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RECORD OF DECISION BUILDING 81 FORMER NAS SOUTH WEYMOUTH MA

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RECORD OF DECISION

BUILDING 81

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS
SEPTEMBER 2014

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLES

NUMBER

FIGURES

NUMBER

ADMINISTRATIVE RECORD REFERENCE TABLE

APPENDICES

ABBREVIATIONS AND ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
BRAC	Base Realignment and Closure
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chemical of concern
CSF	cancer slope factor
CSM	conceptual site model
CVOC	chlorinated volatile organic compound
cy	cubic yard
DCE	dichloroethene
DoD	Department of Defense
EOS	emulsified oil substrate
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
FFA	Federal Facility Agreement
FS	Feasibility Study
ft	feet
ft/d	feet per day
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
ID	identification
ILCR	incremental lifetime cancer risk
IR	Installation Restoration
IRA	Immediate Response Action
ISCO	in-situ chemical oxidation
IUR	inhalation unit risk
LNAPL	light non-aqueous phase liquid
LNR	LNR South Shore, LLC
LTM	long-term monitoring
LUCs	land use controls
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MCP	Massachusetts Contingency Plan
mg/kg	milligram per kilogram
MNA	monitored natural attenuation
mw	monitoring well
NA	Not applicable
NAS	Naval Air Station

ABBREVIATIONS AND ACRONYMS (CONTINUED)

Navy	U.S. Department of Navy
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NPW	net present worth
O&M	operation and maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PRG	Preliminary Remediation Goal
RAB	Restoration Advisory Board
RAM	Release Abatement Measure
RAO	Remedial Action Objective
RD	Remedial Design
RecD	Recreation District
RfC	reference concentration
RfD	reference dose
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SF	slope factor
SI	Site Investigation
SMP	Site Management Plan
SSTTDC	South Shore Tri-Town Development Corporation
SVOC	semi-volatile organic compound
TBC	To Be Considered
TCE	trichloroethene
TPH	total petroleum hydrocarbons
TTZ	target treatment zone
UST	underground storage tank
VCD	Village Center District
VI	vapor intrusion
VOC	volatile organic compound
µg/L	microgram per liter

1.0 DECLARATION

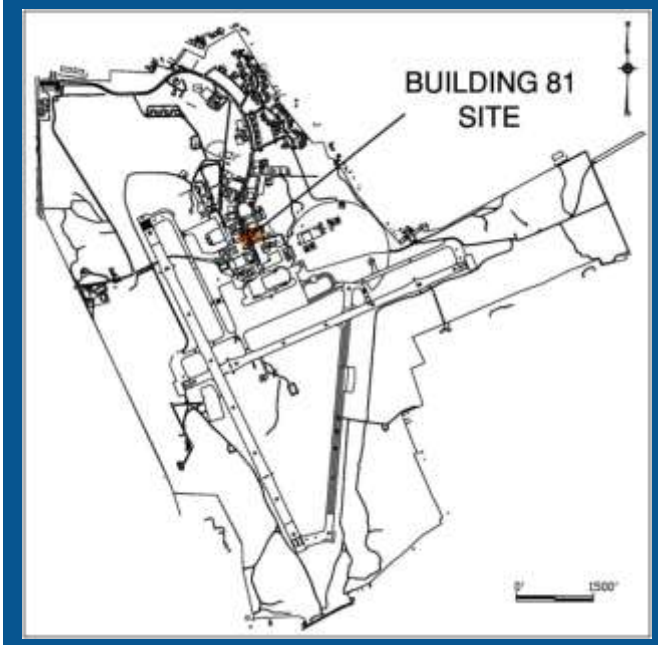
1.1 SITE NAME AND LOCATION

Building 81, which is also known as Operable Unit (OU) 9 and Installation Restoration (IR) Site 9, is located within the former Naval Air Station (NAS) South Weymouth, Weymouth, Massachusetts. The former NAS South Weymouth has been assigned United States Environmental Protection Agency (EPA) Identification (ID) Number MA2170022022.

1.2 STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the Selected Remedy for Building 81 (the Site), which was chosen by the U.S. Department of Navy (Navy) and EPA in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record for the Site. The Massachusetts Department of Environmental Protection (MassDEP) concurs with the Selected Remedy, as shown in Appendix A. Figure 1-1 depicts the location of Building 81 within former NAS South Weymouth.

FIGURE 1-1. BUILDING 81 LOCATION MAP



1.3 ASSESSMENT OF SITE

The response action selected in this ROD is necessary to protect the public health and welfare or the environment from actual or threatened releases of hazardous substances, pollutants, or contaminants into the environment. A CERCLA action is required because concentrations of chlorinated volatile organic compounds (CVOCs), benzene, toluene, and naphthalene in site groundwater would pose unacceptable risks to human health under future recreational, commercial, institutional and/or residential land use scenarios.

1.4 DESCRIPTION OF SELECTED REMEDY

The Selected Remedy addresses potential unacceptable human health risks associated with extraction of site groundwater for production, supply and irrigation uses, or risks associated with vapor intrusion or vapors in construction trenches, by reducing site-wide contaminant concentrations in groundwater to cleanup levels. Land use controls (LUCs) will be implemented as necessary to control exposure pathways until unacceptable risks are eliminated. Implementation of this remedy is expected to achieve substantial long-term risk reduction and will allow for future recreational, commercial, and institutional site uses as consistent with the established zoning and the Reuse Plan.

No unacceptable risks associated with exposure to site soils to a depth of 6 feet (ft) below ground surface (bgs) were identified. Contaminated soils at greater depths were not assessed since it was assumed that such soils would be directly or indirectly addressed by the groundwater remedy. No unacceptable risks

associated with exposure to ambient air are anticipated. There is no significant potential ecological habitat and no exposure pathway for Site contaminants to create an ecological risk.

The major components of the selected remedy for Building 81 include the following:

- Enhanced In-Situ Bioremediation to reduce contaminant concentrations in the overburden and bedrock source zones.
- Bio-barriers in the overburden and bedrock to intercept and treat the contaminant plume at its leading edge.
- Monitored natural attenuation (MNA) in the area between the source zone target treatment zones (TTZ) and the bio-barriers, to further reduce any residual CVOCs remaining after active treatment with enhanced bioremediation.
- Permanent LUCs to: (1) prohibit installation of groundwater production, supply, and irrigation wells at the Site; and (2) prohibit future residential uses within the Recreation District (RecD) zoning district at the Site.
- Interim LUCs to: (1) restrict the type and nature of construction permitted in the source area of the plume where the highest volatile organic compound (VOC) concentrations have been detected and where active remediation might be conducted (as a contingency) until cleanup levels are achieved; (2) restrict construction in the vicinity of the bio-barriers, to prevent disturbance of and damage to the injection wells and allow future injections; (3) require prior Navy, EPA, and MassDEP approval of (a) construction dewatering plans before excavation activities could be conducted; (b) health and safety procedures to be used by construction workers to prevent unacceptable exposure risks, until cleanup levels are achieved; and (c) passive ventilation design and building construction methods, such as a sub-slab vapor mitigation system, to prevent exposure of building occupants to vapor intrusion from VOCs in groundwater at levels that pose an unacceptable risk, until cleanup levels are achieved.
- Inspections to confirm compliance with the LUCs objectives.
- Monitoring of groundwater to evaluate the progress of remediation.
- Completion of five-year reviews as long as chemical of concern (COCs) are present at concentrations that prevent unlimited exposure and unrestricted use.

The remediation at Building 81 will not adversely impact the current use and reasonably anticipated future uses of the Site. This ROD documents the final remedial action for Building 81 and does not include or adversely impact any other sites at former NAS South Weymouth.

1.5 STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, satisfies the statutory requirements of CERCLA §121 and the regulatory requirements of the NCP, is cost-effective, and utilizes permanent solutions to the maximum extent practicable. This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, and/or volume of hazardous substances, pollutants, and contaminants as a principal element through treatment).

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years of initiation of the remedial action and every 5 years thereafter to ensure that the remedy is, or will be, protective of human health and the environment.

1.6 ROD DATA CERTIFICATION CHECKLIST

The locations of specific information required to be included in Section 2.0, the Decision Summary of the ROD, are listed in Table 1-1. Additional information can be found in the Administrative Record file for former NAS South Weymouth.

TABLE 1-1. ROD DATA CERTIFICATION CHECKLIST

DATA	LOCATION IN ROD
COCs and their respective concentrations	Sections 2.5 and 2.7
Baseline risk represented by the COCs	Section 2.7
Cleanup levels established for COCs and the basis for these levels	Sections 2.7 and 2.8
How source materials constituting principal threats are addressed	Section 2.11
Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the risk assessment	Section 2.6
Potential land and groundwater uses that will be available at the Site as a result of the Selected Remedy	Section 2.12.3
Estimated capital, operation and maintenance (O&M), and total net present worth (NPW) costs; discount rate; and number of years over which the remedy costs are projected	Appendix B
Key factors that led to the selection of the remedy	Section 2.12.1

1.7 AUTHORIZING SIGNATURES

David A. Barney
BRAC Environmental Coordinator
BRAC PMO East
U.S. Navy

9/17/14
Date

James T. Owens, III
Director, Office of Site Remediation and Restoration
Region 1 – New England
U.S. Environmental Protection Agency

9/30/14
Date

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The former NAS South Weymouth (the Base), EPA ID number MA2170022022, is located primarily in the Town of Weymouth, Massachusetts. Portions of the former NAS South Weymouth extend into the adjacent Towns of Abington and Rockland, Massachusetts. The Building 81 Site is located within the Town of Weymouth. The Base was developed during the 1940s for dirigible aircraft used to patrol the North Atlantic during World War II. The facility was closed at the end of the war and was reopened in 1953 as a Naval Air Station for aviation training. The Base was in continuous use from that time until it was operationally closed on September 30, 1996, and was administratively closed on September 30, 1997. The majority of the base property has been transferred to the South Shore Tri-Town Development Corporation (SSTTDC) for re-development in accordance with the SSTTDC Reuse Plan and Zoning and Land Use By-Laws.

Contamination at the Site was initially identified during the removal of a waste oil underground storage tank (UST) in 1991, when the Base was converting from underground waste oil storage to above-ground storage in 55-gallon drums. A voluntary Phase I Limited Site Investigation was conducted under the Massachusetts Contingency Plan (MCP) in June 1993 to determine if waste oil from the tank had contaminated the soil below. The Navy performed several soil removals and additional investigations under the MCP regulatory program between 1993 and 1998; CVOCs were detected in soil and groundwater. Once non-petroleum based contaminants were found, the Site was moved from the MCP program into the Navy's IR Program for further investigation under the CERCLA program. The Site was designated as IR Site 9, also referred to as OU 9.

The Building 81 Site is located in the central portion of the Base, approximately 4,500 ft southeast of the main entrance to the Base on Route 18 (Figure 1-1). A part of the Site where the release occurred is fenced and is bounded by Shea Memorial Drive to the west, Redfield Road to the north, an overgrown, heavily vegetated area to the east, and Building 140 to the south (Figure 2-1). A dissolved VOC contaminant plume extends west-southwest, across Shea Memorial Drive toward Building 15 (the Transportation Building), as shown on Figure 2-1. The fenced area of the Site is comprised of approximately 1 acre of level land occupied by the former Building 81 foundation (a concrete slab) and paved areas to the east and south. A large excavated area that has been backfilled but not repaved is located on the Site, east of the building slab.

Only the slab foundation of Building 81 remains at this time. Prior to being demolished in 1997, the building had been a one-story structure measuring 80 ft by 100 ft, and constructed on a concrete slab foundation. The building had two floor drains: one in the western part of the large open bay, which was connected into the sanitary sewer; and the other in the service room in the southwest corner of the building, which was connected to the storm drain system.

The former NAS South Weymouth is a closed facility, and environmental investigations and remediation at the Base are funded under the Department of Defense (DoD) Base Realignment and Closure (BRAC) program. The Navy is the lead agency and EPA the lead regulatory agency for CERCLA activities at the former NAS South Weymouth.

FIGURE 2-1. BUILDING 81 SITE PLAN

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Table 2-1 provides brief summaries of the numerous environmental investigations and removal actions that have been conducted at Building 81. The results of these investigations indicated that CVOCs and benzene, toluene, and naphthalene are present in groundwater at concentrations potentially harmful to human health. A summary of the nature and extent of groundwater contamination is included in Section 2.5.2.

TABLE 2-1. PREVIOUS INVESTIGATIONS AND SITE DOCUMENTATION

INVESTIGATION	DATE	ACTIVITIES
UST Removal	1991	The 500-gallon **waste oil UST** and associated piping at the Site were removed when the Base converted to above-ground storage of waste oil in 55-gallon drums. A small quantity of soil (estimated to be less than 30 cubic yards [cy]) was also removed to gain access to the tank and piping. The work was performed under the MCP.
Voluntary Phase I Limited Site Investigation (SI)	1993	The Phase I Limited SI was conducted under the MCP to further investigate soil and groundwater contamination from the former UST. Two soil borings were advanced and a single monitoring well (MW-1) was installed to collect soil and groundwater samples, respectively, for total petroleum hydrocarbons (TPH) and metals analysis.

TABLE 2-1. PREVIOUS INVESTIGATIONS AND SITE DOCUMENTATION (CONT.)		
INVESTIGATION	**INVESTIGATION**	**INVESTIGATION**
Immediate Response Action (IRA)	1994	Approximately 170 cy of contaminated soil in the vicinity of the former tank grave were removed and replaced with clean fill. Three monitoring wells were installed outside the perimeter of the excavation and sampled. TPH was detected in six of the seven soil samples collected along the sidewalls and floor of the excavation at concentrations exceeding the MCP criterion. Two polycyclic aromatic hydrocarbon (PAH) compounds (naphthalene and 2-methylnaphthalene) were detected in one and three soil samples, respectively, at concentrations exceeding the MCP criteria. A light non-aqueous phase liquid (**LNAPL**) was found and evacuated from the monitoring well installed within the former tank grave.
Phase I Initial SI	1995	The Phase I Initial SI was conducted under the MCP to further investigate conditions in the area of the former waste oil UST to determine the nature and extent of the release and identify potential human and environmental **receptors**. Six borings were installed and three completed as monitoring wells. Soil and groundwater were sampled for TPH, VOCs, semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and metals. Various contaminants were detected, including the chlorinated solvent tetrachloroethene (PCE) at concentrations above EPA Maximum Contaminant Levels (MCLs) for drinking water.
Interim Phase II Comprehensive Site Assessment	1996	Based on the results of the Phase I Initial SI, an additional investigation was performed to further characterize soils and groundwater. The work included soil sampling, groundwater profiling, monitoring well installation and sampling, **hydraulic conductivity** testing, and checks of LNAPL thickness in the wells. The highest PCE concentration was from the well furthest downgradient of the former tank, indicating that the size of the study area needed to be increased.
Supplemental Phase II Comprehensive Site Assessment	1997	The supplemental investigation included additional groundwater profiling, soil sampling, and monitoring well installation and sampling. The investigation concluded that both petroleum-related (benzene, toluene, ethylbenzene, and xylene [BTEX]) contaminants and PCE were from the waste oil. The report **recommended** additional sampling to delineate the vertical extent of contamination.
Release Abatement Measure (RAM)	1998	The RAM was conducted to remove the remaining source of waste oil-impacted soil by excavating VOC-containing soils in the vicinity of the former tank grave as identified in the previous investigations. Soil associated with a localized area of PAH-contamination east of the former tank was also removed. 1,200 cy of VOC-impacted soil were removed from the former UST area in two phases of excavation, and 50 yards were removed to mitigate PAH contamination. Soils were sent off-site for recycling via **asphalt batching** and the excavations backfilled with clean material.
Additional PCE Assessment	1998	The PCE assessment involved well installation, inspection of rock cores, and additional groundwater sampling to support a bedrock investigation.
Bedrock Characterization	1999	The 1999 bedrock investigation, along with the 1998 additional PCE assessment, was intended to support the planned in-situ chemical oxidation (ISCO) pilot study. It included bedrock coring, discrete interval groundwater sampling, injection testing, bedrock well installation, and geophysical testing. Results indicated that injection could be performed with a maximum depth of 30 to 40 ft bgs, but that the injection area would be dependent on bedrock **fracture orientation**.

TABLE 2-1. PREVIOUS INVESTIGATIONS AND SITE DOCUMENTATION (CONT.)		
INVESTIGATION	**INVESTIGATION**	**INVESTIGATION**
ISCO Pilot Test	2000-2001	The pilot test was conducted to assess whether total CVOC concentrations in groundwater could be reduced 80 to 90 percent using ISCO and to evaluate the effectiveness of ISCO for a full-scale application at the Site. Prior to the pilot test, 23 monitoring wells and 51 injection wells were installed, and **Fenton's reagent** was injected in two separate events. Groundwater was sampled before, during, and after injection. A total of 961 gallons of hydrogen peroxide and 1,896 gallons of catalyst solution were injected. The pilot test was relatively effective for BTEX compounds, but did not reduce CVOC concentrations to the target concentration throughout the **plume**.
Phase I Remedial Investigation (RI)	2005	A number of activities were conducted to determine sampling locations and support the full RI: monitoring well inspection and redevelopment, synoptic water level round, bedrock borehole clearing, hydraulic conductivity testing, and bedrock **borehole geophysics**. No samples were collected for chemical analysis.
Phase II RI	2008	The Phase II RI included advancement of soil borings and soil classification; collection of groundwater profiling samples; installation of groundwater monitoring wells; well development; collection of soil and groundwater samples for chemical analysis; water elevation measurements, hydraulic conductivity tests, and surveying. Results are included in the 2011 RI Report.
Supplemental RI Field Program	2009-2011	The supplemental field investigation was conducted to fill **data gaps** identified in the draft RI Report. It included drilling and soil classification, bedrock coring, well installation, borehole geophysics, well development, groundwater sampling, hydraulic conductivity testing, water level measurements, sub-slab and soil gas sampling, and surveying of selected existing monitoring wells and all new monitoring wells.
Feasibility Study (FS)	2013	Based on the results of the RI and the Supplemental RI, potential **alternatives** to address contaminants were developed and evaluated.

Additional information about terms in **blue text** *is provided in the Administrative Record Reference Table included at the end of this ROD.*

There have been no cited violations under federal or state environmental law or any past or pending enforcement actions pertaining to the cleanup of the Building 81 Site.

2.3 COMMUNITY PARTICIPATION

The Navy has performed public participation activities in accordance with CERCLA and the NCP throughout the CERCLA site cleanup process at the former NAS South Weymouth. The Navy released a Community Relations Plan in July 1998 to address community concerns and keep citizens informed about and involved in remediation activities. In September 1995, the Navy initiated a series of public meetings, at which the Restoration Advisory Board (RAB) process was explained, and community members were asked to join the RAB. A sufficient number of interested community members were assembled and RAB meetings began in March 1996. Since that time, RAB meetings have been held on a regular basis to keep the RAB and local community informed of IR Program activities. RAB meetings held during February 2011, and June 2012 included presentations specifically highlighting the Building 81 Site. Other RAB meetings have included brief updates of Building 81 Site activities as they progressed.

The Navy has generated an index of the Administrative Record to identify the documents used in the decision-making process for this Building 81 Site ROD. The index is attached to this ROD. The Administrative Record files are available for public review at several locations, including the Tufts Library in Weymouth, Massachusetts; the Abington Public Library in Abington, Massachusetts; the Hingham Public Library in Hingham, Massachusetts; the Rockland Memorial Library in Rockland, Massachusetts; and the Navy, Caretaker Site Office, South Weymouth, Massachusetts. Site documents and RAB

meeting information are also available on the Department of the Navy BRAC Program Management Office website, www.bracpmo.navy.mil.

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period from October 15, 2013 to November 14, 2013, for the proposed alternative described in the Proposed Plan for Building 81. A public meeting to present the Proposed Plan was held on October 22, 2013, at the Caretaker Site Office, 1134 Main Street, Building 11, South Weymouth. The public meeting was followed by a public hearing to accept oral comments on the Proposed Plan. **Public notice** of the meeting/hearing and availability of documents was published in the Patriot Ledger on October 11, 2013, Weymouth News on October 9, 2013, and Rockland Mariner/Standard on October 11, 2013. Comments received on the Proposed Plan are addressed in Section 3 of this ROD.

2.4 SCOPE AND ROLE OF OPERABLE UNIT

The Building 81 Site is part of the Navy IR Program, a comprehensive environmental investigation and cleanup program being performed at former NAS South Weymouth under CERCLA authority and pursuant to the Federal Facility Agreement (FFA) signed by the Navy and the EPA in April 2000. Eleven IR sites have been identified at former NAS South Weymouth. Building 81 is IR Site 9.

The RODs for IR Sites 1 through 5, 7, 8, 10 and 11 have been finalized and signed by the Navy and EPA. IR Site 6 was transferred out of the IR program and addressed as a petroleum site under the UST program portion of the regulatory structure presented in the MCP. The Site Management Plan (SMP) for former NAS South Weymouth provides further details on the IR sites, ROD issuance dates (as applicable), and schedule for post-ROD activities. The SMP is updated by the Navy on an annual basis.

Investigations at Building 81 indicated the presence of groundwater contamination that poses unacceptable human health risk to potential future receptors at the Site. The remedy documented in this ROD will achieve the Remedial Action Objectives (RAOs) for Building 81, as listed in Section 2.8. Implementation of this remedy will allow for future recreational, commercial, and institutional uses of the Site that are consistent with the established zoning and the Reuse Plan, as well as the overall cleanup strategy for former NAS South Weymouth.

2.5 SITE CHARACTERISTICS

Figure 2-2 presents the Building 81 conceptual site model (CSM) developed using the results of the RI. The CSM identifies potential contaminant sources, contaminant release mechanisms, transport routes, and potential receptors under current and future land use scenarios. The primary contaminant release and transport mechanisms include releases to the subsurface from the former waste oil tank area and migration in groundwater. Human health receptors evaluated in the RI and the actual risks to those receptors are discussed in Section 2.7.1.

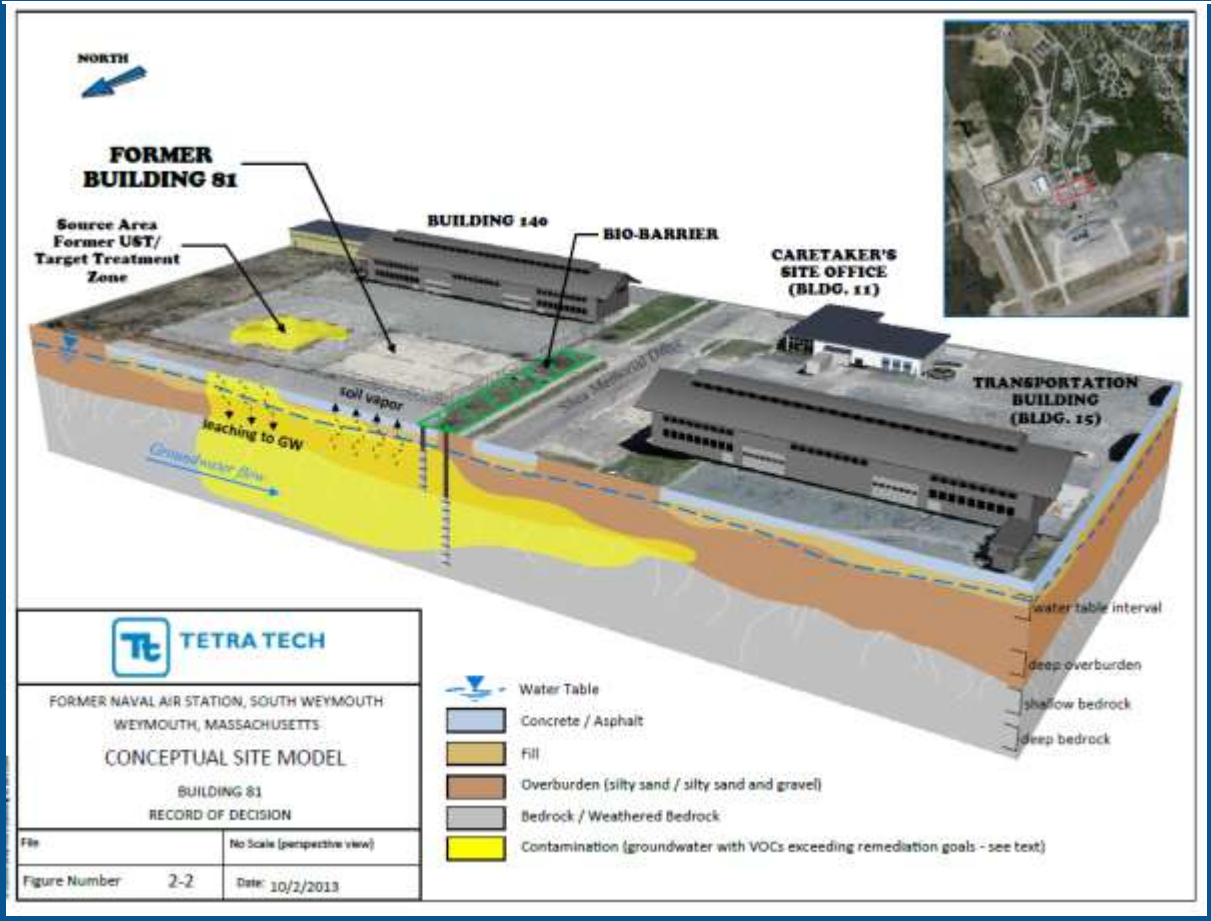
2.5.1 Physical Characteristics

Three general **geologic units** have been identified at the Building 81 Site: fill (artificially placed), overburden (undisturbed), and bedrock. The fill includes materials that have been placed in areas where soil has been excavated for removal actions; construction materials beneath the building slab; and materials that were placed in utility trenches and beneath roadways. The undisturbed overburden consists of approximately 15 to 20 ft of native unconsolidated material, which is predominantly sand with varying amounts of gravel and silt.

Bedrock was confirmed during drilling programs conducted in support of the various investigations at the Site. In total, 71 bedrock exploration points have been drilled and boring logs from 54 bedrock well locations were evaluated to characterize the bedrock beneath the Site. Bedrock core samples indicate that the Site is underlain by granite. The rock is variably **weathered/altered**, fractured, mostly coarse-grained, equi-granular to slightly porphyritic, and light grayish-pink to greenish-gray in color. Principal

constituents include quartz and feldspar, with lesser amounts of biotite and hornblende. The cores showed vertical to near-horizontal fractures with varying apertures. Fractures intersected one another several times. Green-colored alteration minerals (likely chlorite or epidote) were commonly observed on fresh fracture surfaces. Other observations included: iron oxide staining along some of the fractures, fractures filled with sediment, large grain sizes, quartz and calcite filled veins, garnets, and potential evidence of superheating or hydrothermal alteration evidenced by halos and by silica bands that showed no distinguishable constituents. Depth to bedrock encountered during the investigations ranged from about 13.5 to 21 ft bgs.

FIGURE 2-2. BUILDING 81 CONCEPTUAL SITE MODEL



Weathered rock is interpreted to be the upper portion of the rock that is highly fractured or that shows evidence of chemical or mechanical alteration. At Building 81, a discontinuous zone of weathered rock was identified in nearly 45 percent of the drilling locations. None of the rock was so weakened by weathering that it was decomposed or disintegrated to a soil. Borings that encountered weathered rock on the east side of the building footprint are separated from other borings that encountered it on the west side of the building footprint by a dozen intervening bedrock borings that did not encounter this zone. The transition between weathered rock and competent rock is gradational based on examination of available core samples. None of the on-site wells are screened entirely within the weathered zone. Where the weathered bedrock zone exists, it serves as a transition zone between the overburden and the deeper less fractured underlying bedrock. It does not appear to be a barrier to flow based on the presence of contaminants at depth.

The measured depths to groundwater at the Site during several water level events ranged from approximately 2 to 8 ft bgs in the fall and approximately 0 to 7 ft bgs in the spring. Groundwater contour maps prepared for four groundwater depth intervals at the Site, including the shallow and deep overburden, and shallow and deep bedrock units, indicate that the overall groundwater flow direction at the Site is generally toward the west-southwest. Toward the west, the contours progressively flatten out and the groundwater flow direction becomes more westerly or southwesterly with distance from east to west across the Site.

Horizontal **hydraulic gradients** were calculated for the four groundwater depth intervals for the representative seasonal low and high water measurement rounds. The results indicate slightly steeper gradients in shallow bedrock, compared to both the shallow and deep overburden and the deep bedrock units during both time periods, as well as steeper horizontal gradients in the spring than in the fall in all units.

Vertical hydraulic gradients were calculated at 17 monitoring well clusters located throughout the Site to evaluate vertical groundwater flow conditions for all groundwater measurement events. The vertical component of groundwater flow between shallow and deep overburden wells during the fall groundwater measurement round was mostly positive; a combination of upward, downward, and neutral gradients were calculated during the spring groundwater event. Vertical gradients across the bedrock interface (between deep overburden and shallow bedrock) also varied; a combination of upward, downward, and neutral gradients were calculated during all of the events. The vertical gradients between the shallow and deeper bedrock were generally neutral or downward for all the events.

Hydraulic conductivity **slug test** values for the shallow overburden (0.04 to 1.6 ft per day [ft/d]) are an order of magnitude lower than those in the deep overburden (0.6 to 107 ft/d). The hydraulic conductivity values for the shallow bedrock (0.03 to 32 ft/d) are an order of magnitude lower than those for the deep overburden. The range of values for the shallow bedrock is about one order of magnitude higher than the range for the deeper bedrock (0.02 to 0.4 ft/d). These estimates from slug tests are generally consistent with the geologic materials descriptions from the associated boring logs.

The estimated groundwater flow velocities were generally faster during seasonal high water level periods relative to seasonal low water level periods as a result of a steeper horizontal hydraulic gradient. Based on the seasonal high water level data, the groundwater flow velocity estimates were approximately 0.05 ft/d for shallow overburden, 0.6 ft/d for deep overburden, 0.9 ft/d for shallow bedrock, and 0.09 ft/d for deeper bedrock. No highly conductive zones are apparent in either the overburden or bedrock units based on review of the slug test data.

2.5.2 Nature and Extent of Contamination

An evaluation of the groundwater, soil, and soil vapor results presented in the RI is included below.

In general, although most of the continuing source of VOC contamination in soil was removed from the Site in the 1998 excavation activities, some contamination remains in the soils beneath and west of the excavation. This residual contaminant mass may serve as a continuing source of dissolved VOCs in

groundwater. The absence of a **confining layer** above the bedrock surface allowed contaminants to migrate from the overburden into the shallow bedrock. Preferential flow along fractures likely caused increased concentrations with depth. In addition, a limited mass of contaminants migrated into deeper bedrock, either through more vertical or high angle fractures or through the long open borehole injection wells.

