UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
1 CONGRESS STREET, SUITE 1100
BOSTON, MASSACHUSETTS 02114-2023

September 25, 2009

Mr. David E. Strainge
AFCEE/EXC Loring
154 Development Drive, Suite G
Limestone, ME 04750-9743

Re: Five-Year Review Report (2004 to 2009), Pease Air Force Base NPL Site

Dear Mr. Strainge:

This office is in receipt of the Air Force's *Five-Year Review Report (2004 - 2009), Pease Air Force Base* dated September 18, 2009. Upon review of this report, EPA concurs with the findings that all remedies which have been implemented are currently protective of human health and the environment. EPA will continue to work closely with the Air Force to ensure that all Pease AFB remedies continue to remain protective as well as provide technical assistance and oversight of current and future Air Force efforts to optimize existing remedial systems and accelerate cleanup time-frames.

This third five-year review was triggered by the first remedial action which was documented by EPA to be September 30, 1994. Consistent with Section 121(c) of CERCLA and EPA's *Comprehensive Five-Year Review Guidance* (OSWER *Directive 9355.7-03B-P)*, the next statutorily required five-year review must be finalized by September 30, 2014.

Sincerely,

for Mary Sanderson

James T.Owens, III, Director
Office of Site Remediation and Restoration

cc: Bryan Olson, EPA-New England
Mary Sanderson, EPA-New England
Mike Daly, EPA-New England
Monica McEaddy, EPA HQ
Scott Hilton, NHDES

FOR APPROVAL

FINAL
5 - YEAR REVIEW REPORT
(2004 - 2009)

FORMER PEASE AIR FORCE BASE
PORTSMOUTH, NEW HAMPSHIRE

CONTRACT No. FA8903-04-D-8679
TASK ORDER No. 0051

Prepared for:
Air Force Center for Engineering and the Environment (AFCEE)
Brooks-City Base, TX 78235-5328

U.S. AIR FORCE

Prepared by:

URS Group Inc.
77 Goodell Street
Buffalo, NY 14203

September 2009

G4322FF

FINAL
5-YEAR REVIEW REPORT (2004-2009)

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Five-Year Review Summary Form

SITE IDENTIFICATION			
Site name *(from WasteLAN)*: Pease Air Force Base			
EPA ID *(from WasteLAN)*: NH7570024847			
Region: 1	**State:** NH	**City/County:** Portsmouth, Newington, Greenland /Rockingham County	

SITE STATUS			
NPL Status: **X** Final Deleted Other (specify)			
Remediation Status (choose all that apply)**:**	Under Construction	**X** Operating	**X** Complete
Multiple OUs? X Yes No	**Construction completion date:** 09/26/2000		
Has Site been put into reuse? X Yes No			

REVIEW STATUS				
Lead Agency:	EPA	State	Tribe	**X** Other Federal Agency (United States Air Force)
Author name: Steven M. Moeller				
Author title: Senior Geologist				**Author affiliation:** URS Group, Inc.
Review Period: 09/20/2004 to 09/30/2009				
Date(s) of inspection: N/A (see report)				
Type of Review: **X** Post-SARA Pre-SARA NPL-Removal Only Non-NPL Remedial Action Site NPL State/Tribe-lead Regional Discretion				
Review number: 1 (first) 2 (second) **X** 3 (third) Other (specify) ___________				
Triggering Action: Actual RA Start Actual RA On-Site Construction at OU #1 Actual RA Start at OU# _____ Construction Completion Previous Five-Year Review Report Other (specify) Signing of ROD				
Triggering action date (from WasteLAN): 09/30/1994				
Due date (five years after triggering action date): 09/30/2009				

Five-Year Review Summary Form (continued)

Issues:

- Changes to some ARARs have occurred and new ARARs are available for many COCs. However, these changes have not affected the protectiveness of any remedies.

- The evaluation of potential soil vapor intrusion pathways at all IRP sites/Zones needs to be completed.

- Contaminant mass removal at Site 8 has declined; LNAPL and contamination remaining within the saturated zone soils indicate an extended timeframe to achieve groundwater RAOs.

- Elevated metals concentrations were detected in a 2008 Railway Ditch surface water sample.

- The interaction between the stormwater detention basin and the upgradient portion of the Site 49 groundwater contaminant plume needs to be evaluated in greater detail.

Recommendations and Follow-up Actions:

- New/revised ARARs will be identified in future long-term monitoring reports.

- A comparison of Pease AFB groundwater data against EPA and NHDES screening levels will be forthcoming shortly and the results presented in a draft report for review by EPA and NHDES. Based on information provided in the forthcoming VI screening report, buildings will be identified for air sampling to assess potential vapor intrusion pathways.

- Operate and maintain the recently installed air sparging / bioremediation system at Site 8, in conjunction with the pre-existing soil vapor extraction system. The impact of these revised remediation efforts upon the residual LNAPL / contamination should then be assessed.

- Efforts should be made to identify and document any seeps or other anomalies along Railway Ditch that could be potential sources for surface water metals contamination.

- The Air Force should obtain the design details for the stormwater detention basin at Site 49 and evaluate if it is functioning as designed. Additional monitoring should be performed to evaluate the interaction between the stormwater detention basin and the upgradient portion of the Site 49 groundwater contaminant plume.

Protectiveness Statement:

The remedies for all sites are protective of human health and the environment and all immediate threats to human health and the environment have been addressed.

EXECUTIVE SUMMARY

The Air Force Real Property Agency (AFRPA) has initiated a Five-Year Review for the former Pease Air Force Base (Pease AFB) in Portsmouth, New Hampshire. The review was conducted under the Air Force Center for Engineering and the Environment (AFCEE) Contract No. FA8903-04-D-8679, Task Order 51. The Air Force is preparing this Five-Year Review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). A Five-Year Review is required for the former Pease AFB because the implemented remedies have resulted in hazardous substances remaining onsite at concentrations that do not allow unlimited use and unrestricted exposure. This document represents the third Five-Year Review for the former Pease AFB and encompasses the period 2004 through 2009.

The overall purpose of this Five-Year Review is to determine if selected remedies are functioning as intended and are protective of human health and the environment. Methods, findings, and conclusions are documented in this Five-Year Review Report, which also identifies remaining issues and makes recommendations to attain or maintain protectiveness.

Each of the sites included in the Five-Year Review has a remedy in place. Therefore, technical assessments, as required under United States Environmental Protection Agency (EPA) guidance, were performed for each of the sites. These assessments consisted of answering the following questions:

- Question A: Is the remedy functioning as intended by the decision documents?
- Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?
- Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Sites included in the Five-Year Review were organized into three categories:

<u>Category 1, Remedial Action Implemented</u>

- Zone 1: Landfill 5

- Zone 2: Site 10 – Leaded Fuel Tank Sludge Area, Site 22 – Burn Area 1, Site 37 – Burn Area 2, and Site 43 – McIntyre Road Drum Disposal Area

- Zone 3: Site 32 – Building 113, Site 36 – Building 119

- Zone 3: Site 34 – Building 222, Site 39 – Building 227 (encompasses all Zone 3 sites, with the exception of source remediation at Sites 32/36)

- Zone 4: Landfill 6

- Zone 5: Site 8 – Fire Department Training Area

- Zone 7: Site 45 – Old Jet Engine Test Stand

- Zone 3: Site 73 – Building 234

- Zone 3: Site 49 – Building 22

Category 2, Long-Term Monitoring Only, Surface Water/Sediment with Remedial Actions Required and Completed

- Zone 1: Pauls Brook

- Zone 1: Railway Ditch and Flagstone Brook

Category 3, Long-Term Monitoring Only, Surface Water/Sediment

- Zone 2: Peverly Drainage System

- Zone 4: Lower Grafton Ditch

- Zone 5: Knights Brook and Pickering Brook

As recommended in the second *Five-Year Review Report* (Montgomery Watson Harza Americas, Inc. [MWH], 2004), McIntyre Brook was not included this Five-Year Review, nor will it be included in future Five-Year Reviews.

Based on the review, remedies at all sites were found to be functioning as intended by the decision documents. While the remedy at Site 8 is functioning as intended, an enhancement of the chosen remedy in the form of an air sparge (AS) system was installed to achieve Remedial Action Objectives (RAOs) in a timely manner. Several changes were noted in Applicable or Relevant and Appropriate Requirements (ARARs) used to develop cleanup goals (CGs), as noted in the subsections of this Five-Year Review Report. The most significant of these changes are the revised New Hampshire Ambient Groundwater Quality Standards (NHAGQS), under New Hampshire Department of Environmental Services (NHDES) Chapter Env-Or 600, which became effective February 1, 2007. Since the last Five-Year Review, various guidance documents have been issued regarding changes to methodologies for human health and ecological risk assessments and there have been changes to toxicity values; however, these changes should not significantly impact the protectiveness of the remedies since most Record of Decision (ROD) CGs were based on ARARs, rather than risk-based numbers. No additional information was identified that would call into question the protectiveness of any of the individual remedies associated with the sites.

Several issues were identified during the Five-Year Review process. These issues are listed below, on a site-by-site basis. These issues will be addressed during routine site monitoring, data evaluation, and reporting activities, with the exception of the following:

Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-Up Actions: Affects Protectiveness (Y/N)	
				Current	Future
The evaluation of potential soil vapor intrusion pathways at all IRP sites/Zones needs to be completed. Based on information provided in the forthcoming VI screening report, buildings will be identified for air sampling to assess potential vapor intrusion pathways.	AFRPA	EPA/ NHDES	Fall 2009	N	N
Operate and maintain the recently installed air sparging/ bioremediation system at Site 8, in conjunction with pre-existing soil vapor extraction system. Assess impact of revised remediation efforts upon residual LNAPL / contamination.	AFRPA	EPA/ NHDES	Fall 2009	N	N

Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-Up Actions: Affects Protectiveness (Y/N)	
				Current	Future
Efforts should be made to identify and document any seeps or other anomalies along Railway Ditch that could be potential sources for surface water metals contamination.	AFRPA	EPA/ NHDES	Fall 2009	N	N
The Air Force should obtain the design details for the stormwater detention basin at Site 49 and evaluate if it is functioning as designed. Additional monitoring should be performed to evaluate the interaction between the stormwater detention basin and the upgradient portion of the Site 49 groundwater contaminant plume.	AFRPA	EPA/ NHDES	Spring 2009	N	N

Category/Zone/Site	Identified Issue	Recommended Action(s)
Category 1 - Remedial Action Implemented		
Zone 1: Landfill 5	Decrease in Arsenic Federal MCL and State NHAGQS (2/1/07) from 50 µg/L to 10 µg/L. The *Zone 1 ROD* has a risk-based cleanup goal (CG) of 8.1 µg/L for 1,1-dichloroethane; the current NHAGQS is 81 µg/L.	Note changes in regulatory standards in future long-term monitoring reports. Use Pease AFB background value for arsenic (23 µg/L), per New Hampshire regulations Env-Or 602.07 and Env-Or 602.23.
Zone 2: Site 10, Site 22, Site 37, and Site 43	Decrease in Arsenic Federal MCL and State NHAGQS (2/1/07) from 50 µg/L to 10 µg/L. ARARs (NHAGQS) are now available for several groundwater constituents that have risk-based CGs in the *Zone 2 ROD*.	Note changes in regulatory standards in future long-term monitoring reports. Use Pease AFB background value for arsenic (23 µg/L), per New Hampshire regulations Env-Or 602.07 and Env-Or 602.23.
Zone 3: Site 32 and Site 36	ARARs are now available for numerous COCs assigned discharge treatment goals (TGs) in the *Site 32/36 ROD* that were risk-based or based on TBC values. An ARAR is also now available for sec-butylbenzene (NHAGQS = 260 µg/L), which had a risk-based RG of 7.3 µg/L in the *Zone 3 ROD Amendment*.	Discharge TGs should be updated to match NHAGQS and the Pease AFB background value for arsenic (23 µg/L). Note changes in regulatory standards in future long-term monitoring reports.
Zone 3: Site 34 and Site 39	An ARAR is now available for sec-butylbenzene (NHAGQS = 260 µg/L), which had a risk-based RG of 7.3 µg/L in the *Zone 3 ROD Amendment*.	Note ARAR for sec-butylbenzene in future long-term monitoring reports.
Zone 4: Landfill 6	Decrease in Arsenic Federal MCL and State NHAGQS (2/1/07) from 50 µg/L to 10 µg/L. An ARAR is now available for 1,2,4-trimethylbenzene (NHAGQS = 330 µg/L), which had a risk-based CG of 19.8 µg/L in the *Zone 4 ROD*.	Note changes in regulatory standards in future long-term monitoring reports. Use Pease AFB background value for arsenic (23 µg/L), per New Hampshire regulations Env-Or 602.07 and Env-Or 602.23.

