$18.28	$1,462.40	ECHOS
			ECHOS cost with Localization Factor (0.98):				$6,991.01	
Equipment Mobilization								
Mobilize Crew, 100 Miles	2	EA			$100.66	$100.66	$201.32	ECHOS
Per Diem	4	DAY			$95.35	$95.35	$381.40	ECHOS
			ECHOS cost with Localization Factor (0.98):				$571.07	
Temporary Utilities								
Electrical service								
Pole-mounted Capacitors, 6 KW	1	EA	157.42	26.71	608.99	$793.12	$793.12	ECHOS
4/0 ACSR Conductor	1	MLF	734.08	82.71	458.23	$1,275.02	$1,275.02	ECHOS
			ECHOS cost with Localization Factor (0.98):				$2,026.78	
						Subtotal:	$9,588.85	
					Subcontractor Overhead:	25%	$2,397.21	
						Subtotal:	$11,986.06	
					Subcontractor Profit:	8%	$958.88	
						Subtotal:	$12,944.95	
						Subtotal:	$34,519.86	
					Prime Contractor Overhead:	15%	$5,177.98	
						Subtotal:	$39,697.84	
					Prime Contractor Profit:	10%	$3,451.99	
					TOTAL ACTIVITY COST:		$37,971.84	

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
ECHOS. 2006. Environmental Remediation Cost Data - Unit Cost Data

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Current Year (2006) is base year.
☒	Area Cost Factor	ECHOS 2006
☒	Subcontractor Overhead and Profit	Includes 25% overhead and 8% profit.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-3
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction Treatment and Disposal
Capital Cost Sub-Element
Construction Activity: Monitoring, Sampling, Testing, and Analysis

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/06/06

Check by: _____
Date: _____

Work Statement:

To monitor the progress of the ex-situ treatment quarterly groundwater monitoring will be conducted. On-site analytical techniques will be used for some parameters and samples will be shipped to off-site laboratories for other parameters.

Cost Analysis:

Monitoring, Sampling, Testing, and Analysis:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
On-Site Analysis (4 quarters)								
Fe^{+2} Hack Kit	0	EA				$47.30	$0.00	Hach
CO_2 Hack Kit	0	EA				$30.60	$0.00	Hach
pH, temperature, conductivity, O2, and ORP using field monitor with flow thru cell, rental	4	WEEK				$300.00	$1,200.00	Pine
Laboratory Analysis (4 quarters)								
VOCs	55	EA				$130.00	$7,150.00	STL
TAL metals filtered	0	EA				$150.00	$0.00	STL
TAL metals unfiltered	0	EA				$150.00	$0.00	STL
Hexavalent chromium	0	EA				$30.00	$0.00	STL
TOC	50	EA				$45.00	$2,250.00	STL
Filters, 0.45 micron field water filters.	0	EA				$11.75	$0.00	Pine
Shipping	4	LS				$250.00	$1,000.00	Estimate
Incidentials	4	LS				$250.00	$1,000.00	Estimate
PID Rental	4	WEEK				$150.00	$600.00	Pine
Drums	15	EA				$50.00	$750.00	Estimate
						Subtotal:	$13,950.00	
Monitoring Well Sampling	40	WELLS				$300.00	$12,000.00	Estimate
Data Validation	4	LS				$3,000.00	$12,000.00	Estimate
Per Diem	16	DAY				$125.00	$2,000.00	Estimate
						Escalation (4340/3693):	$30,555.10	
Report Preparation								
Senior Engineer	0	HR	$42.14			$42.14	$0.00	ECHOS
Project Engineer	64	HR	$32.94			$32.94	$2,108.16	ECHOS
Field Technician	160	HR	$26.66			$26.66	$4,265.60	ECHOS
						ECHOS costs with Localization Factor (0.98):	$6,246.28	ECHOS
Computers, etc.	0	HR				$25.00	$0.00	Plexus
Report Copying, etc.	4	LS				$1,000.00	$4,000.00	Estimate
Groundwater Modeling	0	LS				$20,000.00	$0.00	Estimate
						Escalation (4340/3693):	$4,425.25	
						Subtotal:	$55,176.64	
						Prime Contractor Overhead: 15%	$8,276.50	
						Subtotal:	$63,453.13	
						Prime Contractor Profit: 10%	$6,345.31	
						TOTAL ACTIVITY COST:	$69,798.45	

Source of Cost Data:

Venders: STL, Pine, and Hach
ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
Plexus 2003 rates CELRL contract

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equi	Level D
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Pro	NA
☒	Prime Contractor Overhead and	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-4
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction Treatment and Disposal
Capital Cost Sub-Element
Construction Activity: Site Work

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/06/06

Check by: _____
Date: _____

Work Statement:

Piping trenches will be required to connect the remedial system to the new wells required at the north and south ends of the plume. The vegetation will have to be reestablished after the piping is installed. Utilities that will be used include electrical and communications wiring and monthly service.

Cost Analysis:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Demolition								
Demo Rod Reinforced Concrete to 6" Thick with Air Equipment	10	CY	$67.43	$18.46		$85.89	$858.90	ECHOS
Earthwork								
Trenching, 1CY Gradall, Light Soil, 95 CY/Hour Continuous Footing Excavation	40	CY	$0.68	$1.27		$1.95	$78.00	ECHOS
Crawler-mounted, 1.0 CY, 215 Hydraulic Excavator	16	HR	$38.10	$70.03		$108.13	$1,730.08	ECHOS
Roads, Patching								
6" Structural Slab on Grade	50	SF	$2.07	$0.18	$2.86	$5.11	$255.50	ECHOS
Vegetation and Planting								
Topsoil 6" Lifts, Off-Site Furnish & Place Imported Topsoil 6" deep.	10	CY	$4.38	$3.07	$22.29	$29.74	$297.40	ECHOS
Seeding, Vegetative Cover	2	ACRE	$72.41	$58.29	$3,890.00	$4,020.70	$8,041.40	ECHOS
Temporary Utilities								
Electrical Usage Fee	12	MO			$500.00	$500.00	$6,000.00	Estimate
Communications Cable 27 Pair 22 AWG Wire	200	LF	$1.05	$0.00	$2.10	$3.15	$630.00	ECHOS
Telephone Service	12	MO			$50.00	$50.00	$600.00	Estimate