Groundwater

The predominant contaminants present at the Building 81 Site are VOCs in groundwater. A dissolved VOC contaminant plume at the Site extends from the vicinity of the former tank approximately 360 ft west-southwest, across Shea Memorial Drive toward Building 15. VOC contaminants are present in groundwater from the shallow overburden down into the deep bedrock; however, the highest concentrations of VOCs are present in the deep overburden and shallow bedrock zones, and the extent of the plume is the greatest in these zones. The CVOCs, PCE and its degradation products, trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride, and the aromatic hydrocarbon benzene, are the most widespread contaminants present at concentrations exceeding the applicable screening criteria. PCE is the most frequently detected compound in groundwater and is present at the highest concentrations. Figures 2-3 and 2-4 show the PCE plume in deep overburden and shallow bedrock groundwater, respectively, the groundwater zones where the highest concentrations and the greatest extent of PCE (and VOCs in general) are present. The concentration contour indicating 5 micrograms per liter (µg/L), the EPA MCL for PCE, is highlighted on the figures for reference only.

Nine SVOCs (benzo(a)anthracene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, 2-methylnaphthalene, 1,4-dioxane, N-nitrosodiphenylamine, and bis(2-ethylhexyl)phthalate) were detected in groundwater at concentrations exceeding the applicable screening criteria, each in a limited number of samples. The highest concentrations of these compounds in groundwater were detected in samples from wells within or immediately downgradient of the former tank excavation area. Where detected, these SVOCs were generally co-located with the predominant VOCs.

Several pesticides in Site groundwater were generally detected infrequently and at low concentrations. Four pesticides (aldrin, dieldrin, heptachlor, and heptachlor epoxide) were detected in overburden and bedrock groundwater at concentrations that exceeded the applicable screening criteria, each in approximately 4 to 11 percent of groundwater samples.

PCBs were not detected in groundwater.

Concentrations of three metals (arsenic, iron, and manganese) exceeded the applicable screening criteria most frequently in all four groundwater depth intervals. Nearly all iron concentrations were lower than the background concentrations; background concentrations have not been established for arsenic and manganese. Because iron is an essential nutrient and is not included in risk calculations, the metals evaluation focused on arsenic and manganese.

Soil

VOCs are present in Site soil, but to a much lesser extent than in groundwater. The VOCs in soil are concentrated mainly in subsurface soils located within the 6 to 20 ft bgs soil depth interval, which coincides with the overburden aquifer. The VOC concentrations in saturated soils are generally low relative to the applicable screening criteria. Concentrations of five VOCs, including PCE and benzene, exceed the screening criteria – each in one or two samples. The maximum concentration of nearly every VOC detected in the 6 to 20 ft bgs soil depth interval is in a sample collected from 12 to 14 ft bgs in soil boring SO-108, located in the former tank excavation area. The most prevalent VOC detected in soil is PCE.

The majority of the SVOCs present in site soil were detected infrequently and usually at low concentrations relative to the screening criteria. Seven SVOCs (all PAHs) were detected in site soil at concentrations exceeding the screening criteria - each in only a small number of samples.

FIGURE 2-3. PCE IN DEEP OVERBURDEN GROUNDWATER

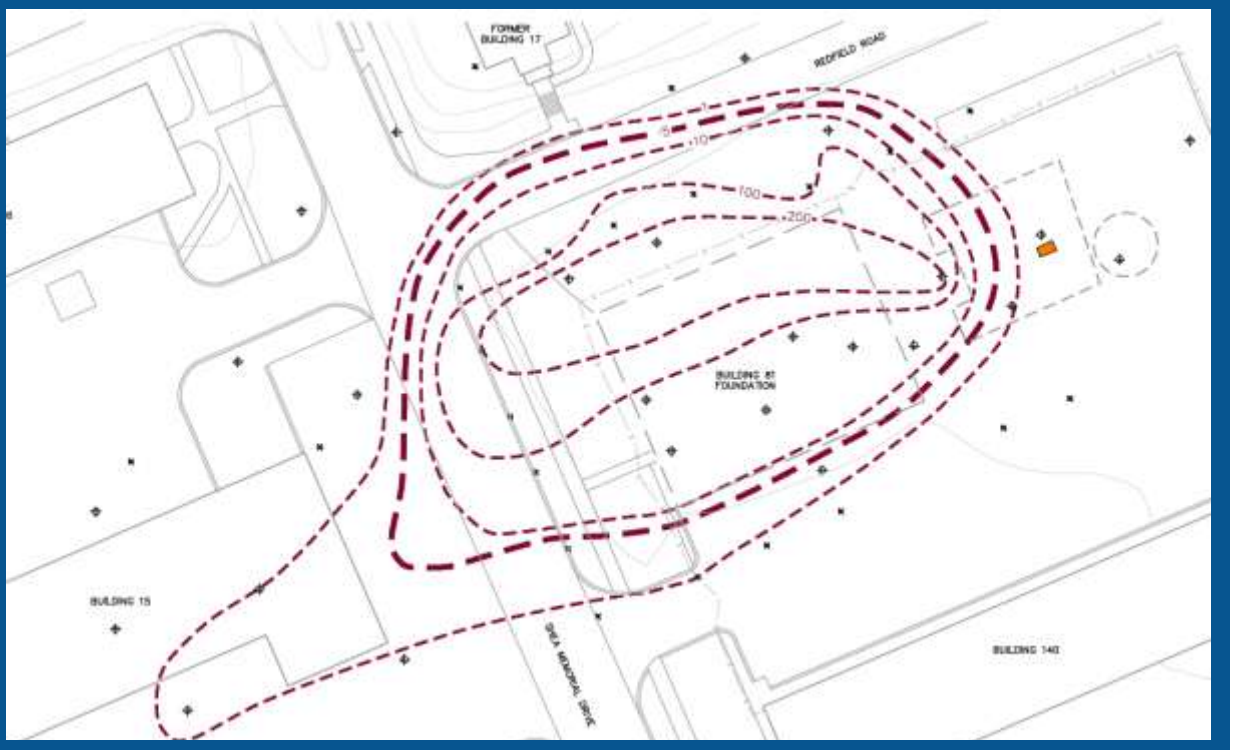


FIGURE 2-4. PCE IN SHALLOW BEDROCK GROUNDWATER

Pesticides in soil did not exceed the screening criteria. One PCB, Aroclor 1260, was detected in five soil samples at concentrations below its screening criteria. The highest concentrations of Aroclor 1260 were detected in soil samples collected from a boring directly beneath the former tank excavation area. Lower concentrations of Aroclor 1260 were detected in surface soil samples from both exposed and paved areas.

Several metals were detected in Site soil, and four metals (arsenic, iron, manganese, and vanadium) were present at concentrations exceeding the applicable screening criteria.

Soil/Sub-slab Vapor

VOCs are present in soil vapor immediately beneath the Building 81 slab (a gravel layer) and in soil approximately 3 to 4 ft below the slab. Three VOCs, including PCE and two petroleum hydrocarbons (benzene and ethylbenzene) were detected at concentrations greater than 10 times the 2010 EPA Regional Screening Levels. The most prevalent VOC detected in soil vapor is PCE, which was detected above the screening criterion in every sample. Maximum concentrations of PCE were detected in the southeast quadrant of the foundation, downgradient of the source area and within the PCE groundwater plume. Elevated levels of benzene were detected in soil vapor samples at depth in three samples near or within the benzene plume in the water table interval.

2.6 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Former NAS South Weymouth was designated for closure under the BRAC Act of 1990, as part of the BRAC Commission's 1995 Base Closure List (BRAC IV). Operational closure of former NAS South Weymouth began in September 1996 with the transfer of aircraft to other Navy facilities, and through personnel reductions. Former NAS South Weymouth was closed administratively under BRAC on September 30, 1997.

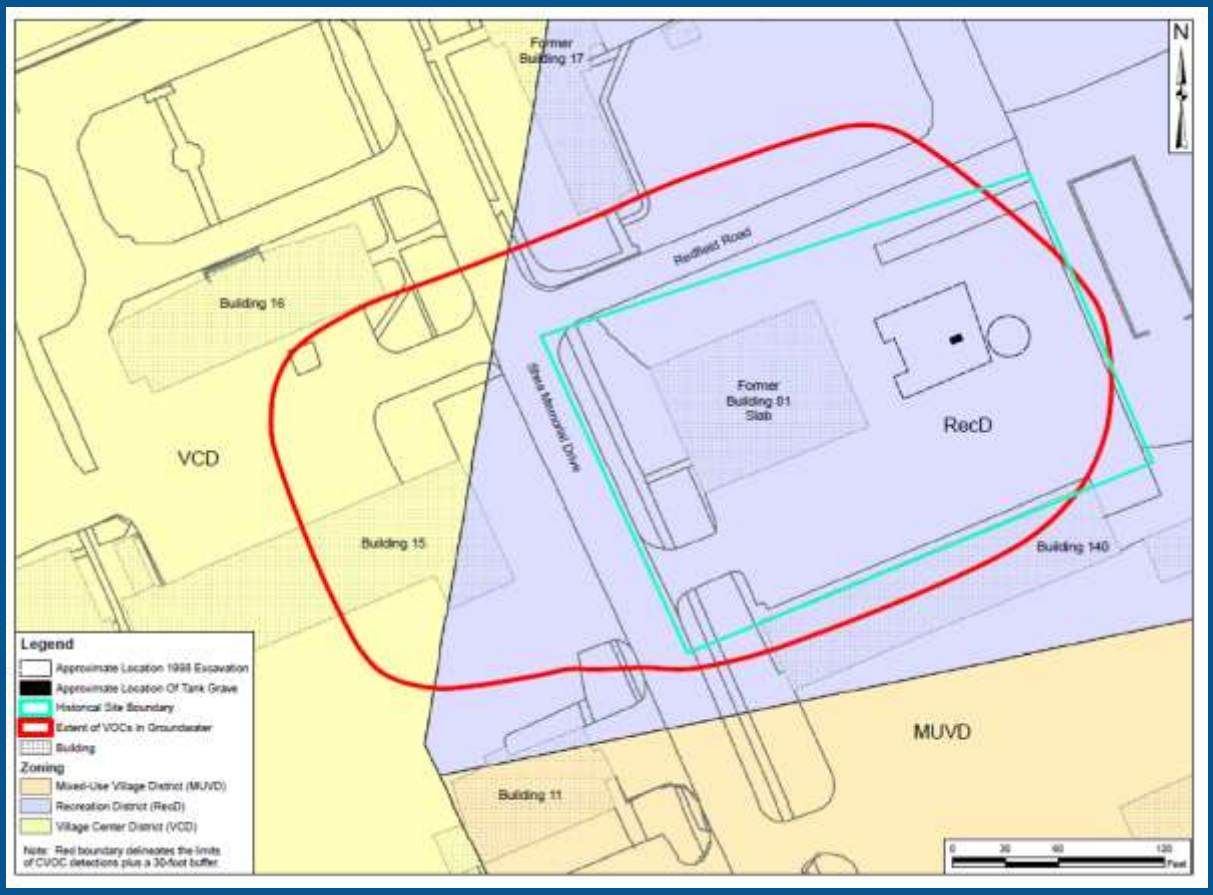
Currently, the Building 81 Site is vacant and remains part of the former NAS South Weymouth property owned by the Navy. The Navy plans to transfer the property as part of the redevelopment of the Base once the environmental cleanup is implemented and the property is determined to be suitable for transfer. The SSTTDC Zoning and Land Use By-Laws established a RecD zone for the part of the Site where the release occurred. Village Center District (VCD) zoning is present to the west, where a dissolved VOC contaminant plume extends across Shea Memorial Drive toward Building 15, as shown on Figure 2-5. In the recreational-zoned area, the range of allowed future uses could include indoor and outdoor commercial recreation, athletic fields, health and fitness clubs, some institutional uses under a special permit only, and passive recreation such as walking trails. The VCD zoning allows for mixed use areas, with a range of future uses that could include residential development, office, commercial and/or retail uses.

There are no medium- or high-yield aquifers mapped at the Site, so site groundwater is not considered a drinking water source. The Local Redevelopment Authority, SSTTDC, as well as the Master Developer, LNR South Shore, LLC (LNR), have indicated that groundwater production, supply, and irrigation needs for the redevelopment can be provided by sources other than the groundwater associated with the Building 81 Site.

2.7 SUMMARY OF SITE RISKS

The baseline risk assessment in the RI estimates what risks the Site poses if no action is taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. A **human health risk assessment** (HHRA) was performed as part of the RI, using only validated analytical results. The risk assessment used data from the 2006 comprehensive groundwater sampling round and the 2009-2010 supplemental investigation. All soil data

FIGURE 2-5. ZONING OF SITE AND SURROUNDING AREA



from previous investigations were included in the HHRA, with the exception of data representing soil that had been excavated in subsequent removal actions. The Building 81 Site lacks any significant potential ecological habitat and there is no current complete exposure pathway for site contaminants to ecological receptors; therefore, an ecological risk assessment (ERA) was not conducted.

2.7.1 Summary of Human Health Risk

The HHRA was conducted using chemical concentrations detected in surface and subsurface soil, groundwater, and soil gas samples (soil gas data were evaluated qualitatively; other evaluations were quantitative). Key steps in the risk assessment process included selection of **COCs**, exposure assessment, toxicity assessment, and risk characterization, as discussed below. Tables summarizing the data used in the HHRA and the associated results are presented in Appendix C. The exposure pathways evaluated in the HHRA are presented in Appendix C, Figure C-1.

Identification of COCs

Tables C-1 through C-5 in Appendix C present exposure point concentrations (EPCs) for the COCs identified in surface soil, subsurface soil, and groundwater. EPCs are the concentrations used in the risk assessment to estimate exposure and risk from each COC. The tables for each medium include the average and maximum detected concentration, the EPC, and how the EPC was derived.

Exposure Assessment

During the **exposure assessment**, current and potential future exposure pathways through which humans might come into contact with the COCs identified in the previous step were evaluated. The results of the exposure assessment were used to refine the CSM shown in Figure 2-2. Potential exposure routes for soil include inadvertent ingestion (swallowing small amounts of soil), dermal contact (skin exposure), and/or inhalation (breathing) of airborne soil particulates. Potential exposure routes for groundwater include inhalation of volatile compounds in indoor air that may volatize from the subsurface, as well as incidental ingestion and dermal contact with groundwater. Potential exposure routes for vapor include inhalation of vapors in future indoor air spaces as well as construction trenches. The HHRA considered receptor exposure under industrial land use (maintenance, construction, and industrial workers), trespassing, and future hypothetical recreational and residential land use, as presented below in Table 2-2. Exposure parameters are summarized in Appendix C, Tables C-6 through C-17.

TABLE 2-2. RECEPTORS AND EXPOSURE ROUTES EVALUATED IN THE HHRA

RECEPTORS	EXPOSURE ROUTES
Current and Future Trespasser (adolescent)	• Inadvertent dermal contact (exposed surface soil) • Inadvertent ingestion (exposed surface soil) • Inhalation of fugitive dust (exposed surface soil)
Future Recreational Users (child and adult)	• Inadvertent dermal contact (surface soil) • Inadvertent ingestion (surface soil) • Inhalation of fugitive dust (surface soil)
Future Resident (child and adult)	• Inadvertent dermal contact (surface and subsurface soil) • Inadvertent ingestion (surface and subsurface soil) • Inhalation of fugitive dust (surface and subsurface soil) • Ingestion of potable water (all groundwater) • Dermal contact with potable water (all groundwater) • Inhalation of vapors while showering (all groundwater) • Inhalation of indoor air (shallow groundwater)
Future Industrial/Commercial Worker (adult)	• Inadvertent dermal contact (surface and subsurface soil) • Inadvertent ingestion (surface and subsurface soil) • Inhalation of fugitive dust (surface and subsurface soil) • Inhalation of indoor air (shallow groundwater)
Future Construction Worker (adult)	• Inadvertent dermal contact (surface and subsurface soil) • Inadvertent ingestion (surface and subsurface soil, shallow groundwater) • Inhalation of fugitive dust (surface and subsurface soil) • Inhalation of trench vapor (shallow groundwater)

Toxicity Assessment

Toxicity assessment involves identifying the types of adverse health effects caused by exposure to site COCs and determining the relationship between the magnitude of the exposure and the severity of adverse effects (i.e., dose-response relationship) for each COC. Based on the quantitative dose-response relationships determined, toxicity values for both cancer (cancer slope factor [CSF] and inhalation unit risk [IUR]) and non-cancer (reference dose [RfD] and reference concentration [RfC]) effects were derived and used to estimate the potential for adverse effects.

Tables C-18 and C-19 in Appendix C provide non-carcinogenic hazard information relevant to the COCs for oral and dermal exposure and inhalation exposure, respectively. Tables C-21 through C-22 provide carcinogenic risk information relevant to the COCs for oral and dermal exposure and for inhalation exposure, respectively.

Risk Characterization

During the risk characterization process, the outputs of the exposure and toxicity assessments are combined to characterize the baseline risk (cancer risks and non-cancer hazards) at the Site if no action was taken to address the contamination. Potential **cancer risks** and **non-cancer hazards** were calculated based on the reasonable maximum exposure (RME) scenario, which assumes the maximum level (worst-case scenario) of human exposure that could reasonably be expected to occur. The HHRA presents equations and discusses in detail the methods used to calculate the site risks. RME cancer risk estimates and hazard indices for the significant receptors and routes of exposure across all media are shown in Table 6-4 of the RI (provided as Table C-36, Appendix C of this ROD).

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

$$Risk = CDI \times SF$$

Where: risk = a unit less probability (e.g., 2×10^{-5}) of an individual developing cancer
CDI = chronic daily intake averaged over 70 years, milligram per kilogram (mg/kg)-day
SF = slope factor, $(mg/kg\text{-}day)^{-1}$

These calculated risks are probabilities that are usually expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} under an RME scenario indicates that an individual experiencing the reasonable maximum exposure estimate has an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposures is 1×10^{-4} (one in ten thousand) to 1×10^{-6} (one in one million).

Table C-36 provides RME cancer risk estimates for the significant receptors and routes of exposure developed by taking into account various conservative assumptions about the frequency and duration of exposure for each receptor and also about the toxicity of the COCs. Total cancer risk estimates for all applicable exposure routes range from 1×10^{-6} for trespassers and future adult recreational users to 3×10^{-1} for hypothetical future lifelong residents. These risk levels indicate that if no cleanup action was taken, the increased probabilities of developing cancer as a result of site-related exposure would range from approximately 1 in 1,000,000 to 3 in 10.

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., a lifetime) to an RfD derived for a similar exposure period. An RfD represents a level to which an individual may be exposed that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD and that toxic non-carcinogenic effects from that chemical are unlikely. The hazard index (HI) is generated by adding the HQs for all chemicals that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may be reasonably exposed. An HI less than 1 indicates that based on the sum of all HQs from different contaminants and exposure routes, toxic non-carcinogenic effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health. The HQ is calculated as follows:

$$\text{Non-cancer HQ} = CDI / RfD$$

Where: CDI = chronic daily intake, mg/kg-day
RfD = reference dose, mg/kg-day

CDIs and RFDs are expressed in the same units and represent the same exposure period (i.e., chronic, sub-chronic, or short-term).

Table C-36 provides RME non-cancer HQs for each receptor and route of exposure and total HIs for all routes of exposure. Total HIs for all applicable exposure routes based on the RME range from 0.003 for hypothetical future adult recreational users to 288 for hypothetical future child residents.

Under the RME scenario, unacceptable cancer and non-cancer hazards were identified for hypothetical future residents (adult, child, and lifelong) and non-cancer hazards were identified for construction workers. The COCs that contribute most significantly to human health risks include: PCE, TCE, vinyl chloride, carcinogenic PAHs, arsenic, cadmium and manganese in groundwater used as drinking water; and PCE and naphthalene in indoor air and trench air (vapor intrusion). No major sources of **uncertainty**, other than those typically associated with risk assessment estimates, were identified for the Building 81 HHRA. A risk summary is presented in Table 2-3 below. Those risks exceeding EPA acceptable levels are in bold.

TABLE 2-3. SUMMARY OF ESTIMATED POTENTIAL HUMAN HEALTH RISKS

EXPOSURE SCENARIO			CANCER RISK	NON-CANCER HI
Current and future receptors under conditions where surface soils remain undisturbed	Future Adult Residents	Surface Soil Groundwater (all) Total	$2x10^{-5}$ $1x10^{-1}$ **$1x10^{-1}$**	0.03 **89** **89**
	Future Child Residents	Surface Soil Groundwater (all) Total	$9x10^{-5}$ $1x10^{-1}$ **$1x10^{-1}$**	0.3 **288** **288**
	Future Lifetime Residents	Total	**$3x10^{-1}$**	NA
	Future Adult Recreational Users	Surface Soil Total	$2x10^{-6}$ $2x10^{-6}$	0.003 0.003
	Future Child Recreational Users	Surface Soil Total	$4x10^{-5}$ $4x10^{-5}$	0.1 0.1
	Future Lifetime Recreational Users	Total	$4x10^{-5}$	NA
	Current/Future Adolescent Trespassers	Surface Soil Total	$7x10^{-6}$ $7x10^{-6}$	0.01 0.01
	Future Adult Industrial Workers	Surface Soil Total	$8x10^{-6}$ $8x10^{-6}$	0.02 0.02
	Future Adult Construction Workers	0 to 6 foot Soil Dust Shallow Groundwater Trench air Total	$4x10^{-7}$ $3x10^{-6}$ $4x10^{-6}$ $3x10^{-5}$ $4x10^{-5}$	0.03 0.4 0.2 **14** **15**
Future receptors under conditions where surface soils have been mixed with subsurface soils during development	Future Adult Residents	0 to 6 foot Soil Groundwater (All) Total	$1x10^{-5}$ **$1x10^{-1}$** **$1x10^{-1}$**	0.03 **89** **89**
	Future Child Residents	0 to 6 foot Soil Groundwater (All) Total	$9x10^{-5}$ **$1x10^{-1}$** **$1x10^{-1}$**	0.2 **288** **288**
	Future Lifetime Residents	Total	**$3x10^{-1}$**	NA
	Future Adult Industrial Workers	0 to 6 foot Soil Total	$7x10^{-6}$ $7x10^{-6}$	0.02 0.02

NA - not applicable
Bolded values indicate unacceptable risks

As discussed in Section 2.6, the Site is located in areas zoned for future recreational and mixed uses (e.g. RecD and VCD). The range of future uses allowed in the recreation zoning district could include indoor and outdoor commercial recreation, and passive recreation such as walking trails; the future uses allowed in the VCD zoning area (a mixed use area) could include residential development, office, commercial and/or retail uses. Also, since site groundwater is not considered a drinking water source, the FS eliminated from further consideration those COCs that were identified in the HHRA strictly due to a potential unacceptable risk to future residents who use groundwater for drinking water. COCs that could contribute to risk through exposure by way of vapor intrusion were retained. The COCs were further reduced after consideration of the low and infrequent concentrations detected in the shallow overburden groundwater (the potential source of vapors into buildings).

Thus, the FS evaluated remedial alternatives to address risks to construction workers and risks to potential occupants of any future buildings from potential vapor intrusion. The remedial alternatives addressed potential future residential exposures via LUCs that would prohibit future use of groundwater for production, supply, and irrigation purposes as well as residential uses in the RecD zone.

2.7.2 Summary of Ecological Risk

An ERA was not conducted since the Building 81 Site lacks any significant potential ecological habitat and there is no current complete exposure pathway for Site contaminants to ecological receptors.

2.7.3 Basis for Action

Unacceptable human health cancer and/or non-cancer risks were estimated in the RI baseline risk assessment for future residents (child, adult and lifetime residents) from exposures to groundwater via ingestion, dermal, or inhalation (vapor intrusion) and for future construction workers from exposures to groundwater via ingestion, dermal contact, or inhalation (vapors in construction trenches). The major contributors to non-cancer risk are arsenic and manganese; for cancer risk the major contributors are PCE, TCE, vinyl chloride, carcinogenic PAHs, arsenic, and cadmium. PCE, TCE, vinyl chloride, carcinogenic PAHs, arsenic, cadmium and manganese in groundwater; and PCE and naphthalene in indoor air and trench air (vapor intrusion) were identified as COCs.

No unacceptable risks were estimated from exposures to soil, and no unacceptable human health risks were identified under current exposure scenarios.

As previously discussed in Section 2.6, although potential future risks were identified for use of site groundwater for drinking water, the Local Redevelopment Authority, SSTTDC, as well as the Master Developer, Starwood Properties, have indicated that groundwater needs for redevelopment can be provided by sources other than that associated with the Building 81 Site. Therefore, future use of site groundwater for production, supply or irrigation are not reasonably foreseeable uses at the site and were not exposure scenarios selected for further evaluation. The FS did, however, evaluate actions to address risks associated with potential future building occupants' and construction workers' exposure to COCs.

2.8 REMEDIAL ACTION OBJECTIVES

Remedial action objectives, or RAOs, are goals, specific to each medium, that define the objective of remedial actions to protect human health and the environment. RAOs specify the COCs, potential exposure pathways and receptors, and acceptable concentrations (i.e., cleanup levels) for a site and provide a general description of what the cleanup will accomplish. Additionally, RAOs are developed to ensure compliance with federal and state applicable or relevant and appropriate requirements (ARARs). RAOs typically serve as the design basis for the remedial alternatives described in Section 2.9. The RAOs for the Building 81 Site were developed to prevent risks associated with the allowable future uses of the Site, as follows:

- Prevent the migration of COC-impacted groundwater at concentrations that pose unacceptable risk.
- Prevent exposure of construction workers to COCs at concentrations that pose unacceptable risk.
- Prevent exposure of potential building occupants to VOCs resulting from vapor intrusion into any future buildings on the Site at concentrations that pose unacceptable risk.
- Prevent human exposure to COCs in groundwater at concentrations that pose unacceptable risk.

COCs are the chemical contaminants that contribute most significantly to the risks measured for the site, and/or those constituents that exceed an applicable regulatory standard. The COCs for the Building 81 Site are identified below, as those constituents contributed more than 10^{-5} risk or a non-cancer HQ of 1 for a single target organ group.

The cleanup levels for COCs in site groundwater were selected from the risk-based value (i.e., the lower of the value representing the 10^{-5} incremental lifetime cancer risk [ILCR] level or HI equal to 1) or the MassDEP GW-3 groundwater standard (310 CMR 40.0974), whichever was lower. For this Site, the federal drinking water standards (MCLs) are not applicable or relevant and appropriate since Site groundwater is not considered a drinking water source.

The groundwater cleanup levels selected for the recreation zoning district are the lowest of the commercial vapor intrusion and construction worker (trench air) preliminary remediation goals (PRGs) calculated for the Site, and the MassDEP GW-3 standards. The cleanup levels selected for the VCD zoning district are the lowest of the residential vapor intrusion and construction worker (trench air) PRGs calculated for the Site, and the MassDEP GW-3 standards. The cleanup levels are shown in Table 2-4 along with the basis for selection.

TABLE 2-4. GROUNDWATER CLEANUP LEVELS

CHEMICAL OF CONCERN	CLEANUP LEVEL RECD ZONING DISTRICT (µg/L)	BASIS FOR SELECTION	CLEANUP LEVEL VCD ZONING DISTRICT (µg/L)	BASIS FOR SELECTION
PCE	500	Human Health Non-Cancer Risk (HI = 1) (Construction Worker Trench Air)	110	Human Health Non-Cancer Risk (HI = 1) (Residential VI)
TCE	23	Human Health Non-Cancer Risk (HI = 1) (Construction Worker Trench Air)	8.5	Human Health Non-Cancer Risk (HI = 1) (Residential VI)
cis-1,2-DCE	29,000	Human Health Non-Cancer Risk (HI = 1) (Construction Worker Trench Air)	29,000	Human Health Non-Cancer Risk (HI = 1) (Construction Worker Trench Air)
Vinyl Chloride	18	Human Health Cancer Risk (ILCR = 10^{-5}) (Commercial VI)	2.6	Human Health Cancer Risk (ILCR = 10^{-5}) (Residential VI)
Toluene	40,000	MassDEP GW-3 standard	32,000	Human Health Non-Cancer Risk (HI = 1) (Residential VI)
Benzene	140	Human Health Cancer Risk (ILCR = 10^{-5}) (Commercial VI)	21	Human Health Cancer Risk (ILCR = 10^{-5}) (Residential VI)
Naphthalene	38	Human Health Non-Cancer Risk (HI = 1) (Construction Worker Trench Air)	38	Human Health Non-Cancer Risk (HI = 1) (Construction Worker Trench Air)

VI – vapor intrusion

2.9 DESCRIPTION OF ALTERNATIVES

To address the COCs and the associated human health risks in groundwater, a screening of **General Response Actions**, **remedial technologies**, and **process options** was conducted as part of the FS. The technologies and process options retained from the detailed screening were assembled into four remedial alternatives for Building 81. Consistent with the NCP, the No Action alternative was evaluated as a baseline for comparison with other alternatives during the comparative analysis.

The alternatives evaluated and presented in the FS include:

- G-1: No Action
- G-2: Bio-barriers, MNA, and LUCs
- G-3: Enhanced In-Situ Bioremediation, Bio-barriers, MNA, and LUCs
- G-4: ISCO, Bio-barriers, MNA, and LUCs

Table 2-5 summarizes the major components and provides estimated costs for each of the remedial alternatives developed for the Building 81 Site.

TABLE 2-5. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED

ALTERNATIVE	COMPONENTS	DETAILS	COST	TIME TO CLEANUP
No Further Action (Alternative G-1)	None	No further actions would be taken. The only costs would be for 5-year reviews under CERCLA.	**Capital**: $11,000 **O&M:** $109,000 **30-Year NPW:** $120,000	Not Applicable
Bio-barriers, MNA, and LUCs (Alternative G-2)	Bio-barriers in overburden and bedrock	Intercept and treat leading edge of contaminant plume in overburden and bedrock using bio-barriers. Inject **emulsified oil substrate** (EOS) in wells placed across the plume and perpendicular to direction of groundwater flow to stimulate reductive dechlorination of groundwater CVOCs.	**Capital**: $1,002,000 **O&M:** $2,543,000 **30-Year NPW:** $3,545,000	250 years
	Monitored Natural Attenuation	Monitoring of groundwater to verify that COC concentrations are decreasing at an acceptable rate. MNA would be conducted within the plume area (other than the bio-barrier area), including the high concentration areas near the former tank location, and up- and downgradient of the bio-barriers.		
	LUCs	Interim LUCs would be implemented to prevent unacceptable exposure to groundwater until cleanup levels are achieved. Permanent LUCs would be implemented to prohibit installation of groundwater production, supply, and irrigation wells at the Site, and to restrict residential use of the Site within the RecD zoning district.		
Enhanced In-Situ Bioremediation, Bio-barriers, MNA, and LUCs (Alternative G-3)	Enhanced In-Situ Bioremediation	Injection of EOS into overburden and bedrock TTZ (TTZs, areas with highest concentrations) to stimulate reductive dechlorination and reduce CVOC source mass of plumes.	**Capital**: $1,200,000 **O&M:** $2,591,000 **30-Year NPW:** $3,791,000	30 years
	Bio-barriers in overburden and bedrock	Same as for Alternative G-2		
	Monitored Natural Attenuation	Nearly identical to this component of Alternative G-2, except that MNA would be implemented in the area between the source area TTZs and bio-barriers after active treatment with enhanced bioremediation for further reduction of any residual CVOCs in the TTZs over time.		
	LUCs	Same as for Alternative G-2		

TABLE 2-5. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED (CONTINUED)

ALTERNATIVE	COMPONENTS	DETAILS	COST	TIME TO CLEANUP
ISCO, Bio-barriers, MNA, and LUCs (Alternative G-4)	ISCO	Active treatment by ISCO in areas with highest concentrations in overburden and bedrock to reduce CVOC source mass of plumes. In deep overburden TTZ, injection of sodium permanganate solution. In shallow and deep bedrock TTZs, hydrofracture emplacement of potassium permanganate and sand blend.	**Capital**: $1,677,000 **O&M:** $2,656,000 **30-Year NPW:** $4,333,000	200 years
	Bio-barriers in overburden and bedrock	Same as for Alternative G-2		
	MNA	Nearly identical to this component of Alternative G-2, except that MNA would be implemented in area between the source zone TTZs and bio-barriers after active treatment with chemical oxidation for further reduction of any residual CVOCs in the TTZs over time.		
	LUCs	Same as for Alternative G-2		

2.10 COMPARATIVE ANALYSIS OF ALTERNATIVES

Table 2-6 and the text in this section summarize the comparison of the remedial alternatives with respect to the nine **CERCLA evaluation criteria** outlined in the NCP at 40 Code of Federal Regulations (CFR) 300.430(e)(9)(iii) and categorized as threshold, primary balancing, and modifying criteria. Further information on the detailed comparison of remedial alternatives is presented in the Building 81 FS.