Category/Zone/Site	Identified Issue	Recommended Action(s)
Category 1 - Remedial Action Implemented		
Zone 4: Landfill 6	Metals are detected at concentrations above regulatory standards in interior LF-6 monitoring well groundwater samples; however, the LF-6 GMZ compliance boundary well groundwater samples are not currently analyzed for metals.	It is recommended that the LF-6 GMZ compliance boundary monitoring well groundwater samples be analyzed for metals. No changes will be made to LF-6 long-term monitoring until a revised draft LTMP is submitted, reviewed, and approved by EPA and NHDES.
Zone 5: Site 8	Mass removal has declined; LNAPL and contamination remaining within the saturated zone soils indicate extended timeframe to achieve groundwater RAOs.	Operate recently installed air sparging/ bioremediation system, in conjunction with pre-existing soil vapor extraction system. Assess impact of revised remediation efforts upon residual LNAPL / contamination.
	Decrease in Arsenic Federal MCL and State NHAGQS (2/1/07) from 50 µg/L to 10 µg/L. ARARs are now available for several groundwater COCs that did not have ARARs at time of *Site 8 ROD*.	Note changes in regulatory standards in future long-term monitoring reports. Use Pease AFB background value for arsenic (23 µg/L), per New Hampshire regulations Env-Or 602.07 and Env-Or 602.23.
Zone 7: Site 45	ARARs are now available for several groundwater COCs that were assigned risk-based CGs in the *Site 45 ROD*.	Note changes in regulatory standards in future long-term monitoring reports.
	The *Site 45 ROD* CG for manganese in groundwater (1,500 µg/L) is higher than the current NHAGQS for manganese (840 µg/L) and the Pease AFB background value (942 µg/L).	Note Pease AFB background value for manganese (942 µg/L) in future long-term monitoring reports.
Zone 3: Site 73	EPA expressed concern that 2008 groundwater contour maps may show apparent groundwater mounding behind the PRB wall.	The Air Force is currently discussing this potential issue with EPA and NHDES.
Zone 3: Site 49	The interaction between the stormwater detention basin and the upgradient portion of the Site 49 groundwater contaminant plume needs to be evaluated in greater detail.	The Air Force should obtain the design details for the stormwater detention basin and evaluate if it is functioning as designed. Additional monitoring should be performed to evaluate the interaction between the stormwater detention basin and the upgradient portion of the Site 49 groundwater contaminant plume.

Category/Zone/Site	Identified Issue	Recommended Action(s)
Category 2 - Long-Term Monitoring Only, Surface Water/Sediment with Remedial Actions Required and Completed		
Zone 1: Pauls Brook	The concentrations of metals in Pauls Brook sediment are not expected to decrease substantially in the near term. The second Five-Year Review Report recommended that the sediment CGs for inorganics within Pauls Brook and the frequency of monitoring should be reevaluated by the BCT; however, these recommendations were not acted upon.	Since the concentrations of metals in Pauls Brook sediment are not expected to decrease substantially in the near term, it is recommended that the sampling frequency for monitoring of sediment within Pauls Brook be reduced from annually to triennially. No changes will be made to long-term monitoring until a revised draft LTMP is submitted, reviewed, and approved by EPA and NHDES.

Category/Zone/Site	Identified Issue	Recommended Action(s)
Category 2 - Long-Term Monitoring Only, Surface Water/Sediment with Remedial Actions Required and Completed		
Zone 1: Railway Ditch	Changes have occurred to surface water and sediment ARARs/TBCs that were used to develop CGs in the *LF-5 ROD.*	Note changes in regulatory standards in future long-term monitoring reports.
	Elevated metals concentrations were detected in a 2008 Railway Ditch surface water sample.	Efforts should be made to identify and document any seeps or other anomalies along Railway Ditch that could be potential sources for metals contamination.
	Any observed impacts to surface water and sediment quality in Flagstone Brook are believed to be due to an upstream source (i.e., discharge from the north apron of the Flightline), not LF-5.	Surface water and sediment monitoring within Flagstone Brook should be discontinued as historical data indicates that metals concentrations in surface water and sediment do not appear to be directly related to LF-5. No changes will be made to long-term monitoring until a revised draft LTMP is submitted, reviewed, and approved by EPA and NHDES.

Category/Zone/Site	Identified Issue	Recommended Action(s)
Category 3 - Long-Term Monitoring Only, Surface Water/Sediment		
Zone 2: Peverly Drainage System	Changes have occurred to surface water and sediment ARARs/TBCs that were used to develop CGs in the *Zone 2 ROD.*	Note changes in regulatory standards in future long-term monitoring reports.
	It is not anticipated that concentrations of pesticides and metals in Peverly Brook drainage sediment will decrease rapidly in the near term.	Since the concentrations of pesticides and metals in Peverly Brook drainage sediment are not expected to decrease substantially in the near term, it is recommended that the sampling frequency for monitoring of sediment within Peverly Brook be reduced from annually to triennially. No changes will be made to long-term monitoring until a revised draft LTMP is submitted, reviewed, and approved by EPA and NHDES.
Zone 4: Lower Grafton Ditch	None.	LTM data for Lower Grafton Ditch surface water samples from 1993 to 2008 indicate no occurrences of VOCs at concentrations exceeding New Hampshire WQC; therefore, it is recommended that VOC monitoring for surface water in Lower Grafton Ditch be discontinued. No changes will be made to long-term monitoring until a revised draft LTMP is submitted, reviewed, and approved by EPA and NHDES.

Category/Zone/Site	Identified Issue	Recommended Action(s)
Category 3 - Long-Term Monitoring Only, Surface Water/Sediment		
Zone 5: Knights Brook and Pickering Brook	None.	The metals data provided by routine LTM of sediment in Pickering Brook has varied little over the 1991 to 2008 monitoring period. This consistency indicates that current Site 8 activities are not contributing to sediment metals loading and metals in sediment do not appear to be desorbing, impacting surface water quality. Since the Site 8 risk assessments did not reveal unacceptable risks to human or ecological receptors from exposure to Pickering Brook sediment and the sediment LTM data has shown little variation over time, it is recommended that sediment monitoring in Pickering Brook be discontinued. No changes will be made to long-term monitoring until a revised draft LTMP is submitted, reviewed, and approved by EPA and NHDES.

DECLARATION STATEMENT

Based upon the results of this Five-Year Review for the former Pease AFB completed in September 2009, it is concluded that the remedies for all sites are currently protective of human health and the environment and all immediate threats to human health and the environment have been addressed.

ROBERT M. MOORE **Director** **Air Force Real Property Agency**	**Date**

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ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
1,2,4-TMB	1,2,4-trimethylbenzene
AA	Alternatives Analysis
AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency
AFCEE	Air Force Center for Engineering and the Environment
AFRPA	Air Force Real Property Agency
a.k.a.	also known as
ARAR	Applicable or Relevant and Appropriate Requirements
AS	air sparging
ASN	Area of Special Notice
ASV	air supply vents
AVGAS	aviation gasoline
BA	Burn Area
BCT	BRAC Cleanup Team
Bechtel	Bechtel Environmental Inc.
BFSA	Bulk Fuels Storage Area
bgs	below ground surface
BRAC	Base Realignment and Closure
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CG	cleanup goal
cis-1,2-DCE	cis-1,2-dichloroethene
COC	contaminants of concern
CRD	Construction Rubble Dump
CREW	concrete recovery extraction well
DBR	deep bedrock
DCA	1,1-dichloroethane
DCE	1,1-dichloroethene
DNAPL	Dense Non-Aqueous Phase Liquid
DOD	Department of Defense
DOI	Department of the Interior
DPE	dual-phase extraction
EPA	United States Environmental Protection Agency
ERA	ecological risk assessment
ER-L	effects range-low
ESD	Explanation of Significant Differences
ETI	Environmental Technologies, Inc.
FDTA	Fire Department Training Area
Fe^0	zero-valent iron
FFA	Federal Facilities Agreement
FMS	Field Maintenance Squadron
FS	Feasibility Study
ft	foot or feet
ft/sec	feet per second

ACRONYMS AND ABBREVIATIONS (Continued)

ft/day	feet per day
GAC	granular activated carbon
gal	gallon
GMP	Groundwater Management Permit
GMZ	Groundwater Monitoring Zone
gpm	gallons per minute
GT	glacial till
GWTP	Groundwater Treatment Plant
HHCs	halogenated hydrocarbons
HHRA	human health risk assessment
HMSA	hazardous materials storage area
IC	Institutional Controls
IR	Intrinsic Remediation
IRM	Interim Remedial Measure
IRP	Installation Restoration Program
JETC	Jet Engine Test Cell
JP-4	jet fuel
LF	Landfill
LFTS	Leaded Fuel Tank Sludge Area
LNAPL	Light Non-Aqueous Phase Liquid
LS	Lower Sand
LTM	Long-Term Monitoring
LTMP	Long Term Monitoring Plan
LUC	Land Use Control
MCL	maximum contaminant level
MCS	Marine Clay and Silt
MRDDA	McIntyre Road Drum Disposal Area
MSL	mean sea level
MWH	Montgomery Watson Harza Americas, Inc.
NCP	National Contingency Plan
NFA	No Further Action
NHAGQS	New Hampshire Ambient Groundwater Quality Standards
NHANG	New Hampshire Air National Guard
NHDES	New Hampshire Department of Environmental Services
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priority List
O&M	Operations and Maintenance
OJETS	Old Jet Engine Test Stand
OPS	operating properly and successfully
PAH	polynuclear aromatic hydrocarbons
PCDA	Paint Can Disposal Area
PCE	tetrachloroethene
PCMMP	Post Closure Maintenance and Monitoring Plan
PDA	Pease Development Authority
Pease AFB	Pease Air Force Base
POTW	Publicly Owned Treatment Works
PRB	permeable reactive barrier
PVC	poly-vinyl chloride
RAO	Remedial Action Objective

ACRONYMS AND ABBREVIATIONS (Continued)

RCRA	Resource Conservation and Recovery Act
RG	Restoration Goals
RI	Remedial Investigation
RI/FS	remedial investigation and feasibility study
RO	remedial objectives
ROD	Record of Decision
ROI	radius of influence
SBR	shallow bedrock
SI	site inspection
SVE	soil vapor extraction
TBC	to be considered
TCE	trichloroethene
TG	treatment goal
TI	Technical Impracticability
TPHs	total petroleum hydrocarbons
US	Upper Sand
USAF	United States Air Force
UST	underground storage tank
VC	vinyl chloride
VOC	volatile organic compounds
WQC	New Hampshire Water Quality Criteria for Toxic Substances
yd^3	cubic yards

1.0 STATEMENT OF AUTHORITY AND PURPOSE

The AFRPA has initiated a Five-Year Review for the former Pease AFB in Portsmouth, New Hampshire. The review was conducted under the AFCEE Contract No. FA8903-04-D-8679, Task Order 51. The overall purpose of this Five-Year Review is to determine if selected remedies are functioning as intended and are protective of human health and the environment. Methods, findings, and conclusions are documented in this *Five-Year Review Report*, which also identifies remaining issues and makes recommendations to attain or maintain protectiveness.

The Air Force is preparing this Five-Year Review pursuant to the CERCLA §121 and the NCP. CERCLA §121 states "If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews."

The United States Environmental Protection Agency (EPA) interpreted this requirement further in the NCP; 40 Code of Federal Regulations (CFR) §300.430(f)(4)(ii) states "If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action."

A Five-Year Review is required for the former Pease AFB, because the implemented remedies have resulted in hazardous substances remaining onsite at concentrations that do not allow unlimited use and unrestricted exposure. This document represents the third Five-Year Review for the former Pease AFB, and encompasses the period September 2004 through September 2009. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) trigger date for the first Five-Year Review was September 30, 1994. The review was performed by Bechtel Environmental, Inc. and submitted on September 28, 1999 (Bechtel Environmental Inc. [Bechtel], 1999). The second Five Year Review was performed by MWH and submitted on September 20, 2004 (MWH, 2004). This third Five-Year Review is required to be submitted to the EPA five years after the second (September 30, 2009).

1.1 REFERENCES

Bechtel, 1999. *Five-Year Review Report*. September.

MWH, 2004. *5-Year Review Report (1999-2004)*. September.

2.0 REPORT ORGANIZATION

The *Comprehensive Five-Year Review Guidance* (EPA, 2001) indicates that the Five-Year Review Report should generally contain the following information:

- An introduction to the review;
- A site chronology and presentation of general site background information;
- A discussion of remedial actions that have taken place at the site;
- Description of progress since the last Five-Year Review, if applicable;
- A discussion of the Five-Year Review process;
- Technical assessment for each site;
- Identification of any issues arising from the review process;
- Recommendations and follow-up actions;
- Protectiveness statements; and
- Identification of the expected date of the next Five-Year Review.

This *Five-Year Review Report* generally follows the report template found in the 2001 EPA Guidance. However, because of the number of sites involved in the review, certain modifications were made to make the data more accessible to the reader. Certain general information was presented in introductory sections, and summary tables were created for each of the site categories for ease of reference. Tables and Figures are included in separate sections at the end of the document. The contents of each section of the *Five-Year Review Report* are as follows:

Section	Contents
1	Introduction to the *Five-Year Review Report*, stating the authority for, and purpose of, the review.
2	Report Organization – Describes the organization of the *Five-Year Review Report.*
3	Methodology – Describes the overall process followed for the Five-Year Review.

Section	Contents
4	Community Involvement – Describes the process for public involvement in the Five-Year Review process.
5	Site Location and Description – Provides general background information for the former Pease AFB.
6	Report Summary – Provides summary maps and a summary table to assist the reader in locating specific site information in the *Five-Year Review Report.*
7	Category 1 Sites – Provides detailed background information on sites with remedial actions implemented, including descriptions of remedial actions, progress since the last Five-Year Review, technical assessments for individual sites, recommendations, and protectiveness statements.
8	Category 2 Sites – Provides detailed information on surface water and sediment sites where remedial actions were required and have been completed and long-term monitoring is currently being performed.
9	Category 3 Sites – Provides detailed information for surface water/sediment sites where only long-term monitoring was required and is being performed.