ECHOS cost with Localization Factor (0.98):		$18,121.45
Subcontractor Overhead:	25%	$4,530.36
	Subtotal:	$22,651.82
Subcontractor Profit:	8%	$1,812.15
	Subtotal:	$24,463.96
Prime Contractor Overhead:	15%	$3,669.59
	Subtotal:	$28,133.56
Prime Contractor Profit:	10%	$2,813.36
TOTAL ACTIVITY COST:		$30,946.91

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
ECHOS. 2006. Environmental Remediation Cost Data - Unit Cost Data

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Current Year (2006) is base year.
☒	Area Cost Factor	ECHOS 2006
☒	Subcontractor Overhead and Profit	Includes 25% overhead and 8% profit.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-5
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction Treatment and Disposal
Capital Cost Sub-Element
Construction Activity: On-Site Treatment

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/06/06

Check by: _____
Date: _____

Work Statement:

The existing trailer and treatment system will be retrofitted as needed and used to treat contaminated groundwater at the site. Two new groundwater extraction wells are anticipated one at the north end of the plume and one at the south end of the plume. The wells will be plumbed together and piped to the trailer. Carbon will be loaded in the canisters in the trailer. The system will be started up and tested.

Cost Analysis:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Mob/Demob								
Drilling Crew	1	LS	$748.00	$3,379.00		$4,127.00	$4,127.00	ECHOS
			ECHOS cost with Localization Factor (0.98):				$4,044.46	
Site Work								
Well Installation								
Loading Supplies and Equipment	1	LS				$1,783.00	$1,783.00	ECHOS
Hollow Stem Auger 13-3/4" Dia Borehole, Depth <= 100 ft	60	LF				$61.29	$3,677.40	ECHOS
6" PVC, Schedule 80 Casing	40	LF				$25.21	$1,008.40	ECHOS
6" PVC, Schedule 80 Screen	20	LF				$48.43	$968.60	ECHOS
6" PVC, Well Plug	2	EA				$124.29	$248.58	ECHOS
6" Screen, Filter Pack	24	LF				$39.89	$957.36	ECHOS
6" Well, Bentonite Seal	2	EA				$233.88	$467.76	ECHOS
6" Well, Portland Cement Grout	32	LF				$10.86	$347.52	ECHOS
Well Development Equipment Rental Weekly	2	WK				$249.95	$499.90	ECHOS
Furnish 55 Gallon Drum for Drill Cuttings & Development Water	10	EA				$95.00	$950.00	ECHOS
			ECHOS cost with Localization Factor (0.98):				$10,690.35	
Process Equipment & Appurtenances								
Surface Seal, Concrete Filled	1	LS				$4,856.00	$4,856.00	ECHOS
Hazardous Area, Traffic Load Well Protection	3	EA				$5,557.00	$16,671.00	ECHOS
4" Submersible Pump, 0.3-7 GPM, 141'< Head <=240', 1/2 hp, w/controls.	3	EA				$2,113.00	$6,339.00	ECHOS
3 Groundwater Pump Control Panel	1	EA				$4,979.00	$4,979.00	ECHOS
2", Class 200, PVC Piping	300	LF				$6.21	$1,863.00	ECHOS
2" PVC, Schedule 80, 90 Degree, Elbow	6	EA				$3.38	$20.28	ECHOS
2" x 2" Bronze Pressure Relief Valve	3	EA				$419.08	$1,257.24	ECHOS
2" Ball Valve, Carbon Steel Trim	6	EA				$297.72	$1,786.32	ECHOS
Coconut-based, High Capacity, 12 x 30 Sieve, 1100 Iodine, <2000 Lb.	1000	LB				$1.35	$1,350.00	ECHOS
			ECHOS cost with Localization Factor (0.98):				$38,339.40	

EXHIBIT C-GW 4-5
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction Treatment and Disposal
Capital Cost Sub-Element
Construction Activity: On-Site Treatment

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/06/06

Check by: _____
Date: _____

Startup and Testing							
Senior Engineer	8	HR	$42.14		$42.14	$337.12	ECHOS
Project Engineer	80	HR	$32.94		$32.94	$2,635.20	ECHOS
Field Technician	80	HR	$26.66		$26.66	$2,132.80	ECHOS
Per Diem	12	DAY		$95.35	$95.35	$1,144.20	ECHOS
			ECHOS cost with Localization Factor (0.98):			$6,124.33	
Car Rental	12	DAY			$85.00	$1,020.00	Estimate
Air Fare	2	EA			$350.00	$700.00	Estimate
					Subtotal:	$7,844.33	
Equipment Upgrade/Replacement							
Retrofit existing trailer							
Project Engineer	40	HR	$32.94		$32.94	$1,317.60	ECHOS
Field Technician	40	HR	$26.66		$26.66	$1,066.40	ECHOS
Per Diem	7	DAY		$95.35	$95.35	$667.45	ECHOS
			ECHOS cost with Localization Factor (0.98):			$2,990.42	
Car Rental	7	DAY			$85.00	$595.00	Estimate
Air Fare	2	EA			$350.00	$700.00	Estimate
Miscellaneous materials	1	LS		$1,000.00	$1,000.00	$1,000.00	Estimate
					Subtotal:	$5,285.42	
					Subtotal:	$66,203.97	
			Subcontractor Overhead:		25%	$16,550.99	
					Subtotal:	$82,754.96	
			Subcontractor Profit:		8%	$6,620.40	
					Subtotal:	$89,375.36	
			Prime Contractor Overhead:		15%	$13,406.30	
					Subtotal:	$102,781.66	
			Prime Contractor Profit:		10%	$10,278.17	
			TOTAL ACTIVITY COST:			$113,059.83	

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
ECHOS. 2006. Environmental Remediation Cost Data - Unit Cost Data

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Current Year (2006) is base year.
☒	Area Cost Factor	ECHOS 2006
☒	Subcontractor Overhead and Profit	Includes 25% overhead and 8% profit.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-6
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction Treatment and Disposal
Capital Cost Sub-Element
Construction Activity: Off-Site Treatment and Disposal

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/07/06

Check by: _____
Date: _____

Work Statement:

Soil cuttings and purge water from the monitoring wells will need to be handled and disposed of.