TABLE 2-6. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

	Alternative G-1	Alternative G-2	Alternative G-3	Alternative G-4
ALTERNATIVE DESCRIPTION/COMPONENTS				
Evaluation Criteria	No Further Action	Bio-barriers, MNA, and LUCs	Enhanced In-Situ Bioremediation, Bio-barriers, MNA, and LUCs	ISCO, Bio-barriers, MNA, and LUCs
ESTIMATED TIMEFRAMES FOR CLEANUP (YEARS)				
Time to achieve cleanup levels	Not Applicable	250	30	200
***CRITERIA ANALYSIS:* Threshold Criteria – Selected alternative must meet these criteria**				
Overall Protection of Human Health	Does not comply	●	★	★
Compliance with ARARs	Does not comply	●	●	●
Primary Balancing Criteria – Used to differentiate between alternatives meeting threshold criteria				
Long-Term Effectiveness and Permanence	⦸	○	●	●
Reduction of Mobility, Toxicity, and Volume of Contaminants through Treatment	⦸	○	●	●

TABLE 2-6. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES (CONTINUED)

	Alternative G-1	Alternative G-2	Alternative G-3	Alternative G-4
Short-Term Effectiveness	⦸	O	★	●
Implementability	●	●	●	●
Cost (30-Year NPW, see Table 2-5)	$120,000	$3,545,000	$3,791,000	$4,333,000
Modifying Criteria – May be used to modify recommended cleanup				
State Agency Acceptance	-	-	Yes	-
Community Acceptance	-	-	Yes	-

Notes:
ARARs: Applicable or relevant and appropriate requirements
MNA: Monitored Natural Attenuation
LUCs: Land use controls

★ Best
● Better
O Good
⦸ Poor

Threshold Criteria

Overall Protection of Human Health and the Environment. Alternatives G-2, G-3, and G-4 would all provide protection to human health and the environment.

Alternative G-3 would provide the best protection because it treats the high-PCE-concentration source areas in overburden and bedrock with enhanced bioremediation, and part of the plume with bio-barriers, in the shortest amount of time. Alternative G-4 provides the next best protection. While ISCO treats the high-PCE concentration source areas in overburden and bedrock with in a shorter time frame than enhanced bioremediation (Alternative G-3) it requires a much longer time for the rest of the plume to reach cleanup levels.

Alternative G-2 would provide the third best protection because it would passively treat groundwater as it flows through the bio-barriers.

Monitoring during Alternatives G-2, G-3, and G-4 would be effective in detecting the potential migration of the plume and in evaluating the progress of the remediation.

The natural attenuation component of Alternatives G-2, G-3, and G-4 would reduce contaminant concentrations. This would significantly reduce the risk from exposure to contaminated groundwater. LUCs would provide protection of human health by controlling the potential exposure pathways until cleanup levels are met.

The No Action alternative (G-1) would not achieve the RAOs and therefore does not protect human health and the environment. Thus, Alternative G-1 is not discussed further in this evaluation.

Compliance with ARARs. ARARs include any federal or state standards, requirements, criteria, or limitations determined to be legally applicable or relevant and appropriate to the Site or remedial action.

Alternatives G-2 through G-4 would comply with location- and action-specific ARARs and To Be Considered (TBC) guidance, and would eventually comply with chemical-specific ARARs and TBCs through a combination of in-situ treatment, natural attenuation, and LUCs.

Primary Balancing Criteria

Long-Term Effectiveness and Permanence. Alternatives G-3 and G-4 would provide the greatest and essentially equal levels of long-term effectiveness and permanence through a combination of active treatment, MNA, and LUCs. Alternative G-2 would be slightly less permanent and effective because there would be no source-area treatment. For all three of these alternatives, LUCs would be maintained until the cleanup levels are met.

Reduction in Toxicity, Mobility, or Volume Through Treatment. Alternatives G-2, G-3, and G-4 would achieve reductions in COC toxicity and volume through treatment. Alternatives G-2, G-3, and G-4 would permanently remove PCE from groundwater flowing through the bio-barriers. In addition, Alternatives G-3 and G-4 would each permanently remove an estimated 1.3 pounds, of PCE from groundwater in the TTZs through source area enhanced bioremediation or ISCO, respectively.

Short-Term Effectiveness. Short-term effects of Alternatives G-2 through G-4 would result in a possibility of exposing site workers to contaminated groundwater during the maintenance and sampling of monitoring wells and during remedial construction and operation. Alternative G-2 would result in the lowest short-term risk, with the potential for exposure only during installation of the injection wells and injection of emulsified oil substrate for the bio-barriers and groundwater sampling. Alternative G-3 would have higher potential for short-term exposures compared to Alternative G-2, with the installation of additional injection wells and injection of EOS for source area treatment. Alternative G-4 would have the highest potential for short-term exposures because workers would also be required to transport and handle a strong oxidizer for the ISCO application in the source areas. However, these risks of exposure would be effectively controlled by wearing appropriate PPE and compliance with proper site-specific health and safety procedures. Implementation of Alternatives G-2 through G-3 would not adversely impact the surrounding community or environment.

Alternatives G-2 through G-4 would achieve groundwater RAO Nos. 2 through 4 immediately upon implementation of LUCs and monitoring. Construction activities associated with Alternatives G-2, G-3, and G-4 would be completed in 2 months, 3 months, and 3 months, respectively. Groundwater RAO No. 1 would be achieved after the biodegradation of CVOCs in the bio-barriers begins. For Alternatives G-2 through G-4, replenishment of organic substrate in the bio-barriers by emulsified oil injection would be completed in approximately 1 week every 5 years after the installation of the bio-barriers. For Alternative G-3, the second injection for the source zone enhanced bioremediation would be completed in approximately 1 week, 5 years after the initial application. For Alternative G-4, the second ISCO injection in the deep overburden TTZ would be completed in approximately 1 week, 6 months to 1 year after the first injection. Based on preliminary modeling using **BIOCHLOR**, it is estimated that it would require less than 10 years for Alternatives G-2, G-3, and G-4, respectively, to attain the groundwater cleanup levels in the overburden. For the shallow bedrock, it is estimated that it would require 60 years, 30 years, and 40 years for Alternatives G-2, G-3, and G-4, respectively. For the deep bedrock, it is estimated that it would require 250 years, less than 5 years, and 200 years for Alternatives G-2, G-3, and G-4, respectively. Alternative G-3 provides the shortest overall cleanup timeframe since the cleanup levels would be met in the overburden and deep bedrock upon completion of the source treatment in the TTZ. The BIOCHLOR modeling is provided in Appendix E of the FS.

Implementability. Alternative G-2 would be the second easiest of the remaining alternatives to implement because only the bio-barriers would need to be installed in addition to groundwater monitoring. Alternatives G-3 and G-4 would both be more difficult to implement than Alternative G-2 because installation of active treatment with enhanced bioremediation or ISCO would be required for the high concentration source areas. Technical implementation of the various components of Alternatives G-2 through G-4 would be feasible, although handling of the oxidizing agent in Alternative G-4 would add to the difficulty of implementation. For Alternatives G-2 through G-4, contractors and equipment are readily available. However, there is uncertainty associated with the distribution of chemicals injected into the bedrock under Alternatives G-2 through G-4 because of the heterogeneity in fractures.

Interim and permanent LUCs would be required in addition to the active groundwater cleanup measures for Alternatives G-2 through G-4. LUCs can be readily prepared and implemented because the Navy

retains ownership of the property. LUCs can be imposed on future property owners through the property transfer process.

Use of the property may be affected by the implementation of the alternatives. Alternatives G-2, G-3, and G-4 would impact site use during installation of the injection wells and injection of substrates into the subsurface. In addition, site uses would be limited: (1) over and near the bio-barriers and source area TTZs because of the presence of and need for access to overburden and bedrock injection wells; and (2) in the vicinity of the long-term monitoring (LTM) well network.

Cost. The costs for Alternatives G-2 and G-3 are comparable (varying by less than $250,000), with Alternative G-3 being somewhat more expensive than Alternative G-2, because it includes source area treatment. Alternative G-4, also including source area treatment, would be the most expensive alternative.

Modifying Criteria

State Acceptance. State involvement has been solicited throughout the CERCLA process. MassDEP's statement on the selected remedy is presented in Appendix A.

Community Acceptance. The community expressed its support for Alternative G-3. There were no comments offered for the record at the public hearing on October 22, 2013. The written comments received during the public comment period generally dealt with the time frame for the selected remedy. These comments and Navy responses are discussed in Section 3.0.

2.11 PRINCIPAL THREAT WASTE

The NCP at 40 CFR 300.430(a)(1)(iii)(A) establishes an expectation that treatment will be used to address the principal threats posed at a site wherever practicable. Principal threat wastes are defined as those source materials considered to be highly toxic or highly mobile, and which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. A source material is a material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air, or acts as a source for direct exposure.

Although contaminants detected at the Site (i.e., VOCs (primarily PCE and TCE), vinyl chloride, carcinogenic PAHs, arsenic, cadmium, and manganese) could potentially pose unacceptable risks to certain receptors under specific exposure scenarios, it has been determined that since there are no current receptors or concerns and any future exposures can be prevented through LUCs, there are no principal threat wastes present at the Building 81 Site. Specifically, permanent LUCs will be implemented to prohibit installation of groundwater production, supply or irrigation wells at the Site (e.g, RecD (recreational) and VCD (mixed use) zoning areas) and prohibit future residential use within the RecD portion of the Site. In addition, interim LUCs will be implemented in the RecD portion of the Site to prevent unacceptable risks until remediation goals are achieved.

2.12 SELECTED REMEDY

2.12.1 Rationale for the Selected Remedy

The selected remedy for the Building 81 Site is Alternative G-3, overburden and bedrock source area Enhanced In-Situ Bioremediation, two bio-barriers, MNA, and LUCs. The Navy and EPA have concluded that this remedy is protective of human health and the environment, and achieves the overall goals established for the Site. This remedy is expected to clean the groundwater concentrations to the RAOs described in this ROD in the shortest amount of time of the alternatives evaluated. The remedy will meet the RAOs by reducing COC concentrations through enhanced bioremediation and passive treatment through bio-barriers, controlling exposure to contaminants in groundwater and vapors through interim LUCs until unacceptable risks are eliminated, and prohibiting the installation of groundwater production,

supply, and irrigation wells within the permanent LUC compliance boundary shown on Figure 2-6 (RecD and VCD zoning districts) as well as prohibiting future residential uses within the RecD zoning district at the Site through permanent LUCs. The permanent LUCs will remain in place beyond attainment of the Remedial Goals (RGs) and thus prohibit residential uses at the Site even if the zoning were changed to allow residential uses. (The RecD and VCD zoning districts are shown on Figure 2-5.) Interim LUCs will require approval of: construction dewatering plans prior to conducting excavation activities; health and safety procedures to be used by construction workers to prevent unacceptable exposure risks, until cleanup levels are achieved; and passive ventilation design and building construction methods to prevent exposure of building occupants to vapor intrusion from VOCs in groundwater at levels that pose an unacceptable risk, until cleanup levels are achieved. These interim LUCs are consistent with the types of construction and uses allowed in the RecD zoning district. The Navy proposes that this remedy be the final remedy for Building 81.

The principal factors in the selection of this remedy included the following:

- The remedy will achieve substantial risk reduction by treating the source materials.
- The remedy will provide safe management of both the overburden and the bedrock source zones.
- The remedy is consistent with the future zoning uses of the Site.

2.12.2 Description of the Selected Remedy

The selected remedy includes the following components, described below and shown on Figure 2-6:

- In-situ (Overburden and Bedrock Source Area) Enhanced Bioremediation
- Bio-barriers
- MNA
- LUCs
- Five-Year Reviews (as needed)

Overburden and Bedrock Source Area Enhanced Bioremediation

This component consists of active treatment by Enhanced In-Situ Bioremediation to reduce the source mass of the PCE plumes in areas with the highest groundwater concentrations in overburden and bedrock. Existing site information and assumptions based on typical enhanced bioremediation systems and bio-barriers were used for the conceptual design in the FS and summarized below.

A commercially available EOS product will be injected in both the overburden and bedrock TTZs through grids of injection points. In the overburden, injection wells will be installed to the bottom of the deep overburden at approximately 18 ft bgs. The EOS will be introduced via injection wells into the TTZs in overburden and bedrock to stimulate the reductive dechlorination of CVOCs in groundwater.

Because of uncertainties associated with current site conditions surrounding the former excavation/tank area, a pilot study may be performed prior to the design of the enhanced bioremediation system. The pilot test would be used to confirm or adjust well spacing, the number of injection wells, and the EOS application rate and volume in both the overburden and the bedrock for optimal effect. The estimated number of injection points, depths and amount of EOS are summarized in the table below.

Enhanced Bioremediation TTZ	Number of Injection Points	Targeted Depth Interval	EOS Product (lb)
Overburden	4	7 – 18 ft bgs	900
Shallow Bedrock	12	entire bedrock zone to a depth of 40 ft bgs(1)	550
Deep Bedrock	8	entire bedrock zone to a depth of 60 ft bgs(1)	

(1) Injected over discrete 10-foot intervals, using packers

The pilot study (if performed) and groundwater monitoring results will be used during the remedial design to determine details for a second EOS injection to replenish the EOS consumed by contaminant degradation and other electron acceptors in the aquifer.

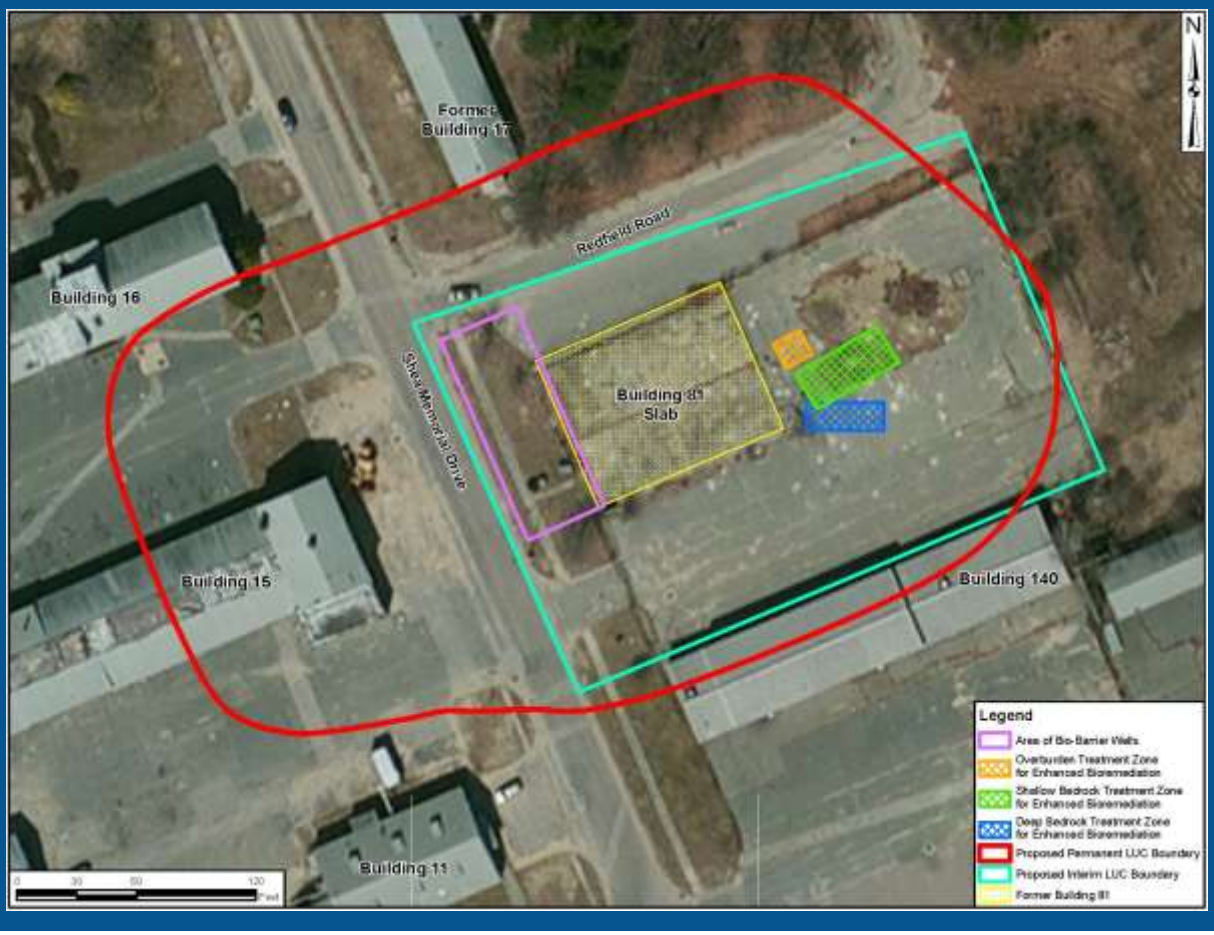
For costing purposes, the FS assumed a specific area, number of wells, and amount of substrate for the system. The pre-design investigation and pilot study (if performed) results will be used in the remedial design (RD) to ensure that the remedy will be effective in reducing source area contamination and preventing further migration of contaminated groundwater. Performance monitoring will be conducted at regular intervals to evaluate the effectiveness and progress of the source area treatment. Additional actions to control and reduce source contaminants will be evaluated if the performance monitoring demonstrates that the bioremediation system is not working as anticipated. In addition, the remedial system will be designed with the objective of achieving all cleanup levels at the Site within the shortest reasonable and cost-effective timeframe.

Bio-barriers

Two bio-barriers will be installed to intercept and treat the contaminant plume at its leading edge, one in the overburden and one in the bedrock.

A commercially available EOS product will be injected into rows of injection points placed across the plume perpendicular to the direction of groundwater flow to stimulate the reductive dechlorination of CVOCs in groundwater by naturally occurring microorganisms. The emulsified oil product will be distributed throughout the bio-barriers to provide a long-lasting electron donor to support anaerobic biodegradation processes as the contaminated groundwater passes through them.

FIGURE 2-6. SUMMARY OF THE REMEDIAL ACTION



A pilot treatability study may be performed to confirm the number and spacing of the injection wells and application rates in both overburden and bedrock. The estimated number of injection points, depths and amount of EOS are summarized in the table below.

Bio-barriers	Number of Injection Wells	Targeted Depth Interval	EOS Product (lb)
Overburden	24	7 – 18 ft bgs	9,400
Shallow Bedrock	21	entire bedrock zone to a depth of 40 ft bgs(1), assumed to be 18 to 40 ft bgs	1,200
Deep Bedrock	4	entire bedrock zone to a depth of 60 ft bgs(1), assumed to be 18 to 60 ft bgs	

(1) Injected over discrete 10-foot intervals, using packers

It is assumed that the bio-barriers will need to be replenished every 5 years to maintain the electron donor supply until the entire plume has passed through the barriers and has been remediated to achieve the cleanup levels.

Groundwater monitoring (baseline and quarterly for 1 year) will be performed to evaluate the effectiveness and progress of the treatment using wells on both sides of the bio-barriers as part of the monitoring program for MNA, as described below. The reducing conditions resulting from injection of the EOS product could potentially cause temporary mobilization of metals such as iron and manganese. A

contingency measure would be implemented if monitoring indicates that concentrations of these metals exceed target levels that would cause unacceptable risks (to be determined during the preparation of the LTM plan).

Monitored Natural Attenuation

MNA will be implemented in the area between the source zone TTZs and bio-barriers after active treatment with enhanced bioremediation for further reduction of any residual CVOCs over time. MNA will be implemented in accordance with the Office of Solid Waste and Emergency Response (OSWER) Directive titled Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites (EPA, 1999b) and other MNA guidance documents.

MNA relies on naturally occurring biological, physical, and/or chemical processes within the aquifer act to reduce the mass, toxicity, volume, or concentration of COCs. Groundwater monitoring will be conducted to assess the effectiveness of natural attenuation over time until the cleanup levels have been achieved. Details regarding the locations and numbers of groundwater monitoring wells and the monitoring frequency will be identified in a long-term monitoring plan to be developed during the RD.

Land Use Controls

Interim LUCs will be established to control exposure to COCs in groundwater until unacceptable risks are eliminated. Permanent LUCs will be implemented to: prohibit installation of groundwater production, supply, and irrigation wells within the permanent LUC compliance boundary at the Building 81 Site (e.g, RecD and VCD zoning districts); and prohibit future residential uses within the RecD zoning district at the Site. The permanent LUC compliance boundary will be determined during the LUC RD. The interim LUCs listed below will be implemented in the RecD portion of the Site to prevent unacceptable risk from vapor intrusion and exposure to vapors in construction trenches until the cleanup levels are achieved. The location of the interim LUC compliance boundary will be determined during the LUC RD.

- A LUC restricting the type and nature of construction permitted in the source area of the plume where the highest VOCs concentrations have been detected and where active remediation might be conducted (as a contingency), until cleanup levels are achieved. Construction in the vicinity of the bio-barriers will also be restricted to prevent disturbance of and damage to the injection wells and allow future injections.

- A LUC requiring prior Navy, EPA and MassDEP approval of construction dewatering plans before excavation activities could be conducted, until the cleanup levels are met.

- A LUC specifying health and safety procedures to be used by construction workers to prevent unacceptable exposure risks until the cleanup levels are met.

- A LUC specifying passive ventilation design and building construction methods, such as a sub-slab vapor migration system, to prevent exposure of building occupants to vapor intrusion from VOCs in groundwater at levels that pose an unacceptable risk, until cleanup levels are achieved.

The LUCs would be implemented and maintained by the Navy through a LUC RD. The LUCs will be enforceable for as long as they are required to prevent unacceptable exposure to contaminated groundwater and until concentrations of hazardous substances in groundwater are at levels that allow for unrestricted use and unlimited exposure. The Navy is responsible for implementing, inspecting, reporting and enforcing the LUCs described in the LUC RD. Although the Navy may later transfer one or more of these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for remedy integrity.

The LUC implementation actions including monitoring and enforcement requirements will be provided in the LUC RD that will be prepared by the Navy as the LUC component of the overall RD. Within 120 days of ROD signature, the Navy shall prepare and submit to EPA and MassDEP for review and comment

(pursuant to those Primary Document review procedures stipulated in the FFA) the LUC RD for Building 81 that shall contain implementation and maintenance actions, including periodic inspections. The Navy will maintain, monitor, and enforce the LUCs according to the LUC RD. LUCs will be developed in accordance with the Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions, per letter dated October 2, 2003, from Raymond F. DuBois, Deputy Under Secretary of Defense (Installations and Environment), to Hon. Marianne Lamont Horinko, Acting Administrator, EPA, and other DoD and Navy guidance. Implementation of this remedy will therefore require a survey of the Site, annual visual inspections, and a five-year review with report preparation.

If the RD provides that MassDEP has the right to enforce the LUCs, the form of LUCs shall be satisfactory to MassDEP, and, to the extent applicable, shall comply with M.G.L. c. 21E and 310 CMR 40.0000.

Annual inspections of the Site will be conducted to confirm compliance with the LUC objectives, and an annual compliance certificate will be prepared and provided to EPA and MassDEP. Prior to any property conveyance, EPA and MassDEP will be notified.

Five-Year Reviews

Five-year reviews will be conducted by the Navy, in conjunction with EPA and MassDEP, until groundwater conditions are restored such that the Site is suitable for unrestricted use and unlimited exposure in accordance with CERCLA. During such reviews, the Navy, EPA, and MassDEP will review site conditions and monitoring data to determine whether the continued implementation of the remedy is appropriate.

2.12.3 Expected Outcomes of the Selected Remedy

The expected outcomes of the selected remedy are to: (1) eliminate the potential for human exposure to groundwater containing contaminant concentrations in excess of the cleanup levels; and (2) eliminate the potential for human exposure to COCs through VI (occupants of future buildings) or trench air (construction workers). Enhanced bioremediation is expected to decrease COC concentrations in the source area TTZs (Figure 2-6) to acceptable levels within approximately 3 years of remedy implementation; the bio-barriers are expected to decrease COC concentrations at the leading edge of the plume to acceptable levels within approximately 30 years. The time frames to achieve Site cleanup are estimates based on the currently available information and will be further evaluated as part of the five-year review process.

Alternative G-3 will reduce the toxicity, mobility, and volume of groundwater COCs through in-situ treatment. Enhanced In-Situ Bioremediation will permanently reduce PCE concentrations in groundwater in the TTZs. Passive treatment with the overburden and bedrock bio-barriers will further remove PCE from the groundwater at the leading edge of the plume. LUCs will be immediately effective for addressing the human exposure pathways of concern until Site cleanup is achieved. This alternative will achieve substantial risk reduction by treating the source materials at the Site and providing safe management of the remaining material.

Upon achieving the groundwater cleanup levels identified in Table 2-4, the Site will be suitable for the recreational and VCD (mixed) uses allowed by the Reuse Plan and associated zoning. Although the groundwater is not considered a drinking water source, permanent LUCs will prohibit extraction of groundwater for production, supply, and irrigation purposes, and restrict residential use of the Site in the RecD zone. The permanent and interim LUCs will prevent any unacceptable risk to human health, even if the current zoning were to be changed to allow residential uses in the RecD zoned area in the future.

Table 2-7 describes how the selected remedy mitigates risk and achieves RAOs for the Site.

TABLE 2-7. HOW SELECTED REMEDY MITIGATES RISK AND ACHIEVES RAOS		
RISK	**RAO**	**COMMENTS**
Ingestion of groundwater and exposure to vapors downgradient of the Site	Prevent migration of groundwater containing COCs at concentrations that pose unacceptable risk.	LUCs will prohibit installation of groundwater production, supply, and irrigation wells. Enhanced bioremediation will reduce the COC concentrations in the TTZ and the bio-barriers will prevent the downgradient migration of groundwater containing COCs at unacceptable levels.
Exposure to vapors during excavation activities	Prevent exposure of construction workers during excavation activities to COCs in groundwater at concentrations that pose unacceptable risk.	LUCs will prevent excavation activities on the Site without approved plans and procedures, until COC concentrations are reduced to the cleanup levels.
Exposure to vapors inside buildings	Prevent exposure of building occupants to VOCs resulting from vapor intrusion into any future buildings at the Site, at concentrations that pose unacceptable risk.	Interim LUCs will prevent buildings on the Site unless plans are specifically approved, until groundwater COC concentrations are reduced to cleanup levels through treatment by enhanced bioremediation and the bio-barriers. Permanent LUCs will prohibit installation of groundwater production, supply, and irrigation wells at the Site, and prohibit future residential uses within the RecD zoning district at the Site (should zoning change in the future to allow residential use), thereby preventing exposure of residents to COCs in groundwater at concentrations that pose unacceptable risk.
Ingestion of groundwater and exposure to vapors	Prevent human exposure to COCs in groundwater at concentrations that pose unacceptable risk.	LUCs will prevent exposure to groundwater and vapors as noted above until COC concentrations are reduced to the cleanup levels and pose no unacceptable risk.

2.13 STATUTORY DETERMINATIONS

In accordance with the NCP, the selected remedy meets the following statutory determinations:

- **Protection of Human Health and the Environment** – The selected remedy will be protective of human health and the environment through the reduction of COC concentrations in site groundwater to achieve cleanup levels. LUCs will be protective of human health during the interim time until site cleanup objectives are achieved. Site conditions do not pose unacceptable risks to human receptors under current site use. There are no ecological receptors or complete exposure pathways at the Site.

- **Compliance with ARARS** – The selected remedy will comply with all federal and state ARARs as presented in Appendix D.

- **Cost-Effectiveness** – The selected remedy is a cost-effective means to achieve site remediation. The costs are proportional to the overall effectiveness during the remediation time frame. Detailed costs for the selected remedy are presented in Appendix B.

- **Utilization of Permanent Solutions and Alternative Treatment or Resource Recovery Technologies to the Maximum Extent Practicable** – The Selected Remedy represents the maximum extent to which permanent solutions and alternative treatment technologies can be used in a practical manner at the Building 81 Site. The selected remedy will be an effective and permanent means of reducing COC concentrations in the source area through treatment. Multiple source zone injections will be performed and the bio-barriers will be maintained until the cleanup levels are met.

- **Preference for Treatment Which Permanently and Significantly Reduces the Toxicity, Mobility, or Volume of the Hazardous Substances as a Principal Element** – By treating the groundwater through bioremediation, the Selected Remedy addresses contamination in the source area through the use of treatment technologies. By utilizing treatment as a significant portion of the remedy, the statutory preference for remedies that employ treatment as a principal element is satisfied. The Selected Remedy includes overburden and bedrock source area treatment to reduce the source mass and break down COCs, thereby reducing the toxicity, mobility, and volume of the groundwater contamination.

- **Five-Year Review Requirement** – Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of the remedial action and every 5 years thereafter to ensure that the remedy is, or will be, protective of human health and the environment.

2.14 DOCUMENTATION OF NO SIGNIFICANT CHANGES

CERCLA Section 117(b) requires an explanation of significant changes from the remedy presented in the Proposed Plan that was published for public comment. Comments received during the public comment period and the October 22, 2013 public hearing were generally supportive of the Proposed Plan. Therefore, no significant changes to the remedy as originally identified in the Proposed Plan were necessary or appropriate. The comments received on the Proposed Plan during the public comment period are presented in Section 3.0.