2.1 REFERENCES

EPA, 2001. *Comprehensive Five-Year Review Guidance*, OSWER No. 9355.7-03B-P, EPA 540-R-01-007. June.

3.0 METHODOLOGY

3.1 APPLICABLE GUIDANCE

The *Comprehensive Five-Year Review Guidance* (EPA, 2001) was the primary document used to prepare this third *Five-Year Review Report* for the former Pease AFB. This guidance provides an overview of the review process and describes roles and responsibilities, components of the Five-Year Review process, and procedures for assessing the protectiveness of remedies. Since the last five-year review, USEPA has made available a Q&A document to clarify issues regarding the five-year review process (EPA, 2004).

3.2 SITE CATEGORIZATION

Under the Federal Facilities Agreement (FFA) for the former Pease AFB, eight Installation Restoration Program (IRP) zones were established. Multiple IRP sites are present within these zones. During the first Five-Year Review (Bechtel, 1999), three categories of sites were established on a hierarchy, based on status of remedy and IRP zone. The categories established in the first Five-Year Review included:

- Category 1 - Remedial action implemented;
- Category 2 - Long-term monitoring only, remedial actions required and completed (surface water and sediment only);
- Category 3 - Long-term monitoring only, no remedial action requirement other than long-term monitoring (surface water and sediment only); and
- Category 4 - Sites without remedial actions implemented.

Within each category, sites were then grouped by IRP zone.

For this third *Five-Year Review Report*, the first three categories listed above were also used, for purposes of consistency. Since the time of the first Five-Year Review, all remedial actions under the IRP at the former Pease AFB have been implemented. Therefore, no sites remain in the fourth category.

3.3 SITE DATA

Numerous documents were reviewed for each site during the process of the Five-Year Review. These documents are cited as references at the end of individual sections of the report. These documents are maintained in the official Information Repository for the former Pease AFB, located at the URS Group, Inc. (URS) Field Office at 20 Short Street, Pease Air Force Base, Portsmouth, New Hampshire. Currently, URS is contracted to maintain this repository through the end of 2011. Additional information can be found on the Air Force's Administrative Record database via the following web link "https://afrpaar.lackland.af.mil/ar/docsearch.aspx".

3.4 INTERVIEWS AND SITE INSPECTIONS

Specific site interviews and inspections were not performed for this *Five-Year Review Report*. All sites included in the Five-Year Review are routinely inspected and subject to ongoing monitoring and maintenance. Inspection logs included in annual reports, contractor and AFRPA personnel responsible for individual sites, and the onsite Operations and Maintenance (O&M) manager were consulted for specific information relative to the performance of individual remedies during preparation of this *Five-Year Review Report*.

3.5 TECHNICAL ASSESSMENTS

Each of the sites included in the Five-Year Review has a remedy in place. Therefore, technical assessments, as required under EPA guidance, were made for each of the sites in the three categories. These assessments consisted of answering the following questions:

- Question A: Is the remedy functioning as intended by the decision documents?

- Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

- Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Section 4 of the *Comprehensive Five-Year Review Guidance* (EPA, 2001) was used to develop appropriate responses to these questions. In general, the response to Question A was developed based on review of the RAOs set forth in the applicable Records of Decision (RODs), followed by assessment of current remedy performance data and progress toward cleanup goals (CGs). Question B was answered through an assessment of significant changes in standards and assumptions that were used at the time of remedy selection. Because most of the CGs established for the sites are based on promulgated standards, this assessment generally focused on changes in those promulgated standards that have occurred since the last *Five-Year Review Report* (MWH, 2004) that would have an impact on remedy management. Where risk-based values were established as CGs, the underlying toxicity data were also reviewed. Other information, such as potential changes in land use that could affect the protectiveness of the remedy, was considered in responding to Question C.

3.6 REFERENCES

Bechtel, 1999. *Five-Year Review Report*. September.

EPA, 2001. *Comprehensive Five-Year Review Guidance*, OSWER No. 9355.7-03B-P, EPA 540-R-01-007. June.

EPA, 2004. *5-Year Review Questions and Answers*, www.epa.gov/superfund/cleanup/postconstruction/5yr.htm. December.

MWH, 2004. *5-Year Review Report (1999-2004)*. September.

4.0 COMMUNITY INVOLVEMENT

The Information Repository for the former Pease AFB IRP is currently maintained at the URS Field Office at 20 Short Street, Portsmouth, New Hampshire. A public notice announcing initiation of the five-year review was published in the Portsmouth Herald on March 19, 2009 (Appendix A).

The final five-year review report will be placed in the Information Repository and Administrative Record for the Former Pease AFB and made available for public review. A second public notice will be published announcing the completion of the five-year review and its availability at the Information Repository. Additional community involvement activities were not conducted as part of this five-year review due to lack of community interest.

5.0 SITE LOCATION AND DESCRIPTION

The former Pease AFB is located in the Towns of Newington and Greenland and the City of Portsmouth in Rockingham County, New Hampshire. As shown in Figure 5-1, the former AFB occupies approximately 4,365 acres and is located on a peninsula in southeastern New Hampshire. The peninsula is bounded on the west and southwest by Great Bay, on the northwest by Little Bay, and on the north and northeast by the Piscataqua River.

At the onset of World War II, an airport at the former AFB location was used by the U.S. Navy. The U.S. Air Force assumed control of the site in 1951 and construction of the base was completed in 1956. Under Air Force command, the base served to maintain a combat-ready force capable of long-range bombardment operations. Over time, various quantities of fuels, oils, lubricants, solvents, and protective coatings were used to support the mission, and as a result, contaminants from these substances were released into the environment.

In 1976, the Department of Defense (DOD) initiated an assessment of the environmental contamination resulting from the past operation and disposal practices at all DOD facilities. In 1980, in response to the Resource Conservation and Recovery Act (RCRA), and in anticipation of the CERCLA, DOD issued a memorandum requiring identification of all hazardous waste disposal sites on DOD facilities. In 1983, a Phase I Problem Identification Search was conducted at the former Pease AFB to assess whether potential hazardous waste sites warranted further investigation. A pre-survey was submitted in 1984.

In December 1988, Pease AFB was selected as one of 86 military installations to be closed by the Secretary of Defense's Commission on Base Realignment and Closure (BRAC). The base was closed as an active installation in March 1991. The Air Force has transferred most of the former AFB to the Pease Development Authority (PDA) via quitclaim deed (a.k.a. Pease Deed). The airfield is now a fully operational commercial airport. Other property is currently being used or developed for light commercial and industrial facilities. A portion of the base was transferred to the U.S. Department of the Interior (DOI) for use as a national wildlife refuge and the Air Force retained 229 acres of the former base for use by the New Hampshire Air National Guard (NHANG).

In accordance with Executive Order 12580, the Air Force is designated the lead agency authority to conduct CERCLA cleanup activities at the former AFB and is responsible for all costs associated with the cleanup of contamination associated with past Air Force activities. The Air Force has been conducting an environmental cleanup program at the former AFB since 1983. This program is executed according to the guidelines of the Air Force IRP and the NHDES Underground Storage Tank (UST) program. The former AFB was proposed for addition to the National Priority List (NPL) in 1989 and was listed in 1990. On April 24, 1991 the Air Force, EPA, and NHDES signed the interagency Pease Air Force Base FFA under CERCLA Section 120 establishing the protocols for conducting the environmental study and cleanup of the former AFB.

The FFA established eight IRP zones at Pease AFB for which separate remedial investigation and feasibility study (RI/FS) reports were prepared (See Figure 5-2). Zones 6 and 8 are located in the western portion of Pease AFB, within parcels L and M, which is the area established by the DOI as the Great Bay National Wildlife Refuge. Zones 6 and 8 do not require Five-Year Reviews. The IRP zones and the sites included in this *Five-Year Review Report* are:

- Zone 1 is located in the eastern part of Pease AFB and includes the following IRP sites discussed in this report: Landfill 5, Railway Ditch, Flagstone Brook, and Pauls Brook.

- Zone 2 is located in the northwestern sector of Pease AFB and includes the following IRP sites discussed in this report: Site 10, Site 22, Site 37, Site 43, and the Peverly Drainage System.

- Zone 3 encompasses the area of Pease AFB where most of the industrial and aircraft maintenance shops were located. Zone 3 includes the following IRP sites discussed in this report: Sites 32 and 36, Sites 34 and 39, Site 73, and Site 49.

- Zone 4 is located on the southeastern margin of Pease AFB, southeast of Zone 3, and is relatively isolated from other IRP sites or zones. Zone 4 is bordered by Interstate 95 on the east and Buildings 94, 95, and 96 to the north. Zone 4 includes the following IRP sites discussed in this report: Landfill 6 and Lower Grafton Ditch.

- Zone 5 is located at the northern end of Pease AFB adjacent to the town of Newington and includes the following IRP sites discussed in this report: Site 8 and Knights Brook.

- Zone 7 is located in the southwestern portion of Pease AFB and includes the following IRP site discussed in this report: Site 45 (DOD, 1994).

Remedial Investigation (RI) and Feasibility Study (FS) Reports were prepared by 1994 (DOD, 1994). The RI/FS reports were utilized to develop RODs for the individual IRP zones. Source area RODs were also developed for several sites where interim remedial measures had been implemented. These sites were prioritized by the Air Force as posing significant risks to human health and the environment; they include Site 8, Site 32/36, Site 34 and Landfill 5. The RODs have become the controlling documents for site cleanup at the former Pease AFB.

5.1 REFERENCES

DOD, 1994. *BRAC Cleanup Plan: Implementing President Clinton's Decision to Promote Early Reuse of Closing Bases by Expediting Environmental Cleanup, Pease AFB, New Hampshire*. April.

6.0 REPORT SUMMARY

This section is included in this *Five-Year Review Report* to aid the reader in locating information specific to a particular IRP Zone or site.

6.1 MAPS

Figure 5-2 presented the IRP Zones at the former Pease AFB. Figure 6.1-1 presents the locations of IRP Zones, individual IRP sites, and land use parcels identified at the Former Pease AFB.

6.2 SUMMARY TABLE

Table 6.2-1 is provided as a reference for locating information on specific sites that were included in the Five-Year Review. Table 6.2-1 includes the following information:

- **Site I.D.** – Specifies IRP Zone and site identifier used in the first *Five-Year Review Repor*t (Bechtel, 1999).

- **Sites Included -** Lists individual IRP sites included under the IRP Zone/site identifier in this *Five-Year Review Report.*

- **Site Categories** – Indicates the category (1, 2, or 3) individual IRP sites were included in this *Five-Year Review Report.*

- **Location in Report** – Indicates the report section where information for specific sites can be located.

6.3 REFERENCES

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base*. September.

7.0 CATEGORY 1 SITES, REMEDIAL ACTION IMPLEMENTED

7.1 MAP

Category 1 sites are those with remedial action implemented. Category 1 sites addressed in this *Five-Year Review Report* include individual IRP sites located in Zones 1, 2, 3, 4, 5, and 7. IRP site locations are illustrated in Figure 7.1-1.

7.2 DATA SUMMARY TABLE

Data summary tables have been included for each site category in this *Five-Year Review Report* to condense site information for easier reference. Table 7.2-1 summarizes information in this *Five-Year Review Report* for the sites included in Category 1. The columns in this table include the following information:

- Site I.D. – The IRP Zone and site identifier used in the first *Five-Year Review Report* (Bechtel, 1999).

- Sites Included – A listing of individual IRP sites included under the IRP Zone/site identifier in this *Five-Year Review Report*.

- Site Chronology – A chronological listing of major documents associated with remedial actions performed at the sites.

- Background – Description of site location and brief history of site activities that may have resulted in the release of hazardous substances to the environment.

- Remedial Actions – Description of cleanup actions performed at the site.

- Implementation of Recommendations from Last Five-Year Review – Summary of IRP actions performed during the reporting period (2004 – 2009).

- Remarks – Primary document(s) governing remedial actions at the site.

7.3 FIVE-YEAR REVIEW OF CATEGORY 1 SITES

Individual subsections are provided to document the Five-Year Review process for each of the sites included in Category 1. These subsections are organized by IRP Zone/site identifier used in the first *Five Year Review Report* (Bechtel, 1999), and include the following:

- Background information: site description, initial responses, and basis for taking action;
- Remedial/removal action description: regulatory actions, RAOs, remedy description, and remedy implementation;
- Implementation of recommendations from last five year review;
- Technical assessment: answers to Questions A, B, and C in the *Comprehensive Five-Year Review Guidance* (EPA, 2001);
- Issues;
- Recommendations and follow-up actions;
- Protectiveness statements; and
- References.

7.4 ZONE 1, LANDFILL 5

7.4.1 Background

7.4.1.1 Site Description

Landfill (LF) 5 is located in Zone 1, in the northeastern portion of the former Pease AFB, as shown on Figure 7.4-1. The original landfill consisted of approximately 23 acres; consolidation of wastes during remedial action resulted in a capped area of approximately 18.5 acres. As shown on Figure 7.4-2, LF-5 is bordered by Arboretum Drive on the north, the Railway Ditch paralleling an abandoned railway bed on the east, Flagstone Brook to the west, the Paint Can Disposal Area (PCDA – Site 44) on the south, and the Bulk Fuels Storage Area (BFSA - Site 13) to the southeast.