Cost Analysis:

Off-Site Treatment and Disposal

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Transportation/Treatment/Disposal	10	EA				$216.38	$2,163.80	ECHOS
						Subtotal:	$2,163.80	
					Subcontractor Overhead:	25%	$540.95	
						Subtotal:	$2,704.75	
					Subcontractor Profit:	8%	$216.38	
						Subtotal:	$2,921.13	
					Prime Contractor Overhead:	15%	$438.17	
						Subtotal:	$3,359.30	
					Prime Contractor Profit:	10%	$335.93	
					TOTAL ACTIVITY COST:		$3,695.23	

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Unit Cost Data

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equip only)	Level D
Escalation to Base Year	NA
Area Cost Factor	NA
Subcontractor Overhead and Profit	Calculated at 25% and 8%.
Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-7
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction Treatment and Disposal
Capital Cost Sub-Element
Construction Activity: Institutional Controls

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/07/06

Check by: _____
Date: _____

Work Statement:

Institutional Control include preparing a plan to present the process of developing institutional controls and putting them into action. The Institutional Controls on the site could include restrictive covenants, zoning restrictions instituted through Madison County, property easements if needed, deed notices, advisories, and groundwater use restrictions. In addition, the site information database is to be updated and maintained. A similar cost element will be included with the other media remedial costs, duplication of costs will have to be resolved during detailed project cost analysis.

Cost Analysis:

Costs for Institutional Controls:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Environmental Attorney	40	HR	$50.00			$50.00	$2,000.00	Estimate
Senior Engineer	40	HR	$42.14			$42.14	$1,685.60	ECHOS
Secretarial/Administrative	32	HR	$15.86			$15.86	$507.52	ECHOS
			ECHOS costs with Localization Factor (0.98):				$2,149.26	ECHOS
Computers, etc.	0	HR				$25.00	$0.00	Plexus
Report Copying, etc.	1	LS				$5,000.00	$5,000.00	Estimate
Other Non-Itemized Direct Costs	1	LS				$200.00	$200.00	Estimate
Per Diem	4	DAY				$125.00	$500.00	Estimate
						Subtotal:	$9,849.26	
					Prime Contractor Overhead:	15%	$1,477.39	
						SUBTOTAL:	$11,326.65	
					Prime Contractor Profit:	10%	$1,132.66	
						TOTAL UNIT COST:	$12,459.31	

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
Estimate based on experience
An attorney has been added to assist the contractor and the Army in negotiation with the City and State.
The hours for Engineering Support have been increased as well to cover meetings and negotiations.

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equip only)	Quote is for Level D.
Escalation to Base Year	Costs from 2003 CELRL rates, base year is 2006.
Area Cost Factor	ECHOS 2006 localization factor
Subcontractor Overhead and Profit	NA
Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-8

COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction, Treatment and Disposal

O&M: Monitoring, Sampling, Testing and Analysis

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/07/06

Check by: _____
Date: _____

Work Statement:

To monitor the progress of the pump and treat system annual groundwater monitoring will be conducted. On-site analytical techniques will be used for some parameters and samples will be shipped to off-site laboratories for other parameters.

Cost Analysis:

Monitoring, Sampling, Testing, and Analysis: (quarterly)

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
On-Site Analysis (1 quarter)								
Fe^{+2} Hack Kit	0	EA				$47.30	$0.00	Hach
CO_2 Hack Kit	0	EA				$30.60	$0.00	Hach
pH, temperature, conductivity, O2, and ORP using field monitor with flow thru cell, rental	1	WEEK				$300.00	$300.00	Pine
Laboratory Analysis (1 quarter)								
VOCs	15	EA				$130.00	$1,950.00	STL
TAL metals filtered	0	EA				$150.00	$0.00	STL
TAL metals unfiltered	0	EA				$150.00	$0.00	STL
Hexavalent chromium	0	EA				$30.00	$0.00	STL
TOC	12	EA				$45.00	$540.00	STL
Filters, 0.45 micron field water filters.	0	EA				$11.75	$0.00	Pine
Shipping	1	LS				$250.00	$250.00	Estimate
Incidentials	1	LS				$250.00	$250.00	Estimate
PID Rental	1	WEEK				$150.00	$150.00	Pine
Drums	2	EA				$95.00	$190.00	ECHOS
						Subtotal:	$3,630.00	
Monitoring Well Sampling	10	WELLS				$300.00	$3,000.00	Estimate
Data Validation	1	LS				$3,000.00	$3,000.00	Estimate
Per Diem	4	DAY				$125.00	$500.00	Estimate
						Escalation (4340/3693):	$7,638.78	
Field Work & Report Preparation								
Senior Engineer	2	HR	$42.14			$42.14	$84.28	ECHOS
Project Engineer	16	HR	$32.94			$32.94	$527.04	ECHOS
Field Technician	40	HR	$26.66			$26.66	$1,066.40	ECHOS
						ECHOS costs with Localization Factor (0.98):	$1,644.17	ECHOS
Computers, etc.	0	HR				$25.00	$0.00	Plexus
Report Copying, etc.	1	LS				$1,000.00	$1,000.00	Estimate
Groundwater Modeling	0	LS				$20,000.00	$0.00	Estimate
						Escalation (4340/3693):	$1,106.31	
						Subtotal:	$14,019.25	
						Prime Contractor Overhead: 15%	$2,102.89	
						Subtotal:	$16,122.14	
						Prime Contractor Profit: 10%	$1,612.21	
						TOTAL ACTIVITY COST (1 QUARTER):	$17,734.36	

EXHIBIT C-GW 4-8

COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction, Treatment and Disposal

O&M: Monitoring, Sampling, Testing and Analysis

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/07/06

Check by: _____
Date: _____

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
Plexus 2003 rates CELRL contract

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level D
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-9

COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction, Treatment and Disposal

O&M: Extraction System

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/07/06

Check by:
Date:

Work Statement:

O&M will be required on the pumps and the system carbon will have to be regenerated assume annually.