3.0 RESPONSIVENESS SUMMARY

3.1 STAKEHOLDER COMMENTS AND LEAD AGENCY RESPONSES

Participants in the public meeting and public hearing held on October 22, 2013 included members of the public and representatives of the Navy, EPA, and MassDEP. There were no comments provided by the public at the public hearing. Comments received during the public comment period are addressed in Table 3-1. The public hearing transcript and comment letters received during the 30-day public comment period on the Proposed Plan are included in Appendix E.

TABLE 3-1. SUMMARY OF QUESTIONS FROM PUBLIC HEARING AND COMMENT PERIOD

QUESTION	RESPONSE
LNR South Shore, LLC provided written comments. The main issues discussed in the comment letter are summarized below. • LNR is concerned that the Proposed Plan is not as aggressive as it should be and therefore remediation will take longer than could be achieved with readily available technology. They do not believe that the Proposed Plan is the appropriate remedial plan for the Site. • The timeframe for the selected remedy, Alternative G-3, is long because it relies heavily on monitored natural attenuation and permanent institutional controls that restrict the future uses and activities at the Site. In addition the LTM component of the remedies evaluated complicate and limit the potential developable uses of the Site until all required monitoring is completed. • Technically feasible remedies that could result in a faster cleanup were not fully considered or evaluated by the Navy. Site cleanup could be achieved more quickly using the Navy's proposed technology, enhanced bioremediation, if the technology were applied more frequently over a larger area of the Site. • Construction of the planned skating rink or other recreational amenity where the Site is located will be delayed due to the length of time it will take to achieve the cleanup goals. A more aggressive remedial plan would allow development of the future uses more quickly. • LNR requested that the BRAC Cleanup Team work together to design and agressively implement a cleanup plan that returns the Site to productive use in a reasonable time frame, which they feel should be far less than the estimated 30 years for Alternative G-3.	The FS for the Building 81 Site evaluated technically feasible remedial alternatives in detail and was reviewed by EPA and MassDEP. EPA provided concurrence with the FS in a letter dated February 28, 2013. The Proposed Plan for the Site evaluates the information included in the FS and proposes the optimum remedial approach to attain the project objectives based on the consideration and balancing of various criteria. The Navy's objective is to implement the selected remedy, meet the Remedial Action Objectives, and transfer the property. The Navy believes that enhanced bio-remediation is a readily available and sufficiently aggressive technology and is appropriate for the Site. LNR appears to support this technology but suggests that it be applied more frequently over a larger area of the Site. The Navy has selected an alternative that provides an appropriate balance between clean up speed and cost while ensuring protection of human health and the environment. The Navy notes that LNR has agreed to the permanent institutional controls identified in the FS. The Navy's desire to clean up the Site in an expedient manner is noted in the Proposed Plan: "The results of the pilot study will be used, in conjunction with data collected during the pre-design investigation, to determine the appropriate level of effort for the aggressive source control component of the final bioremediation system design… In addition, the remedial system will be designed with the objective of achieving all remedial goals at the site within the shortest reasonable, and cost-effective, timeframe." The Navy will continue to work with regulators and the community as it designs and implements the selected remedy.

3.2 TECHNICAL AND LEGAL ISSUES

No technical or legal issues associated with the Building 81 ROD were identified.

Administrative Record Reference Table

ADMINISTRATIVE RECORD REFERENCE TABLE

ITEM	REFERENCE PHRASE IN ROD	LOCATION IN ROD	LOCATION OF INFORMATION IN ADMINISTRATIVE RECORD
1	**borehole geophysics**	Table 2-1	Tetra Tech, Inc. (Tetra Tech), 2011. Remedial Investigation for Building 81. (April). Page 2-10. (Section 2.6.3.3)
2	**waste oil UST**	Table 2-1	Halliburton NUS, 1995. Phase I Initial Site Investigation Report, Building 81 - Former Waste Oil Tank Area (April).
3	**light non-aqueous phase liquid**	Table 2-1	Halliburton NUS, 1995.
4	**receptors**	Table 2-1	Halliburton NUS, 1995.
5	**hydraulic conductivity**	Table 2-1	Brown & Root Environmental, 1997a. Interim Phase II Comprehensive Site Assessment, Building 81 (April).
6	**recommended**	Table 2-1	Brown & Root Environmental, 1997b. Supplemental Phase II Comprehensive Site Assessment, Building 81 (October).
7	**asphalt batching**	Table 2-1	Tetra Tech, 1999. Release Abatement Measure Completion and Additional PCE Assessment Report, Building 81 Site (May).
8	**fracture orientation**	Table 2-1	ENSR, 1999. Bedrock Characterization Letter (October).
9	**Fenton's reagent**	Table 2-1	Tetra Tech, 2002. In-Situ Chemical Oxidation Pilot Test Performance Assessment, Building 81 Site. (March).
10	**plume**	Table 2-1	Tetra Tech, 2002.
11	**data gaps**	Table 2-1	Tetra Tech, 2011. Page 2-8 (Section 2.6)
12	**alternatives**	Table 2-1	Tetra Tech, 2013. Feasibility Study (Section 4.2)
13	**public notice**	Section 2.3	Tetra Tech, 2011. Proposed Plan, Building 81 – Operable Unit 9 (month)
14	**confining layer**	Section 2.5	Tetra Tech, 2011. Page 3-8 (Section 3.2.2.2)
15	**geologic units**	Section 2.5.1	Tetra Tech, 2011. Page 3-5 to 3-23 (Section 3.2.2)
16	**weathered/altered**	Section 2.5.1	Tetra Tech, 2011. Page 3-11 to 3-19 (Section 3.2.2.3)
17	**hydraulic gradients**	Section 2.5.1	Tetra Tech, 2011. Page 3-29 to 3-33 (Section 3.3.2.2 and 3.3.2.3)
18	**slug tests**	Section 2.5.1	Tetra Tech, 2011. Page 3-33 to 3-36 (Section 3.3.2.4)
19	**human health risk assessment**	Section 2.7	Tetra Tech, 2011. Section 6.
20	**COCs**	Section 2.7.1	Tetra Tech, 2011. Page 6-14 to 6-22 (Section 6.2.2)
21	**exposure assessment**	Section 2.7.1	Tetra Tech, 2011. Page 6-24 to 6-48 (Section 6.3)
22	**cancer risks**	Section 2.7.1	Tetra Tech, 2011. Page 6-81 (Section 6.7.2)
23	**non-cancer risks**	Section 2.7.1	Tetra Tech, 2011. Page 6-80 to 6-81 (Section 6.7.1)
24	**uncertainty**	Section 2.7.1	Tetra Tech, 2011. Page 6-62 to 6-79 (Section 6.6)
25	**general response actions**	Section 2.9	Tetra Tech, 2011 (FS): Section 3.1
26	**remedial technologies**	Section 2.9	Tetra Tech, 2011 (FS): Section 3.1
27	**process options**	Section 2.9	Tetra Tech, 2011 (FS): Section 3.1
28	**EOS**	Table 2-5, Section 2.9	Tetra Tech, 2011 (FS): Sections 3.2.3, 4.2
29	**30-year NPW**	Table 2-5	Tetra Tech, 2011 (FS): Section 4.2
30	**CERCLA evaluation criteria**	Section 2.10	Tetra Tech, 2011 (FS): Section 4.1.1
31	**BIOCHLOR**	Section 2.10	Tetra Tech, 2011 (FS): Section 4.2, Appendix E

Detailed site information referenced in this ROD in **bold blue text** is contained in the Administrative Record. For access to information contained in the Administrative Record for "Building 81", please contact the NAS South Weymouth Caretaker Site Office, 1134 Main Street, Building 11, Weymouth, Massachusetts.

Appendix A
Massachusetts Department of Environmental Protection Concurrence Letter

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

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Mail Code: OSRR07-03
Boston, MA 02114-2023

Re: Record of Decision
Building 81 Site (OU 9)
Former South Weymouth NAS
MassDEP RTN 4-3002621

Dear Mr. Owens:

The Massachusetts Department of Environmental Protection (MassDEP) reviewed the *Record of Decision, Building 81 Site, Operable Unit 9, Naval Air Station South Weymouth*, dated July 2014. The Record of Decision summarizes the results from the site investigations, interim removal actions, and feasibility study that were used to characterize and develop cleanup options for the site and documents the Navy's rationale for selecting remedial alternative G-3: In-Situ Enhanced Bioremediation, Bio-Barriers, Monitored Natural Attenuation, and Land Use Controls. MassDEP concurs with the selected remedy.

If you have any questions or comments, please contact David Chaffin, Project Manager (617-348-4005), or Anne Malewicz, Federal Facilities Section Chief (617-292-5659).

Sincerely,

Benjamin Ericson
Assistant Commissioner
Bureau of Waste Site Cleanup

cc: D. Barney, USN-S. Weymouth
C. Keating, USEPA
Chief Executive Officer, SSTTDC
RAB Members
J. Naparstek, MADEP-Boston

Appendix B
Cost Estimate

COST ESTIMATE DISCLAIMER

The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-3: Enhanced In-Situ Bioremediation, Bio-Barriers, MNA, and LUCs
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans	500	hr			$60.00		$0	$0	$30,000	$0	$30,000
1.2 Prepare LTM Plans	300	hr			$60.00		$0	$0	$18,000	$0	$18,000
1.3 Prepare LUCs	150	hr			$60.00		$0	$0	$9,000	$0	$9,000
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.2 Equipment Mobilization/Demobilization	4	ea			$188.00	$566.00	$0	$0	$752	$2,264	$3,016
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Office Trailer	3	mo				$365.00	$0	$0	$0	$1,095	$1,095
3.2 Field Office Equipment, Utilities, & Support	3	mo		$508.00			$0	$1,524	$0	$0	$1,524
3.3 Storage Trailer	3	mo				$94.00	$0	$0	$0	$282	$282
3.4 Survey Support	4	day	$1,150.00				$4,600	$0	$0	$0	$4,600
3.5 Site Superintendent	55	day		$166.00	$420.00		$0	$9,130	$23,100	$0	$32,230
3.6 Site Health & Safety and QA/QC	55	day		$166.00	$370.00		$0	$9,130	$20,350	$0	$29,480
3.7 Underground Utility Clearance	1	ls	$10,000.00				$10,000	$0	$0	$0	$10,000
4 DECONTAMINATION											
4.1 Decontamination Services	2	mo		$1,220.00	$2,245.00	$1,550.00	$0	$2,440	$4,490	$3,100	$10,030
4.2 Temporary Equipment Decon Pad	1	ls		$1,500.00	$2,000.00	$300.00	$0	$1,500	$2,000	$300	$3,800
4.3 Decon Water	2,000	gal		$0.20			$0	$400	$0	$0	$400
4.4 Decon Water Storage Tank, 6,000 gallon	2	mo				$813.00	$0	$0	$0	$1,626	$1,626
4.5 Clean Water Storage Tank, 4,000 gallon	2	mo				$731.00	$0	$0	$0	$1,462	$1,462
4.6 Disposal of Decon Waste (liquid & solid)	2	mo	$985.00				$1,970	$0	$0	$0	$1,970
5 SITE PREPARATION											
5.1 Material Handling Pad, 100' by 100'	5,000	sf		$5.84	$0.89	$1.34	$0	$29,200	$4,450	$6,700	$40,350
5.2 Signs on Fence	4	ea		$123.50	$23.35	$12.89	$0	$494	$93	$52	$639
6 IN-SITU BIOREMEDIATION											
6.1 Injection Wells, 24 wells	1,032	lf	$50.00				$51,600	$0	$0	$0	$51,600
6.2 Injection Wells Heads	24	ea	$500.00				$12,000	$0	$0	$0	$12,000
6.3 Inject Pumps	5	day				$525.00	$0	$0	$0	$2,625	$2,625
6.4 Site Labor (2 laborers)	10	day			$280.80		$0	$0	$2,808	$0	$2,808
6.5 AquaBupH	8	drum		$1,608.00			$0	$12,864	$0	$0	$12,864
6.6 Water Tank Truck	5	day				$485.00	$0	$0	$0	$2,425	$2,425
6.8 Injection Water	4,200	gal		$0.20			$0	$840	$0	$0	$840
7 BIO-BARRIER											
7.1 Injection Wells, 49 wells	1,512	lf	$50.00				$75,600	$0	$0	$0	$75,600
7.2 Injection Wells Heads	49	ea	$500.00				$24,500	$0	$0	$0	$24,500
7.3 Inject Pumps	20	day				$525.00	$0	$0	$0	$10,500	$10,500
7.4 Site Labor (2 laborers)	40	day			$280.80		$0	$0	$11,232	$0	$11,232
7.5 AquaBupH	56	drum		$1,608.00			$0	$90,048	$0	$0	$90,048
7.6 Water Tank Truck	20	day				$485.00	$0	$0	$0	$9,700	$9,700
7.7 Injection Water	42,500	gal		$0.20			$0	$8,500	$0	$0	$8,500
8 SITE RESTORATION											
8.1 Area Seeding	17	msf	$96.50				$1,641	$0	$0	$0	$1,641
9 POST CONSTRUCTION COST											
9.1 Contractor Completion Report	300	hr			$60.00		$0	$0	$18,000	$0	$18,000
9.2 Remedial Action Closeout Report	250	hr			$60.00		$0	$0	$15,000	$0	$15,000
Subtotal							$181,911	$167,070	$159,275	$45,631	$553,886
Overhead on Labor Cost @ 30%									$47,783		$47,783
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$18,191	$16,707	$15,928	$4,563	$55,389
Tax on Materials and Equipment Cost @ 6.25%								$10,442		$2,852	$13,294
Total Direct Cost							$200,102	$194,219	$222,986	$53,046	$670,352

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-3: Enhanced In-Situ Bioremediation, Bio-Barriers, MNA, and LUCs
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Indirects on Total Direct Cost @ 25%											$167,588
Profit on Total Direct Cost @ 10%											$67,035
Subtotal											$904,975
Health & Safety Monitoring @ 2%											$18,099
Total Field Cost											$923,074
Engineering on Total Field Cost @ 10%											$92,307
Contingency on Total Field Cost @ 20%											$184,615
TOTAL CAPITAL COST											**$1,199,996**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-3: Enhanced In-Situ Bioremediation, Bio-Barriers, MNA, and LUCs
O & M Cost: Years 5, 10, 15, 20, 25 Reinjection Bio-Barriers

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans	150	hr			$60.00		$0	$0	$9,000	$0	$9,000
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Equipment Mobilization/Demobilization	3	ea			$188.00	$566.00	$0	$0	$564	$1,698	$2,262
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Storage Trailer	2	mo				$94.00	$0	$0	$0	$188	$188
3.2 Site Superintendent and QA/QC	24	day		$166.00	$420.00		$0	$3,984	$10,080	$0	$14,064
4 DECONTAMINATION											
4.1 Decontamination Services	1	mo		$1,220.00	$2,245.00	$1,550.00	$0	$1,220	$2,245	$1,550	$5,015
4.2 Temporary Equipment Decon Pad	0	ls		$1,500.00	$2,000.00	$300.00	$0	$0	$0	$0	$0
4.3 Decon Water	1,000	gal		$0.20			$0	$200	$0	$0	$200
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$813.00	$0	$0	$0	$813	$813
4.5 Clean Water Storage Tank, 4,000 gallon	1	mo				$731.00	$0	$0	$0	$731	$731
4.6 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 BIO-BARRIER											
5.1 Inject Pumps	20	day				$525.00	$0	$0	$0	$10,500	$10,500
5.2 Site Labor (2 laborers)	40	day			$280.80		$0	$0	$11,232	$0	$11,232
5.3 AquaBupH	56	drum		$1,608.00			$0	$90,048	$0	$0	$90,048
5.4 Water Tank Truck	20	day				$485.00	$0	$0	$0	$9,700	$9,700
5.5 Injection Water	42,500	gal		$0.20			$0	$8,500	$0	$0	$8,500
6 POST CONSTRUCTION COST											
6.1 Contractor Completion Report	100	hr			$60.00		$0	$0	$6,000	$0	$6,000
Subtotal							$985	$103,952	$39,121	$25,180	$169,238
Overhead on Labor Cost @ 30%									$11,736		$11,736
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$99	$10,395	$3,912	$2,518	$16,924
Tax on Materials and Equipment Cost @ 6.25%								$6,497		$1,574	$8,071
Total Direct Cost							$1,084	$120,844	$54,769	$29,272	$205,969
Indirects on Total Direct Cost @ 25%											$51,492
Profit on Total Direct Cost @ 10%											$20,597
Subtotal											$278,058
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$278,058
Engineering on Total Field Cost @ 25%											$69,514
Contingency on Total Field Cost @ 25%											$69,514
TOTAL CAPITAL COST											**$417,087**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-3: Enhanced In-Situ Bioremediation, Bio-Barriers, MNA, and LUCs
O & M Cost: Year 5 only, Reinjection In-Situ Bioremediation

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans	0	hr			$60.00		$0	$0	$0	$0	$0
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Equipment Mobilization/Demobilization	0	ea			$188.00	$566.00	$0	$0	$0	$0	$0
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Storage Trailer	0	mo				$94.00	$0	$0	$0	$0	$0
3.2 Site Superintendent and QA/QC	5	day		$166.00	$420.00		$0	$830	$2,100	$0	$2,930
4 DECONTAMINATION											
4.1 Decontamination Services	0	mo		$1,220.00	$2,245.00	$1,550.00	$0	$0	$0	$0	$0
4.2 Temporary Equipment Decon Pad	0	ls		$1,500.00	$2,000.00	$300.00	$0	$0	$0	$0	$0
4.3 Decon Water	0	gal		$0.20			$0	$0	$0	$0	$0
4.4 Decon Water Storage Tank, 6,000 gallon	0	mo				$813.00	$0	$0	$0	$0	$0
4.5 Clean Water Storage Tank, 4,000 gallon	0	mo				$731.00	$0	$0	$0	$0	$0
4.6 Disposal of Decon Waste (liquid & solid)	0	mo	$985.00				$0	$0	$0	$0	$0
5 IN-SITU BIOREMEDIATION											
5.1 Inject Pumps	3	day				$525.00	$0	$0	$0	$1,575	$1,575
5.2 Site Labor (2 laborers)	6	day			$280.80		$0	$0	$1,685	$0	$1,685
5.3 AquaBupH	4	drum		$1,608.00			$0	$6,432	$0	$0	$6,432
5.4 Water Tank Truck	3	day				$485.00	$0	$0	$0	$1,455	$1,455
5.5 Injection Water	2,100	gal		$0.20			$0	$420	$0	$0	$420
6 POST CONSTRUCTION COST											
6.1 Contractor Completion Report	100	hr			$60.00		$0	$0	$6,000	$0	$6,000
Subtotal							$0	$7,682	$9,785	$3,030	$20,497
Overhead on Labor Cost @ 30%									$2,935		$2,935
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$0	$768	$978	$303	$2,050
Tax on Materials and Equipment Cost @ 6.25%								$480		$189	$670
Total Direct Cost							$0	$8,930	$13,699	$3,522	$26,151
Indirects on Total Direct Cost @ 25%											$6,538
Profit on Total Direct Cost @ 10%											$2,615
Subtotal											$35,304
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$35,304
Engineering on Total Field Cost @ 25%											$8,826
Contingency on Total Field Cost @ 25%											$8,826
TOTAL CAPITAL COST											**$52,957**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-3: Enhanced In-Situ Bioremediation, Bio-Barriers, MNA, and LUCs
Annual Cost

Item	Item Cost year 1	Item Cost years 2 - 3	Item Cost years 4 - 30	Item Cost every 5 years	Notes
Site Inspection: Visit	$2,350	$2,350	$2,350		One-day visit and report to verify LUC RD
Surface Water & Groundwater Sampling	$22,100	$11,050	$5,525		Labor and supplies to collect samples from 12 wells, quarterly year 1, semi-annually years 2 & 3, annually years 4-30.
Analysis: Groundwater	$38,268	$19,134	$9,567		Analyze groundwater samples for VOCs, PAHs, arsenic, cadmium, manganese, & MNA
Sampling Report	$48,000	$24,000	$12,000		
Five Year Site Review				$23,000	
Subtotal	$110,718	$56,534	$29,442	$23,000	
Contingency @ 10%	$11,072	$5,653	$2,944	$2,300	
TOTAL	**$121,790**	**$62,187**	**$32,386**	**$25,300**	

NAVAL AIR STATION SOUTH WEYMOUTH
Building 81 FS
Weymouth, MA
Alternative G-3: Enhanced In-Situ Bioremediation, Bio-Barriers, MNA, and LUCs
Present Worth Analysis

Year	Capital Cost	Operation & Maintenance Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$1,199,996			$1,199,996	1.000	$1,199,996
1			$121,790	$121,790	0.980	$119,402
2			$62,187	$62,187	0.961	$59,773
3			$62,187	$62,187	0.942	$58,601
4			$32,386	$32,386	0.924	$29,920
5		$470,044	$57,686	$527,730	0.906	$477,981
6			$32,386	$32,386	0.888	$28,758
7			$32,386	$32,386	0.871	$28,194
8			$32,386	$32,386	0.853	$27,641
9			$32,386	$32,386	0.837	$27,099
10		$417,087	$57,686	$474,773	0.820	$389,479
11			$32,386	$32,386	0.804	$26,047
12			$32,386	$32,386	0.788	$25,536
13			$32,386	$32,386	0.773	$25,036
14			$32,386	$32,386	0.758	$24,545
15		$417,087	$57,686	$474,773	0.743	$352,763
16			$32,386	$32,386	0.728	$23,592
17			$32,386	$32,386	0.714	$23,129
18			$32,386	$32,386	0.700	$22,676
19			$32,386	$32,386	0.686	$22,231
20		$417,087	$57,686	$474,773	0.673	$319,509
21			$32,386	$32,386	0.660	$21,368
22			$32,386	$32,386	0.647	$20,949
23			$32,386	$32,386	0.634	$20,538
24			$32,386	$32,386	0.622	$20,135
25		$417,087	$57,686	$474,773	0.610	$289,389
26			$32,386	$32,386	0.598	$19,353
27			$32,386	$32,386	0.586	$18,974
28			$32,386	$32,386	0.574	$18,602
29			$32,386	$32,386	0.563	$18,237
30			$57,686	$57,686	0.552	$31,847
				TOTAL PRESENT WORTH		**$3,791,298**

Appendix C
Human Health Risk Assessment Summary Tables

FIGURE C-1

HUMAN HEALTH CONCEPTUAL SITE MODEL
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

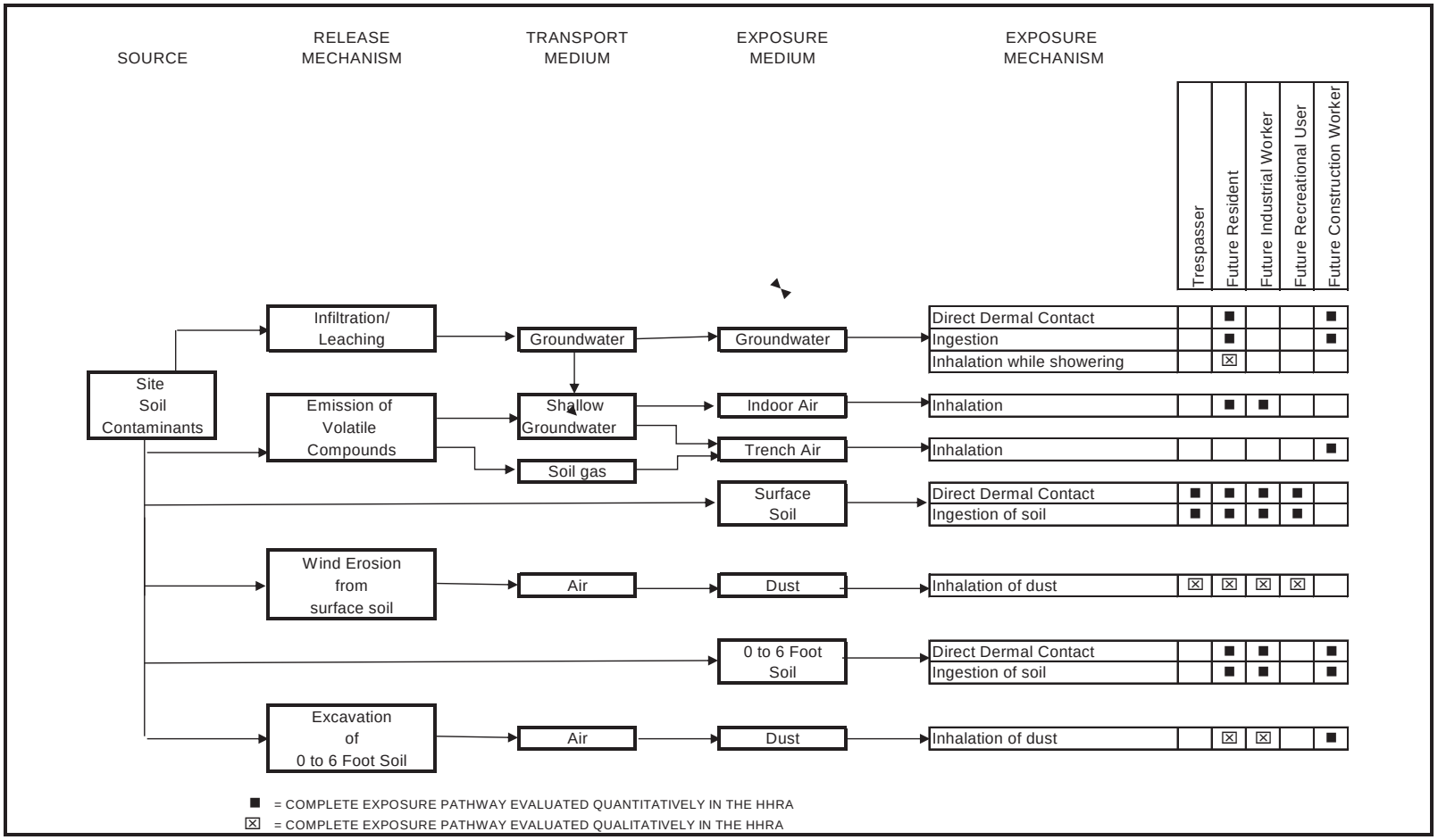

TABLE C-1
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Exposed Surface Soil
Exposure Medium: Exposed Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale[1]
Building 81	Benzo(a)pyrene Equivalents	mg/kg	0.74	1.4 (G)	2.68 J	2.68	mg/kg	Maximum Concentration	< 10 Samples
	Arsenic	mg/kg	3.7	5.0 (N)	5.87	5.87	mg/kg	Maximum Concentration	< 10 Samples
	Chromium	mg/kg	17.3	51.9 (G)	61.7	61.7	mg/kg	Maximum Concentration	< 10 Samples
	Lead	mg/kg	453	4750 (L)	2610	453	mg/kg	Mean Concentration	(2)
	Manganese (Soil)	mg/kg	166	285 (N)	436	436	mg/kg	Maximum Concentration	< 10 Samples

For non-detects, the sample quantitation limit was used as the input concentration.
G = Gamma distribution.
N = Normal distribution.
NP = Nonparametric distribution.

1 - The maximum concentration is used because the data set contains less than 10 samples, there are less than three detections, or the UCL exceeds the maximum concentration.
2 - The mean concentration is used as exposure point concentration for evaluating exposures to lead.
U.S. EPA, 1994: Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for lead in children.

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE C-2
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Future Surface Soil
Exposure Medium: Future Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale[1]
Building 81	Benzo(a)pyrene Equivalents	mg/kg	0.24	0.45 (G)	2.7 J	0.45	mg/kg	95% KM (t) UCL	ProUCL 4.00.04
	Arsenic	mg/kg	2.6	3.4 (N)	5.87	3.4	mg/kg	95% Student's-t UCL	ProUCL 4.00.04
	Chromium	mg/kg	13.2	19.4 (L)	61.7	19.4	mg/kg	95% H-UCL	ProUCL 4.00.04
	Lead	mg/kg	198	2050 (NP)	2610	198	mg/kg	Mean Concentration	(2)
	Manganese (Soil)	mg/kg	225	275 (N)	436	275	mg/kg	95% Student's-t UCL	ProUCL 4.00.04

For non-detects, the sample quantitation limit was used as an input concentration.
G = Gamma distrubtion.
L = Lognormal distribution.
N = Normal distribution.
NP = Nonparametric distribution.

1 - The maximum concentration is used because the data set contains less than 10 samples, there are less than three detections, or the UCL exceeds the maximum concentration.
2 - The mean concentration is used as exposure point concentration for evaluating exposures to lead.
U.S. EPA, 1994: Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for lead in children.

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE C-3
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: All Soil (0-6 ft.)
Exposure Medium: All Soil (0-6 ft.)

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale[1]
Building 81	Benzo(a)pyrene Equivalents	mg/kg	0.18	0.31 (G)	2.7 J	0.31	mg/kg	95% KM (t) UCL	ProUCL 4.00.04
	Arsenic	mg/kg	2.2	2.8 (G)	5.87	2.8	mg/kg	95% Approximate Gamma UCL	ProUCL 4.00.04
	Chromium	mg/kg	11.3	22.3 (NP)	61.7	22.3	mg/kg	95% Chebyshev (Mean, Sd) UCL	ProUCL 4.00.04
	Lead	mg/kg	128	1300 (NP)	2610	128	mg/kg	Mean Concentration	(2)
	Manganese (Soil)	mg/kg	206	240 (N)	436	240	mg/kg	95% Student's-t UCL	ProUCL 4.00.04

For non-detects, the sample quantitation limit was used as an input concentration.
G = Gamma distribution.
L = Lognormal distribution.
N = Normal distribution.

1 - The maximum concentration is used because the data set contains less than 10 samples, there are less than three detections, or the UCL exceeds the maximum concentration.
2 - The mean concentration is used as exposure point concentration for evaluating exposures to lead.
U.S. EPA, 1994: Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for lead in children.