LF-5 reportedly was used between 1964 and 1975 as the primary base landfill, although some disposal occurred as late as 1979. Most of the material placed in the landfill consisted of municipal-type solid wastes generated from on-base housing, barracks, offices, dining facilities, etc. Industrial wastes were also reported to be disposed of in the landfill, including an unspecified quantity of waste oils, solvents, paints, paint strippers and thinners, pesticide containers, empty cans and drums, and sludge from the industrial waste treatment and base wastewater treatment facilities. Landfill operations reportedly included trench and fill methods involving excavation of overburden soils such that wastes were buried in direct contact with the underlying bedrock (Bechtel, 1999).

Before landfill closure, LF-5 sloped generally northward from a high of approximately 100-feet (ft) mean sea level (MSL) in the south to approximately 60-ft MSL to the north, an average slope of 4%. Prior to capping, bedrock was exposed in the central portion of the landfill (Bechtel, 1999).

The overburden deposits across Zone 1 include younger sediments, such as marsh deposits, and older deposits, such as glacial-marine deposits. The unconsolidated stratigraphic units identified at Pease AFB are fill, Upper Sand (US), Marine Clay and Silt (MCS), Lower Sand (LS), and glacial till (GT). One or more of these units may be absent at any particular location. The Upper Sand ranges in thickness from approximately 0.6 to 10 ft across Zone 1. The Lower Sand unit is not prevalent in Zone 1 due to the limited presence of the MCS unit across Zone 1. Glacial till is discontinuous across Zone 1 and is not present over portions of LF-5.

The topography of the bedrock surface across Zone 1 is accentuated by several prominent highs and one prominent valley, with up to 75 ft of relief zone-wide. A relatively large, broad bedrock high extends from the BFSA north toward LF-5, with an outcrop forming a small circular knob in central LF-5. The bedrock consists of rocks of the Eliot Formation, which is generally composed of interbedded phyllite, metagraywacke, and quartzite.

7.4.1.2 Initial Response

A drum disposal area was identified in the southeastern portion of the landfill area during the Stage 2 field effort. As a result, a drum removal operation was implemented as an interim remedial measure. This operation resulted in the excavation of an area of approximately 1.1 acres, with more than 1,000 intact, crushed and partially crushed 55-gallon (gal) drums and 5-gal cans being removed. Additionally, seven tanks ranging in size from 250 to 5,000 gal were removed (Weston, 1992).

7.4.1.3 Basis for Taking Action

RI Reports for LF-5 and Zone 1 (Weston, 1992 and 1993b) were completed in April 1992 and October 1993, respectively. The presence of buried wastes and contamination in soil, groundwater, surface water, and sediment in the areas surrounding the landfill was documented in the *IRP Stage 3C Landfill 5 Remedial Investigation* (Weston, 1992). The information included in the LF-5 RI was confirmed in the Zone 1 RI (Bechtel, 1999).

The RI Reports identified the following:

- Three volatile organic compounds (VOCs) whose concentrations exceeded the maximum contaminant level (MCLs) were identified in the groundwater: tetrachloroethene, trichloroethene, and benzene. Additionally, concentrations of arsenic, beryllium, chromium, and nickel exceeded MCLs.

- The hydraulic gradients across LF-5 indicated that groundwater flows towards Flagstone Brook and the Railway Ditch. These drainageways also receive surface water from LF-5. VOCs were detected in surface water in Flagstone Brook and the Railway Ditch which are located west and east of Landfill 5 respectively (Note: Surface water and sediment associated with LF-5 are addressed under Section 8.6 of this *Five-Year Review Report.*)

- Pesticides were detected at low concentrations in soils across the landfill. Polynuclear aromatic hydrocarbons (PAHs) and metals were detected at elevated levels in soil from the drum removal area near the southeastern edge of the landfill and in soils from the northern trench area. PAHs and pesticides were detected in sediments in Flagstone Brook and the Railway Ditch. Elevated metals concentrations were detected in the Railway Ditch sediments.

7.4.2 Remedial/Removal Actions

The following subsections describe regulatory actions and remedial actions performed at LF-5.

7.4.2.1 Regulatory Actions

Controlling documents for ongoing remedial actions at LF-5 include the following:

Landfill 5 ROD (1993): The *Record of Decision for a Source Area Remedial Action at Landfill 5* (Weston, 1993a) outlined the selection of a source control remedy which included partial excavation and installation of a barrier cap.

Zone 1 ROD (1995): The Zone 1 RI/FS focused on a number of sites and contaminated media in the zone, including LF-2 and LF-4, the PCDA, and groundwater at LF-5. Evaluation of the risk assessment results and other data from the RI/FS resulted in the focusing of the Zone 1 response action on contaminated groundwater associated with LF-5. The *Record of Decision for a Remedial Action at Zone 1 (Zone 1 ROD)* (Weston, 1995) specified a *management of migration remedy* to address dissolved-phase contamination at LF-5, including contamination within the LF-5 boundary, which had migrated beyond its footprint.

7.4.2.2 Remedial Action Objectives

The following RAOs were identified in the *LF-5 ROD* (Weston, 1993a):

- Prevent or minimize risks to ecological receptors resulting from exposure to contaminated sediment in the Railway Ditch and associated wetlands or to contaminated soil and debris associated with LF-5;

- Prevent or minimize risks to humans resulting from exposure to contaminated soil or debris associated with LF-5; and

- Minimize further migration of contaminants from the LF-5 source area into the groundwater or surface water.

The RAOs identified in the *Zone 1 ROD* (Weston, 1995) include the following:

- Protect human receptors from exposure to contaminated groundwater that may present unacceptable health risks; and,

- Comply with chemical specific ARARs and/or attain background levels for specific contaminants in groundwater. Table 7.4-1 lists the LF-5 groundwater CGs.

7.4.2.3 Remedy Description

The *Landfill 5 ROD* (Weston, 1993a) specified a *source control remedy* having the following components:

- Excavating and consolidation/disposal of Railway Ditch sediments into LF-5 that contained contaminants at concentrations exceeding site-specific CGs;

- Excavating of soil and debris from LF-2 and LF-4 with consolidation/disposal into LF-5;

- Excavating of soil and landfill debris from LF-5 that would be in contact with groundwater (after placement of excavated material from other sites and capping); excavated areas would be backfilled with clean fill to a level 2 ft above water table (as measured after capping);

- Re-grading and capping of LF-5 with a composite barrier cap designed to meet RCRA Subtitle C cap performance standards; and,

- Conducting long-term monitoring (including 5-year reviews) and placement of institutional controls (deed restrictions) to restrict future activities on the capped area.

The *Zone 1 ROD* (Weston, 1995) specified a *management of migration remedy* to address dissolved-phase contamination at LF-5, including contamination within the LF-5 boundary, which had migrated beyond its footprint. Specific components of the action included:

- Natural attenuation and biodegradation of contaminated groundwater in Zone 1;

- Placement of deed restrictions on future use of groundwater in Zone 1 in the vicinity of the LF-5 source area;

- Establishment of a Groundwater Management Zone (GMZ) in Zone 1 in the vicinity of the LF-5 source area; and,

- Long-term environmental monitoring in the zone to allow the continued evaluation of the magnitude of contamination including groundwater, surface water and sediment sampling and analysis.

7.4.2.4 Remedy Implementation

Excavation and relocation of landfill debris, soils, and sediments from LF-2, LF-4, and LF-5 and the adjacent Railway Ditch to LF-5 were performed between December 1993 and June 1995. Additionally, a lined sedimentation basin was constructed to receive groundwater, site runoff, and water pumped from the excavation. Relocated waste was consolidated above the predicted seasonal high groundwater level. An intermediate cap was constructed to cover debris as a precursor to Phase II cap construction (IT, 1995).

During the second phase of the LF-5 remedial action, additional debris and waste soils from LF-6, the UST Flightline area, Site 34, and Site 72 were consolidated into LF-5. Following consolidation, LF-5 was capped with a composite-barrier-type final cover system to minimize water infiltration and prevent contact between landfill debris and either human or ecological receptors. After completion of capping, piezometers, landfill gas monitoring probes and vents, and survey monuments were installed as specified in the design. This work was completed between May 1995 and July 1996 (Bechtel, 1996).

Inspections and long-term groundwater monitoring are ongoing components of the LF-5 remedy. In accordance with the current *Post Closure Maintenance and Monitoring Plan Revision 3* (PCMMP) (MWH, 2003), nine GMZ perimeter wells are sampled once per year in the spring and five interior GMZ boundary wells are sampled every other year in the spring. Other samples taken yearly in the spring include six surface water and three sediment samples from Flagstone Brook and the Railway Ditch. Surface water and sediment samples are further addressed in Section 8.6. Semiannual screening of twenty-five gas vents and probes at LF-5 with field instruments is performed in the summer and fall. Semiannual visual inspections of the landfill are performed concurrently with the spring sampling and also in the fall and include identification of any deficiencies with the cap, drainage systems, and sedimentation basin.

The most recent sampling data (2008) from LF-5 groundwater indicates that all site-specific contaminants of concern (COCs) are presently below their respective CGs in all monitored locations (URS, 2009).

Results from visual inspections indicate that the facility was both properly designed and constructed. All components of the closure action are functioning as intended. The site and surrounding areas have stabilized and vegetation is well established following the extensive earthwork associated with the closure.

Land Use Controls and Institutional Controls (LUC/ICs) were specified in the *Landfill 5 ROD* (Weston, 1993a) and *Zone 1 ROD* (Weston, 1995) and are in place for LF-5 in the form of restrictions in the deed executed between the Air Force and the current owner of the property (PDA). The deed implemented several LUC/IC measures. These include a GMZ prohibiting use of groundwater and a Use Restriction Zone (URZ) prohibiting residential use and establishment of childcare facilities, playgrounds, athletic fields, or elementary/secondary schools. The deed established the LF-5 GMZ and URZ as Areas of Special Notice (ASN) requiring concurrence from the Air Force for any development (i.e., digging, excavation, or construction) within the GMZ or URZ and specifically prohibits any activity that could disturb ongoing remedies or the integrity of the landfill cover system. The semiannual visual inspections performed as part of the long-term monitoring (LTM) at LF-5 also serve to verify that LUC/ICs have not been violated; inspection results are documented in the *Landfills and CRDs Annual Reports*. The ASN and PDA dig permit review processes, both requiring Air Force review and approval, also aid in LUC/IC enforcement. The ongoing use of the property conforms to the restrictions of the URZ and this use is not expected to change. A small portion of the LF-5 GMZ falls on NHANG property; the Air Force coordinates enforcement of LUC/ICs on this property with the NHANG environmental staff. The LUC/ICs remain protective; no deficiencies have been identified. No violations of the LUC/ICs have been identified.

7.4.3 Implementation of Recommendations from Last Five-Year Review

The second *Five-Year Review Report* (MWH, 2004) concluded that the remedy at LF-5 remained protective of human health and the environment. Recommendations in the *Five-Year Review Report* included continued annual evaluation of environmental monitoring data and assessment of opportunities to refine monitoring activities, and that the change in the federal and state MCL for arsenic should be noted in future long-term monitoring reports. Annual long-term monitoring has been performed since 2004, and the results of this monitoring are presented in the following documents:

- *Landfills and Construction Rubble Dumps 2004 Annual Report* (MWH, 2005),
- *Landfills and Construction Rubble Dumps (CRDs) 2005 Annual Report* (MWH, 2006),
- *Landfills and CRDs 2006 Annual Report* (URS, 2008a),
- *Landfills and CRDs 2007 Annual Report* (URS, 2008b), and
- *Landfills and CRDs 2008 Annual Report* (URS, 2009).

Based on remedy performance, long-term monitoring was not adjusted during this Five-Year Review period.

7.4.4 Technical Assessment

The technical assessment component of the Five-Year Review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (EPA, 2001).

7.4.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

A review of documents, ARARs, risk assumptions, and the results of annual monitoring and inspections indicates that the remedy is functioning as intended. The excavation and capping have served to isolate landfill wastes and reduce infiltration. The cover is maintained and is functioning as designed, based on groundwater elevations and decreasing trends in groundwater contaminant concentrations. The most recent sampling data from LF-5 groundwater monitoring wells indicate that all site-specific COCs are presently below their respective CGs in all monitored locations. There have been no exceedances of CGs at the GMZ boundary. The gas vents are functioning as designed to collect and discharge landfill gases and ambient air quality is not being adversely impacted by landfill gas discharge.