Cost Analysis:

Extraction System O&M

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Operations Labor								
Project Engineer	12	HR	$32.94			$32.94	$395.28	ECHOS
Field Technician	120	HR	$26.66			$26.66	$3,199.20	ECHOS
Maintenance Labor								
Project Engineer	12	HR	$32.94			$32.94	$395.28	ECHOS
Field Technician	120	HR	$26.66			$26.66	$3,199.20	ECHOS
			ECHOS costs with Localization Factor (0.98):				$7,045.18	
Equipment Upgrade/Replace Repair								
Annual Cost Upgrade/Replace	1	LS		$1,000.00		$1,000.00	$1,000.00	Estimate
Pump & Motor Maintenance/Repair	4	EA				$533.67	$2,134.68	ECHOS
			ECHOS costs with Localization Factor (0.98):				$2,091.99	
						Subtotal:	$3,091.99	
Spare Parts								
Annual Cost Assume	1	LS			$500.00	$500.00	$2,341.99	Estimate
Consumable Supplies								
Supplies	1	LS			$250.00	$250.00	$250.00	Estimate
						Subtotal:	$2,591.99	
Raw/Process Materials								
Carbon	50	LB			$1.35	$1.35	$67.50	ECHOS
Removal, Transport, Regeneration of spent carbon, <2K lbs	1000	LB			$0.65	$0.65	$650.00	ECHOS
			ECHOS costs with Localization Factor (0.98):				$703.15	
Utilities								
Electrical Usage Fee	12	MO			$500.00	$500.00	$6,000.00	Estimate
Phone Service	12	MO			$50.00	$50.00	$600.00	Estimate
						Subtotal:	$6,600.00	
						Subtotal:	$20,032.30	
			Prime Contractor Overhead:			15%	$3,004.85	
						Subtotal:	$23,037.15	
			Prime Contractor Profit:			10%	$2,303.71	
			TOTAL ACTIVITY COST:				$25,340.86	

EXHIBIT C-GW 4-9

COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction, Treatment and Disposal

O&M: Extraction System

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/07/06

Check by:
Date:

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level D
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-10

COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction, Treatment and Disposal

O&M: Off-Site Treatment and Disposal

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/07/06

Check by: _____
Date: _____

Work Statement:

Purge water from the monitoring wells will need to be handled and disposed of.

Cost Analysis:

Off-Site Treatment and Disposal

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Drums for Purge Water, 55 Gallon DOT	15	EA			$95.00	$95.00	$1,425.00	ECHOS
Transportation/Treatment/Disposal	15	EA				$216.38	$3,245.70	ECHOS
						ECHOS costs with Localization Factor (0.98):	$4,577.29	
						Subcontractor Overhead: 25%	$1,144.32	
						Subtotal:	$5,721.61	
						Subcontractor Profit: 8%	$457.73	
						Subtotal:	$6,179.34	
						Prime Contractor Overhead: 15%	$926.90	
						Subtotal:	$7,106.24	
						Prime Contractor Profit: 10%	$710.62	
						TOTAL ACTIVITY COST:	$7,816.86	

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Unit Costs

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level D
☒	Escalation to Base Year	NA
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	Calculated at 25% and 8%.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-11
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction, Treatment and Disposal

O&M: Institutional Controls

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/07/06

Check by: _____
Date: _____

Work Statement:

An annual inspection of the site for compliance with institutional controls will be required under the GW 4 - Extraction, Treatment and Disposal Alternative.

Cost Analysis:

Annual Institutional Control Costs:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Project Manager	50	HR	$40.66			$40.66	$2,033.00	ECHOS
			ECHOS costs with Localization Factor (0.98):				$1,992.34	ECHOS
Per Diem	1	DAY				$125.00	$125.00	Plexus
ODCs/equipment	1	LS				$250.00	$250.00	Plexus
						Escalation (4340/3693):	$440.70	
						Subtotal:	$2,433.04	
						Prime Contractor Overhead: 15%	$364.96	
						SUBTOTAL:	$2,797.99	
						Prime Contractor Profit: 10%	$279.80	
						TOTAL UNIT COST:	$3,077.79	

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
Plexus 2003 rates CELRL contract

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level E
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-12
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction Treatment and Disposal

Periodic: Site Work

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/06/06

Check by: _____
Date: _____

Work Statement:

Once the remediation is complete the piping from the wells to the system will have to be removed.
The vegetation will have to be reestablished after the piping is removed.
The on site temporary utilities will have to be removed.

Cost Analysis:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Demolition								
Demo Rod Reinforced Concrete to 6" Thick with Air Equipment	10	CY	$67.43	$18.46		$85.89	$858.90	ECHOS
Earthwork								
Trenching, 1CY Gradall, Light Soil, 95 CY/Hour Continuous Footing Excavation	40	CY	$0.68	$1.27		$1.95	$78.00	ECHOS
Crawler-mounted, 1.0 CY, 215 Hydraulic Excavator	16	HR	$38.10	$70.03		$108.13	$1,730.08	ECHOS
Vegetation and Planting								
Topsoil 6" Lifts, Off-Site Funish & Place Imported Topsoil 6" deep.	10	CY	$4.38	$3.07	$22.29	$29.74	$297.40	ECHOS
Seeding, Vegetative Cover	2	ACRE	$72.41	$58.29	$3,890.00	$4,020.70	$8,041.40	ECHOS
Roads, Patching								
6" Structural Slab on Grade	50	SF	$2.07	$0.18	$2.86	$5.11	$255.50	ECHOS
Temporary Utilities								
Electrical Usage Fee	12	MO			$500.00	$500.00	$6,000.00	Estimate
Communications Cable 27 Pair 22 AWG Wire	200	LF	$1.05	$0.00	$2.10	$3.15	$630.00	ECHOS
Telephone Service	12	MO			$50.00	$50.00	$600.00	Estimate

ECHOS cost with Localization Factor (0.98):		$18,121.45
Subcontractor Overhead:	25%	$4,530.36
	Subtotal:	$22,651.82
Subcontractor Profit:	8%	$1,812.15
	Subtotal:	$24,463.96
Prime Contractor Overhead:	15%	$3,669.59
	Subtotal:	$28,133.56
Prime Contractor Profit:	10%	$2,813.36
TOTAL ACTIVITY COST:		$30,946.91

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
ECHOS. 2006. Environmental Remediation Cost Data - Unit Cost Data

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Current Year (2006) is base year.
☒	Area Cost Factor	ECHOS 2006
☒	Subcontractor Overhead and Profit	Includes 25% overhead and 8% profit.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-13
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction Treatment and Disposal

Periodic: Mobilization/Demobilization

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/07/06

Check by: _____
Date: _____

Work Statement:

Construction equipment will have to be mobilized to the site to excavate and remove the piping from the extraction wells to the system trailer.