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE C-4
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: All Groundwater
Exposure Medium: All Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Building 81	1,1,2-Trichloroethane	ug/L	0.19	0.20 (N)	1.2 J	1.2	ug/L	Maximum Concentration	(1)
	1,2,4-Trichlorobenzene	ug/L	0.55	1.2 (N)	4.7	4.7	ug/L	Maximum Concentration	(1)
	1,2,4-Trimethylbenzene	ug/L	1.0	2.9 (N)	9	9	ug/L	Maximum Concentration	(1)
	1,2-Dibromo-3-chloropropane	ug/L	NA(3)	NA(3)	0.14 J	0.14	ug/L	Maximum Concentration	(1)
	1,2-Dichloroethane	ug/L	0.16	NA(4)	2.1 J	2.1	ug/L	Maximum Concentration	(1)
	Benzene	ug/L	0.64	1.3 (L)	12	12	ug/L	Maximum Concentration	(1)
	Bromodichloromethane	ug/L	0.18	0.12 (G)	2	2	ug/L	Maximum Concentration	(1)
	Chlorodibromomethane	ug/L	0.14	0.061 (N)	0.36	0.36	ug/L	Maximum Concentration	(1)
	Chloroform	ug/L	0.68	1.7 (L)	24	24	ug/L	Maximum Concentration	(1)
	cis-1,2-Dichloroethene	ug/L	7.2	10.3 (G)	125 J	125	ug/L	Maximum Concentration	(1)
	Dichlorodifluoromethane	ug/L	2.4	4.4 (G)	114 J	114	ug/L	Maximum Concentration	(1)
	Ethylbenzene	ug/L	1.2	2.4 (L)	36 J	36	ug/L	Maximum Concentration	(1)
	Tetrachloroethene	ug/L	180	850 (L)	11000	11000	ug/L	Maximum Concentration	(1)
	Toluene	ug/L	10	19 (G)	480	480	ug/L	Maximum Concentration	(1)
	Total Xylenes	ug/L	1.8	5.2 (L)	80	80	ug/L	Maximum Concentration	(1)
	Trichloroethene	ug/L	6.1	20 (L)	190	190	ug/L	Maximum Concentration	(1)
	Vinyl chloride	ug/L	0.65	1.4 (L)	11	11	ug/L	Maximum Concentration	(1)
	1,4-Dioxane	ug/L	0.55	2.3 (N)	8 J	8	ug/L	Maximum Concentration	(1)
	2-Methylnaphthalene	ug/L	0.52	1.1 (N)	19.5	19.5	ug/L	Maximum Concentration	(1)
	Benzo(a)pyrene Equivalents	ug/L	0.047	0.057 (NP)	0.13	0.13	ug/L	Maximum Concentration	(1)
	Bis(2-ethylhexyl)phthalate	ug/L	1.1	1.6 (NP)	16	16	ug/L	Maximum Concentration	(1)
	N-Nitrosodiphenylamine	ug/L	2.6	8.3 (N)	35	35	ug/L	Maximum Concentration	(1)
	Naphthalene	ug/L	1.6	6.7 (NP)	57	57	ug/L	Maximum Concentration	(1)
	Aldrin	ug/L	NA(3)	NA(3)	0.0057 J	0.0057	ug/L	Maximum Concentration	(1)
	Dieldrin	ug/L	NA(3)	NA(3)	0.03 J	0.03	ug/L	Maximum Concentration	(1)
	Heptachlor	ug/L	0.0038	0.0072 (NP)	0.024 J	0.024	ug/L	Maximum Concentration	(1)
	Heptachlor epoxide	ug/L	NA(3)	NA(3)	0.01 J	0.01	ug/L	Maximum Concentration	(1)
	Antimony	ug/L	NA(3)	NA(3)	5.87 J	5.87	ug/L	Maximum Concentration	(1)
	Arsenic	ug/L	1.3	1.5 (G)	6.5	6.5	ug/L	Maximum Concentration	(1)
	Cadmium (Water)	ug/L	0.23	0.59 (NP)	11.3	11.3	ug/L	Maximum Concentration	(1)
	Chromium	ug/L	1.1	1.1 (NP)	5.8	5.8	ug/L	Maximum Concentration	(1)
	Lead	ug/L	1.8	4.5 (L)	49.5	4.5	ug/L	Mean Concentration	(2)
	Manganese (Water)	ug/L	718	1130 (G)	4590	4590	ug/L	Maximum Concentration	(1)
	Zinc	ug/L	153	502 (L)	4510 J	4510	ug/L	Maximum Concentration	(1)

For non-detects, the sample quantitation limit was used as an input concentration.
G - Gamma distribution.
L - Lognormal distribution.
N - Normal distribution.
NP = Nonparametric distribution.

1 - The maximum detected concentration is used as the exposure point concentration for groundwater used as drinking water in the RME scenario.
2 - The mean concentration is used as exposure point concentration for evaluating exposures to lead.
U.S. EPA, 1994:Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for lead in Children.
3 - The mean and UCL were not calculated if there were less than three positive detections.
4 - Only four detected concentrations for this chemical; ProUCL did not calculate a UCL.

TABLE C-5
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Shallow Groundwater
Exposure Medium: Shallow Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Building 81	1,1,2-Trichloroethane	ug/L	0.13	0.21 (N)	0.97	0.97	ug/L	Maximum Concentration	(1)
	1,2,4-Trichlorobenzene	ug/L	0.52	1.1 (N)	4	4	ug/L	Maximum Concentration	(1)
	1,2,4-Trimethylbenzene	ug/L	NA(3)	NA(3)	7	7	ug/L	Maximum Concentration	(1)
	1,2-Dibromo-3-chloropropane	ug/L	NA(3)	NA(3)	0.14 J	0.14	ug/L	Maximum Concentration	(1)
	Benzene	ug/L	0.54	0.99 (G)	12	12	ug/L	Maximum Concentration	(1)
	Bromodichloromethane	ug/L	0.092	0.082 (N)	0.28	0.28	ug/L	Maximum Concentration	(1)
	Chlorodibromomethane	ug/L	NA(3)	NA(3)	0.36	0.36	ug/L	Maximum Concentration	(1)
	Chloroform	ug/L	0.33	0.50 (N)	2.6	2.6	ug/L	Maximum Concentration	(1)
	cis-1,2-Dichloroethene	ug/L	6.1	17 (L)	100	100	ug/L	Maximum Concentration	(1)
	Dichlorodifluoromethane	ug/L	1.3	3.0 (G)	42 J	42	ug/L	Maximum Concentration	(1)
	Ethylbenzene	ug/L	0.63	1.2 (N)	12	12	ug/L	Maximum Concentration	(1)
	Tetrachloroethene	ug/L	31	48 (G)	300	300	ug/L	Maximum Concentration	(1)
	Trichloroethene	ug/L	1.9	6.8 (L)	28	28	ug/L	Maximum Concentration	(1)
	Vinyl chloride	ug/L	0.40	0.78 (G)	11	11	ug/L	Maximum Concentration	(1)
	Benzo(a)pyrene Equivalents	ug/L	0.042	0.019 (NP)	0.020	0.020	ug/L	Maximum Concentration	(1)
	Naphthalene	ug/L	2.0	17 (NP)	57	57	ug/L	Maximum Concentration	(1)
	Aldrin	ug/L	NA(3)	NA(3)	0.0057 J	0.0057	ug/L	Maximum Concentration	(1)
	Dieldrin	ug/L	NA(3)	NA(3)	0.03 J	0.03	ug/L	Maximum Concentration	(1)
	Heptachlor	ug/L	NA(3)	NA(3)	0.024 J	0.024	ug/L	Maximum Concentration	(1)
	Heptachlor epoxide	ug/L	NA(3)	NA(3)	0.01 J	0.01	ug/L	Maximum Concentration	(1)
	Arsenic	ug/L	1.4	2.1 (N)	6.5	6.5	ug/L	Maximum Concentration	(1)
	Cadmium (Water)	ug/L	0.42	1.0 (NP)	11.3	11.3	ug/L	Maximum Concentration	(1)
	Chromium	ug/L	1.2	1.2 (N)	5.8	5.8	ug/L	Maximum Concentration	(1)
	Lead	ug/L	1.0	3.0 (NP)	18.6 J	1.0	ug/L	Mean Concentration	(2)
	Manganese (Water)	ug/L	571	900 (G)	3230	3230	ug/L	Maximum Concentration	(1)
	Zinc	ug/L	247	972 (L)	4510 J	4510	ug/L	Maximum Concentration	(1)

For non-detects, the sample quantitation limit was used as an input concentration.
G - Gamma distribution.
L - Lognormal distribution.
N - Normal distribution.
NP = Nonparametric distribution.

1 - The maximum detected concentration is used as the exposure point concentration for shallow groundwater in the RME scenario.
2 - The mean concentration is used as exposure point concentration for evaluating exposures to lead.
U.S. EPA, 1994:Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for lead in Children.
3 - The mean and UCL were not calculated if there were less than three positive detections.

TABLE C-6

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS- SOILS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Surface Soil/Subsurface Soil
Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	330	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 2002b	BW x AT
				EF	Exposure Frequency	130	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
Dermal	Construction Workers	Adult	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	5729	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.13	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	130	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

Notes:

1 - Professional judgment.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 2.40E-08 Cancer Dermal Intake = 5.41E-08

Noncancer Ingestion Intake = 1.68E-06 Noncancer Dermal Intake = 3.79E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE C-7

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS - SOILS TO AIR

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Surface/Subsurface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	Building 81	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	(1)	$\frac{CA \times ET \times EF \times ED}{AT \times 24\ hours/day}$
				EF	Exposure Frequency	130	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.40E+06	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	

Notes:

1 - Professional judgment.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 1.70E-03 Noncancer Inhalation Intake = 1.19E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Unit Risk

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Concentration

TABLE C-8

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS - GROUNDWATER

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	Building 81	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	0.01	L/day	(1)	$\frac{CGW \times CF \times IR\text{-}GW \times EF \times ED}{BW \times AT}$
				EF	Exposure Frequency	65	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
Dermal	Construction Workers	Adult	Building 81	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	ug/L	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	$\frac{DAevent \times EV \times EF \times ED \times SA}{BW \times AT}$
				CF	Conversion factor	0.001	L/cm^3	- -	
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	5749	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	65	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration	1	years	(1)	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	70	kg	USEPA, 1989	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)]
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

Notes

1 - Professional judgment.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Dermal Intake = 2.09E-01 Noncancer Dermal Intake = 1.46E+01

Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE C-9

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS - GROUNDWATER TO AIR

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	Building 81	CA	Chemical concentration in air	Calculated	mg/m3	VDEQ, 2004	Exposure Concentration (mg/m^3) =
				CW	Chemical concentration in water.	Average	ug/L	--	
				CF	Conversion Factor	0.001	mg/ug	--	$\frac{CA \times ET \times EF \times ED}{AT \times 24\ hours/day}$
				ET	Exposure Time	8	hours/day	(1)	
				EF	Exposure Frequency	65	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	CA = CW x CF x VF
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
				VF	Volatilization Factor	Calculated	(mg/m3)/(mg/L)	VDEQ, 2004	

Notes:

1 - Professional judgment.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

VDEQ, 2004: Virginia Department of Environmental Quality (VDEQ, online- http://www.deq.state.va.us/vrprisk/homepage.html).

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 8.48E-07 Noncancer Inhalation Intake = 5.94E-05

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE C-10

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - INDUSTRIAL WORKERS - SOIL

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Surface Soil/Subsurface Soil
Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Industrial Workers	Adult	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 2002b	BW x AT
				EF	Exposure Frequency	250	days/year	USEPA, 2002b	
				ED	Exposure Duration	25	years	USEPA, 2002b	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 1989	
Dermal	Industrial Workers	Adult	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	250	days/year	USEPA, 2002b	
				ED	Exposure Duration	25	years	USEPA, 1989	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 2002a:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 3.49E-07 Cancer Dermal Intake = 2.31E-06

Noncancer Ingestion Intake = 9.78E-07 Noncancer Dermal Intake = 6.46E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE C-11

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADOLESCENT TRESPASSERS - SOILS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Exposed Surface Soil
Exposure Medium: Exposed Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	39	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	39	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	4184	cm2	(3)	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.05	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	39	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	39	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 1989	

Notes:

For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor of 3 in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

1 - Professional judgment. Assumes 1 day/week during 9 months per year for RME; assumes 1 day/week during 2 months per year for CTE.

2 - Older child from age 6 to 16.

3 - Assumes forearms, lower legs, and feet are exposed (USEPA, 2004).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake =	3.91E-08	Cancer Dermal Intake =	8.19E-08
Noncancer Ingestion Intake =	2.74E-07	Noncancer Dermal Intake =	5.73E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE C-12

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RECREATIONAL USERS - SOILS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Future Surface Soil
Exposure Medium: Future Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(1)	BW x AT
				EF	Exposure Frequency	141	days/year	(1)	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2190	days	USEPA, 1989	
Dermal	Recreational User	Child	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	141	days/year	USEPA, 1997	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2190	days	USEPA, 1989	

Notes:

1 - Professional judgement.

2 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 1997. Exposure Factors Handbook. Volume I, Aug. 1997, EPA/600/P-25/002FA.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 6) = 4.41E-07 Cancer Dermal Intake (Age 0 - 6) = 1.24E-06

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 1.47E-07 Cancer Dermal Intake (Age 0 - 2) = 4.12E-07

Cancer Ingestion Intake (Age 2 - 6) = 2.94E-07 Cancer Dermal Intake (Age 2 - 6) = 8.24E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 5.15E-06 Noncancer Dermal Intake = 1.44E-05

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE C-13
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE - ADULT RECREATIONAL USERS - SOILS
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Future Surface Soil
Exposure Medium: Future Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(1)	BW x AT
				EF	Exposure Frequency	39	days/year	(2)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Recreational User	Adult	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	39	days/year	(2)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(3), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(3), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Professional judgement.

2 - Professional judgment. RME: one day per week for 9 months. CTE: one day per month for 12 months.

3 - Adults will be evaluated as one age group (6 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 6 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 30) = 5.23E-08 Cancer Dermal Intake (Age 6 - 30) = 2.09E-07

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 2.18E-08 Cancer Dermal Intake (Age 6 - 16) = 8.70E-08

Cancer Ingestion Intake (Age 16 - 30) = 3.05E-08 Cancer Dermal Intake (Age 16 - 30) = 1.22E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.53E-07 Noncancer Dermal Intake = 6.09E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE C-14
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - SOILS
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface Soil/Subsurface Soil
Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 2002b	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2002b	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1994: USEPA Region I Risk Updates, August 1994.

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 6) = 1.10E-06 Cancer Dermal Intake (Age 0 - 6) = 3.07E-06

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 3.65E-07 Cancer Dermal Intake (Age 0 - 2) = 1.02E-06

Cancer Ingestion Intake (Age 2 - 6) = 7.31E-07 Cancer Dermal Intake (Age 2 - 6) = 2.05E-06

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.28E-05 Noncancer Dermal Intake = 3.58E-05

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE C-15
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - GROUNDWATER
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Child	Building 81	CGW	Chemical Concentration in Groundwater	Maximum	ug/L	USEPA, 1994	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	1.5	L/day	USEPA, 1994	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 1994	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Residents	Child	Building 81	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Maximum	ug/L	USEPA, 1994	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	1	hr/event	USEPA, 2004	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	6,600	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 1994	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1994: USEPA Region I Risk Updates, August 1994.

USEPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 6) = 8.22E-06 Cancer Dermal Intake Time (Age 0 - 6) = 3.62E+01

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 2.74E-06 Cancer Dermal Intake (Age 0 - 2) = 1.21E+01

Cancer Ingestion Intake (Age 2 - 6) = 5.48E-06 Cancer Dermal Intake (Age 2 - 6) = 2.41E+01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 9.59E-05 Noncancer Dermal Intake = 4.22E+02

Cancer risk from ingestion = Groundwater concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Groundwater concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE C-16

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - SOILS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface Soil/Subsurface Soil
Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 2002b	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	Building 81	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2002b	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Adults will be evaluated as one age group (6 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 6 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002a :Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 30) = 4.70E-07 Cancer Dermal Intake (Age 6 - 30) = 1.87E-06

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 1.96E-07 Cancer Dermal Intake (Age 6 - 16) = 7.81E-07

Cancer Ingestion Intake (Age 16 - 30) = 2.74E-07 Cancer Dermal Intake (Age 16 - 30) = 1.09E-06

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.37E-06 Noncancer Dermal Intake = 5.47E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE C-17
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - GROUNDWATER
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Adult	Building 81	CGW	Chemical Concentration in Groundwater	Maximum	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	2	L/day	USEPA, 1994	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 1994	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Residents	Adult	Building 81	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Maximum	ug/L	USEPA, 2002a	DAevent x EV x EF x ED x SA
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	BW x AT
				CF	Conversion factor	0.001	L/cm^3	- -	
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	For inorganics
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	
				tevent	Duration of event	0.58	hr/event	USEPA, 2004	For organics if tevent <= t*
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				SA	Skin Surface Available for Contact	18,000	cm2	USEPA, 2004	
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 1994	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Adults will be evaluated as one age group (6 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 6 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1994: USEPA Region I Risk Updates, August 1994.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 30) = 9.39E-06 Cancer Dermal Intake (Age 6 - 30) = 8.45E+01

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 3.91E-06 Cancer Dermal Intake (Age 6 - 16) = 3.52E+01

Cancer Ingestion Intake (Age 16 - 30) = 5.48E-06 Cancer Dermal Intake (Age 16 - 30) = 4.93E+01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.74E-05 Noncancer Dermal Intake = 2.47E+02

Cancer risk from ingestion = Groundwater concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Groundwater concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE C-18

NON-CANCER CHRONIC TOXICITY DATA -- ORAL/DERMAL
BUILDING 81 SITE
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value[1]	Oral RfD Units	GI Absorption in Toxicity Study	Adjusted Dermal RfD[2]	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (MM/DD/YYYY)[4]	Dermal Absorption Factor for Soils (DABS)
Antimony	Chronic	4.0E-04	mg/kg-day	0.15	6.0E-05	mg/kg-day	Blood	1000	IRIS	05/27/2010	NA
Arsenic	Chronic	3.0E-04	mg/kg-day	1	3.0E-04	mg/kg-day	Skin, CVS	3	IRIS	05/27/2010	0.03
Cadmium - water	Chronic	5.0E-04	mg/kg-day	0.05	2.5E-05	mg/kg-day	Kidney	10	IRIS	05/27/2010	0.001
Chromium	Chronic	3.0E-03	mg/kg-day	0.025	7.5E-05	mg/kg-day	None Reported	300/3	IRIS	05/27/2010	NA
Lead	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Manganese - soil[3]	Chronic	1.4E-01	mg/kg-day	1	1.4E-01	mg/kg-day	CNS	1	IRIS	05/27/2010	NA
Manganese - water[3]	Chronic	2.4E-02	mg/kg-day	0.04	9.6E-04	mg/kg-day	CNS	1	IRIS	05/27/2010	NA
Zinc	Chronic	3.E-01	mg/kg-day	1	3.00E-01	mg/kg-day	Blood	3	IRIS	05/27/2010	NA
1,4-Dioxane	Chronic	1.0E-01	mg/kg-day	1	1.00E-01	mg/kg-day	NA	NA	ATSDR	09/2007	0.1
2-Methylnaphthalene	Chronic	4.0E-03	mg/kg-day	1	4.0E-03	mg/kg-day	Lungs	1000	IRIS	05/27/2010	NA
Benzo(a)pyrene Equivalents	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	0.13
Benzo(a)anthracene	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	0.13
Benzo(a)pyrene	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	0.13
Benzo(b)fluoranthene	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	0.13
Bis(2-ethylhexyl)phthalate	Chronic	2.0E-02	mg/kg-day	1	2.0E-02	mg/kg-day	Liver	1000	IRIS	05/27/2010	0.1
Dibenzo(a,h)anthracene	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	0.13
Indeno(1,2,3-cd)pyrene	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	0.13
N-nitrosodiphenylamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.1
Naphthalene	Chronic	2.0E-02	mg/kg-day	1	2.0E-02	mg/kg-day	Body Weight	3000	IRIS	05/27/2010	0.13
1,1,2-Trichloroethane	Chronic	4.0E-03	mg/kg-day	1	4.0E-03	mg/kg-day	Blood	1000	IRIS	05/27/2010	NA
1,2,4-Trichlorobenzene	Chronic	1.0E-02	mg/kg-day	1	1.0E-02	mg/kg-day	Adrenals	1000	IRIS	05/27/2010	NA
1,2,4-Trimethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	Chronic	2.0E-04	mg/kg-day	1	2.0E-04	mg/kg-day	NA	NA	PPRTV	08/03/2006	NA
1,2-Dichloroethane	Chronic	2.0E-02	mg/kg-day	1	2.0E-02	mg/kg-day	NA	NA	PPRTV	10/31/2002	NA
Benzene	Chronic	4.0E-03	mg/kg-day	1	4.0E-03	mg/kg-day	Blood	300	IRIS	05/27/2010	NA
Bromodichloromethane	Chronic	2.0E-02	mg/kg-day	1	2.0E-02	mg/kg-day	Kidney	1000	IRIS	05/27/2010	NA
Chlorodibromomethane	Chronic	2.0E-02	mg/kg-day	1	2.0E-02	mg/kg-day	Liver	1000	IRIS	05/27/2010	0.1
Chloroform	Chronic	1.0E-02	mg/kg-day	1	1.0E-02	mg/kg-day	Liver	1000	IRIS	05/27/2010	NA
cis-1,2-Dichloroethene	Chronic	1.0E-02	mg/kg-day	1	1.0E-02	mg/kg-day	Blood	3000	PPRTV	03/01/2006	NA
Dichlorodifluoromethane	Chronic	2.0E-01	mg/kg-day	1	2.0E-01	mg/kg-day	Body Weight	100	IRIS	05/27/2010	NA
Ethylbenzene	Chronic	1.0E-01	mg/kg-day	1	1.0E-01	mg/kg-day	Liver, Kidney	1000	IRIS	05/27/2010	NA
Tetrachloroethene	Chronic	1.0E-02	mg/kg-day	1	1.0E-02	mg/kg-day	Liver	1000	IRIS	05/27/2010	NA
Toluene	Chronic	8.0E-02	mg/kg-day	1	8.0E-02	mg/kg-day	Kidney	3000	IRIS	05/27/2010	NA
Trichloroethene	Chronic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride	Chronic	3.0E-03	mg/kg-day	1	3.0E-03	mg/kg-day	Liver	30	IRIS	05/27/2010	NA
Total Xylenes	Chronic	2.0E-01	mg/kg-day	1	2.0E-01	mg/kg-day	Body Weight	1000	IRIS	05/27/2010	NA
Aldrin	Chronic	3.0E-05	mg/kg-day	1	3.0E-05	mg/kg-day	Liver	1000	IRIS	05/27/2010	0.1
Dieldrin	Chronic	5.0E-05	mg/kg-day	1	5.0E-05	mg/kg-day	Liver	100	IRIS	05/27/2010	0.1
Heptachlor	Chronic	5.0E-04	mg/kg-day	1	5.0E-04	mg/kg-day	Liver	300	IRIS	05/27/2010	0.1
Heptachlor epoxide	Chronic	1.3E-05	mg/kg-day	1	1.3E-05	mg/kg-day	Liver	1000	IRIS	05/27/2010	0.1

ATSDR = Agency for Toxic Substances and Disease Registry
IRIS = Integrated Risk Information System
NA = Not Applicable
PPRTV - Provisional Peer Review Toxicity Value

(1) To be used for oral pathway only. Based on administered dose.
(2) Adjusted RfD = oral RfD x GI absorption value in toxicity study upon which the RfD is based. To be used for dermal pathway only.
(3) Values for manganese (soil) and manganese (water) correspond with those advocated in the EPA Region I Risk Updates, September 1999.
(4) For IRIS values, the date IRIS was searched.
For remaining values, the date of the corresponding reference is presented.

TABLE C-19

NON-CANCER TOXICITY DATA -- INHALATION
BUILDING 81
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD[1]	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ	Dates[2] (MM/DD/YYYY)
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	Chronic	1.5E-05	mg/m^3	4.3E-06	mg/kg-day	NA	NA	CalEPA	09/2009
Cadmium	Chronic	1.0E-05	mg/m^3	2.9E-06	mg/kg/day	NA	NA	ATSDR	09/2008
Chromium	Chronic	1.0E-04	mg/m^3	2.9E-05	mg/kg-day	Lungs	300	IRIS	05/27/2010
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	Chronic	5.E-05	mg/m^3	1.4E-05	mg/kg-day	CNS	1000	IRIS	05/27/2010
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dioxane	Chronic	3.6E+00	mg/m^3	1.0E+00	mg/kg/day	NA	NA	ATSDR	09/2007
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene equivalents	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
N-nitrosodiphenylamine	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Chronic	3.0E-03	mg/m^3	8.6E-04	mg/kg/day	Nasal	3,000	IRIS	05/27/2010
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	Chronic	2.0E-03	mg/m^3	5.7E-04	mg/kg/day	NA	NA	PPRTV	06/17/2009
1,2,4-Trimethylbenzene	Chronic	7.0E-03	mg/m^3	2.0E-03	mg/kg/day	NA	NA	PPRTV	06/11/2007
1,2-Dibromo-3-chloropropane	Chronic	2.0E-04	mg/m^3	5.7E-05	mg/kg/day	Testes	1,000	IRIS	05/27/2010
1,2-Dichloroethane	Chronic	2.4E+00	mg/m^3	6.9E-01	mg/kg/day	NA	NA	ATSDR	09/2001
Benzene	Chronic	3.0E-02	mg/m^3	8.6E-03	mg/kg/day	Blood	300	IRIS	05/27/2010
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorodibromomethane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	Chronic	9.8E-02	mg/m^3	2.8E-02	mg/kg/day	Liver	NA	ATSDR	09/1997
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	Chronic	2.0E-01	mg/m^3	5.7E-02	mg/kg/day	NA	NA	HEAST	07/1997
Ethylbenzene	Chronic	1.0E+00	mg/m^3	2.9E-01	mg/kg/day	Developmental	300	IRIS	05/27/2010
Tetrachloroethene	Chronic	2.7E-01	mg/m^3	7.7E-02	mg/kg/day	Liver	NA	ATSDR	09/1997
Toluene	Chronic	5.0E+00	mg/m^3	1.4E+00	mg/kg/day	CNS	10	IRIS	05/27/2010
Trichloroethene	Chronic	1.0E-02	mg/m^3	2.9E-03	mg/kg/day	CNS	NA	NYSDOH	10/2006
Vinyl chloride	Chronic	1.0E-01	mg/m^3	2.9E-02	mg/kg/day	Liver	30	IRIS	05/27/2010
Total Xylenes	Chronic	1.0E-01	mg/m^3	2.9E-02	mg/kg/day	CNS	300	IRIS	05/27/2010
Aldrin	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA

N/A = Not Applicable
ATSDR = Agency for Toxic Substances and Disease Registry
Cal EPA = California Environmental Protection Agency, Technical Support Document for Describing Available Cancer Slope Factors, September 2009.
IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables
PPRTV - Provisional Peer Review Toxicity Value
(1) InhalationRfD= Inhalation RfC x 20 m3/day x 1/70kg
(2) For IRIS values, the date IRIS was searched.
For remaining values, the date of the corresponding reference is presented.

TABLE C-20

CHEMICAL-SPECIFIC DERMAL PARAMETERS FOR EVALUATING WATER CONTACT
BUILDING 81 SITE
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Chemical of Potential Concern	Dermal Permeability Coeffient in Water (K_p) cm/hr	B	TAU (hr)	t* (hr)	FA
Antimony	1.00E-03	NA	NA	NA	1
Arsenic	1.00E-03	NA	NA	NA	1
Cadmium (Water)	1.00E-03	NA	NA	NA	1
Lead	1.00E-03	NA	NA	NA	1
Manganese (Water)	1.00E-03	NA	NA	NA	1
Zinc	6.00E-04	NA	NA	NA	1
1,4-Dioxane	3.32E-04	1.20E-03	3.32E-01	7.97E-01	1
2-Methylnaphthalene	8.94E-02	4.10E-01	6.57E-01	1.58E+00	1
Benzo(a)pyrene Equivalents	7.01E-01	4.27E+00	2.69E+00	1.17E+01	0
Benzo(a)anthracene	4.74E-01	2.75E+00	2.03E+00	8.53E+00	0
Benzo(b)fluoranthene	7.02E-01	4.29E+00	2.77E+00	1.20E+01	0
Bis(2-ethylhexyl)phthalate	2.49E-02	1.90E-01	1.66E+01	3.99E+01	0.8
Dibenzo(a,h)anthracene	1.51E+00	9.68E+00	3.88E+00	1.76E+01	0
Indeno(1,2,3-cd)pyrene	1.04E+00	6.65E+00	3.78E+00	1.68E+01	0.6
N-nitrosodiphenylamine	1.45E-02	7.88E-02	1.38E+00	3.31E+00	1
Naphthalene	4.66E-02	2.03E-01	5.58E-01	1.34E+00	1
1,1,2-Trichloroethane	6.44E-03	2.86E-02	5.96E-01	1.43E+00	1
1,2,4-Trichlorobenzene	6.63E-02	3.43E-01	1.11E+00	2.66E+00	1
1,2,4-Trimethylbenzene	8.37E-02	3.53E-01	4.95E-01	1.19E+00	1
1,2-Dibromo-3-chloropropane	6.76E-03	4.00E-02	2.21E+00	5.31E+00	1
1,2-Dichloroethane	4.20E-03	1.61E-02	3.82E-01	9.18E-01	1
Benzene	1.49E-02	5.05E-02	2.92E-01	7.00E-01	1
Bromodichloromethane	4.62E-03	2.27E-02	8.83E-01	2.12E+00	1
Chlorodibromomethane	3.22E-03	1.79E-02	1.57E+00	3.77E+00	1
Chloroform	6.83E-03	2.87E-02	4.98E-01	1.19E+00	1
cis-1,2-Dichloroethene	1.09E-02	4.12E-02	3.66E-01	8.80E-01	1
Dichlorodifluoromethane	8.95E-03	3.79E-02	5.07E-01	1.22E+00	1
Ethylbenzene	4.93E-02	1.95E-01	4.20E-01	1.01E+00	1
Tetrachloroethene	3.34E-02	1.66E-01	9.06E-01	2.18E+00	1
Toluene	3.11E-02	1.15E-01	3.50E-01	8.39E-01	1
Trichloroethene	1.16E-02	5.13E-02	5.81E-01	1.39E+00	1
Vinyl chloride	5.60E-03	1.70E-02	2.39E-01	5.73E-01	1
Total Xylenes	4.62E-02	1.83E-01	4.13E-01	9.91E-01	1
Aldrin	1.40E-03	1.03E-02	1.19E+01	2.85E+01	1
Dieldrin	1.22E-02	9.18E-02	1.46E+01	3.51E+01	0.8
Heptachlor	8.64E-03	6.43E-02	1.33E+01	3.19E+01	0.8
Heptachlor epoxide	2.03E-02	1.54E-01	1.59E+01	3.82E+01	1

All values from EPA's Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, July 2004.