7.4.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: The *Landfill 5 ROD* identified CGs for soil that were used to guide excavation, consolidation, and capping of landfill wastes. These soil CGs do not govern post-closure care of the landfill. Groundwater CGs at LF-5 were identified in the *Zone 1 ROD* (Table 7.4-1) and were based on background (inorganics only), Federal Safe Drinking Water Act MCLs, New Hampshire Drinking Water Quality Standards (Env-Ws 316, 317, and 318), New Hampshire Ambient Groundwater Quality Standards (NHAGQS in Env-Ws 410), and New Hampshire Department of Health and Human Services, Division of Public Health Services, Bureau of Health Risk Assessment (NHDPHS) drinking water standards. New Hampshire Drinking Water Quality Standards Env-Ws 316-318 have been superceded by Env-Ws 310-316 (effective November 30, 2005). Env-Ws 410 was superceded by Env-Wm 1403 (effective February 24, 1999) which was superceded by Env-Or 600 (effective February 1, 2007), which presents the current NHAGQS (NHDES, 2007). The LF-5 CGs are consistent with current standards, with the following exceptions:

Arsenic: On January 22, 2001, EPA adopted a new Federal MCL for arsenic (changed from 50 µg/L to 10 µg/L; effective February 22, 2002). Similarly, the New Hampshire MCL was reduced from 50 µg/L to 10 µg/L on February 8, 2002, which was incorporated into the revised NHAGQS (NHDES, 2007). However, definitions in Env-Or 602.07 and Env-Or 602.23 exempt naturally occurring substances at naturally occurring or background levels. Background concentrations of arsenic at the former Pease AFB have been documented as 23 µg/L (Weston, 1993c), which is greater than the arsenic NHAGQS value; therefore, the enforceable standard at Pease AFB is that of background.

1,1-Dichloroethane: The *Zone 1 ROD* indicates a risk-based CG of 8.1 µg/L for 1,1-dichloroethane. The current NHAGQS is 81 µg/L.

There have been no changes in groundwater standards that would affect the protectiveness of the remedy. Standards for surface water and sediment at Landfill 5 are discussed in Section 8.6.

Changes in Exposure Pathways: There have been no changes in physical conditions, exposure pathways, or land use that would affect the protectiveness of the remedy.

Since completion of the last Five Year Review, additional guidance, including NHDES' *Vapor Intrusion Guidance* (NHDES, 2006; revised 2007), have been developed to aid in evaluating the potential for human exposure from the vapor intrusion pathway. EPA has also recently updated generic risk screening levels presented in the *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway* *from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (EPA, 2002) for several compounds.

To address the issue of possible soil vapor intrusion pathways, a comparison of LF-5 groundwater data against EPA and NHDES screening levels will be forthcoming shortly and the results presented in a draft report for review by EPA and NHDES. There is no current vapor intrusion to indoor air pathway at LF-5 as there are no habitable structures nearby. The indoor air VI screening report will aid the Air Force, EPA, and NHDES in evaluating future ASN requests that include the construction of habitable structures within Pease GMZs/URZs.

Changes in Toxicity and Other Contaminant Characteristics: ARARs, risk-based concentrations (1,1-dichloroethane [DCA] only), and background values were used to establish groundwater CGs in Zone 1. An ARAR (NHAGQS) is now available for 1,1-DCA (81 µg/L). Therefore, changes in toxicity values or other contaminant characteristics do not affect the protectiveness of the remedy.

Changes in Risk Assessment Methods: The original human health risk assessments (HHRAs) were conducted following then current EPA and EPA Region 1 guidance. The health protectiveness of the original CGs would not be expected to change because the groundwater CGs were established primarily using ARARs and background values. Also, any risk-based CGs currently have ARARs available.

Risk assessments are performed somewhat differently now than they were at the time of the last Five-Year Review and especially since the time of the *LF-5* and *Zone 1 RODs*. Guidance documents/risk assessment tools that have been issued include:

- Background guidance (2002), which changed the way background comparisons are performed for metals.
- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.
- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.
- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.
- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.

- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

Expected Progress Toward Meeting RAOs: Implementation of the remedy at LF-5 is currently achieving the RAOs specified in the applicable RODs.

7.4.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

7.4.4.4 Technical Assessment Summary

As is described in Section 7.4.4.2 above, the remedy is functioning as intended at LF-5 to protect human health and the environment. While minor changes in ARARs have affected groundwater cleanup levels, these changes have not impacted the protectiveness of the remedy, based on site-specific groundwater monitoring data. No changes in exposure pathways are affecting the protectiveness of the remedy. The remedy is currently achieving RAOs. LUC/ICs are in place and performing as expected. No other information has come to light that would call into question the protectiveness of the remedy.

7.4.5 Issues

Issues identified for LF-5 include:

- Decrease in Arsenic Federal and State MCL from 50 µg/L to 10 µg/L.

- Availability of an ARAR (NHAGQS) for 1,1-dichloroethane, which had a risk-based CG in the 1995 *Zone 1 ROD*.

These issues do not impact the protectiveness of the groundwater remedy at LF-5. Current arsenic concentrations are less than 23 µg/L, which represents the maximum background value for the former

Pease AFB (Weston, 1993c). The *Zone 1 ROD* risk-based CG for 1,1-dichloroethane was more stringent than the current NHAGQS.

7.4.6 Recommendations and Follow-up Actions

Remedial measures at LF-5 remain protective of human health and the environment. Annual evaluation of environmental monitoring results should continue, with data analysis including identification of opportunities to streamline monitoring and reporting. The change in the Federal and State MCL for arsenic and the availability of an ARAR (NHAGQS) for 1,1-dichloroethane should be noted in future long-term monitoring reports.

7.4.7 Protectiveness Statement

Because of the relocation of the landfill debris above the seasonally high groundwater elevation, the installation of the composite barrier cap, the establishment/maintenance of the GMZ and other ICs, attainment of groundwater cleanup goals, and routine maintenance and monitoring, the remedial action is protective of human health and the environment.

7.4.8 References

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7.5 ZONE 2

7.5.1 Background

7.5.1.1 Site Description

Zone 2 is located in the northwestern portion of the former Pease AFB, as shown in Figure 7.5-1. Zone 2 contains six sites investigated under the Air Force's IRP. The sites include: Site 1 (LF-1), Site 7 (Fire Department Training Area 1 or FDTA-1), Site 10 (Leaded Fuel Tank Sludge Area or LFTS), Site 22 (Burn Area 1 or BA-1), Site 37 (Burn Area 2 or BA-2), and Site 43 (McIntyre Road Drum Disposal Area or MRDDA). Figure 7.5-2 illustrates the location of each site in Zone 2.

The *Zone 2 Record of Decision* (Weston, 1995) specified no further action (NFA) for LF-1 under CERCLA. Therefore, LF-1 is not addressed further in this review document. The Zone 2 Zone-Wide LTM Unit addresses long-term monitoring associated with Site 22, Site 37, Site 10, and Site 43. A description of each site is provided below.

Site 10

Site 10 consists of two separate areas on the eastern and western sides of Nottingham Road, both within approximately 300 ft of Site 22. From the late 1950s to 1978, Site 10 was used for disposal of sludge obtained from leaded aviation gasoline tank cleaning operations conducted at the on-base BFSA. An estimated 350 gal of sludge containing water, rust, residual fuels, fuel sludge, and residue from sand blasting tank interiors was generated during the approximately 20-year disposal period. Historic aerial photographs indicated that drum disposal may have also occurred at Site 10 to the south-southeast of the current site boundaries (MWH, 2004a).

Site 22

Site 22 is located in the central portion of Zone 2 and is the main source of contamination in Zone 2. Site 22 has been reported to have been used as a fire training area and a site for burning spent fuel and solvents between 1954 and 1976. The primary contaminant source was found to consist of two circular areas characterized by blackened or stained surface soil with little or no vegetation. Relatively flat, this site has no obvious surface drainageways, so precipitation rapidly infiltrates the sandy subsoils (MWH, 2004a).

Site 37

Site 37 is located southwest of Site 10, adjacent to the eastern side of McIntyre Road. Site 37 covers approximately 3.4 wooded acres surrounding roughly circular areas characterized by blackened surface soil with little or no vegetation. Site 37 is a suspected former fire training area or waste solvent BA. Although the exact period of use is not certain, based on aerial photographs it is estimated that fire training or waste solvent burn activities commenced between 1954 and 1960 and ended before 1976 (MWH, 2004a).

Site 43

Site 43, the MRDDA, is located west of McIntyre Road and south of Nottingham Road in Zone 2. It is generally open, with a thick growth of low brush and small trees covering the northern quarter of the site. Elsewhere the ground surface is generally devoid of topsoil and is covered with sand and gravel. The area is generally flat along the side bordering McIntyre Road; however, the southwestern edge has a steep embankment with a topographic relief of approximately 30 feet. Little information is available concerning the history and use of MRDDA, although the area shows signs of past earthmoving activities. An elongated ridge approximately four feet high and approximately 50 feet by 425 feet in size was parallel to McIntyre Road. A cluster of 55-gal drums and 5-gal cans was partially exposed at the surface of the ridge; consequently, the ridge and adjacent areas were suspected to be locations of historic subsurface disposal. Investigation did not find evidence of subsurface disposal, and it was concluded that the MRDDA was not a contaminant source area (Bechtel, 1999a).

The native overburden deposits in Zone 2 consist of the US, which is underlain successively by the MCS, LS, and GT. Fill material overlies the US at some locations, primarily at LF-1, Site 43, and areas of the zone bordering the runway. One or more of these units may be absent at any particular location. The thickness of the overburden is thin to absent to the west and southwest of Site 43 and the maximum overburden thickness is along the eastern border of the zone, where the bedrock surface drops sharply (MWH, 2004a).

The bedrock in Zone 2 consists primarily of the Eliot Formation, composed of phyllite, metagraywacke, and quartzite. In general, bedding strikes northeast with steep dips to the northwest. Open fractures are abundant in shallow bedrock and open fracture densities decrease significantly in deeper bedrock (MWH, 2004a).

Groundwater occurs in both overburden and bedrock underlying Zone 2. The major water-bearing units are the US, LS, and bedrock. The water table is typically present in the US unit during periods of high water levels (spring) and the LS and MCS units during periods of low water levels (fall/winter). The MCS unit appears to be a confining layer in some areas but is absent in other areas. The relatively flat topographic high in the central portion of Zone 2, typically coarse and permeable surface soil, and the lack of surface drainage features indicate that some groundwater recharge does occur across the site. To the north and west of the topographic high, the ground surface slopes toward the Peverly Ponds. Much of the low-lying portion of Zone 2 consists of ponds and wetlands, which are points of groundwater discharge (MWH, 2004a).

7.5.1.2 Initial Response

No remedial action was performed within Zone 2 prior to the finalization of the *Zone 2 ROD* (Weston, 1995).

7.5.1.3 Basis for Taking Action

Sites in Zone 2 were investigated during multiple investigations under the IRP (Stages 1, 2, and 4) between 1984 and 1993 (Weston, 1995). Aromatic hydrocarbons in the form of benzene, toluene, ethylbenzene, and xylenes (BTEX) were found to be the primary COCs in the overburden groundwater, while benzene was the primary COC in bedrock groundwater. Other organic contaminants, including ethylene dibromide, naphthalene, 1,2,4-trimethylbenzene (1,2,4-TMB), and trichloroethene (TCE), were detected at scattered locations across Zone 2 at concentrations exceeding NHAGQS. These contaminants appear to be more prevalent near known source areas; however, these source areas do not appear to have generated any spatially significant dissolved-phase plumes. Other organics, including halogenated hydrocarbons and PAHs, were detected at concentrations below the NHAGQS. Low concentrations of metals (arsenic, manganese, and lead) have also been detected with isolated exceedances of the NHAGQS.

The source areas of concern within Zone 2 consist of contaminated soils at Sites 22, 37, and 10. While the soil in the unsaturated zone at these locations contained only negligible levels of contamination, the saturated soils in these areas were found to have relatively significant amounts of residual contamination. The COCs include BTEX and total petroleum hydrocarbons (TPHs). The highest levels of contamination typically occur at the US/MCS interface (Weston, 1995).

7.5.2 Remedial/Removal Actions

The following subsections describe regulatory actions and remedial actions at Zone 2.

7.5.2.1 Regulatory Actions

Zone 2 ROD (1995): The *Zone 2 Record of Decision* (Weston, 1995) documented the selection of a remedy that included soil vapor extraction/air sparging (SVE/AS) (Site 22 only), long-term monitoring, natural attenuation, and institutional controls.

7.5.2.2 Remedial Action Objectives

The baseline risk assessment completed as part of the RI process for Zone 2 identified adverse human health risks for future groundwater users in areas associated with the contaminant plumes at Sites 22, 10, and 37. Minimal ecological risks were identified for soils at LF-1 and BA-2 and surface water and sediment in the Peverly Brook drainage system.

The *Zone 2 ROD* identified RAOs that defined the scope and purpose of the cleanup action needed to mitigate the potential threats to human health and the environment identified in the Baseline Risk Assessment. The following site-specific RAOs were developed for Zone 2 (Bechtel, 1999a):

Soils

- Site 10 – No RAOs were established for soils because there were no exceedances;
- Site 22 – Remove light non-aqueous phase liquid (LNAPL) and residual product from Site 22 soil; and
- Site 37 – No RAOs were established for soil because the extent of contamination was limited.

Groundwater

- Protect human receptors from contaminated groundwater that may present an unacceptable health risk (total cancer risk greater than 10^{-4} to 10^{-6} or a hazard index of greater than 1);
- Comply with chemical-specific, regulatory-based remedial objectives (ROs);

- Prevent contaminated groundwater from affecting surface water quality;

- Protect against potential leaching of soil contaminants from Site 22 soils to groundwater at levels that could cause exceedances of groundwater ROs; and

- Surface water, sediment, and biota – Monitoring of surface water and sediment quality over time in Upper and Lower Peverly and Bass Ponds (Note: Surface water and sediment monitoring are addressed in Sections 8 and 9 of this *Five-Year Review Report*).