Cost Analysis:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Equipment Mobilization								
Mobilize Crew, 100 Miles	2	EA			$100.66	$100.66	$201.32	ECHOS
Per Diem	8	DAY			$95.35	$95.35	$762.80	ECHOS
						ECHOS cost with Localization Factor (0.98):	$944.84	
Temporary Utilities								
Remove electrical & telephone service								
Electrician	40	HR	$44.00			$44.00	$1,760.00	ECHOS
						ECHOS cost with Localization Factor (0.98):	$1,724.80	
						Subtotal:	$2,669.64	
					Subcontractor Overhead:	25%	$667.41	
						Subtotal:	$3,337.05	
					Subcontractor Profit:	8%	$266.96	
						Subtotal:	$3,604.01	
					Prime Contractor Overhead:	15%	$540.60	
						Subtotal:	$4,144.61	
					Prime Contractor Profit:	10%	$414.46	
					TOTAL ACTIVITY COST:		$4,559.07	

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
ECHOS. 2006. Environmental Remediation Cost Data - Unit Cost Data

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Current Year (2006) is base year.
☒	Area Cost Factor	ECHOS 2006
☒	Subcontractor Overhead and Profit	Includes 25% overhead and 8% profit.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-14
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction Treatment and Disposal

Periodic: Process Equipment and Appurtenances

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/24/06

Check by: _____
Date: _____

Work Statement:

Periodically equipment will need to be replaced at the site as the remediation goes forward.

Cost Analysis:

Cost for Replacing Process Equipment and Appurtenances

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Process Equipment & Appurtenances								
4" Submersible Pump, 0.3-7 GPM, 141'< Head <=240', 1/2 hp, w/controls.	3	EA				$2,113.00	$6,339.00	ECHOS
3 Groundwater Pump Control Panel	1	EA				$4,979.00	$4,979.00	ECHOS
2", Class 200, PVC Piping	300	LF				$6.21	$1,863.00	ECHOS
2" PVC, Schedule 80, 90 Degree, Elbow	6	EA				$3.38	$20.28	ECHOS
2" x 2" Bronze Pressure Relief Valve	3	EA				$419.08	$1,257.24	ECHOS
2" Ball Valve, Carbon Steel Trim	6	EA				$297.72	$1,786.32	ECHOS
Coconut-based, High Capacity, 12 x 30 Sieve, 1100 Iodine, <2000 Lb.	1000	LB				$1.35	$1,350.00	ECHOS
Remove/Reinstall Carbon Adsorber Unit	2	EA				$260.49	$520.98	ECHOS
25 GPM, 330 Lb Fill, High-density Polyethylene, Permanent	2	EA				$3,013.00	$6,026.00	ECHOS

ECHOS cost with Localization Factor (0.98):		$23,658.98
Subtotal:		$23,658.98
Subcontractor Overhead:	25%	$5,914.75
Subtotal:		$29,573.73
Subcontractor Profit:	8%	$2,365.90
Subtotal:		$31,939.63
Prime Contractor Overhead:	15%	$4,790.94
Subtotal:		$36,730.57
Prime Contractor Profit:	10%	$3,673.06
TOTAL ACTIVITY COST:		$40,403.63

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
ECHOS. 2006. Environmental Remediation Cost Data - Unit Cost Data

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Current Year (2006) is base year.
☒	Area Cost Factor	ECHOS 2006
☒	Subcontractor Overhead and Profit	Includes 25% overhead and 8% profit.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-15
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction Treatment and Disposal

Periodic: Startup and Testing

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/06/06

Check by: _____
Date: _____

Work Statement:

Following the replacement/repair of equipment the system will have to go through start-up and testing.

Cost Analysis:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Startup and Testing								
Senior Engineer	8	HR	$42.14			$42.14	$337.12	ECHOS
Project Engineer	80	HR	$32.94			$32.94	$2,635.20	ECHOS
Field Technician	80	HR	$26.66			$26.66	$2,132.80	ECHOS
Per Diem	12	DAY			$95.35	$95.35	$1,144.20	ECHOS
						ECHOS cost with Localization Factor (0.98):	$6,124.33	
Car Rental	12	DAY				$85.00	$1,020.00	Estimate
Air Fair	2	EA				$350.00	$700.00	Estimate
						Subtotal:	$7,844.33	
						Subcontractor Overhead: 25%	$1,961.08	
						Subtotal:	$9,805.42	
						Subcontractor Profit: 8%	$784.43	
						Subtotal:	$10,589.85	
						Prime Contractor Overhead: 15%	$1,588.48	
						Subtotal:	$12,178.33	
						Prime Contractor Profit: 10%	$1,217.83	
						TOTAL ACTIVITY COST:	$13,396.16	

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
ECHOS. 2006. Environmental Remediation Cost Data - Unit Cost Data

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Current Year (2006) is base year.
☒	Area Cost Factor	ECHOS 2006
☒	Subcontractor Overhead and Profit	Includes 25% overhead and 8% profit.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-16
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction, Treatment and Disposal

Periodic: Demobilization & Well Abandonment

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 06/30/06

Check by: _____
Date: _____

Work Statement:

Following remedial activities demobilization from the site. All of the monitoring & extraction wells on the site will need to be abondoned. The trailer and piping will have to be removed from the site.

Cost Analysis:

Costs Demobilization & Well Abandonment:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Senior Engineer	8	HR	$42.14			$42.14	$337.12	ECHOS
Project Engineer	80	HR	$32.94			$32.94	$2,635.20	ECHOS
Field Technician	100	HR	$26.66			$26.66	$2,666.00	ECHOS
			ECHOS costs with Localization Factor (0.98):				$5,525.55	ECHOS
Computers, etc.	0	HR				$25.00	$0.00	Plexus
Report Copying, etc.	1	LS				$1,000.00	$1,000.00	Plexus
Other Non-Itemized Direct Costs	1	LS				$500.00	$500.00	Plexus
Per Diem	12	DAY				$125.00	$1,500.00	Plexus
					Escalation (4340/3693):		$3,525.59	
*Well Abandonment	33	EA				$500.00	$16,500.00	Estimate
						Subtotal:	$25,551.14	
					Subcontractor Overhead:	25%	$6,387.79	
						Subtotal:	$31,938.93	
					Subcontractor Profit:	8%	$2,555.11	
						Subtotal:	$34,494.04	
					Prime Contractor Overhead:	15%	$5,174.11	
						SUBTOTAL:	$39,668.15	
					Prime Contractor Profit:	10%	$3,966.81	
					TOTAL UNIT COST:		$43,634.96	

Source of Cost Data:

Plexus 2003 rates CELRL Contract
ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	Calculated using 25 % overhead and 8% profit.
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-17

COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction, Treatment and Disposal

Periodic: 5-Year Review Report

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/07/06

Check by: _____
Date: _____

Work Statement:

Services to prepare required five-year review reports. The five-year review is designed to summarize the previous five-years of remedial work, evaluate progress, and suggest changes in remedial approach as appropriate.