NA = Not Available/Not Applicable
B = Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis
TAU = Lagtime per event (hr)
t* = Time to reach steady state (hr)
FA = Fraction absorbed (dimensionless)

TABLE C-21

CANCER TOXICITY DATA -- ORAL/DERMAL
BUILDING 81 SITE
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Chemical of Potential Concern	Oral Cancer Slope Factor (1)	GI Absorption in Toxicity Study	Adjusted Dermal Cancer Slope Factor (2)	Units	Weight of Evidence Narrative Descriptor	Source	Date (MM/DD/YYYY) (3)	Dermal Absorption Factor for Soils (DABS)
Antimony	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	1.5E+00	1.0E+00	1.5E+00	1/(mg/kg-day)	A / Human Carcinogen	IRIS	05/27/2010	0.03
Cadmium	NA	NA	NA	NA	B1 / Probable human carcinogen	IRIS	05/27/2010	0.001
Chromium	5.0E-01	2.5E-02	2.0E+01	1/(mg/kg-day)	D (Not classifiable as to human carcinogenicity)	IRIS	05/27/2010	NA
Lead	NA	NA	NA	NA	B2 (Probable human carcinogen)	IRIS	05/27/2010	NA
Manganese	NA	NA	NA	NA	D (Not classifiable as to human carcinogenicity)	IRIS	05/27/2010	NA
Zinc	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	05/27/2010	NA
1,4-Dioxane	1.1E-02	1.0E+00	1.1E-02	1/(mg/kg-day)	B2 / Probable human carcinogen	IRIS	05/27/2010	0.1
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene equivalents	7.3E+00	1.0E+00	7.3E+00	1/(mg/kg-day)	B2 (Probable human carcinogen)	ECAO	1993	0.13
Benzo(a)anthracene	7.3E-01	1.0E+00	7.3E-01	1/(mg/kg-day)	B2 (Probable human carcinogen)	ECAO	1993	0.13
Benzo(a)pyrene	7.3E+00	1.0E+00	7.3E+00	1/(mg/kg-day)	B2 (Probable human carcinogen)	IRIS	05/27/2010	0.13
Benzo(b)fluoranthene	7.3E-01	1.0E+00	7.3E-01	1/(mg/kg-day)	B2 (Probable human carcinogen)	ECAO	1993	0.13
Bis(2-ethylhexyl)phthalate	1.4E-02	1.0E+00	1.4E-02	1/(mg/kg-day)	B2 (Probable human carcinogen)	IRIS	05/27/2010	0.1
Dibenzo(a,h)anthracene	7.3E+00	1.0E+00	7.3E+00	1/(mg/kg-day)	B2 (Probable human carcinogen)	ECAO	1993	0.13
Indeno(1,2,3-cd)pyrene	7.3E-01	1.0E+00	7.3E-01	1/(mg/kg-day)	B2 (Probable human carcinogen)	ECAO	1993	0.13
N-nitrosodiphenylamine	4.9E-03	1.0E+00	4.9E-03	1/(mg/kg-day)	B2 (Probable human carcinogen)	IRIS	05/27/2010	NA
Naphthalene	NA	NA	NA	NA	C / Possible human carcinogen	IRIS	05/27/2010	0.13
1,1,2-Trichloroethane	5.7E-02	1.0E+00	5.7E-02	1/(mg/kg-day)	C / Possible human carcinogen	IRIS	05/27/2010	NA
1,2,4-Trichlorobenzene	2.9E-02	1.0E+00	2.9E-02	1/(mg/kg-day)	NA	IRIS	05/27/2010	NA
1,2,4-Trimethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	8.0E-01	1.0E+00	8.0E-01	1/(mg/kg-day)	NA	PPRTV	08/03/2006	NA
1,2-Dichloroethane	9.1E-02	1.0E+00	9.1E-02	1/(mg/kg-day)	B2 / Probable human carcinogen	IRIS	05/27/2010	NA
Benzene	5.5E-02	1.0E+00	5.5E-02	1/(mg/kg-day)	A / Human Carcinogen	IRIS	05/27/2010	NA
Bromodichloromethane	6.2E-02	1.0E+00	6.2E-02	1/(mg/kg-day)	B2 / Probable human carcinogen	IRIS	05/27/2010	NA
Chlorodibromomethane	8.4E-02	1.0E+00	8.4E-02	1/(mg/kg-day)	C / Possible human carcinogen	IRIS	5/27/2010	NA
Chloroform	3.1E-02	1.0E+00	3.1E-02	1/(mg/kg-day)	B1 (Probable human carcinogen)	IRIS	05/27/2010	NA
cis-1,2-Dichloroethene	NA	NA	NA	NA	D (Not classifiable as to human carcinogenicity)	IRIS	05/27/2010	NA
Dichlorodifluoromethane	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	1.1E-02	1.0E+00	1.1E-02	1/(mg/kg-day)	D / Not classifiable as to human carcinogenicity	CalEPA	11/2007	NA
Tetrachloroethene	5.4E-01	1.0E+00	5.4E-01	1/(mg/kg-day)	NA	CalEPA	09/2009	NA
Toluene	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	5.9E-03	1.0E+00	5.9E-03	1/(mg/kg-day)	NA	CalEPA	09/2009	NA
Vinyl chloride - adult life	7.2E-01	1.0E+00	7.2E-01	1/(mg/kg-day)	A / Human Carcinogen	IRIS	05/27/2010	NA
Vinyl chloride - child life	1.5E+00	1.0E+00	1.5E+00	1/(mg/kg-day)	A / Human Carcinogen	IRIS	05/27/2010	NA
Total Xylenes	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	1.7E+01	1.0E+00	1.7E+01	1/(mg/kg-day)	B2 / Probable human carcinogen	IRIS	05/27/2010	0.1
Dieldrin	1.6E+01	1.0E+00	1.6E+01	1/(mg/kg-day)	B2 / Probable human carcinogen	IRIS	05/27/2010	0.1
Heptachlor	4.5E+00	1.0E+00	4.5E+00	1/(mg/kg-day)	B2 / Probable human carcinogen	IRIS	05/27/2010	0.1
Heptachlor epoxide	9.1E+00	1.0E+00	9.1E+00	1/(mg/kg-day)	B2 / Probable human carcinogen	IRIS	05/27/2010	0.1

CalEPA = California EPA
IRIS = Integrated Risk Information System
ECAO = Environmental Criteria and Assessment Office (EPA, 1993).
PPRTV = Provisional Peer Review Toxicity Value

(1) To be used for oral pathway only. Based on administered dose.
(2) - Adjusted dermal cancer slope factor = oral cancer slope factor/oral absorption efficiency for dermal.
(3) For IRIS values, the date IRIS was searched.
For remaining values, the date of the corresponding reference is presented.

TABLE C-22
CANCER TOXICITY DATA -- INHALATION
BUILDING 81
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Chemical of Potential Concern	Unit Risk	Units	Adjustment	Inhalation Cancer Slope Factor (1)	Units	Weight of Evidence/ Cancer Guideline Description	Source	Date (1) (MM/DD/YY)
Antimony	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	4.3E-03	$(ug/m^3)^{-1}$	NA	1.5E+01	$(mg/kg-d)^{-1}$	A (Human carcinogen)	IRIS	05/27/2010
Cadmium	1.8E-03	NA	NA	6.3E+00	$(mg/kg-d)^{-1}$	B1 / Probable human carcinogen	IRIS	5/27/2010
Chromium	8.4E-02	$(ug/m^3)^{-1}$	NA	2.9E+02	$(mg/kg-d)^{-1}$	A (Human carcinogen)	IRIS	5/27/2010
Lead	NA	NA	NA	NA	NA	B2 (Probable human carcinogen)	IRIS	5/27/2010
Manganese	NA	NA	NA	NA	NA	D (Not classifiable as to human carcinogenicity)	IRIS	5/27/2010
Zinc	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	5/27/2010
1,4-Dioxane	7.7E-06	$(ug/m^3)^{-1}$	NA	2.7E-02	$(mg/kg-d)^{-1}$	B2 / Probable human carcinogen	CalEPA	09/2009
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene equivalents	1.1E-03	$(ug/m^3)^{-1}$	NA	1.1E-03	$(mg/kg-d)^{-1}$	NA	CalEPA	09/2009
Benzo(a)anthracene	1.1E-04	$(ug/m^3)^{-1}$	NA	3.9E-01	$(mg/kg-d)^{-1}$	B2 (Probable human carcinogen)	CalEPA	09/2009
Benzo(a)pyrene	1.1E-03	$(ug/m^3)^{-1}$	NA	3.9E+00	$(mg/kg-d)^{-1}$	B2 (Probable human carcinogen)	CalEPA	09/2009
Benzo(b)fluoranthene	1.1E-04	$(ug/m^3)^{-1}$	NA	3.9E-01	$(mg/kg-d)^{-1}$	B2 (Probable human carcinogen)	CalEPA	09/2009
Bis(2-ethylhexyl)phthalate	2.4E-06	$(ug/m^3)^{-1}$	NA	2.4E-06	$(mg/kg-d)^{-1}$	B2 / Probable human carcinogen	CalEPA	09/2009
Dibenzo(a,h)anthracene	1.2E-03	$(ug/m^3)^{-1}$	NA	4.2E+00	$(mg/kg-d)^{-1}$	B2 (Probable human carcinogen)	CalEPA	09/2009
Indeno(1,2,3-cd)pyrene	1.1E-03	$(ug/m^3)^{-1}$	NA	3.9E+00	$(mg/kg-d)^{-1}$	B2 (Probable human carcinogen)	CalEPA	09/2009
N-Nitrosodiphenylamine	2.6E-06	$(ug/m^3)^{-1}$	NA	2.6E-06	$(mg/kg-d)^{-1}$	B2 / Probable human carcinogen	CalEPA	09/2009
Naphthalene	3.4E-05	$(ug/m^3)^{-1}$	NA	1.2E-01	$(mg/kg-d)^{-1}$	C/ Possible Human Carcinogen	CalEPA	08/2004
1,1,2-Trichloroethane	1.6E-05	$(ug/m^3)^{-1}$	NA	5.6E-02	$(mg/kg-d)^{-1}$	C / Possible human carcinogen	IRIS	5/27/2010
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	6.0E-03	$(ug/m^3)^{-1}$	NA	2.1E+01	$(mg/kg-d)^{-1}$	NA	PPRTV	08/03/2006
1,2-Dichloroethane	2.6E-05	$(ug/m^3)^{-1}$	NA	9.1E-02	$(mg/kg-d)^{-1}$	B2 / Probable human carcinogen	IRIS	5/27/2010
Benzene	7.8E-06	$(ug/m^3)^{-1}$	NA	2.7E-02	$(mg/kg-d)^{-1}$	A / Known human carcinogen	IRIS	5/27/2010
Bromodichloromethane	3.7E-05	$(ug/m^3)^{-1}$	NA	1.3E-01	$(mg/kg-d)^{-1}$	B2 / Probable human carcinogen	CalEPA	09/2009
Chlorodibromomethane	2.7E-05	$(ug/m^3)^{-1}$	NA	9.5E-02	$(mg/kg-d)^{-1}$	C / Possible human carcinogen	CalEPA	09/2009
Chloroform	2.3E-05	$(ug/m^3)^{-1}$	NA	8.1E-02	$(mg/kg-d)^{-1}$	B2 / Probable human carcinogen	IRIS	5/27/2010
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	2.5E-06	$(ug/m^3)^{-1}$	NA	8.8E-03	$(mg/kg-d)^{-1}$	D / Not classifiable as to human carcinogenicity	CalEPA	11/2007
Tetrachloroethene	5.9E-06	$(ug/m^3)^{-1}$	NA	2.1E-02	$(mg/kg-d)^{-1}$	NA	CalEPA	09/2009
Toluene	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	2.0E-06	$(ug/m^3)^{-1}$	NA	7.0E-03	$(mg/kg-d)^{-1}$	NA	CalEPA	09/2009
Vinyl chloride - adult life	4.4E-06	$(ug/m^3)^{-1}$	NA	1.5E-02	$(mg/kg-d)^{-1}$	A / Known/likely human carcinogen	IRIS	5/27/2010
Vinyl chloride - child life	8.8E-06	$(ug/m^3)^{-1}$	NA	3.1E-02	$(mg/kg-d)^{-1}$	A / Known/likely human carcinogen	IRIS	5/27/2010
Total Xylenes	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	4.9E-03	$(ug/m^3)^{-1}$	NA	1.7E+01	$(mg/kg-d)^{-1}$	B2 / Probable human carcinogen	IRIS	5/27/2010
Dieldrin	4.6E-03	$(ug/m^3)^{-1}$	NA	1.6E+01	$(mg/kg-d)^{-1}$	B2 / Probable human carcinogen	IRIS	5/27/2010
Heptachlor	1.3E-03	(ug/m3)-1	NA	4.6E+00	$(mg/kg-d)^{-1}$	B2 / Probable human carcinogen	IRIS	5/27/2010
Heptachlor epoxide	2.6E-03	(ug/m3)-1	NA	9.1E+00	$(mg/kg-d)^{-1}$	B2 / Probable human carcinogen	IRIS	5/27/2010

CalEPA = California EPA

IRIS = Integrated Risk Information System

PPRTV = Provisional Peer-Reviewed Toxicity Value

(1) InhalationCSF= Inhalation Unit risk x 70kg x 1/20 m3/day x 1000 ug/mg

(2) For IRIS values, the date IRIS was searched.

For remaining values, the date of the corresponding reference is presented.

TABLE C-23

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - CONSTRUCTION WORKERS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
All Soil (0-6 ft.)	All Soil (0-6 ft.)	Building 81	Benzo(a)pyrene Equivalents	5E-08	--	2E-08	--	7E-08	NA	--	- -	--	--
			Arsenic	1E-07	--	7E-09	--	1E-07	Skin, CVS	0.02	- -	0.001	0.02
			Chromium	3E-07	--	- -	--	3E-07	None Reported	0.01	- -	--	0.01
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese (Soil)	- -	--	- -	--	- -	CNS	0.003	- -	--	0.003
			Chemical Total	4E-07	--	2E-08	--	4E-07		0.03	--	0.001	0.03
		Exposure Point Total						4E-07					0.03
	Exposure Medium Total							4E-07					0.03
	Air	Building 81	Benzo(a)pyrene Equivalents	--	4E-10	--	--	4E-10	NA	- -	--	- -	--
			Arsenic	--	1E-08	--	--	1E-08	NA	- -	0.02	- -	0.02
			Chromium	--	2E-06	--	--	2E-06	Lungs	- -	0.02	- -	0.02
			Lead	--	- -	--	--	- -	NA	- -	--	- -	--
			Manganese (Soil)	--	- -	--	--	- -	CNS	- -	0.4	- -	0.4
			Chemical Total	--	2E-06	--	--	2E-06		- -	0.4	- -	0.4
		Exposure Point Total						2E-06					0.4
	Exposure Medium Total							2E-06					0.4
Medium Total								3E-06					0.5

TABLE C-23

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - CONSTRUCTION WORKERS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Shallow Groundwater	Shallow Groundwater	Building 81	1,1,2-Trichloroethane	2E-11	--	2E-10	--	3E-10	Blood	0.000006	- -	0.00007	0.00008
			1,2,4-Trichlorobenzene	4E-11	--	7E-09	--	7E-09	Adrenals	0.00001	- -	0.002	0.002
			1,2,4-Trimethylbenzene	- -	--	- -	--	- -	NA	--	- -	--	--
			1,2-Dibromo-3-chloropropane	4E-11	--	9E-10	--	1E-09	NA	0.00002	- -	0.0004	0.0004
			Benzene	2E-10	--	5E-09	--	5E-09	Blood	0.00008	- -	0.002	0.002
			Bromodichloromethane	6E-12	--	6E-11	--	7E-11	Kidney	0.0000004	- -	0.000003	0.000004
			Chlorodibromomethane	1E-11	--	1E-10	--	1E-10	Liver	0.0000005	- -	0.000004	0.000005
			Chloroform	3E-11	--	3E-10	--	4E-10	Liver	0.000007	- -	0.00008	0.00008
			cis-1,2-Dichloroethene	- -	--	- -	--	- -	Blood	0.0003	- -	0.004	0.005
			Dichlorodifluoromethane	- -	--	- -	--	- -	Body Weight	0.000005	- -	0.00008	0.00009
			Ethylbenzene	5E-11	--	4E-09	--	4E-09	Liver, Kidney	0.000003	- -	0.0002	0.0002
			Tetrachloroethene	6E-08	--	4E-06	--	4E-06	Liver	0.0008	- -	0.05	0.06
			Trichloroethene	6E-11	--	1E-09	--	1E-09	NA	--	- -	--	--
			Vinyl chloride	3E-09	--	2E-08	--	3E-08	Liver	0.00009	- -	0.0007	0.0008
			Benzo(a)pyrene Equivalents	5E-11	--	- -	--	5E-11	NA	--	- -	--	--
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.00007	- -	0.006	0.006
			Aldrin	4E-11	--	4E-10	--	4E-10	Liver	0.000005	- -	0.00005	0.00006
			Dieldrin	2E-10	--	1E-08	--	1E-08	Liver	0.00002	- -	0.001	0.001
			Heptachlor	4E-11	--	2E-09	--	2E-09	Liver	0.000001	- -	0.00007	0.00007
			Heptachlor epoxide	3E-11	--	6E-09	--	6E-09	Liver	0.00002	- -	0.004	0.004
			Arsenic	4E-09	--	4E-09	--	8E-09	Skin, CVS	0.0006	- -	0.0006	0.001
			Cadmium (Water)	- -	--	- -	--	- -	Kidney	0.0006	- -	0.01	0.01
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese (Water)	- -	--	- -	--	- -	CNS	0.003	- -	0.10	0.1
			Zinc	- -	--	- -	--	- -	Blood	0.0004	- -	0.0003	0.0006
			Chemical Total	7E-08	--	4E-06	--	4E-06		0.006	--	0.2	0.2
		Exposure Point Total						4E-06					0.2
	Exposure Medium Total							4E-06					0.2

TABLE C-23

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - CONSTRUCTION WORKERS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Shallow Groundwater	Air	Building 81	1,1,2-Trichloroethane	--	1E-07	--	--	1E-07	NA	- -	--	- -	--
			1,2,4-Trichlorobenzene	--	- -	--	--	- -	NA	- -	0.9	- -	0.9
			1,2,4-Trimethylbenzene	--	- -	--	--	- -	NA	- -	0.6	- -	0.6
			1,2-Dibromo-3-chloropropane	--	4E-06	--	--	4E-06	Testes	- -	--	- -	--
			Benzene	--	1E-06	--	--	1E-06	Blood	- -	0.3	- -	0.3
			Bromodichloromethane	--	7E-08	--	--	7E-08	NA	- -	--	- -	--
			Chlorodibromomethane	--	6E-08	--	--	6E-08	NA	- -	--	- -	--
			Chloroform	--	5E-07	--	--	5E-07	Liver	- -	0.02	- -	0.02
			cis-1,2-Dichloroethene	--	- -	--	--	- -	NA	- -	--	- -	--
			Dichlorodifluoromethane	--	- -	--	--	- -	NA	- -	0.1	- -	0.1
			Ethylbenzene	--	3E-07	--	--	3E-07	Developmental	- -	0.008	- -	0.008
			Tetrachloroethene	--	1E-05	--	--	1E-05	Liver	- -	0.6	- -	0.6
			Trichloroethene	--	5E-07	--	--	5E-07	CNS	- -	2	- -	2
			Vinyl chloride	--	6E-07	--	--	6E-07	Liver	- -	0.09	- -	0.09
			Benzo(a)pyrene Equivalents	--	- -	--	--	- -	NA	- -	--	- -	--
			Naphthalene	--	1E-05	--	--	1E-05	Nasal	- -	10	- -	10
			Aldrin	--	- -	--	--	- -	NA	- -	--	- -	--
			Dieldrin	--	- -	--	--	- -	NA	- -	--	- -	--
			Heptachlor	--	- -	--	--	- -	NA	- -	--	- -	--
			Heptachlor epoxide	--	- -	--	--	- -	NA	- -	--	- -	--
			Arsenic	--	- -	--	--	- -	NA	- -	--	- -	--
			Cadmium (Water)	--	- -	--	--	- -	NA	- -	--	- -	--
			Lead	--	- -	--	--	- -	NA	- -	--	- -	--
			Manganese (Water)	--	- -	--	--	- -	CNS	- -	--	- -	--
			Zinc	--	- -	--	--	- -	NA	- -	--	- -	--
			Chemical Total	--	3E-05	--	--	3E-05		- -	14	- -	14
		Exposure Point Total						3E-05					14
	Exposure Medium Total							3E-05					14
Medium Total								4E-05					15
Receptor Total							Receptor Risk Total	4E-05				Receptor HI Total	15

TABLE C-23

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - CONSTRUCTION WORKERS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Total Adrenals HI	0.002
Total Blood HI	0.3
Total Body Weight HI	0.006
Total CNS HI	2
Total CVS HI	0.02
Total Developmental HI	0.008
Total Kidney HI	0.01
Total Liver HI	0.7
Total Lungs HI	0.02
Total Nasal HI	10
Total None Reported HI	0.01
Total Skin HI	0.02

TABLE C-24

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - CHILD RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Future Surface Soil	Future Surface Soil	Building 81	Benzo(a)pyrene Equivalents	2E-05	--	7E-06	--	3E-05	NA	--	- -	--	--
			Arsenic	6E-06	--	5E-07	--	6E-06	Skin, CVS	0.1	- -	0.01	0.2
			Chromium	6E-05	--	- -	--	6E-05	None Reported	0.08	- -	--	0.08
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese (Soil)	- -	--	- -	--	- -	CNS	0.03	- -	--	0.03
			Chemical Total	8E-05	--	7E-06	--	9E-05		0.3	--	0.01	0.3
		Exposure Point Total						9E-05					0.3
	Exposure Medium Total							9E-05					0.3
Medium Total								9E-05					0.3

TABLE C-24

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - CHILD RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Building 81	1,1,2-Trichloroethane	6E-07	--	3E-08	--	6E-07	Blood	0.03	- -	0.002	0.03
			1,2,4-Trichlorobenzene	1E-06	--	1E-06	--	2E-06	Adrenals	0.05	- -	0.04	0.08
			1,2,4-Trimethylbenzene	- -	--	- -	--	- -	NA	--	- -	--	--
			1,2-Dibromo-3-chloropropane	5E-06	--	6E-07	--	6E-06	NA	0.07	- -	0.008	0.08
			1,2-Dichloroethane	2E-06	--	5E-08	--	2E-06	NA	0.01	- -	0.0003	0.01
			Benzene	5E-06	--	6E-07	--	6E-06	Blood	0.3	- -	0.03	0.3
			Bromodichloromethane	1E-06	--	5E-08	--	1E-06	Kidney	0.010	- -	0.0005	0.01
			Chlorodibromomethane	2E-07	--	1E-08	--	3E-07	Liver	0.002	- -	0.00008	0.002
			Chloroform	6E-06	--	4E-07	--	6E-06	Liver	0.2	- -	0.01	0.2
			cis-1,2-Dichloroethene	- -	--	- -	--	- -	Blood	1	- -	0.10	1
			Dichlorodifluoromethane	- -	--	- -	--	- -	Body Weight	0.05	- -	0.004	0.06
			Ethylbenzene	3E-06	--	1E-06	--	5E-06	Liver, Kidney	0.03	- -	0.01	0.05
			Tetrachloroethene	5E-02	--	2E-02	--	7E-02	Liver	105	- -	41	146
			Toluene	- -	--	- -	--	- -	Kidney	0.6	- -	0.1	0.7
			Total Xylenes	- -	--	- -	--	- -	Body Weight	0.04	- -	0.01	0.05
			Trichloroethene	9E-06	--	1E-06	--	1E-05	NA	--	- -	--	--
			Vinyl chloride	3E-04	--	1E-05	--	4E-04	Liver	0.4	- -	0.01	0.4
			1,4-Dioxane	7E-07	--	2E-09	--	7E-07	NA	0.008	- -	0.00002	0.008
			2-Methylnaphthalene	- -	--	- -	--	- -	Lungs	0.5	- -	0.4	0.9
			Benzo(a)pyrene Equivalents	4E-05	--	- -	--	4E-05	NA	--	- -	--	--
			Bis(2-ethylhexyl)phthalate	2E-06	--	2E-06	--	4E-06	Liver	0.08	- -	0.08	0.2
			N-Nitrosodiphenylamine	1E-06	--	3E-07	--	2E-06	NA	--	- -	--	--
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.3	- -	0.1	0.4
			Aldrin	8E-07	--	5E-08	--	8E-07	Liver	0.02	- -	0.001	0.02
			Dieldrin	4E-06	--	2E-06	--	6E-06	Liver	0.06	- -	0.03	0.08
			Heptachlor	9E-07	--	3E-07	--	1E-06	Liver	0.005	- -	0.001	0.006
			Heptachlor epoxide	7E-07	--	7E-07	--	1E-06	Liver	0.07	- -	0.07	0.1
			Antimony	- -	--	- -	--	- -	Blood	1	- -	0.04	1
			Arsenic	8E-05	--	4E-07	--	8E-05	Skin, CVS	2	- -	0.009	2
			Cadmium (Water)	- -	--	- -	--	- -	Kidney	2	- -	0.2	2
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese (Water)	- -	--	- -	--	- -	CNS	18	- -	2	20
			Zinc	- -	--	- -	--	- -	Blood	1	- -	0.004	1
			Chemical Total	5E-02	--	2E-02	--	7E-02		135	--	44	179
		Exposure Point Total						7E-02					179
	Exposure Medium Total							7E-02					179

TABLE C-24

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - CHILD RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Air	Building 81	1,1,2-Trichloroethane	--	6E-07	--	--	6E-07	NA	- -	0.03	- -	0.03
			1,2,4-Trichlorobenzene	--	1E-06	--	--	1E-06	NA	- -	0.05	- -	0.05
			1,2,4-Trimethylbenzene	--	- -	--	--	- -	NA	- -	--	- -	--
			1,2-Dibromo-3-chloropropane	--	5E-06	--	--	5E-06	Testes	- -	0.07	- -	0.07
			1,2-Dichloroethane	--	2E-06	--	--	2E-06	NA	- -	0.01	- -	0.01
			Benzene	--	5E-06	--	--	5E-06	Blood	- -	0.3	- -	0.3
			Bromodichloromethane	--	1E-06	--	--	1E-06	NA	- -	0.010	- -	0.010
			Chlorodibromomethane	--	2E-07	--	--	2E-07	NA	- -	0.002	- -	0.002
			Chloroform	--	6E-06	--	--	6E-06	Liver	- -	0.2	- -	0.2
			cis-1,2-Dichloroethene	--	- -	--	--	- -	NA	- -	1	- -	1
			Dichlorodifluoromethane	--	- -	--	--	- -	NA	- -	0.05	- -	0.05
			Ethylbenzene	--	3E-06	--	--	3E-06	Developmental	- -	0.03	- -	0.03
			Tetrachloroethene	--	5E-02	--	--	5E-02	Liver	- -	105	- -	105
			Toluene	--	- -	--	--	- -	CNS	- -	0.6	- -	0.6
			Total Xylenes	--	- -	--	--	- -	CNS	- -	0.04	- -	0.04
			Trichloroethene	--	9E-06	--	--	9E-06	CNS	- -	--	- -	--
			Vinyl chloride	--	3E-04	--	--	3E-04	Liver	- -	0.4	- -	0.4
			1,4-Dioxane	--	- -	--	--	- -	NA	- -	--	- -	--
			2-Methylnaphthalene	--	- -	--	--	- -	Nasal	- -	0.5	- -	0.5
			Benzo(a)pyrene Equivalents	--	- -	--	--	- -	NA	- -	--	- -	--
			Bis(2-ethylhexyl)phthalate	--	- -	--	--	- -	NA	- -	--	- -	--
			N-Nitrosodiphenylamine	--	- -	--	--	- -	NA	- -	--	- -	--
			Naphthalene	--	- -	--	--	- -	Nasal	- -	0.3	- -	0.3
			Aldrin	--	- -	--	--	- -	NA	- -	--	- -	--
			Dieldrin	--	- -	--	--	- -	NA	- -	--	- -	--
			Heptachlor	--	- -	--	--	- -	NA	- -	--	- -	--
			Heptachlor epoxide	--	- -	--	--	- -	NA	- -	--	- -	--
			Antimony	--	- -	--	--	- -	NA	- -	--	- -	--
			Arsenic	--	- -	--	--	- -	NA	- -	--	- -	--
			Cadmium (Water)	--	- -	--	--	- -	NA	- -	--	- -	--
			Lead	--	- -	--	--	- -	NA	- -	--	- -	--
			Manganese (Water)	--	- -	--	--	- -	CNS	- -	--	- -	--
			Zinc	--	- -	--	--	- -	NA	- -	--	- -	--
			Chemical Total	--	5E-02	--	--	5E-02		- -	109	- -	109
		Exposure Point Total						5E-02					109
	Exposure Medium Total							5E-02					109
Medium Total								1E-01					288
Receptor Total							Receptor Risk Total	1E-01				Receptor HI Total	288

TABLE C-24

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - CHILD RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

Total Adrenals HI	0.08
Total Blood HI	5
Total Body Weight HI	0.5
Total CNS HI	21
Total CVS HI	2
Total Developmental HI	0.03
Total Kidney HI	3
Total Liver HI	253
Total Lungs HI	0.9
Total Nasal HI	0.7
Total None Reported HI	0.1
Total Skin HI	2

TABLE C-25

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - CHILD RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
All Soil (0-6 ft.)	All Soil (0-6 ft.)	Building 81	Benzo(a)pyrene Equivalents	1E-05	--	5E-06	--	2E-05	NA	--	- -	--	--
			Arsenic	5E-06	--	4E-07	--	5E-06	Skin, CVS	0.1	- -	0.01	0.1
			Chromium	7E-05	--	- -	--	7E-05	None Reported	0.10	- -	--	0.10
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese (Soil)	- -	--	- -	--	- -	CNS	0.02	- -	--	0.02
			Chemical Total	8E-05	--	5E-06	--	9E-05		0.2	--	0.01	0.2
		Exposure Point Total						9E-05					0.2
	Exposure Medium Total							9E-05					0.2
Medium Total								9E-05					0.2

TABLE C-25

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - CHILD RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Building 81	1,1,2-Trichloroethane	6E-07	--	3E-08	--	6E-07	Blood	0.03	- -	0.002	0.03
			1,2,4-Trichlorobenzene	1E-06	--	1E-06	--	2E-06	Adrenals	0.05	- -	0.04	0.08
			1,2,4-Trimethylbenzene	- -	--	- -	--	- -	NA	--	- -	--	--
			1,2-Dibromo-3-chloropropane	5E-06	--	6E-07	--	6E-06	NA	0.07	- -	0.008	0.08
			1,2-Dichloroethane	2E-06	--	5E-08	--	2E-06	NA	0.01	- -	0.0003	0.01
			Benzene	5E-06	--	6E-07	--	6E-06	Blood	0.3	- -	0.03	0.3
			Bromodichloromethane	1E-06	--	5E-08	--	1E-06	Kidney	0.010	- -	0.0005	0.01
			Chlorodibromomethane	2E-07	--	1E-08	--	3E-07	Liver	0.002	- -	0.00008	0.002
			Chloroform	6E-06	--	4E-07	--	6E-06	Liver	0.2	- -	0.01	0.2
			cis-1,2-Dichloroethene	- -	--	- -	--	- -	Blood	1	- -	0.10	1
			Dichlorodifluoromethane	- -	--	- -	--	- -	Body Weight	0.05	- -	0.004	0.06
			Ethylbenzene	3E-06	--	1E-06	--	5E-06	Liver, Kidney	0.03	- -	0.01	0.05
			Tetrachloroethene	5E-02	--	2E-02	--	7E-02	Liver	105	- -	41	146
			Toluene	- -	--	- -	--	- -	Kidney	0.6	- -	0.1	0.7
			Total Xylenes	- -	--	- -	--	- -	Body Weight	0.04	- -	0.01	0.05
			Trichloroethene	9E-06	--	1E-06	--	1E-05	NA	--	- -	--	--
			Vinyl chloride	3E-04	--	1E-05	--	4E-04	Liver	0.4	- -	0.01	0.4
			1,4-Dioxane	7E-07	--	2E-09	--	7E-07	NA	0.008	- -	0.00002	0.008
			2-Methylnaphthalene	- -	--	- -	--	- -	Lungs	0.5	- -	0.4	0.9
			Benzo(a)pyrene Equivalents	4E-05	--	- -	--	4E-05	NA	--	- -	--	--
			Bis(2-ethylhexyl)phthalate	2E-06	--	2E-06	--	4E-06	Liver	0.08	- -	0.08	0.2
			N-Nitrosodiphenylamine	1E-06	--	3E-07	--	2E-06	NA	--	- -	--	--
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.3	- -	0.1	0.4
			Aldrin	8E-07	--	5E-08	--	8E-07	Liver	0.02	- -	0.001	0.02
			Dieldrin	4E-06	--	2E-06	--	6E-06	Liver	0.06	- -	0.03	0.08
			Heptachlor	9E-07	--	3E-07	--	1E-06	Liver	0.005	- -	0.001	0.006
			Heptachlor epoxide	7E-07	--	7E-07	--	1E-06	Liver	0.07	- -	0.07	0.1
			Antimony	- -	--	- -	--	- -	Blood	1	- -	0.04	1
			Arsenic	8E-05	--	4E-07	--	8E-05	Skin, CVS	2	- -	0.009	2
			Cadmium (Water)	- -	--	- -	--	- -	Kidney	2	- -	0.2	2
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese (Water)	- -	--	- -	--	- -	CNS	18	- -	2	20
			Zinc	- -	--	- -	--	- -	Blood	1	- -	0.004	1
			Chemical Total	5E-02	--	2E-02	--	7E-02		135	--	44	179
		Exposure Point Total						7E-02					179
	Exposure Medium Total							7E-02					179