7.5.2.3 Remedy Description

The remedial alternative selected by the *Zone 2 ROD* (Weston, 1995) included the following:

- In situ SVE/AS treatment of BA-1 [Site 22] source area LNAPL and residual LNAPL (enhanced by injection of air below the water table into the MCS) and treatment of extracted soil vapor for removal of VOCs;

- Establishment of institutional controls restricting the future use of Zone 2 groundwater, including a GMZ and performance of long-term GMZ monitoring;

- Natural attenuation (which may include natural biodegradation) of residual groundwater contamination after excavation, AS, and SVE; and

- Monitoring of surface water, sediment and fish tissue.

Cleanup goals for Zone 2 groundwater were specified in the *Zone 2 ROD* (Weston, 1995). These cleanup goals are listed in Table 7.5-1. No specific cleanup goals were established for soil.

7.5.2.4 Remedy Implementation

The Site 22 remedial system for source soils was constructed in late 1996 and early 1997 and began operation in May 1997. The system was divided into two areas: the primary area, that included the western portion of the site; and the expansion area, that included the eastern portion of the site. The original design called for treatment in the primary area only. Subsequent investigations indicated that soil remediation was necessary in additional areas and the system was expanded to meet this need. However, AS was limited in the expansion area and SVE was the primary form of treatment in the expansion area.

The in situ AS system consisted of 10 manifolds (S1 - S10) piped to a total of 70 vertical AS wells. Fifty-two AS wells were located in the primary area and 18 AS wells were located in the expansion area. The AS system also consisted of a blower assembly, heat exchanger, manifold, and ancillary items, including flow control valves, pressure, temperature, and flow indicators, and sample ports. The primary area and expansion area SVE systems consisted of the blower assembly, knockout tank, manifold, and ancillary items, including flow control valves, temperature, vacuum, and flow indicators, and sample ports. The primary area blower system was piped above grade to 7 SVE well manifolds (P1 - P7), which contained a total of 34 SVE wells. The expansion area blower system was piped above grade to 10 SVE well manifolds (E1 - E10) containing a total of 61 SVE wells.

In situ SVE/AS of the source area for removal of LNAPL and residual product from the soil and treatment of extracted soil vapor for removal of VOCs was the active remedy for Site 22 from May 1997 through 2000 (except for the winter months) and for portions of 2002.

It was successfully demonstrated to the EPA that the system was operating properly and successfully (OPS) in April 2000, allowing for the deed transfer of the property, which was undergoing long-term remedial action prior to all environmental cleanup objectives being accomplished.

EPA and NHDES concurred with the 2000 Zone 2 Annual Report proposal not to operate the SVE/AS system during 2001 while continuing to monitor groundwater quality to evaluate the effects of not operating the system. While the SVE/AS system was offline, the Air Force implemented soil confirmation sampling to assess the remaining amount of soil contamination that might continue to pose a threat to Zone 2 groundwater quality. Upon review of confirmation soil sampling data, the SVE/AS system was restarted on September 23, 2002 (select laterals only) to determine the viability of removing recalcitrant soil contaminants from portions of the site. The system was shut down on October 23, 2003 and was not restarted after that date.

LNAPL and residual product are no longer observed in Site 22 soils. No rebound of soil vapor concentrations has been observed in monitoring data collected since system shutdown. Organic constituent concentrations in groundwater have declined since the implementation of the SVE/AS system and will continue to decrease via natural attenuation processes. Concentrations of benzene in all Site 22 source area wells are now below the CG. Concentrations of more persistent compounds (naphthalenes and alkylbenzenes) are decreasing in the northeastern portion of the site and are expected to meet the

NHAGQS within a reasonable timeframe via natural attenuation. Site 22 is well within the Zone 2 GMZ and no risks to receptors are expected while natural attenuation processes work to achieve CGs.

The LTM groundwater sampling results, together with the 2005 SVE groundwater results and soil sampling results in 2002 and 2003, indicate that the SVE/AS system has clearly met its objectives for Site 22 soils and that natural attenuation is the appropriate technology for the downgradient plume. A Site 22 SVE/AS System Closeout Report was included in the *Zone 2 2006 Annual Report* (URS, 2008a); this Closeout Report is also included as Appendix B in this report. With regulatory agency approval, the SVE/AS system at Site 22 can be scheduled for decommissioning.

Long-term monitoring of the Zone 2 GMZ to assess the progress of natural attenuation is ongoing. The *Site 22 System Start-up and System Long-Term Monitoring Plan (LTMP)* was revised by the *Zone 2 LTMP, Revision 1* (Bechtel, 1999b), and then the *Zone 2 LTMP, Revision 2* (MWH, 2002). Each long-term monitoring plan revision reduced the number of monitoring points and list of analytes to be reported as well as the frequency of collection across the zone. The *Zone 2 LTMP, Revision 2* (MWH, 2002) requires that a total of 32 locations be sampled (Figure 7.5-3). Parameters to be monitored include Zone 2 COCs and intrinsic remediation parameters, as necessary. Additionally, the collection of water levels is also required on a semi-annual basis to assess groundwater elevations and flow directions. The 2008 contaminant concentrations detected in groundwater at concentrations above CGs are shown on Figure 7.5-4.

Among the Zone 2 GMZ boundary wells, the only detection to exceed CGs in 2008 was cadmium at an estimated concentration of 9.8 µg/L in point of compliance well 01-5106 [US] (CG is 5 µg/L); well 01-5106 is screened in the Upper Sand from 5.9 to 8.9 ft below ground surface (bgs) and monitors an extreme downgradient location. Cadmium concentrations in this well have exceeded the CG since 2005 (124 µg/L in 2005; 12.3 µg/L in 2006; and 89.7 µg/L in 2007). However, cadmium was only detected in well 01-5106 once (8 µg/L in 1994) during the previous 19 groundwater sampling events conducted between 1993 and 2004 (URS, 2009). Historically, cadmium has been detected at concentrations above the CG in the current Zone 2 LTM wells only twice (19 µg/L in well 01-530 [hybrid] in 1995; and 52 µg/L in well 10-7580 [US] in 1995). Cadmium has not been a widespread or significant contaminant in Zone 2 groundwater and the cause of the cadmium CG exceedances in well 01-5106 is unknown. Future groundwater sampling results should be assessed to evaluate cadmium concentration trends in well 01-5106.

The Site 10 benzene contaminant plume typically includes wells 10-5112 and 22-5062 and generally follows the north-northwestward groundwater flow at the site. In 2008, for the first time in its monitoring history, no organic COCs were detected at concentrations above their CGs in the sample from well 22-5062 (URS, 2009). Historical benzene, ethylbenzene, and naphthalene concentrations for well 22-5062 are depicted on Figure 7.5-5, clearly illustrating a gradual decrease in groundwater contaminant concentrations in the Site 10 midplume area monitored by this well. The 2008 LTM data for Site 10 showed benzene at concentrations above the NHAGQS only in well 10-5112. Historical benzene concentrations for wells 10-5112 and 10-5059, located upgradient of 10-5112, are depicted on Figure 7.5-6. Samples from well 10-5059 have shown decreasing benzene concentrations since 1997, with benzene concentrations being below CGs for ten consecutive years. Benzene concentrations in well 10-5112 had shown an increasing trend until late 2000, when they became relatively asymptotic. Because of the recalcitrant benzene concentrations at well 10-5112, it was agreed at the June 17, 2008 BRAC Cleanup Team (BCT) meeting to pilot test an in-situ submerged oxygen curtain (iSOC®) diffuser at this location. The iSOC® diffuser unit was installed in well 10-5112 on July 1, 2008; sampling of this well will resume in Fall 2009 to evaluate the impact of the iSOC® usage on the benzene concentrations in groundwater at this location.

Monitoring at Site 22 indicates the SVE/AS has been effective in remediating the soils within the Site 22 source area. In 2008, the only remaining wells at Site 22 that had contaminant concentrations greater than CGs are: source area wells 22-5107 [LS], 22-7433 [US], and 22-7935 [US/LS]; and midplume well 22-5124 [LS] (Figure 7.5-4) (URS, 2009). VOCs and SVOCs concentrations detected in source area groundwater have generally decreased below CGs as a result of SVE/AS treatment and have not rebounded since SVE/AS system shutdown; the concentrations of some metals still exceed CGs. Figure 7.5-7 illustrates decreasing VOC concentrations at source area well 22-5107. Two wells, 22-545 [US] and 22-5124 [LS], monitor the midplume area (the area of residual naphthalenes and alkylbenzenes contamination) located in the northeast corner of Site 22 (Figure 7.5-3). The concentrations of residual naphthalene and alkylbenzene compounds in the midplume wells has been decreasing (see Figure 7.5-8), suggesting that natural attenuation is occurring and that no significant rebound effects have arisen from the shutdown of the SVE/AS system. No COCs were detected at concentrations above CGs in the 2008 upgradient (22-7731 [US]) or downgradient (43-5134 [Till]) groundwater samples (URS, 2009).

VOC groundwater contamination at Site 37 is isolated, being observed only at source area well 37-5125 (Figure 7.5-4). In 2008, 1,2,4-TMB was detected in well 37-5125 at a concentration of 29 µg/L, which exceeds the ROD CG (19.8 µg/L), but is well below the current NHAQGS value (330 µg/L). Well 37-

5125 has shown a decreasing 1,2,4-TMB concentration trend since monitoring began and clearly documents the success of natural attenuation at this site (Figure 7.5-9).

In 2008 at Site 43, benzene in monitoring well 43-6114 (10 µg/L) was the only COC detected at a concentration above CGs (5 µg/L) (URS, 2009). Benzene concentrations in well 43-6114 have shown a continual decreasing trend over the last nine sampling rounds (Figure 7.5-10).

LUC/ICs were specified in the *Zone 2 ROD* (Weston, 1995) and are in place in Zone 2 in the form of restrictions communicated in the deeds that were executed between the Air Force and the current property owners (PDA and the Town of Newington [McIntyre Road only]); LUC/ICs were also included in the transfer of Zone 2 property between the Air Force and DOI. The deeds implemented several LUC/IC measures including a GMZ prohibiting use of groundwater and a URZ prohibiting both residential use and establishment of childcare facilities, playgrounds, athletic fields, or elementary/secondary schools. The deeds established the Zone 2 GMZ and URZ as ASNs, requiring concurrence from the Air Force for any development (i.e., digging, excavation, or construction) within the GMZ or URZ and specifically prohibits any activity that could disturb ongoing remedies. Observations are made during the performance of LTM activities in Zone 2 to ensure that LUC/ICs have not been violated; these observations are documented in the *Zone 2 Annual Reports*. The ASN and PDA dig permit review processes, both requiring Air Force review and approval, also aid in LUC/IC enforcement. It should also be noted that access to Zone 2 is generally restricted (i.e., fences and locked gates) and redevelopment activities will not be permitted in the national wildlife refuge. The ongoing use of the property conforms to the restrictions of the URZ and property use is not expected to change. The LUC/ICs remain protective and no deficiencies have been identified.

7.5.3 Implementation of Recommendations From Previous Five-Year Review

The second *Five-Year Review Report* (MWH, 2004b) concluded that the remedies for Zone 2 and Site 22 remained protective of human health and the environment. The following recommendations were included in the second *Five-Year Review* (MWH, 2004b):

- Annual monitoring should continue along the established GMZ;

- Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess progress toward the Zone 2 RAOs and to identify opportunities to optimize remedial activities;

- The ARARs now available for isopropylbenzene, 2-methylnaphthalene, sec-butylbenzene, and 1,2,4trimethylbenzene should be noted in future long-term monitoring reports; and

- The Air Force, EPA, and NHDES should continue discussions relative to the effectiveness of the Site 22 soil remedy and determine a path forward during calendar year 2004.

Annual evaluation of system performance, progress toward cleanup goals, and optimization efforts were documented in the following:

- *Zone 2, Sites 22, 37, and 10 2004 Report* (MWH, 2005),

- *Zone 2, Sites 22, 37, and 10 2005 Report* (MWH, 2006),

- *Zone 2, Sites 22, 37, and 10 2006 Report* (URS, 2008a),

- *Zone 2, Sites 22, 37, and 10 2007 Report* (URS, 2008b), and

- *Zone 2, Sites 22, 37, and 10 2008 Report* (URS, 2009).

Optimization of long-term monitoring was not conducted during this Five-Year Review period.

7.5.4 Technical Assessment

The technical assessment component of the Five-Year Review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001).

7.5.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

A review of documents, ARARs, risk assumptions, and the results of annual system and groundwater monitoring indicates that the remedy is functioning as intended, as described below.

- LNAPL and residual product are no longer observed in Site 22 soils.

- LUC/ICs are in place, remain protective, and are functioning as intended.

- Natural attenuation of contamination in overburden and bedrock groundwater is occurring and progress is being monitored.

- Monitoring of surface water and sediment quality over time is being performed in Upper and Lower Peverly and Bass ponds (Note: Surface water and sediment monitoring are addressed in Sections 8 and 9 of this *Five-Year Review Report*).