Cost Analysis:

Costs per Five-Year Review:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Senior Engineer	8	HR	$42.14			$42.14	$337.12	ECHOS
Project Engineer	56	HR	$32.94			$32.94	$1,844.64	ECHOS
Field Technician	96	HR	$26.66			$26.66	$2,559.36	ECHOS
			ECHOS costs with Localization Factor (0.98):				$4,646.30	ECHOS
Computers, etc.	0	HR				$25.00	$0.00	Plexus
Report Copying, etc.	1	LS				$1,000.00	$1,000.00	Estimate
Other Non-Itemized Direct Costs	1	LS				$250.00	$250.00	Estimate
Per Diem	8	DAY				$125.00	$1,000.00	Plexus
						Escalation (4340/3693):	$2,644.19	
						Subtotal:	$7,290.49	
					Prime Contractor Overhead:	15%	$1,093.57	
						SUBTOTAL:	$8,384.06	
					Prime Contractor Profit:	10%	$838.41	
						TOTAL UNIT COST:	$9,222.47	

Source of Cost Data:

ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.
Plexus 2003 rates CELRL contract

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Quote is for Level D.
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

EXHIBIT C-GW 4-18
COST WORKSHEET - ALTERNATIVE GW-4

Alternative GW-4 Extraction, Treatment and Disposal

Periodic: Institutional Controls

Site: Nike SL-10 Launch Area Groundwater
Location: Marine, Illinois
Phase: Focused Feasibility Study (-30% to +50%)
Base Year: 2006

Prepared by: WWM
Date: 07/24/06

Check by: _____
Date: _____

Work Statement:

The Institutional Control Plan will be updated in accordance with the findings of the annual inspections for compliance.

Cost Analysis:

Annual Institutional Control Costs:

DESCRIPTION	QTY	UNIT	LABOR	EQUIP	MTRL	UNIT TOTAL	TOTAL	COMMENT
Senior Engineer	96	HR	$42.14			$42.14	$4,045.44	ECHOS
			ECHOS costs with Localization Factor (0.98):				$3,964.53	ECHOS
Per Diem	0	DAY				$125.00	$0.00	Plexus
ODCs/equipment	1	LS				$1,000.00	$1,000.00	Plexus
						Escalation (4340/3693):	$1,175.20	
						Subtotal:	$5,139.73	
						Prime Contractor Overhead: 15%	$770.96	
						SUBTOTAL:	$5,910.69	
						Prime Contractor Profit: 10%	$591.07	
						TOTAL UNIT COST:	$6,501.76	

Source of Cost Data:

Plexus 2003 rates CELRL contract
ECHOS. 2006. Environmental Remediation Cost Data - Assemblies.

Cost Adjustment Checklist:

	FACTOR:	NOTES:
☒	H&S Productivity (labor and equip only)	Level E
☒	Escalation to Base Year	Escalation to 2006 Base Year.
☒	Area Cost Factor	The localization cost factor for the SL-10 zip code per ECHOS is 0.98.
☒	Subcontractor Overhead and Profit	NA
☒	Prime Contractor Overhead and Profit	Includes 15% overhead and 10% profit.

TABLE C-GW 4-1

CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-4 EXTRACTION, TREATMENT AND DISPOSAL

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
Construction Activities		
Mobilization/ Demobilization	Bringing equipment and personnel to the site (mobilization) or removing equipment and personnel (demobilization) for purposes of constructing or installing the remedial action. Includes setup/construction and/or removal of temporary facilities and utilities. Does not include mobilization or demobilization specific to construction or installing an on-site treatment facility.	☒ Construction Equipment ☒ Submittals/Implementation Plans ___ Air Monitoring Plan ✓ Construction Quality Control Plan ✓ Construction Schedule ✓ Environmental Protection Plan ✓ Materials Handling/Transportation/Disposal Plan ✓ Permits ✓ Sampling and Analysis Plan ✓ Site Health and Safety Plan ___ Site Security Plan ✓ Site Work Plan ___ Storm Water Pollution Prevention Plan ✓ Training & Medical Certifications ☐ Temporary Facilities ___ Office Trailers ___ Storage Facilities ___ Security Fencing & Signs ___ Roads and Parking ___ Decontamination Facilities ☒ Temporary Utilities ☐ Temporary Relocation of Roads/Structures/Utilities ☒ Post-Construction Submittals ✓ As-Built Drawings ✓ O&M Manuals ✓ QA/QC Documentation ☐ Site Security Personnel ☐

TABLE C-GW 4-1

CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-4 EXTRACTION, TREATMENT AND DISPOSAL

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Construction Activities			
Monitoring, Sampling, Testing, and Analysis	Sampling, testing, on- or off-site analysis, data management, and quality assurance/quality control. Includes monitoring to evaluate remedy performance and/or compliance with regulations.		Meteorological Monitoring
			Air Monitoring and Sampling
			Radiation Monitoring
		X	Health and Safety Monitoring
		X	Personnel Protective Equipment
		X	Monitoring Wells
			Geotechnical Instrumentation
			Soil Sampling
			Sediment Sampling
			Surface Water Sampling
		X	Groundwater Sampling
			Radioactive Waste Sampling
			Asbestos Sampling
		X	Laboratory Chemical Analysis
		X	On-Site Chemcial Analysis
			Radioactive Waste Analysis
			Geotechnical Testing
		X	Chemical Data Management

TABLE C-GW 4-1

CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-4 EXTRACTION, TREATMENT AND DISPOSAL