TABLE C-25

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - CHILD RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Air	Building 81	1,1,2-Trichloroethane	--	6E-07	--	--	6E-07	NA	- -	0.03	- -	0.03
			1,2,4-Trichlorobenzene	--	1E-06	--	--	1E-06	NA	- -	0.05	- -	0.05
			1,2,4-Trimethylbenzene	--	- -	--	--	- -	NA	- -	--	- -	--
			1,2-Dibromo-3-chloropropane	--	5E-06	--	--	5E-06	Testes	- -	0.07	- -	0.07
			1,2-Dichloroethane	--	2E-06	--	--	2E-06	NA	- -	0.01	- -	0.01
			Benzene	--	5E-06	--	--	5E-06	Blood	- -	0.3	- -	0.3
			Bromodichloromethane	--	1E-06	--	--	1E-06	NA	- -	0.010	- -	0.010
			Chlorodibromomethane	--	2E-07	--	--	2E-07	NA	- -	0.002	- -	0.002
			Chloroform	--	6E-06	--	--	6E-06	Liver	- -	0.2	- -	0.2
			cis-1,2-Dichloroethene	--	- -	--	--	- -	NA	- -	1	- -	1
			Dichlorodifluoromethane	--	- -	--	--	- -	NA	- -	0.05	- -	0.05
			Ethylbenzene	--	3E-06	--	--	3E-06	Developmental	- -	0.03	- -	0.03
			Tetrachloroethene	--	5E-02	--	--	5E-02	Liver	- -	105	- -	105
			Toluene	--	- -	--	--	- -	CNS	- -	0.6	- -	0.6
			Total Xylenes	--	- -	--	--	- -	CNS	- -	0.04	- -	0.04
			Trichloroethene	--	9E-06	--	--	9E-06	CNS	- -	--	- -	--
			Vinyl chloride	--	3E-04	--	--	3E-04	Liver	- -	0.4	- -	0.4
			1,4-Dioxane	--	- -	--	--	- -	NA	- -	--	- -	--
			2-Methylnaphthalene	--	- -	--	--	- -	Nasal	- -	0.5	- -	0.5
			Benzo(a)pyrene Equivalents	--	- -	--	--	- -	NA	- -	--	- -	--
			Bis(2-ethylhexyl)phthalate	--	- -	--	--	- -	NA	- -	--	- -	--
			N-Nitrosodiphenylamine	--	- -	--	--	- -	NA	- -	--	- -	--
			Naphthalene	--	- -	--	--	- -	Nasal	- -	0.3	- -	0.3
			Aldrin	--	- -	--	--	- -	NA	- -	--	- -	--
			Dieldrin	--	- -	--	--	- -	NA	- -	--	- -	--
			Heptachlor	--	- -	--	--	- -	NA	- -	--	- -	--
			Heptachlor epoxide	--	- -	--	--	- -	NA	- -	--	- -	--
			Antimony	--	- -	--	--	- -	NA	- -	--	- -	--
			Arsenic	--	- -	--	--	- -	NA	- -	--	- -	--
			Cadmium (Water)	--	- -	--	--	- -	NA	- -	--	- -	--
			Lead	--	- -	--	--	- -	NA	- -	--	- -	--
			Manganese (Water)	--	- -	--	--	- -	CNS	- -	--	- -	--
			Zinc	--	- -	--	--	- -	NA	- -	--	- -	--
			Chemical Total	--	5E-02	--	--	5E-02		- -	109	- -	109
		Exposure Point Total						5E-02					109
	Exposure Medium Total							5E-02					109
Medium Total								1E-01					288
Receptor Total							Receptor Risk Total	1E-01				Receptor HI Total	288

TABLE C-25

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - CHILD RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

Total Adrenals HI	0.08
Total Blood HI	5
Total Body Weight HI	0.5
Total CNS HI	21
Total CVS HI	2
Total Developmental HI	0.03
Total Kidney HI	3
Total Liver HI	253
Total Lungs HI	0.9
Total Nasal HI	0.7
Total None Reported HI	0.1
Total Skin HI	2

TABLE C-26

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - ADULT RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Future Surface Soil	Future Surface Soil	Building 81	Benzo(a)pyrene Equivalents	3E-06	--	1E-06	--	4E-06	NA	--	- -	--	--
			Arsenic	2E-06	--	3E-07	--	3E-06	Skin, CVS	0.02	- -	0.002	0.02
			Chromium	8E-06	--	- -	--	8E-06	None Reported	0.009	- -	--	0.009
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese (Soil)	- -	--	- -	--	- -	CNS	0.003	- -	--	0.003
			Chemical Total	1E-05	--	2E-06	--	2E-05		0.03	--	0.002	0.03
		Exposure Point Total						2E-05					0.03
	Exposure Medium Total							2E-05					0.03
Medium Total								2E-05					0.03

TABLE C-26

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - ADULT RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Building 81	1,1,2-Trichloroethane	6E-07	--	6E-08	--	7E-07	Blood	0.008	- -	0.0008	0.009
			1,2,4-Trichlorobenzene	1E-06	--	2E-06	--	3E-06	Adrenals	0.01	- -	0.02	0.03
			1,2,4-Trimethylbenzene	- -	--	- -	--	- -	NA	--	- -	--	--
			1,2-Dibromo-3-chloropropane	2E-06	--	4E-07	--	2E-06	NA	0.02	- -	0.004	0.02
			1,2-Dichloroethane	2E-06	--	9E-08	--	2E-06	NA	0.003	- -	0.0001	0.003
			Benzene	6E-06	--	9E-07	--	7E-06	Blood	0.08	- -	0.01	0.09
			Bromodichloromethane	1E-06	--	1E-07	--	1E-06	Kidney	0.003	- -	0.0002	0.003
			Chlorodibromomethane	3E-07	--	2E-08	--	3E-07	Liver	0.0005	- -	0.00004	0.0005
			Chloroform	7E-06	--	6E-07	--	8E-06	Liver	0.07	- -	0.006	0.07
			cis-1,2-Dichloroethene	- -	--	- -	--	- -	Blood	0.3	- -	0.04	0.4
			Dichlorodifluoromethane	- -	--	- -	--	- -	Body Weight	0.02	- -	0.002	0.02
			Ethylbenzene	4E-06	--	2E-06	--	6E-06	Liver, Kidney	0.010	- -	0.006	0.02
			Tetrachloroethene	5E-02	--	3E-02	--	9E-02	Liver	30	- -	18	48
			Toluene	- -	--	- -	--	- -	Kidney	0.2	- -	0.06	0.2
			Total Xylenes	- -	--	- -	--	- -	Body Weight	0.01	- -	0.006	0.02
			Trichloroethene	1E-05	--	2E-06	--	1E-05	NA	--	- -	--	--
			Vinyl chloride	1E-04	--	7E-06	--	1E-04	Liver	0.1	- -	0.005	0.1
			1,4-Dioxane	8E-07	--	3E-09	--	8E-07	NA	0.002	- -	0.000008	0.002
			2-Methylnaphthalene	- -	--	- -	--	- -	Lungs	0.1	- -	0.2	0.3
			Benzo(a)pyrene Equivalents	2E-05	--	- -	--	2E-05	NA	--	- -	--	--
			Bis(2-ethylhexyl)phthalate	2E-06	--	3E-06	--	5E-06	Liver	0.02	- -	0.03	0.06
			N-Nitrosodiphenylamine	2E-06	--	5E-07	--	2E-06	NA	--	- -	--	--
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.08	- -	0.05	0.1
			Aldrin	9E-07	--	8E-08	--	1E-06	Liver	0.005	- -	0.0005	0.006
			Dieldrin	5E-06	--	3E-06	--	8E-06	Liver	0.02	- -	0.01	0.03
			Heptachlor	1E-06	--	5E-07	--	1E-06	Liver	0.001	- -	0.0006	0.002
			Heptachlor epoxide	9E-07	--	1E-06	--	2E-06	Liver	0.02	- -	0.03	0.05
			Antimony	- -	--	- -	--	- -	Blood	0.4	- -	0.01	0.4
			Arsenic	9E-05	--	5E-07	--	9E-05	Skin, CVS	0.6	- -	0.003	0.6
			Cadmium (Water)	- -	--	- -	--	- -	Kidney	0.6	- -	0.06	0.7
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese (Water)	- -	--	- -	--	- -	CNS	5	- -	0.7	6
			Zinc	- -	--	- -	--	- -	Blood	0.4	- -	0.001	0.4
			Chemical Total	5E-02	--	3E-02	--	9E-02		39	--	19	58
		Exposure Point Total						9E-02					58
	Exposure Medium Total							9E-02					58

TABLE C-26

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - ADULT RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Air	Building 81	1,1,2-Trichloroethane	--	6E-07	--	--	6E-07	NA	- -	0.008	- -	0.008
			1,2,4-Trichlorobenzene	--	1E-06	--	--	1E-06	NA	- -	0.01	- -	0.01
			1,2,4-Trimethylbenzene	--	- -	--	--	- -	NA	- -	--	- -	--
			1,2-Dibromo-3-chloropropane	--	2E-06	--	--	2E-06	Testes	- -	0.02	- -	0.02
			1,2-Dichloroethane	--	2E-06	--	--	2E-06	NA	- -	0.003	- -	0.003
			Benzene	--	6E-06	--	--	6E-06	Blood	- -	0.08	- -	0.08
			Bromodichloromethane	--	1E-06	--	--	1E-06	NA	- -	0.003	- -	0.003
			Chlorodibromomethane	--	3E-07	--	--	3E-07	NA	- -	0.0005	- -	0.0005
			Chloroform	--	7E-06	--	--	7E-06	Liver	- -	0.07	- -	0.07
			cis-1,2-Dichloroethene	--	- -	--	--	- -	NA	- -	0.3	- -	0.3
			Dichlorodifluoromethane	--	- -	--	--	- -	NA	- -	0.02	- -	0.02
			Ethylbenzene	--	4E-06	--	--	4E-06	Developmental	- -	0.010	- -	0.010
			Tetrachloroethene	--	5E-02	--	--	5E-02	Liver	- -	30	- -	30
			Toluene	--	- -	--	--	- -	CNS	- -	0.2	- -	0.2
			Total Xylenes	--	- -	--	--	- -	CNS	- -	0.01	- -	0.01
			Trichloroethene	--	1E-05	--	--	1E-05	CNS	- -	--	- -	--
			Vinyl chloride	--	1E-04	--	--	1E-04	Liver	- -	0.1	- -	0.1
			1,4-Dioxane	--	- -	--	--	- -	NA	- -	--	- -	--
			2-Methylnaphthalene	--	- -	--	--	- -	Nasal	- -	0.1	- -	0.1
			Benzo(a)pyrene Equivalents	--	- -	--	--	- -	NA	- -	--	- -	--
			Bis(2-ethylhexyl)phthalate	--	- -	--	--	- -	NA	- -	--	- -	--
			N-Nitrosodiphenylamine	--	- -	--	--	- -	NA	- -	--	- -	--
			Naphthalene	--	- -	--	--	- -	Nasal	- -	0.08	- -	0.08
			Aldrin	--	- -	--	--	- -	NA	- -	--	- -	--
			Dieldrin	--	- -	--	--	- -	NA	- -	--	- -	--
			Heptachlor	--	- -	--	--	- -	NA	- -	--	- -	--
			Heptachlor epoxide	--	- -	--	--	- -	NA	- -	--	- -	--
			Antimony	--	- -	--	--	- -	NA	- -	--	- -	--
			Arsenic	--	- -	--	--	- -	NA	- -	--	- -	--
			Cadmium (Water)	--	- -	--	--	- -	NA	- -	--	- -	--
			Lead	--	- -	--	--	- -	NA	- -	--	- -	--
			Manganese (Water)	--	- -	--	--	- -	CNS	- -	--	- -	--
			Zinc	--	- -	--	--	- -	NA	- -	--	- -	--
			Chemical Total	--	5E-02	--	--	5E-02		- -	31	- -	31
		Exposure Point Total						5E-02					31
	Exposure Medium Total							5E-02					31
Medium Total								1E-01					89
Receptor Total							Receptor Risk Total	1E-01				Receptor HI Total	89

TABLE C-26

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - ADULT RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

Total Adrenals HI	0.03
Total Blood HI	1
Total Body Weight HI	0.2
Total CNS HI	6
Total CVS HI	0.6
Total Developmental HI	0.010
Total Kidney HI	0.9
Total Liver HI	79
Total Lungs HI	0.3
Total Nasal HI	0.2
Total None Reported HI	0.01
Total Skin HI	0.6

TABLE C-27

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - ADULT RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
All Soil (0-6 ft.)	All Soil (0-6 ft.)	Building 81	Benzo(a)pyrene Equivalents	2E-06	--	1E-06	--	3E-06	NA	--	- -	--	--
			Arsenic	2E-06	--	2E-07	--	2E-06	Skin, CVS	0.01	- -	0.002	0.01
			Chromium	1E-05	--	- -	--	1E-05	None Reported	0.01	- -	--	0.01
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese (Soil)	- -	--	- -	--	- -	CNS	0.002	- -	--	0.002
			Chemical Total	1E-05	--	1E-06	--	1E-05		0.03	--	0.002	0.03
		Exposure Point Total						1E-05					0.03
	Exposure Medium Total							1E-05					0.03
Medium Total								1E-05					0.03

TABLE C-27

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - ADULT RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Building 81	1,1,2-Trichloroethane	6E-07	--	6E-08	--	7E-07	Blood	0.008	- -	0.0008	0.009
			1,2,4-Trichlorobenzene	1E-06	--	2E-06	--	3E-06	Adrenals	0.01	- -	0.02	0.03
			1,2,4-Trimethylbenzene	- -	--	- -	--	- -	NA	--	- -	--	--
			1,2-Dibromo-3-chloropropane	2E-06	--	4E-07	--	2E-06	NA	0.02	- -	0.004	0.02
			1,2-Dichloroethane	2E-06	--	9E-08	--	2E-06	NA	0.003	- -	0.0001	0.003
			Benzene	6E-06	--	9E-07	--	7E-06	Blood	0.08	- -	0.01	0.09
			Bromodichloromethane	1E-06	--	1E-07	--	1E-06	Kidney	0.003	- -	0.0002	0.003
			Chlorodibromomethane	3E-07	--	2E-08	--	3E-07	Liver	0.0005	- -	0.00004	0.0005
			Chloroform	7E-06	--	6E-07	--	8E-06	Liver	0.07	- -	0.006	0.07
			cis-1,2-Dichloroethene	- -	--	- -	--	- -	Blood	0.3	- -	0.04	0.4
			Dichlorodifluoromethane	- -	--	- -	--	- -	Body Weight	0.02	- -	0.002	0.02
			Ethylbenzene	4E-06	--	2E-06	--	6E-06	Liver, Kidney	0.010	- -	0.006	0.02
			Tetrachloroethene	5E-02	--	3E-02	--	9E-02	Liver	30	- -	18	48
			Toluene	- -	--	- -	--	- -	Kidney	0.2	- -	0.06	0.2
			Total Xylenes	- -	--	- -	--	- -	Body Weight	0.01	- -	0.006	0.02
			Trichloroethene	1E-05	--	2E-06	--	1E-05	NA	--	- -	--	--
			Vinyl chloride	1E-04	--	7E-06	--	1E-04	Liver	0.1	- -	0.005	0.1
			1,4-Dioxane	8E-07	--	3E-09	--	8E-07	NA	0.002	- -	0.000008	0.002
			2-Methylnaphthalene	- -	--	- -	--	- -	Lungs	0.1	- -	0.2	0.3
			Benzo(a)pyrene Equivalents	2E-05	--	- -	--	2E-05	NA	--	- -	--	--
			Bis(2-ethylhexyl)phthalate	2E-06	--	3E-06	--	5E-06	Liver	0.02	- -	0.03	0.06
			N-Nitrosodiphenylamine	2E-06	--	5E-07	--	2E-06	NA	--	- -	--	--
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.08	- -	0.05	0.1
			Aldrin	9E-07	--	8E-08	--	1E-06	Liver	0.005	- -	0.0005	0.006
			Dieldrin	5E-06	--	3E-06	--	8E-06	Liver	0.02	- -	0.01	0.03
			Heptachlor	1E-06	--	5E-07	--	1E-06	Liver	0.001	- -	0.0006	0.002
			Heptachlor epoxide	9E-07	--	1E-06	--	2E-06	Liver	0.02	- -	0.03	0.05
			Antimony	- -	--	- -	--	- -	Blood	0.4	- -	0.01	0.4
			Arsenic	9E-05	--	5E-07	--	9E-05	Skin, CVS	0.6	- -	0.003	0.6
			Cadmium (Water)	- -	--	- -	--	- -	Kidney	0.6	- -	0.06	0.7
			Lead	- -	--	- -	--	- -	NA	--	- -	--	--
			Manganese (Water)	- -	--	- -	--	- -	CNS	5	- -	0.7	6
			Zinc	- -	--	- -	--	- -	Blood	0.4	- -	0.001	0.4
			Chemical Total	5E-02	--	3E-02	--	9E-02		39	--	19	58
		Exposure Point Total						9E-02					58
	Exposure Medium Total							9E-02					58

TABLE C-27
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs
REASONABLE MAXIMUM EXPOSURES - ADULT RESIDENTS
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Air	Building 81	1,1,2-Trichloroethane	--	6E-07	--	--	6E-07	NA	- -	0.008	- -	0.008
			1,2,4-Trichlorobenzene	--	1E-06	--	--	1E-06	NA	- -	0.01	- -	0.01
			1,2,4-Trimethylbenzene	--	- -	--	--	- -	NA	- -	--	- -	--
			1,2-Dibromo-3-chloropropane	--	2E-06	--	--	2E-06	Testes	- -	0.02	- -	0.02
			1,2-Dichloroethane	--	2E-06	--	--	2E-06	NA	- -	0.003	- -	0.003
			Benzene	--	6E-06	--	--	6E-06	Blood	- -	0.08	- -	0.08
			Bromodichloromethane	--	1E-06	--	--	1E-06	NA	- -	0.003	- -	0.003
			Chlorodibromomethane	--	3E-07	--	--	3E-07	NA	- -	0.0005	- -	0.0005
			Chloroform	--	7E-06	--	--	7E-06	Liver	- -	0.07	- -	0.07
			cis-1,2-Dichloroethene	--	- -	--	--	- -	NA	- -	0.3	- -	0.3
			Dichlorodifluoromethane	--	- -	--	--	- -	NA	- -	0.02	- -	0.02
			Ethylbenzene	--	4E-06	--	--	4E-06	Developmental	- -	0.010	- -	0.010
			Tetrachloroethene	--	5E-02	--	--	5E-02	Liver	- -	30	- -	30
			Toluene	--	- -	--	--	- -	CNS	- -	0.2	- -	0.2
			Total Xylenes	--	- -	--	--	- -	CNS	- -	0.01	- -	0.01
			Trichloroethene	--	1E-05	--	--	1E-05	CNS	- -	--	- -	--
			Vinyl chloride	--	1E-04	--	--	1E-04	Liver	- -	0.1	- -	0.1
			1,4-Dioxane	--	- -	--	--	- -	NA	- -	--	- -	--
			2-Methylnaphthalene	--	- -	--	--	- -	Nasal	- -	0.1	- -	0.1
			Benzo(a)pyrene Equivalents	--	- -	--	--	- -	NA	- -	--	- -	--
			Bis(2-ethylhexyl)phthalate	--	- -	--	--	- -	NA	- -	--	- -	--
			N-Nitrosodiphenylamine	--	- -	--	--	- -	NA	- -	--	- -	--
			Naphthalene	--	- -	--	--	- -	Nasal	- -	0.08	- -	0.08
			Aldrin	--	- -	--	--	- -	NA	- -	--	- -	--
			Dieldrin	--	- -	--	--	- -	NA	- -	--	- -	--
			Heptachlor	--	- -	--	--	- -	NA	- -	--	- -	--
			Heptachlor epoxide	--	- -	--	--	- -	NA	- -	--	- -	--
			Antimony	--	- -	--	--	- -	NA	- -	--	- -	--
			Arsenic	--	- -	--	--	- -	NA	- -	--	- -	--
			Cadmium (Water)	--	- -	--	--	- -	NA	- -	--	- -	--
			Lead	--	- -	--	--	- -	NA	- -	--	- -	--
			Manganese (Water)	--	- -	--	--	- -	CNS	- -	--	- -	--
			Zinc	--	- -	--	--	- -	NA	- -	--	- -	--
			Chemical Total	--	5E-02	--	--	5E-02		- -	31	- -	31
		Exposure Point Total						5E-02					31
	Exposure Medium Total							5E-02					31
Medium Total								1E-01					89
Receptor Total							Receptor Risk Total	1E-01				Receptor HI Total	89

TABLE C-27

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - ADULT RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

Total Adrenals HI	0.03
Total Blood HI	1
Total Body Weight HI	0.2
Total CNS HI	6
Total CVS HI	0.6
Total Developmental HI	0.010
Total Kidney HI	0.9
Total Liver HI	79
Total Lungs HI	0.3
Total Nasal HI	0.2
Total None Reported HI	0.01
Total Skin HI	0.6

TABLE C-28

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - LIFELONG RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Lifelong (Child + Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Future Surface Soil	Future Surface Soil	Building 81	Benzo(a)pyrene Equivalents	2E-05	--	8E-06	--	3E-05					
			Arsenic	8E-06	--	8E-07	--	9E-06					
			Chromium	7E-05	--	- -	--	7E-05					
			Lead	- -	--	- -	--	- -					
			Manganese (Soil)	- -	--	- -	--	- -					
			Chemical Total	1E-04	--	9E-06	--	1E-04					
		Exposure Point Total						1E-04					
	Exposure Medium Total							1E-04					
Medium Total								1E-04					

TABLE C-28

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - LIFELONG RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Lifelong (Child + Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Building 81	1,1,2-Trichloroethane	1E-06	--	9E-08	--	1E-06					
			1,2,4-Trichlorobenzene	2E-06	--	3E-06	--	5E-06					
			1,2,4-Trimethylbenzene	- -	--	- -	--	- -					
			1,2-Dibromo-3-chloropropane	7E-06	--	1E-06	--	8E-06					
			1,2-Dichloroethane	3E-06	--	1E-07	--	4E-06					
			Benzene	1E-05	--	1E-06	--	1E-05					
			Bromodichloromethane	2E-06	--	1E-07	--	2E-06					
			Chlorodibromomethane	5E-07	--	3E-08	--	6E-07					
			Chloroform	1E-05	--	1E-06	--	1E-05					
			cis-1,2-Dichloroethene	- -	--	- -	--	- -					
			Dichlorodifluoromethane	- -	--	- -	--	- -					
			Ethylbenzene	7E-06	--	4E-06	--	1E-05					
			Tetrachloroethene	1E-01	--	5E-02	--	2E-01					
			Toluene	- -	--	- -	--	- -					
			Total Xylenes	- -	--	- -	--	- -					
			Trichloroethene	2E-05	--	3E-06	--	2E-05					
			Vinyl chloride	5E-04	--	2E-05	--	5E-04					
			1,4-Dioxane	2E-06	--	5E-09	--	2E-06					
			2-Methylnaphthalene	- -	--	- -	--	- -					
			Benzo(a)pyrene Equivalents	6E-05	--	- -	--	6E-05					
			Bis(2-ethylhexyl)phthalate	4E-06	--	5E-06	--	9E-06					
			N-Nitrosodiphenylamine	3E-06	--	8E-07	--	4E-06					
			Naphthalene	- -	--	- -	--	- -					
			Aldrin	2E-06	--	1E-07	--	2E-06					
			Dieldrin	8E-06	--	5E-06	--	1E-05					
			Heptachlor	2E-06	--	8E-07	--	3E-06					
			Heptachlor epoxide	2E-06	--	2E-06	--	4E-06					
			Antimony	- -	--	- -	--	- -					
			Arsenic	2E-04	--	8E-07	--	2E-04					
			Cadmium (Water)	- -	--	- -	--	- -					
			Lead	- -	--	- -	--	- -					
			Manganese (Water)	- -	--	- -	--	- -					
			Zinc	- -	--	- -	--	- -					
			Chemical Total	1E-01	--	5E-02	--	2E-01					
		Exposure Point Total						2E-01					
	Exposure Medium Total							2E-01					

TABLE C-28

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - LIFELONG RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Lifelong (Child + Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Air	Building 81	1,1,2-Trichloroethane	--	1E-06	--	--	1E-06					
			1,2,4-Trichlorobenzene	--	2E-06	--	--	2E-06					
			1,2,4-Trimethylbenzene	--	- -	--	--	- -					
			1,2-Dibromo-3-chloropropane	--	7E-06	--	--	7E-06					
			1,2-Dichloroethane	--	3E-06	--	--	3E-06					
			Benzene	--	1E-05	--	--	1E-05					
			Bromodichloromethane	--	2E-06	--	--	2E-06					
			Chlorodibromomethane	--	5E-07	--	--	5E-07					
			Chloroform	--	1E-05	--	--	1E-05					
			cis-1,2-Dichloroethene	--	- -	--	--	- -					
			Dichlorodifluoromethane	--	- -	--	--	- -					
			Ethylbenzene	--	7E-06	--	--	7E-06					
			Tetrachloroethene	--	1E-01	--	--	1E-01					
			Toluene	--	- -	--	--	- -					
			Total Xylenes	--	- -	--	--	- -					
			Trichloroethene	--	2E-05	--	--	2E-05					
			Vinyl chloride	--	5E-04	--	--	5E-04					
			1,4-Dioxane	--	- -	--	--	- -					
			2-Methylnaphthalene	--	- -	--	--	- -					
			Benzo(a)pyrene Equivalents	--	- -	--	--	- -					
			Bis(2-ethylhexyl)phthalate	--	- -	--	--	- -					
			N-Nitrosodiphenylamine	--	- -	--	--	- -					
			Naphthalene	--	- -	--	--	- -					
			Aldrin	--	- -	--	--	- -					
			Dieldrin	--	- -	--	--	- -					
			Heptachlor	--	- -	--	--	- -					
			Heptachlor epoxide	--	- -	--	--	- -					
			Antimony	--	- -	--	--	- -					
			Arsenic	--	- -	--	--	- -					
			Cadmium (Water)	--	- -	--	--	- -					
			Lead	--	- -	--	--	- -					
			Manganese (Water)	--	- -	--	--	- -					
			Zinc	--	- -	--	--	- -					
			Chemical Total	--	1E-01	--	--	1E-01					
		Exposure Point Total						1E-01					
	Exposure Medium Total							1E-01					
Medium Total								3E-01					
Receptor Total							Receptor Risk Total	3E-01					

TABLE C-28

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - LIFELONG RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Lifelong (Child + Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

TABLE C-29

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - LIFELONG RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Lifelong (Child + Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
All Soil (0-6 ft.)	All Soil (0-6 ft.)	Building 81	Benzo(a)pyrene Equivalents	2E-05	--	6E-06	--	2E-05					
			Arsenic	7E-06	--	6E-07	--	7E-06					
			Chromium	7E-05	--	- -	--	7E-05					
			Lead	- -	--	- -	--	- -					
			Manganese (Soil)	- -	--	- -	--	- -					
			Chemical Total	1E-04	--	6E-06	--	1E-04					
		Exposure Point Total						1E-04					
	Exposure Medium Total							1E-04					
Medium Total								1E-04					

TABLE C-29

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - LIFELONG RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Lifelong (Child + Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Building 81	1,1,2-Trichloroethane	1E-06	--	9E-08	--	1E-06					
			1,2,4-Trichlorobenzene	2E-06	--	3E-06	--	5E-06					
			1,2,4-Trimethylbenzene	- -	--	- -	--	- -					
			1,2-Dibromo-3-chloropropane	7E-06	--	1E-06	--	8E-06					
			1,2-Dichloroethane	3E-06	--	1E-07	--	4E-06					
			Benzene	1E-05	--	1E-06	--	1E-05					
			Bromodichloromethane	2E-06	--	1E-07	--	2E-06					
			Chlorodibromomethane	5E-07	--	3E-08	--	6E-07					
			Chloroform	1E-05	--	1E-06	--	1E-05					
			cis-1,2-Dichloroethene	- -	--	- -	--	- -					
			Dichlorodifluoromethane	- -	--	- -	--	- -					
			Ethylbenzene	7E-06	--	4E-06	--	1E-05					
			Tetrachloroethene	1E-01	--	5E-02	--	2E-01					
			Toluene	- -	--	- -	--	- -					
			Total Xylenes	- -	--	- -	--	- -					
			Trichloroethene	2E-05	--	3E-06	--	2E-05					
			Vinyl chloride	5E-04	--	2E-05	--	5E-04					
			1,4-Dioxane	2E-06	--	5E-09	--	2E-06					
			2-Methylnaphthalene	- -	--	- -	--	- -					
			Benzo(a)pyrene Equivalents	6E-05	--	- -	--	6E-05					
			Bis(2-ethylhexyl)phthalate	4E-06	--	5E-06	--	9E-06					
			N-Nitrosodiphenylamine	3E-06	--	8E-07	--	4E-06					
			Naphthalene	- -	--	- -	--	- -					
			Aldrin	2E-06	--	1E-07	--	2E-06					
			Dieldrin	8E-06	--	5E-06	--	1E-05					
			Heptachlor	2E-06	--	8E-07	--	3E-06					
			Heptachlor epoxide	2E-06	--	2E-06	--	4E-06					
			Antimony	- -	--	- -	--	- -					
			Arsenic	2E-04	--	8E-07	--	2E-04					
			Cadmium (Water)	- -	--	- -	--	- -					
			Lead	- -	--	- -	--	- -					
			Manganese (Water)	- -	--	- -	--	- -					
			Zinc	- -	--	- -	--	- -					
			Chemical Total	1E-01	--	5E-02	--	2E-01					
		Exposure Point Total						2E-01					
	Exposure Medium Total							2E-01					

TABLE C-29

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - LIFELONG RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Lifelong (Child + Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Air	Building 81	1,1,2-Trichloroethane	--	1E-06	--	--	1E-06					
			1,2,4-Trichlorobenzene	--	2E-06	--	--	2E-06					
			1,2,4-Trimethylbenzene	--	- -	--	--	- -					
			1,2-Dibromo-3-chloropropane	--	7E-06	--	--	7E-06					
			1,2-Dichloroethane	--	3E-06	--	--	3E-06					
			Benzene	--	1E-05	--	--	1E-05					
			Bromodichloromethane	--	2E-06	--	--	2E-06					
			Chlorodibromomethane	--	5E-07	--	--	5E-07					
			Chloroform	--	1E-05	--	--	1E-05					
			cis-1,2-Dichloroethene	--	- -	--	--	- -					
			Dichlorodifluoromethane	--	- -	--	--	- -					
			Ethylbenzene	--	7E-06	--	--	7E-06					
			Tetrachloroethene	--	1E-01	--	--	1E-01					
			Toluene	--	- -	--	--	- -					
			Total Xylenes	--	- -	--	--	- -					
			Trichloroethene	--	2E-05	--	--	2E-05					
			Vinyl chloride	--	5E-04	--	--	5E-04					
			1,4-Dioxane	--	- -	--	--	- -					
			2-Methylnaphthalene	--	- -	--	--	- -					
			Benzo(a)pyrene Equivalents	--	- -	--	--	- -					
			Bis(2-ethylhexyl)phthalate	--	- -	--	--	- -					
			N-Nitrosodiphenylamine	--	- -	--	--	- -					
			Naphthalene	--	- -	--	--	- -					
			Aldrin	--	- -	--	--	- -					
			Dieldrin	--	- -	--	--	- -					
			Heptachlor	--	- -	--	--	- -					
			Heptachlor epoxide	--	- -	--	--	- -					
			Antimony	--	- -	--	--	- -					
			Arsenic	--	- -	--	--	- -					
			Cadmium (Water)	--	- -	--	--	- -					
			Lead	--	- -	--	--	- -					
			Manganese (Water)	--	- -	--	--	- -					
			Zinc	--	- -	--	--	- -					
			Chemical Total	--	1E-01	--	--	1E-01					
		Exposure Point Total						1E-01					
	Exposure Medium Total							1E-01					
Medium Total								3E-01					
Receptor Total							Receptor Risk Total	3E-01					

TABLE C-29

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR SITE-RELATED COPCs

REASONABLE MAXIMUM EXPOSURES - LIFELONG RESIDENTS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Lifelong (Child + Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Inhalation exposures are assumed to be equal to the exposures from ingestion of groundwater.