7.5.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: Groundwater CGs in the *Zone 2 ROD* were based on ARARs, except where ARARs were not available. ARARs included Federal Safe Drinking Water Act MCLs and the NHAGQS (Env-Ws 410). Of the sixteen constituents for which CGs were established, ARARs were used for benzene, bis(2ethylhexyl) phthalate, 1,2-dibromoethane, ethylbenzene, methyl isobutyl ketone, naphthalene, toluene, trichloroethene, arsenic, cadmium, and lead. Risk-based CGs were established for isopropylbenzene, 2-methylnaphthalene, sec-butylbenzene, and 1,2,4-trimethylbenzene and background conditions were used to establish the CG for manganese.

As noted previously (Section 7.4.4.2), there have been updates to the ARARs used to derive the CGs in the *Zone 2 ROD*, but the *Zone 2 ROD* CGs based on ARARs are still consistent with current standards, with the exception of methyl isobutyl ketone (CG of 350 µg/L; current NHAGQS is 2000 µg/L).

NHAGQS (NHDES, 2007) have been established for constituents in the *Zone 2 ROD* that had risk-based CGs: isopropylbenzene, 2-methylnaphthalene, sec-butylbenzene, and 1,2,4-trimethylbenzene. The current NHAGQS (800 µg/L, 280 µg/L, 260 µg/L and 330 µg/L, respectively) are significantly higher than the risk-based CGs included in the *Zone 2 ROD* (see following table).

Constituent	ROD Risk-Based Cleanup Goal (µg/L)	Current NHAGQS (µg/L)
isopropylbenzene	88.1	800
2-methylnaphthalene	13.4	280
sec-butylbenzene	7.3	260
1,2,4-trimethylbenzene	19.8	330

Current groundwater concentrations throughout Zone 2 meet the new ARARs for isopropylbenzene, 2-methylnaphthalene, and sec-butylbenzene.

On January 22, 2001, EPA adopted a new Federal MCL for arsenic (changed from 50 µg/L to 10 µg/L). Similarly, the New Hampshire MCL was reduced from 50 µg/L to 10 µg/L on February 8, 2002, which was incorporated into the revised NHAGQS (NHDES, 2007). However, definitions in Env-Or 602.07 and Env-Or 602.23 exempt naturally occurring substances at naturally occurring or background levels. Background concentrations of arsenic at the former Pease AFB have been documented as 23 µg/L (Weston, 1993), which is greater than the arsenic NHAGQS value; therefore, the enforceable standard at Pease AFB is that of background.

There have been no changes in standards that would affect the protectiveness of the remedy.

<u>Changes in Exposure Pathways:</u> There have been no changes in physical conditions, exposure pathways, or land use that would affect the protectiveness of the remedy.

Since completion of the last Five Year Review, additional guidance, including NHDES' *Vapor Intrusion Guidance* (NHDES, 2006; revised 2007), have been developed to aid in evaluating the potential for human exposure from the vapor intrusion pathway. EPA has also recently updated generic risk screening levels presented in the *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (EPA, 2002) for several compounds.

To address the issue of possible soil vapor intrusion pathways, a comparison of Zone 2 groundwater data against EPA and NHDES screening levels will be forthcoming shortly and the results presented in a draft report for review by EPA and NHDES. There is no current vapor intrusion to indoor air pathway at Zone

2 as there are no habitable structures nearby. The indoor air VI screening report will aid the Air Force, EPA, and NHDES in evaluating future ASN requests that include the construction of habitable structures within Pease GMZs/URZs.

Changes in Toxicity and Other Contaminant Characteristics: Groundwater COCs with risk-based CGs in the *Zone 2 ROD* included 1,2,4-trimethylbenzene, 2-methylnaphthalene, sec-butylbenzene, and isopropylbenzene. As was stated previously, updated ARARs based on current toxicity information (NHAGQS) are now available for each of these constituents. The *Zone 2 ROD* risk-based CGs were much more stringent than the current NHAGQS.

Changes in Risk Assessment Methods: The original HHRA was conducted following then current EPA and EPA Region 1 guidance. The health protectiveness of the original CGs would not be expected to change because the groundwater CGs were established primarily using ARARs and background values. Also, any risk-based CGs currently have ARARs available.

Risk assessments are performed somewhat differently now than they were at the time of the last Five-Year Review and especially since the time of the *Zone 2 ROD*. Guidance documents/risk assessment tools that have been issued include:

- Background guidance (2002), which changed the way background comparisons are performed for metals.
- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.
- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.
- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.
- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.
- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

Expected Progress Toward Meeting RAOs: LNAPL and residual product are no longer observed in Zone 2 soils. By establishing and maintaining the GMZ, the remedy provides protection to human receptors from contaminated groundwater that may present an unacceptable health risk (total cancer risk greater than 10^{-4} to 10^{-6} or a hazard index of greater than 1). Additionally, concentrations of organic constituents in groundwater will continue to decrease via natural attenuation processes.

In May of 2005, groundwater samples were collected and analyzed from 15 SVE extraction wells within the footprint of the Site 22 soil treatment zone to evaluate if residual soil contamination was having a significant effect on groundwater quality. Only 2 of the 15 locations had cleanup goal exceedences: one for naphthalene at 32 µg/L (NHAGQS of 20 µg/L); and another for naphthalene at 140 µg/L and ethylbenzene at 720 µg/L (NHAGQS of 700 µg/L). Based on these data, soil sampling results in 2002 and 2003, and results from ongoing LTM efforts, the soils at Site 22 no longer appeared to pose a significant threat to groundwater quality and that natural attenuation is expected to achieve groundwater cleanup goals for Site 22.

7.5.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

7.5.4.4 Technical Assessment Summary

The remedy at Zone 2 is functioning as intended. LNAPL and residual product are no longer observed in Zone 2 soils. Both inorganic and organic constituents in groundwater have declined since the implementation of the remedy across Zone 2 and concentrations of organic constituents will continue to decrease via natural attenuation processes. Concentrations of isopropylbenzene, 2-methylnaphthalene, and sec-butylbenzene throughout Zone 2 currently achieve ARARs now available for these constituents. Concentrations of 1,2,4-trimethylbenzene will achieve the current ARAR (330 µg/L) more quickly than the risk-based CG included in the 1995 ROD (19.8 µg/L). The progress of natural attenuation toward achievement of groundwater ROs will continue to be assessed. Potential exposure pathways at the site have not changed. The remedy remains protective because the ICs, including a GMZ, are in place and maintained to prevent groundwater exposures.

7.5.5 Issues

Issues identified for Zone 2 include:

- Decrease in Arsenic Federal and State MCL from 50 µg/L to 10 µg/L.

- Availability of ARARs (NHAGQS) for groundwater COCs having risk-based CGs in the *Zone 2 ROD* (Weston, 1995).

These issues do not impact the future protectiveness of the groundwater remedy across Zone 2. The *Zone 2 ROD* risk-based CGs were much more stringent than the current NHAGQS. Current arsenic concentrations at the Zone 2 GMZ boundary are less than 23 µg/L, which represents the maximum background value for the former Pease AFB, with the exception of location 22-7771. Arsenic has historically been detected above the background value of 23 µg/L at this location. However, 22-7771 is a boundary point for the Zone 2 GMZ as well as the adjacent Landfill 1 GMZ and lies within the Landfill 1 and Zone 2 Land Use Restriction Zones. Consequently, the area where 22-7771 is located is completely contained within the boundaries of LUC/ICs implemented and monitored for Zone 2.

7.5.6 Recommendations and Follow-up Actions

Routine long-term monitoring should continue throughout Zone 2. Annual monitoring should continue along the established GMZ. Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess progress toward the Zone 2 RAOs, and to identify opportunities to optimize remedial activities. The change in the Federal and State MCL for arsenic and the availability of ARARs (NHAGQS) for groundwater COCs having risk-based standards should be noted in future long-term monitoring reports.

7.5.7 Protectiveness Statement

The remedy at Zone 2 remains protective. LNAPL and residual product are no longer observed in Zone 2 soils. Concentrations of organic and inorganic COCs in groundwater have steadily declined across the zone. The remedy is protective of human health and the environment and exposure pathways that could result in unacceptable risks are being controlled by the established GMZ and LUC/ICs.

7.5.8 References

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7.6 ZONE 3, SITE 32/36

7.6.1 Background

Zone 3 is located in the central portion of the former Pease AFB and occupies approximately 440 acres (see Figure 7.6-1). The zone contains numerous buildings with adjacent paved parking areas, a network of roads, and the flightline area. A large section of Zone 3 covers the flightline area of the base, which includes portions of the runway, aircraft parking apron, and the grassy infield between the aircraft parking apron and the runway. The aircraft parking apron is a major feature of the base, covering nearly one third of the zone. Zone 3 encompasses seven individual IRP sites including Site 32 (Building 113), Site 33 (Building 229), Site 34 (Building 222), Site 35 (Building 226), Site 36 (Building 119), Site 38 (Building 120), and Site 39 (Building 227). The locations of these sites are shown on Figure 7.6-2. Sites 32 and 36 are adjacent sites and are discussed in the following sub sections. Zone 3 Sites 34 and 39 are discussed in Section 7.7 of this review document (Sites 33, 35, and 38 are also discussed in that section).

Three UST sites (Sites 72, 76, and 81) and one IRP site (Site 73) are also located in Zone 3, but these sites have separate reporting requirements and are addressed in other documentation (Sites 72, 76, and 81) or other sections of this review document (Site 73 is discussed in Section 7.11). In addition, Site 49 (located outside of the Zone 3 boundary) was included in the *Zone 3 Record of Decision Amendment* (MWH, 2003) to formally document the response action implemented at that site; Site 49 is discussed in Section 7.12.

7.6.1.1 Site Description

Sites 32 and 36 encompass Buildings 113 (Site 32) and 119 (Site 36) in the center of the base in the area known as the Industrial Shop/Parking Area (see Figure 7.6-2). Much of the sites is paved or covered by buildings. Newfields Ditch, a stormwater drainage swale, passes between Buildings 113 and 119. The ditch drains toward the northeast and eventually discharges into Hodgsons Brook. A summary of groundwater contamination remaining at concentrations above cleanup goals at each of the sites in 2008, as well as the remainder of Zone 3, can be found on Figure 7.6-3. Figure 7.6-4 presents a flow diagram for the Site 32 groundwater extraction and treatment system process.

Site 32

Building 113 (Site 32) was used between 1955 and 1991 primarily for aircraft munitions systems and avionics maintenance, including some vapor degreasing operations. A 1,200-gal concrete UST was located near the northeastern corner of Building 113. The UST received waste TCE from degreasing operations conducted inside Building 113 from 1956 to 1968. Sometime after 1977, use of the UST was discontinued and it was filled with sand. In 1988, the UST was excavated and removed and an underground overflow discharge pipe associated with the UST was discovered. The soil and groundwater contamination at this site is believed to be primarily a result of the historic use of the TCE tank and associated overflow pipe.

Site 36

Jet engine and engine accessory maintenance was performed in Building 119 (Site 36) between 1956 and 1990. Prior to 1971, waste generated in the building, including fuel and TCE, was disposed of at a fire training area (Site 8). From 1971 to 1990, these wastes were either drummed and stored in a designated drum storage area on-site for contractor removal or were piped to Building 226 (Site 35, industrial waste treatment plant) for treatment. During the early stages of investigations at Building 119, soil surrounding the drum storage area and oil rack behind the building was observed to be visibly stained, apparently from former waste spills. An underground sewer line located along Dover Avenue transported wastes from Building 119 to Building 226 (Site 35; Building 226 was removed in 1992/1993). A break in the line between the two buildings may have resulted in a release of contaminants.

Zone Wide Geological, Hydrogeological and Groundwater Flow Descriptions

The shallow subsurface beneath Zone 3 generally consists of five stratigraphic units. Unconsolidated strata include the US, MCS, LS, and GT. The bedrock underlying these units is either the Kittery or Eliot Formation, depending on the specific Site location within Zone 3. The thickness of the overlying unconsolidated units varies across the site. In addition, the elevation of the bedrock surface is highly variable, likely a result of the region's glacial history.

Regional groundwater flow is to the south-southeast within Zone 3 under static conditions (i.e., when the Haven Well is not being used). Depending upon the season, localized flow vectors may also exist at each of the Sites. A more detailed description of the geologic, hydrogeologic, and hydrologic characteristics of Zone 3 can be found within the *ROD for Zone 3* (Weston, 1995a).

Groundwater contaminant plumes extending beyond the identified source areas have been delineated at IRP Sites 32 and 36. The identified contaminant plumes are primarily halogenated hydrocarbons (HHCs) with the most extensive groundwater contaminant plume originating from IRP Site 32 (see Figure 7.6-3). The current nature and extent of groundwater contamination at each of the sites within Zone 3 is discussed in the *Zone 3 2008 Annual Report* (URS, 2009).

7.6.1.2 Initial Response

As part of the Stage IIIB field investigations in 1990 at Sites 32 and 36, the overflow pipe and contaminated soil near the waste TCE UST were excavated. Approximately 315 cubic yards (yd^3) of contaminated soil were removed along with the UST overflow pipe. In addition to the remedial excavation, a pilot groundwater extraction and treatment system was constructed to recover and treat contaminated groundwater from the lower sand.