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
Construction Activities		
Site Work	Activities to establish the infrastructure necessary for the project (i.e., site preparation). Also includes permanent site improvements and restoration of areas or site features disturbed during site remediation. Site work is generally assumed to be "clean work," meaning that there is no contact with contaminated media or materials. Excludes all site work specific to constructing or installing an on-site treatment facility.	☒ Demolition ☐ Clearing and Grubbing ☒ Earthwork ✓ Stripping Stockpiling ✓ Excavation Borrow Grading ✓ Backfill ✓ Topsoil ☒ Roads/Parking/Curbs/Walks ☒ Vegetation and Planting ✓ Topsoil ✓ Seeding/Mulch/Fertilizer Sodding ✓ Erosion Control Fabric Shrubs/Trees/Ground Cover ☐ Fencing/Signs/Gates ☒ Utilities ✓ Electrical ✓ Telephone/Communications Water/Sewer/Gas ☐ Storm Drainage/Subdrainage ☐ Sediment Barriers ☐ ☐
Surface Water Collection or Containment	Collection or containment of contaminated surface water. Excludes treatment, off-site transportation, or off-site treatment/ disposal of contaminanted surface water.	☐ Pumping ☐ Draining ☐ Channel/Waterway ☐ Berm/Dike ☐ Lagoon/Basin/Tank ☐ ☐

TABLE C-GW 4-1

CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-4 EXTRACTION, TREATMENT AND DISPOSAL

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
Construction Activities		
Groundwater Extraction or Containment	Extraction or containment of contaminated groundwater. Excludes treatment, off-site transportation, or off-site treatment/disposal of contaminated groundwater.	[X] Extraction/Injection Wells ✓ Vertical Horizontal [ ] Extraction Trench [X] Pumps [X] Piping [ ] Lagoon/Basin/Tank [ ] Subsurface Drains [ ] Subsurface Barrier Slurry Wall Grout Curtain Sheet Piling [ ] [ ]
Gas/Vapor Collection/ Control	Collection or control of off-gas or air emissions from contaminated sources.	[ ] Collection Well System [ ] Collection Trench System [ ] Collection System at Lagoon Cover [ ] Fugitive Dust Control [ ] Vapor/Gas Emission Control [ ] [ ]
Soil Excavation	Excavation and handling of contaminated soil. Excludes treatment, off-site transportation, or off-site treatment/disposal of contaminated soil.	[ ] Excavation [ ] Hauling [ ] Stockpiling [ ] [ ]
Sediment / Sludge Removal or Containment	Removal or containment of contaminated sediment or sludge. Excludes treatment, off-site transportation, or off-site treatment/disposal of contaminated sediment or sludge.	[ ] Excavation [ ] Dredging [ ] Vacuuming [ ] Lagoon/Basin/Tank [ ] [ ]

TABLE C-GW 4-1

CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-4 EXTRACTION, TREATMENT AND DISPOSAL

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Construction Activities			
Demolition and Removal	Demolition/removal of contaminated or hazardous materials or structures. Excludes treatment, off-site transportation, or off-site disposal of contaminated or hazardous materials or structures.		Drum Removal
			Tank Removal
			Piping Removal
			Structure Removal
			Asbestos Removal
			Contaminated Paint Removal
			Ordnance Removal and Destruction
Cap or Cover	Construction of a multi-layered cap or cover over contaminated materials or media (e.g., soil, sediment, sludge) to prevent or reduce exposure and minimize infiltration of surface water and production of leachate.		Subgrade Preparation
			Gas Collection Layer
			Low Permeability Clay Layer
			Bentonite
			Geosynthetic Clay Layer
			Geotextile
			Geomembrane
			Granular Drainage Layer
			Geonet
			Waste Placement (Cut/Fill)
			Protective Soil Layer
			Asphalt/Concrete Pavement
			Topsoil
			Erosion Control Fabric
			Seeding/Mulch/Fertilizer
On-Site Treatment	Construction or installation of a complete and usable on-site facility for treatment of contaminated media (e.g., soil, solids, sediment, sludge, surface water, groundwater), including in-situ and ex-situ techniques. Includes all mobilization and site work required for the treatment facility.	X	Mobilization/Demobilization
		X	Site Work
			Structures
		X	Process Equipment and Appurtenances
			Non-Process Equipment
		X	Startup and Testing
		X	Equipment Upgrade/Replacement

TABLE C-GW 4-1
CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-4 EXTRACTION, TREATMENT AND DISPOSAL

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
Construction Activities		
Off-Site Treatment / Disposal	Final placement of contaminated media, material, or treatment residuals at off-site commercial facilities, such as solid or hazardous waste landills and incinerators, that charge fees to accept waste based on certain criteria.	☒ Material Handling/Loading ☒ Transportation to Off-Site Facility ☒ Treatment/Disposal Fees ☐
Contingency	Costs added to cover unknown, unforeseen circumstances, or unanticipated conditions related to construction or installation of the remedial action.	☒ Scope Contingency ☒ Bid Contingency
Project Management	Services to support construction or installation of remedial action not specific to remedial design or construction management.	☒ Planning ☒ Community Relations ☒ Bid/Contract Administration ☒ Cost and Performance Reporting ☒ Permitting ☒ Legal ☒ Construction Complete Report ☐
Remedial Design	Services to design the remedial action, including pre-design activities to collect the necessary data.	☒ Field Data Collection and Analysis ☒ Design Survey ☒ Treatability Study ___ Bench-Scale ___ Pilot-Scale ✓ Field-Scale ☒ Preliminary/Intermediate/Final Design ✓ Design Analysis ✓ Plans & Specifications ✓ Construction Cost Estimate ✓ Construction Schedule ☐

TABLE C-GW 4-1

CAPITAL COST ELEMENT CHECKLIST - ALTERNATIVE GW-4 EXTRACTION, TREATMENT AND DISPOSAL

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Construction Activities			
Construction Management	Services to manage construction or installation of remedial action, excluding any similar services provided as part of construction activities.	☒	Submittal Review
		☒	Change Order Review
		☒	Design Modification
		☒	Construction Observation
		☒	Construction Survey
		☒	Construction Schedule Tracking
		☒	QA/QC Documentation
		☒	O&M Manual
		☒	Record Drawings
		☐	
		☐	
Institutional Controls	Non-engineering (i.e., administrative or legal) measures to reduce or minimize potential for exposure to site contamination or hazards (i.e., limit site access or restrict site access).	☒	Institutional Control Plans
		☒	Restrictive Covenants
		☒	Zoning
		☒	Property Easements
		☒	Deed Notice
		☒	Advisories
		☒	Groundwater Use Restrictions
		☒	Site Information Database
		☐	
		☐	