TABLE C-30

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURES - ADOLESCENT TRESPASSERS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Exposed Surface Soil	Exposed Surface Soil	Building 81	Ingestion	Benzo(a)pyrene Equivalents	2.68	mg/kg	3.1E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.3E-06	7.3E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	5.87	mg/kg	2.3E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.4E-07	1.6E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.005
				Chromium	61.7	mg/kg	7.2E-06	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	3.6E-06	1.7E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.006
				Lead	453	mg/kg	1.8E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.2E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese (Soil)	436	mg/kg	1.7E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.2E-04	(mg/kg/day)	1.4E-01	(mg/kg/day)	0.0009
			Exp. Route Total								6.3E-06					0.01
			Dermal	Benzo(a)pyrene Equivalents	2.68	mg/kg	8.6E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	6.2E-07	2.0E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	5.87	mg/kg	1.4E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.2E-08	1.0E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0003
				Chromium	61.7	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Lead	453	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese (Soil)	436	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.4E-01	(mg/kg/day)	--
			Exp. Route Total								6.5E-07					0.0003
		Exposure Point Total									6.9E-06					0.01
	Exposure Medium Total										6.9E-06					0.01
Medium Total											6.9E-06					0.01
										Total of Receptor Risks Across All Media	6.9E-06			Total of Receptor Hazards Across All Media		0.01

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE C-31

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURES - ADULT RECREATIONAL USERS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Recreational User
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Future Surface Soil	Future Surface Soil	Building 81	Ingestion	Benzo(a)pyrene Equivalents	0.450	mg/kg	4.3E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	3.2E-07	6.9E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	3.40	mg/kg	1.8E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.7E-07	5.2E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Chromium	19.4	mg/kg	1.9E-06	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	9.3E-07	3.0E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.0010
				Lead	198	mg/kg	1.0E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.0E-05	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese (Soil)	275	mg/kg	1.4E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.2E-05	(mg/kg/day)	1.4E-01	(mg/kg/day)	0.0003
			Exp. Route Total								1.5E-06					0.003
			Dermal	Benzo(a)pyrene Equivalents	0.450	mg/kg	2.2E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.6E-07	3.6E-08	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	3.40	mg/kg	2.1E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.2E-08	6.2E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
				Chromium	19.4	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Lead	198	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese (Soil)	275	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.4E-01	(mg/kg/day)	--
			Exp. Route Total								2.0E-07					0.0002
		Exposure Point Total									1.7E-06					0.003
	Exposure Medium Total										1.7E-06					0.003
Medium Total											1.7E-06					0.003
										Total of Receptor Risks Across All Media	1.7E-06			Total of Receptor Hazards Across All Media		0.003

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE C-32

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURES - CHILD RECREATIONAL USERS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Recreational User
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Future Surface Soil	Future Surface Soil	Building 81	Ingestion	Benzo(a)pyrene Equivalents	0.450	mg/kg	1.1E-06	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	7.7E-06	2.3E-06	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	3.40	mg/kg	1.5E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.3E-06	1.8E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.06
				Chromium	19.4	mg/kg	4.6E-05	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	2.3E-05	1.0E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.03
				Lead	198	mg/kg	8.7E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.0E-03	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese (Soil)	275	mg/kg	1.2E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.4E-03	(mg/kg/day)	1.4E-01	(mg/kg/day)	0.01
			Exp. Route Total								3.3E-05					0.1
			Dermal	Benzo(a)pyrene Equivalents	0.450	mg/kg	3.9E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.8E-06	8.4E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	3.40	mg/kg	1.3E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.9E-07	1.5E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.005
				Chromium	19.4	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Lead	198	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese (Soil)	275	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.4E-01	(mg/kg/day)	--
			Exp. Route Total								3.0E-06					0.005
		Exposure Point Total									3.6E-05					0.1
	Exposure Medium Total										3.6E-05					0.1
Medium Total											3.6E-05					0.1
											Total of Receptor Risks Across All Media	3.6E-05		Total of Receptor Hazards Across All Media		0.1

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE C-33

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADULT RECREATIONAL VISITOR EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE
BUILDING 81 SITE
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Recreational Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	All Surface Soil (0-2 ft)	Arsenic	2.63E-07	--	3.15E-08	2.94E-07	Arsenic	Skin, blood	1.70E-03	--	2.04E-04	1.91E-03
			Cadmium	--	--	--	--	Cadmium	Kidney	2.75E-04	--	4.39E-05	3.19E-04
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			Manganese	--	--	--	--	Manganese	CNS	6.00E-04	--	5.98E-05	6.59E-04
			Vanadium	--	--	--	--	Vanadium	Hair	4.29E-04	--	6.58E-05	4.95E-04
			Benzo(a)anthracene	4.93E-08	--	2.56E-08	7.48E-08	Benzo(a)anthracene	NA	--	--	--	--
			Benzo(a)pyrene	4.13E-07	--	2.14E-07	6.27E-07	Benzo(a)pyrene	NA	--	--	--	--
			Benzo(b)fluoranthene	1.97E-08	--	1.02E-08	2.99E-08	Benzo(b)fluoranthene	NA	--	--	--	--
			Dibenzo(a,h)anthracene	1.13E-07	--	5.87E-08	1.72E-07	Dibenzo(a,h)anthracene	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	2.23E-08	--	1.16E-08	3.39E-08	Indeno(1,2,3-cd)pyrene	NA	--	--	--	--
			(Total)	8.80E-07	0.00E+00	3.51E-07	1.23E-06	(Total)		3.01E-03	0.00E+00	3.74E-04	3.38E-03
						Total Risk Across Soil	1.23E-06					Total Hazard Index Across Soil	3.38E-03

Total Skin HI =	1.91E-03
Total CNS HI =	6.59E-04
Total Blood HI =	1.91E-03
Total Hair HI =	4.95E-04
Total Kidney HI =	3.19E-04

TABLE C-34

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURES - INDUSTRIAL WORKERS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Future Surface Soil	Future Surface Soil	Building 81	Ingestion	Benzo(a)pyrene Equivalents	0.450	mg/kg	1.6E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.1E-06	4.4E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	3.40	mg/kg	1.2E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.8E-06	3.3E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.01
				Chromium	19.4	mg/kg	6.8E-06	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	3.4E-06	1.9E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.006
				Lead	198	mg/kg	6.9E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.9E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese (Soil)	275	mg/kg	9.6E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.7E-04	(mg/kg/day)	1.4E-01	(mg/kg/day)	0.002
			Exp. Route Total								6.3E-06					0.02
			Dermal	Benzo(a)pyrene Equivalents	0.450	mg/kg	1.3E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	9.8E-07	3.8E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	3.40	mg/kg	2.4E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.5E-07	6.6E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Chromium	19.4	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Lead	198	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese (Soil)	275	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.4E-01	(mg/kg/day)	--
			Exp. Route Total								1.3E-06					0.002
		Exposure Point Total									7.7E-06					0.02
	Exposure Medium Total										7.7E-06					0.02
Medium Total											7.7E-06					0.02
										Total of Receptor Risks Across All Media	7.7E-06			Total of Receptor Hazards Across All Media		0.02

TABLE C-35

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURES - INDUSTRIAL WORKERS

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
All Soil (0-6 ft.)	All Soil (0-6 ft.)	Building 81	Ingestion	Benzo(a)pyrene Equivalents	0.310	mg/kg	1.1E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	7.9E-07	3.0E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	2.80	mg/kg	9.8E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.5E-06	2.7E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.009
				Chromium	22.3	mg/kg	7.8E-06	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	3.9E-06	2.2E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.007
				Lead	128	mg/kg	4.5E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.3E-04	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese (Soil)	240	mg/kg	8.4E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.3E-04	(mg/kg/day)	1.4E-01	(mg/kg/day)	0.002
			Exp. Route Total								6.2E-06					0.02
			Dermal	Benzo(a)pyrene Equivalents	0.310	mg/kg	9.3E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	6.8E-07	2.6E-07	(mg/kg/day)	NA	(mg/kg/day)	--
				Arsenic	2.80	mg/kg	1.9E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.9E-07	5.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Chromium	22.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Lead	128	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)	--
				Manganese (Soil)	240	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.4E-01	(mg/kg/day)	--
			Exp. Route Total								9.7E-07					0.002
		Exposure Point Total									7.1E-06					0.02
	Exposure Medium Total										7.1E-06					0.02
Medium Total											7.1E-06					0.02
										Total of Receptor Risks Across All Media	7.1E-06			Total of Receptor Hazards Across All Media		0.02

TABLE C-36

SUMMARY OF RECEPTOR RISKS AND HAZARDS[1]
BUILDING 81 SITE
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario/ Receptor	Media	Lead[2]	CR>1E-04 or HI>1	Total Cancer Risks (RME)	Major contributors to cancer risk above 1E-04 (those with individual cancer risk>1E-06**)	Total Noncancer Hazard Index (RME)	Major contributors to noncancer Hazard Index above 1.0 (those with HQ greater than 0.1***)
Trespassers	Exposed Surface Soil	Not Evaluated	NO	7E-06	NA	0.01	NA
Adult Recreational Users	Future Surface Soil	Not Evaluated	NO	2E-06	NA	0.003	NA
Child Recreational Users	Future Surface Soil	Not Evaluated	NO	4E-05	NA	0.1	NA
Lifetime Recreational Users	Future Surface Soil	Not Evaluated	NO	4E-05	NA	NA	NA
Adult Residents*	Future Surface Soil and Groundwater	Not Evaluated	YES	1E-01	**groundwater** - 1,2,4-Trichlorobenzene, 1,2-Dibromo-3-chloropropane, 1,2-DCA, Benzene, Bromodichloromethane, Chloroform, Ethylbenzene, PCE, TCE, Vinyl chloride, cPAHs, Bis(2-ethylhexyl)phthalate, N-Nitrosodiphenylamine, Dieldrin, Heptachlor epoxide, Arsenic	89	**groundwater** - Manganese, PCE (cis-1,2-dichloroethene, antimony, zinc, vinyl chloride)
Child Residents*	Future Surface Soil and Groundwater	0.2%	YES	1E-01	**groundwater** - 1,2,4-Trichlorobenzene, 1,2-Dibromo-3-chloropropane, 1,2-DCA, Benzene, Bromodichloromethane, Chloroform, Ethylbenzene, PCE, TCE, Vinyl chloride, cPAHs, Bis(2-ethylhexyl)phthalate, N-Nitrosodiphenylamine, Dieldrin, Arsenic	288	**groundwater** - cis-1,2-DCE, PCE, Arsenic, Cadmium, Manganese (Benzene, Chloroform, Toluene, Vinyl chloride, Bis(2-ethylhexyl)phthalate, Antimony, Zinc)
Lifetime Residents*	Future Surface Soil and Groundwater	Not Evaluated	YES	3E-01	**groundwater** - 1,1,2-TCA, 1,2,4-trichlorobenzene, 1,2-Dibromo-3-chloropropane, 1,2-DCA, Benzene, Bromodichloromethane, Chloroform, Ethylbenzene, PCE, TCE, Vinyl chloride, 1,4-Dioxane, cPAHs, Bis(2-ethylhexyl)phthalate, N-Nitrosodiphenylamine, Aldrin, Dieldrin, Heptachlor, Heptahlor epoxide, Arsenic	NA	NA
Adult Residents*	0 to 6 foot Soil and Groundwater	Not Evaluated	YES	1E-01	**groundwater** - 1,2,4-Trichlorobenzene, 1,2-Dibromo-3-chloropropane, 1,2-DCA, Benzene, Bromodichloromethane, Chloroform, Ethylbenzene, PCE, TCE, Vinyl chloride, cPAHs, Bis(2-ethylhexyl)phthalate, N-Nitrosodiphenylamine, Dieldrin, Heptachlor epoxide, Arsenic	89	**groundwater** - Manganese, PCE (cis-1,2-dichloroethene, vinyl chloride, antimony, zinc)

TABLE C-36

SUMMARY OF RECEPTOR RISKS AND HAZARDS[1]
BUILDING 81 SITE
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS
PAGE 2 OF 3

Scenario/ Receptor	Media	Lead[2]	CR>1E-04 or HI>1	Total Cancer Risks (RME)	Major contributors to cancer risk above 1E-04 (those with individual cancer risk>1E-06**)	Total Noncancer Hazard Index (RME)	Major contributors to noncancer Hazard Index above 1.0 (those with HQ greater than 0.1***)
Child Residents*	0 to 6 foot Soil and Groundwater	0.02%	YES	1E-01	**groundwater** - 1,2,4-Trichlorobenzene, 1,2-Dibromo-3-chloropropane, 1,2-DCA, Benzene, Bromodichloromethane, Chloroform, Ethylbenzene, PCE, TCE, Vinyl chloride, cPAHs, Bis(2-ethylhexyl)phthalate, N-Nitrosodiphenylamine, Dieldrin, Arsenic	288	**groundwater** - cis-1,2-DCE, PCE, Arsenic, Cadmium, Manganese (Benzene, Chloroform, Toluene, Vinyl chloride, Bis(2-ethylhexyl)phthalate, Antimony, Zinc)

TABLE C-36

SUMMARY OF RECEPTOR RISKS AND HAZARDS[1]
BUILDING 81 SITE
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario/ Receptor	Media	Lead[2]	CR>1E-04 or HI>1	Total Cancer Risks (RME)	Major contributors to cancer risk above 1E-04 (those with individual cancer risk>1E-06**)	Total Noncancer Hazard Index (RME)	Major contributors to noncancer Hazard Index above 1.0 (those with HQ greater than 0.1***)
Lifetime Residents*	0 to 6 foot Soil and Groundwater	Not Evaluated	YES	3E-01	**groundwater** - 1,1,2-TCA, 1,2,4-trichlorobenzene, 1,2-Dibromo-3-chloropropane, 1,2-DCA, Benzene, Bromodichloromethane, Chloroform, Ethylbenzene, PCE, TCE, Vinyl chloride, 1,4-Dioxane, cPAHs, Bis(2-ethylhexyl)phthalate, N-Nitrosodiphenylamine, Aldrin, Dieldrin, Heptachlor, Heptahlor epoxide, Arsenic	NA	NA
Future Industrial Workers*	Future Surface Soil	0.01%	NO	8E-06	NA	0.02	NA
Future Industrial Workers*	0 to 6 foot Soil	0.007%	NO	7E-06	NA	0.02	NA
Construction Workers	0 to 6 foot Soil, Dust, Shallow Groundwater, and Trench Air	0.008%	YES	4E-05	NA	15	**trench air** - TCE, Naphthalene

Notes:

(1) Risks and hazard indices for site-related COPCs only (see text).

(2) Probability that blood lead levels exceed 10 ug/dL; EPA's goal is that a probability of no more than 5% of individuals will have blood lead concentrations above 10 ug/dL.

NA- Not Applicable

RME - Reasonable Maximum Exposure.

* Future residents and future industrial workers are presented twice to present 1) total hazard indices from all media including future surface soil and 2) total hazard indices from all media including 0 to 8 foot soil.

** Chemicals with cancer risk > 1E-06 in media with cancer risk > 1E-04.

*** Chemicals with hazard quotient (HQ) >0.1 in media with hazard index (HI) > 1.0. Chemicals listed before parenthesis have HQ > 1, chemicals listed in parenthesis have HQ between 0.1 and 1.0.

media shown in bold type - indicates media with cancer risk > 1E-04 or HI > 1.0.

Appendix D
ARARs and To Be Considered Guidance

TABLE D-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal				
Cancer Slope Factors (CSFs)	US EPA, Integrated Risk Information System	To Be Considered (TBC)	Guidance used to compute individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media.	This alternative will meet the risk-based cleanup levels developed through the use of this guidance since treating groundwater that poses potential carcinogenic risks through bioremediation and natural attenuation will address long-term risk, while land use controls (LUCs) will prevent short-term exposure until risk-based cleanup levels are achieved.
Reference Doses (RfDs)	US EPA, Integrated Risk Information System	TBC	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media.	This alternative will meet the risk-based cleanup levels developed through the use of this guidance since treating groundwater that poses potential non-carcinogenic risks through bioremediation and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup levels are achieved.

TABLE D-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal (Continued)				
Guidelines for Carcinogen Risk Assessment	EPA/630/p-03/001F March 2005	TBC	Guidelines for assessing cancer risk	This alternative will meet the risk-based cleanup levels developed through the use of this guidance since treating groundwater that poses potential carcinogenic risks through bioremediation and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup levels are achieved.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA.630/r-03/003F March 2005	TBC	Guidance for assessing cancer risks in children	This alternative will meet the risk-based cleanup levels developed through the use of this guidance since treating groundwater that poses potential carcinogenic risks to children through bioremediation and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup levels are achieved.

TABLE D-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal (Continued)				
Draft Guidance for Evaluating Vapor Intrusion to Indoor Air Pathways from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)	EPA 530-D-02-004 November, 2002	TBC	Guidance for assessing vapor intrusion risk.	Since the future use includes structures on the Site, assessment of potential vapor intrusion risks will be conducted in accordance with the guidance and LUCs that address building design and construction methods will control exposure.
State				
Massachusetts Contingency Plan – GW-3 Standards	310 CMR 40.0974(2)	TBC	Least protective state cleanup standards.	Risk-based cleanup levels will be compared to the GW-3 standards, and the GW-3 standards will be used when less than the risk-based cleanup levels.

TABLE D-2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
There are no federal location-specific ARARs.				
State				
Massachusetts Endangered Species Act	MGL Ch. 131A; 321 CMR 10.00	Applicable	Sets out authority to research, list, and protect any species deemed endangered, threatened, or of other special concern. Actions must be conducted in a manner that minimizes the effect on listed Massachusetts species.	A state-listed species of special concern (Eastern Box Turtle) has been observed at the Base, but not at the Building 81 Site. The existing area is highly developed and little suitable habitat is present. Appropriate measures will be taken during implementation of the selected remedial action to ensure that the species is not harmed.

TABLE D-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal				
Resource Conservation and Recovery Act (RCRA)	42 USC § 6901 *et seq*.	Applicable	Federal standards used to identify, manage, and dispose of hazardous waste. Massachusetts has been delegated the authority to administer the RCRA standards through its state hazardous waste management regulations.	Specific state hazardous waste standards authorized under the Act apply when determining whether or not a solid waste is hazardous, either by being listed or by exhibiting a hazardous characteristic, such as contaminated purge water from groundwater sampling or contaminated material generated from well installation or maintenance. Existing data do not indicate that any wastes will be hazardous. Any water generated by this action that requires off-site disposal will be tested.
Underground Injection Control	40 CFR 144, 146, 147.1100	Relevant and Appropriate	These regulations address the discharge of wastes, chemicals or other substances into the subsurface. The federal UIC program designates injection wells incidental to aquifer remediation and experimental technologies as Class V wells authorized by rule that do not require a separate UIC permit. State requirements apply in this case; see 310 CMR 27.00 below.	These standards regulate the injection of biological or chemical substances into the groundwater. In-situ treatment using enhanced bioremediation and injection-based bio-barriers will be conducted in compliance with these standards.
CAA National Emission Standards for Hazardous Air Pollutants (NESHAPs)	42 U.S.C § 7412 40 CFR Parts 61 and 63	Applicable	The regulations establish emission standards for 189 hazardous air pollutants. Standards are set for fugitive dust and other release sources.	If remedial activities generate regulated air pollutants, then measures will be implemented to meet the standards.

TABLE D-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal (Continued)				
Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites	OSWER Directive 9200.4-17P (April 21, 1999)	TBC	EPA guidance regarding the use of monitored natural attenuation (MNA) for the cleanup of contaminated soil and groundwater. In particular, a reasonable time frame for achieving cleanup standard through monitored attenuation would be comparable to that which could be achieved through active restoration.	The monitored natural attenuation (MNA) component of this alternative will only meet these standards if natural attenuation will attain all groundwater cleanup standards within a reasonable time frame. It is estimated that cleanup goals will be achieved in <10 years in overburden, in 30 years in shallow bedrock, and in <5 years in deep bedrock.
State				
Hazardous Waste Rules for Identification and Listing of Hazardous Wastes	310 CMR 30.100	Applicable	Establish requirements for determining whether wastes are hazardous. Defines listed and characteristic hazardous wastes.	These regulations apply when determining whether or not a solid waste generated as part of this remedial action is classified as hazardous, either by being listed or by exhibiting a hazardous characteristic, such as contaminated purge water from groundwater sampling or contaminated material generated from well installation or maintenance. Existing data do not indicate that any wastes will be hazardous.

TABLE D-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State (Continued)				
Management Procedures for Remedial Wastewater and Remedial Additives	310 CMR 40.0040	Applicable	Establishes requirements and procedures for the management of remedial wastewater and/or remedial additives, and for the construction, installation, modification, operation and maintenance of treatment works for the management of remedial wastewater and/or remedial additives.	These regulations apply to remedial actions that involve underground injection, such as an electron donor for bioremediation. To ensure that the remedial action complies with the substantive requirements of these regulations, the proposed quantities to be injected will be included in the design and submitted to EPA and MassDEP for comment and concurrence and the groundwater monitoring program will assess the impact of the injected compounds.
Hazardous Waste Management Rules – Requirements for Generators	310 CMR 30.300	Applicable	These regulations contain requirements for generators of hazardous waste. The regulations apply to generators of sampling waste and also apply to the accumulation of waste prior to off-site disposal.	Any hazardous wastes generated as part of the remedial action will be handled in compliance with the requirements of these regulations.

TABLE D-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State (Continued)				
Underground Injection Control Program	310 CMR 27.00	Applicable	The federal Underground Injection Control program under the Safe Drinking Water Act has been delegated to the Commonwealth of Massachusetts. Establishes a State Underground Injection Control Program consistent with federal requirements to protect underground sources of drinking water.	The regulations apply to remedial actions involving underground injection, including use of bioremediation agents. To ensure that the remedial action complies with the substantive requirements of these regulations, the proposed quantities to be injected will be included in the design and submitted to EPA and MassDEP for comment and concurrence and the groundwater monitoring program will assess the impact of the injected compounds.
Certification of Well Drillers and Filing of Well Completion Reports	313 CMR 3.03 (predecessor regulations); 310 CMR 46	Applicable	Requirements relating to well abandonment	Well drillers will follow all regulatory requirements for drilling and decommissioning of wells.
Standard References for Monitoring Wells	WSC-310-91 MADEP April 1991	TBC	This guidance describes the technical requirements for locating, drilling, installing, sampling and decommissioning monitoring wells.	Applies to wells installed for monitoring and injection wells for groundwater treatment.
Erosion and Sediment Control Guidance	-	TBC	This guidance includes standards for preventing erosion and sedimentation.	Remedial actions, such as installation and maintenance of wells, will be managed to control erosion and sedimentation.

Appendix E
Public Hearing Transcript and Comments Received on the Building 81 Proposed Plan

Proposed Plan

Building 81 - Operable Unit 9

Former Naval Air Station South Weymouth

Weymouth, Massachusetts

Public Hearing
8:00 p.m.
October 22, 2013
Caretaker Site Office
Shea Memorial Drive
South Weymouth, MA

Leavitt Reporting, Inc.

119 Broad Street
Weymouth, MA 02188
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leavittreporting@comcast.net

Hearings ◆ Conferences ◆ Legal Proceedings

P R O C E E D I N G S

MR. GOODRICH: I'm going to open the public hearing. If there is anybody who would like to make a comment, please raise your hand and I will call on you.

If no one wants to make a comment, then we'll close the public hearing. Thank you.

(The proceedings closed at 8:15:51 p.m.)

C E R T I F I C A T E

I hereby certify that the foregoing 3 pages contain a full, true and correct transcription of all my stenographic notes to the best of my ability taken in the above-captioned matter at said time and place.

Carol DiFazio
Registered Professional Reporter

GT GreenbergTraurig

Paul R. McIntyre
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October 17, 2013

VIA UPS

Mr. Brian Helland
Remedial Project Manager
BRAC Program Management Office, Northeast
4911 South Broad Street
Philadelphia, PA 19112

Re: Former Naval Air Station South Weymouth, Massachusetts
Comments from LNR South Shore, LLC
Proposed Plan for Building 81 Site

Dear Brian:

Enclosed are formal public comments from LNR South Shore, LLC, to the Navy's Proposed Plan for the Building 81 Site.

Very truly yours,

Paul McIntyre

Paul R. McIntyre

PRM/mg
Enclosure

cc: Robin Daniels (w/encl.)
Curtis Toll (w/encl.)

Comments from LNR South Shore, LLC to
Proposed Plan for the Building 81 Site
Former Naval Air Station South Weymouth

LNR South Shore, LLC ("LNR") presents the following comments on the Proposed Plan for Building 81 – Operable Unit 9, at the Former Naval Air Station South Weymouth, Massachusetts. As the master developer of the former Naval Air Station, LNR has consistently advocated that the Navy and the U.S. Environmental Protection Agency ("EPA") prepare and implement environmental remediation plans that facilitate the thorough investigation and cleanup of historic contamination on the property, and which return those contaminated areas of the property to safe and productive use within a reasonable timeframe. We are submitting these comments because we are concerned that the Proposed Plan for the Building 81 Site is not as aggressive as it should be, and that the remediation will therefore take longer to complete than could be achieved with readily available technology. For this reason, LNR does not believe that the Proposed Plan is the appropriate remedial plan for the Site.

The Proposed Plan provides that the selected remedy, Alternative G-3, "provides a shorter overall time frame than either Alternative G-2 or Alternative G-4." While this appears to be accurate, the Proposed Plan neglects to mention that the Navy expects even this "shorter timeframe" remediation to take 30 years to complete. Although 30 years is preferable to the 250 and 200 year timeframes estimated to complete remediation under Alternatives G-2 and G-4, respectively, it highlights LNR's concern that the proposed remedy is not as aggressive as it can and should be. Part of the reason that the timeframe for the remediation is so long is that the Navy is relying heavily on monitored natural attenuation – i.e., the natural degradation of contamination – combined with permanent institutional controls that restrict the future uses and activities that can occur on the Site, rather than aggressive treatment technology. Furthermore, all of the remedies evaluated in the Proposed Plan will require long-term maintenance of remedial infrastructure at the Site (e.g., groundwater treatment and monitoring wells), which will complicate and limit the potential developable uses of the Site until all required monitoring associated with the remediation is complete.

Technically feasible remedies are available that could result in a faster cleanup of the Site, yet such potential remedial alternatives have not been fully considered or evaluated by the Navy. In fact, the cleanup of the Site could be achieved more quickly using the very same technology the Navy is proposing to use, if the Navy would simply apply the remedial technology more frequently over a larger area of the Site. By doing so, the enhanced bioremediation would destroy more of the Site contaminants in a shorter time.

The area where the Building 81 Site is located is zoned for recreational use and has long been planned for use as a skating rink or other recreational amenity. Such an amenity would be an asset to both Southfield residents and residents of the surrounding communities. Construction of the skating rink – or any other recreational use – will be seriously constrained and delayed because of the relatively passive remedy selected by the Navy, the components of the Navy's proposed remedial plan, and the length of time it will take to achieve the clean-up goals. The Site could be returned to productive use more quickly if the Navy implemented a more aggressive remedial plan.

Based on the foregoing, LNR hereby requests that the Navy, EPA and the Massachusetts Department of Environmental Protection work together and with LNR and South Shore Tri-Town Development Corporation to design a cleanup plan and provide the resources necessary to implement it aggressively, so that this highly visible Site near the center of Southfield can be returned to safe and economically productive use in a reasonable time frame. Our collective goal should be to transform this area of the former Naval Air Station from a blighted, ugly, contaminated Brownfield, to a clean and productive use that benefits the community – and it should take far less than 30 years to accomplish.

Comments submitted by: Robin Daniels, Director of Development

Address: LNR South Shore, LLC
c/o Starwood CPG Operations, LLC
300 Congress Street, Suite 310
Quincy, MA 02169