TABLE C-GW 4-2

O&M COST ELEMENT CHECKLIST - ALTERNATIVE GW-4 EXTRACTION, TREATMENT, AND DISPOSAL

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
O&M Activities			
Monitoring, Sampling, Testing, and Analysis[1]	Sampling, testing, on- or off-site analysis, data management, and quality assurance/quality control during the O&M period. Can include monitoring to evaluate remedy performance/compliance with regulations, or monitoring to track migration of contaminant plume.	☐	Meteorological Monitoring
		☐	Air Monitoring and Sampling
		☐	Radiation Monitoring
		☒	Health and Safety Monitoring
		☒	Personnel Protective Equipment
		☒	Monitoring Wells
		☐	Soil Sampling
		☐	Sediment Sampling
		☐	Surface Water Sampling
		☒	Groundwater Sampling
		☐	Process Water Sampling
		☐	Process Air Sampling
		☒	Laboratory Chemical Analysis
		☒	On-Site Chemcial Analysis
		☒	Chemical Data Management
		☐	
		☐	
Extraction Containment, or Treatment Systems[2]	Operation and maintenance of on-site systems to extract, contain, or treat contaminated media (e.g., soil, sediment, sludge, surface water, or groundwater).	☒	Operations Labor
		☒	Maintenance Labor
		☒	Equipment Upgrade/Replacement Repair
		☒	Spare Parts
		☐	Equipment Ownership/Rental/Lease
		☒	Consumable Supplies
		☐	Bulk Chemicals
		☒	Raw/Process Materials
		☒	Utilities
		☐	
		☐	

[1] Site Monitoring, performance monitoring, or compliance monitoring.

[2] Specify extraction, containment, or treatment system. Examples include groundwater extraction system, engineered cap or cover, soil vapor extraction system, groundwater treatment facility, etc. More than one system may be associated with an individual alternative.

TABLE C-GW 4-2

O&M COST ELEMENT CHECKLIST - ALTERNATIVE GW-4 EXTRACTION, TREATMENT, AND DISPOSAL

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description	Sub-Elements
O&M Activities		
Off-Site Treatment / Disposal	Treatment and/or disposal of wastes generated during operations and maintenance (e.g., on-site treatment residuals, monitoring wastes) at off-site commercial facilities, such as solid or hazardous waste landfills and incinerators.	☒ Material Handling/Loading ☒ Transportation to Off-Site Facility ☒ Treatment/Disposal Fees ☐
Contingency	Costs to cover unknowns, unforeseen circumstances, or unanticipated conditions associated with annual O&M of the remedial action.	☒ Scope Contingency ☒ Bid Contingency
Professional/Technical Services		
Project Management	Services to manage O&M activities not specific to technical support listed below.	☒ Planning ☒ Community Relations ☒ Cost and Performance Reporting ☒ Permitting ☒ Legal ☐
Technical Support	Services to monitor, evaluate, and report progress of remedial actions.	☒ O&M Manual Updates ☒ O&M Oversight ☒ Progress Reports ☐
Institutional Controls	Annual update or maintenance of non-engineering measures to reduce or minimize potential for exposure to site contaminants or hazards.	☒ Institutional Control Plans ☒ Restrictive Covenants ☒ Zoning ☒ Property Easements ☒ Deed Notice ☒ Advisories ☒ Groundwater Use Restrictions ☒ Site Information Database ☐

TABLE C-GW 4-3

PERIODIC COST ELEMENT CHECKLIST - ALTERNATIVE GW-4 EXTRACTION, TREATMENT, AND DISPOSAL

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Construction/O&M Activities			
Remedy Failure or Replacement	Construction activities to replace an installation remedy or key components of the remedy.	☒	Mobilization/Demobilization
		☒	Site Work
		☐	Structures
		☒	Process Equipment and Appurtenances
		☐	Non-Process Equipment
		☒	Startup and Testing
		☐	
		☐	
Demobilization of On-Site Extraction, Containment, or Treatment Systems[1]	Construction activity to dismantle or take down extraction, containment, or treatment facility or equipment upon completion of remedial action.	☒	Demolition and Removal
		☒	Well Abondonment
		☐	
		☐	
Contingency	Costs to cover unknowns, unforeseen circumstances, or unanticipated conditions associated with Construction /O&M activities.	☒	Scope Contingency
		☒	Bid Contingency

[1] Specify extraction, containment, or treatment system. Examples include groundwater extraction systems, soil vapor extraction system, groundwater treatment facility, etc. More than one system may be associated with an individual alternative.

Professional/Technical Services			
Five Year Review	Services to prepare five-year review reports (if hazardous substances, pollutants, or contaminants remain on-site above levels that allow for unrestricted use and unlimited exposure.	☒	Site Visit
		☒	Field Data Collection
		☒	Data Review and Analysis
		☒	Report Preparation
		☐	
		☐	

TABLE C-GW 4-3

PERIODIC COST ELEMENT CHECKLIST - ALTERNATIVE GW-4 EXTRACTION, TREATMENT, AND DISPOSAL

Feasibility Study
Nike SL-10 Launch Area Groundwater
Marine, Illinois

Cost Element	Description		Sub-Elements
Professional/Technical Services (cont.)			
Groundwater Performance Optimization Study	Services to analyze and optimize on-going groundwater pump and treat systems.	☒	Site Visit
		☒	Field Data Collection
		☒	Data Review and Analysis
		☒	Report Preparation
		☐	
		☐	
Remedial Acion Report	Services to prepare remedial action report upon completion of remedial action.	☒	Site Visit
		☒	Field Data Collection
		☒	Data Review and Analysis
		☒	Report Preparation
		☐	
		☐	
Institutional Controls	Periodic update or maintenance of non-engineering measures to reduce or minimize potential for exposure to site contaminants or hazards.	☒	Institutional Control Plans
		☒	Restrictive Covenants
		☒	Zoning
		☒	Property Easements
		☒	Deed Notice
		☒	Advisories
		☒	Groundwater Use Restrictions
		☒	Site Information Database
		☐	
		☐	