7.6.1.3 Basis for Taking Action

Remedial Investigation (1983 -1993): In 1983, an IRP Phase I Problem Identification/Records Search was conducted at Pease AFB. The study identified Sites 32 and 36 as potential sources for the release of TCE into the environment. Subsequently, a remedial investigation was conducted at Sites 32 and 36 in three stages from 1983 through 1993.

The pilot groundwater extraction/treatment system was modified to extract groundwater from shallow fractured bedrock to provide some control of the migration of contaminated groundwater at Site 32 (Weston, 1995b). This pilot plant operated from March 1991 through June 1995.

It was concluded that complete groundwater restoration to ARARs at Site 32, in a reasonable timeframe, was not feasible under any remedial scenario (Weston, 1995b). A Technical Impracticability (TI) evaluation recommended containment of the Site 32/36 source area to prevent continued migration of contaminated groundwater.

7.6.2 Remedial/Removal Actions

7.6.2.1 Regulatory Actions

The controlling documents that present the selected remedy include:

Record of Decision for Site 32/36 (Site 32/36 ROD) (1995): The Air Force's preferred alternative for remediation as stated in the *Site 32/36 ROD* (Weston, 1995b) involved containment of the source area both physically and hydraulically.

Record of Decision for Zone 3 (Zone 3 ROD) (1995): The Air Force's preferred alternative for remediation as stated in the *Zone 3 ROD* (Weston 1995a) involved the excavation of contaminated soils and sediments, extraction of contaminated groundwater at selected source areas, and natural attenuation of dissolved-phase contaminated plumes including the plume downgradient of the Site 32/36 source area.

Zone 3 ROD Amendment (2003): The *Zone 3 ROD Amendment* (MWH, 2003) presented a modified Zone 3 cleanup approach to improve the long-term effectiveness of the remedy and document cleanup actions for sites that were not addressed in the 1995 *Zone 3 ROD*.

7.6.2.2 Remedial Action Objectives

Site 32/36 ROD

The results of the human health and ERAs revealed that contaminants in the Site 32/36 source area soil did not pose unacceptable risks to human or ecological receptors under current or future exposure pathways selected for the site, except for lead and copper at the former drum storage area at Site 36, which contributed 90% of the total hazard indices that exceeded benchmark values. Due to the limited area that could provide habitat for ecological receptors and other uncertainties associated with the ERA, RAOs for ecological risk were not developed. Because some of the contaminants in Site 32/36 source area soil could leach to groundwater at concentrations that could present an unacceptable human health risk, the following source control RAO was developed:

- To reduce the migration of contaminants from Site 32/36 source area soil and groundwater such that groundwater outside the TI Zone will attain all chemical-specific groundwater standards within the 30-year reasonable timeframe for groundwater restoration (Weston, 1995b).

RAOs addressing contaminants that had migrated to surface water and sediment from the Site 32/36 source area and dissolved phase contaminants in groundwater beyond the boundary of the TI Zone were addressed in the *Zone 3 FS* (Weston, 1993a) and *Zone 3 ROD* (Weston, 1995a).

Zone 3 ROD

The remedy selected in the 1995 *Zone 3 ROD* was developed to satisfy the following RAOs applicable to the dissolved-phase portion of Site 32/36 overburden and shallow bedrock groundwater:

- Protect human receptors from ingestion of, or direct contact with, contaminated groundwater that may present an unacceptable health risk;

- Comply with chemical-specific ARARs and/or established background levels for specific contaminants in groundwater, as appropriate;

- Prevent discharge of contaminated groundwater to surface water bodies where such discharges may cause unacceptable risks to human health and the environment; and

- Prevent contaminant migration toward the Haven Well.

Zone 3 ROD Amendment

The first three RAOs for overburden and bedrock groundwater were unchanged. The fourth RAO was revised to allow for increased demand for water from the Haven Well.

- Minimize contaminant migration toward the Haven Well should increased water demand require pumping the Haven well at the maximum safe yield.

Since Site 32/36 is located outside of the influence of the Haven Well, the amended remedial objective has a minimal impact on Site 32/36.

7.6.2.3 Remedy Description

Site 32/36 ROD

Specifically, the selected remedy for Site 32/36 included the following remedial action components:

- Containment of the source area or dense non-aqueous phase liquid (DNAPL) zone at Site 32 using a vertical barrier (installed in November 1996) and hydraulic control through ground water extraction and treatment (operational February 1997 and Ongoing).

- Excavation and off-site disposal of Site 36 VOC and metals contaminated soil [completed in 1996, (Bechtel, 1998)].

Subsurface discharge goals were established for groundwater extracted from within the Site 32 TI zone (i.e., the source area) in the *Sites 32/36 ROD* (Weston, 1995b) and are presented in Table 7.6-1.

Zone 3 ROD

CGs for the dissolved-phase groundwater plume downgradient of the Site 32 TI zone were developed in the original *Zone 3 ROD* (Weston, 1995a) and are presented in Table 7.6-2. A description of the remedy for portions of Site 32/36 and in areas adjacent to these sites follows below:

- Natural attenuation and biodegradation of the dissolved-phase contaminant plume emanating from the Site 32/36 source area outside the TI containment zone [Ongoing].

- Protect human receptors from exposure to contaminated groundwater by implementing institutional controls, such as establishing a Zone 3 GMZ [Ongoing].

- Long-term environmental performance monitoring in Zone 3, consisting of groundwater sampling (including water level measurement) and analysis for GMZ maintenance, groundwater extraction system performance monitoring, and process monitoring at groundwater treatment facilities [Ongoing].

Zone 3 ROD Amendment

As noted earlier, the *Zone 3 ROD* has been amended (MWH, 2003); the modified cleanup approach was designed to improve the long-term effectiveness of the remedy and document cleanup actions for sites that were not addressed in the 1995 *Zone 3 ROD* (Weston, 1995a). Major components of the modified remedy that affected Site 32/36 include:

- Modification of the Zone 3 long-term monitoring program to measure the performance of the selected remedy (MWH, 2004b), which includes monitoring of Haven sentry wells to ascertain if migration of potentially contaminated groundwater will impact the Haven Well.

- CGs for the dissolved-phase groundwater plume downgradient of the Site 32 TI zone were modified by the *Zone 3 ROD Amendment* (MWH, 2003) from those presented in the original

Zone 3 ROD (Weston, 1995a) and are presented as Table 7.6-3. These restoration goals (RGs) now govern the dissolved-phase plume emanating from both Sites 32 and 36.

7.6.2.4 Remedy Implementation

Soil and Sediment Remedial Action. The selected remedy specified the removal of contaminated soil from Site 36. A total of 1,403 tons of chlorobenzene contaminated soil was removed from Site 36 in 1996 (Bechtel, 1998).

Groundwater Remedial Action. The selected remedy for Site 32/36, as noted above, required containment of the Site 32 source area through installation of a physical barrier and hydraulic control through extraction and treatment of groundwater. Installation of the sheet piling was completed in November 1996 and pumping of groundwater at Site 32 commenced in February 1997. On-going operation of this containment system and long-term monitoring continue at Site 32. Long-term monitoring of the natural attenuation of site contaminants also continues at Site 36.

The layout of the Site 32 groundwater treatment plant (GWTP) is shown in Figure 7.6-4. Groundwater is extracted from the Site 32 source area from seven wells located to contain groundwater at the site. These seven wells include three LS wells and four shallow bedrock (SBR) wells. In addition to the seven extraction wells at Site 32, groundwater extracted by three US wells and one hybrid well in the Site 39 source area is also treated by the Site 32 GWTP.

Water pumped from the extraction wells is directed to an equalization tank. The water is then pumped from the equalization tank to three granular activated carbon (GAC) units operating in series (the multimedia filters are currently bypassed due to low suspended solids in the extracted groundwater). Following the GAC units, the flow is directed into an effluent tank prior to discharge from the plant.

Flow from the Site 32 treatment plant is directed to a 300-gal wet well near the Site 34 GWTP. Treated groundwater is pumped from the wet well across the flightline into a 250,000-gal holding tank. From the holding tank, the treated water is gravity fed to a groundwater recharge trench (Figure 7.6-4). The recharge trench consists of four 250 ft laterals of perforated poly-vinyl chloride (PVC) pipe installed in the overburden. The ability to discharge to the Pease wastewater treatment facility is available as a contingency. The treated groundwater is often utilized by the adjacent golf course during the spring, summer, and fall months.

Historically, groundwater extracted from Sites 32, 35, and 39 (from the upper sand only) has been treated by the Site 32 plant. However, as discussed in Section 7.7, groundwater is no longer extracted from Site 35. Groundwater currently extracted from the US, LS, and SBR units at Site 39 is treated by the Site 32 system.

Current Status of the Groundwater Remedial Action. The downgradient contaminant plume associated with Site 32/36 contains significantly higher concentrations of TCE and its degradation byproducts when compared with the rest of Zone 3. However, Site 32/36 contaminant trends have decreased and the extent of contamination at Zone 3 has decreased since the implementation of the remedy (URS, 2009).

Figure 7.6-5 presents historical analytical data from three wells in the Site 32 source area (32-5268 [LS], 32-6074 [SBR], and 32-6134[SBR]). Contaminant concentrations in all three wells have decreased since the implementation of the selected remedy and they still exhibit generally decreasing TCE concentration trends. Contaminant concentrations in the last several years have shown more variability than in previous years, especially at wells 32-5268 and 32-6134. TCE concentrations in all three locations are still above the RG.

Figure 7.6-6 presents analytical data for wells located between Sites 32 and 36 (32-570 [LS], 32-6029 [SBR], and 36-6075 [SBR]). Concentrations in all three wells have shown a steady downward trend since 2004. The 2007 and 2008 TCE concentrations in these wells were all below the RG.

Plots for wells downgradient of Site 32 (Figures 7.6-7, 7.6-8, and 7.6-9) also indicate that TCE concentrations decreased steadily after implementation of the remedy and concentrations have reached or are near asymptotic levels at several locations. For the past several years, the concentrations of TCE have decreased to values below the RG in locations downgradient of the source area (Figure 7.6-7). The detected TCE concentrations in monitoring wells 32-573 [LS], 32-6008 [SBR], and 32-632 [DBR], located approximately 425 ft downgradient of the source area, have below the RG since the year 2000 (see Figure 7.6-8). The detected TCE concentrations in monitoring wells 32-5032 [LS], 32-6033 [SBR], and 32-6031 [DBR], located approximately 850 feet downgradient of the Site 32 source area, have been at or below the RG since 1998 (see Figure 7.6-9). Since the downgradient dissolved plume emanating from the Site 32 TI area has steadily decreased, the distance from the TI area to the GMZ was also decreased in the spring of 2003 (MWH, 2004a). However, it should be noted that while TCE concentrations in many monitoring wells are below RGs, the concentrations of the TCE degradation byproducts cis-1,2-

dichloroethene (cis-1,2-DCE) and vinyl chloride (VC) may be above RGs in these same wells (Figure 7.6-3).

Evaluation of water level data indicates that the Site 32 extraction system is maintaining an inward gradient (hydraulic capture) inside the sheet piles (overburden and bedrock). Evaluation of system performance and LTM data show that since system startup in 1997 the downgradient dissolved-phase plume has decreased in its extent and the levels of TCE and cis-1,2-DCE have decreased to levels that are below RGs (wells 32-632 and 32-6008). The data indicate that the containment at Site 32 has been and continues to be effective and that natural attenuation has been effective in degrading the downgradient portion of the Site 32 plume.

LUC/ICs were specified in the *Zone 3 ROD* (Weston, 1995a) and are in place for are in place for Zone 3, including Site 32/36, in the form of restrictions in the deed. All Zone 3 property has been transferred by the Air Force to PDA via quitclaim deed. The LUC/ICs that have been implemented include a GMZ prohibiting use of groundwater and a URZ prohibiting both residential use and establishment of childcare facilities, playgrounds, athletic fields, or elementary/secondary schools. The Zone 3 GMZ and URZ are ASNs requiring concurrence from the Air Force for any development (i.e., digging, excavation, or construction) within the GMZ or URZ and specifically prohibits any activity that could disturb ongoing remedies. Observations are made during the performance of LTM activities in Zone 3 to ensure that LUC/ICs have not been violated; these observations are documented in the *Zone 3 Annual Reports*. The ASN and PDA dig permit review processes, both requiring Air Force review and approval, also aid in LUC/IC enforcement. The ongoing use of the property conforms with the restrictions of the URZ and land use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.6.3 Implementation of Recommendations from Last Five-Year Review

The second *Five-Year Review Report* (MWH, 2004c) concluded that the remedy at Site 32/36 remained protective of human health and the environment. The *Five-Year Review Report* (MWH, 2004c) also recommended the following:

- Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess performance of the Site 32 groundwater extraction system and progress toward RGs, and to identify opportunities to optimize remedial activities.

- System operation and monitoring at the Site 32 GWTP should also be assessed to identify opportunities to optimize extraction to reduce the time to achieving the RGs and increase the cost effectiveness of the operation of the system.

- The development of ARARs (NHAGQS) for several site COCs should be documented in future long-term monitoring reports.

- Discharge goals should be updated to match NHAGQS and the Pease background value for arsenic.

- Investigation of the possible soil vapor intrusion pathway should be undertaken when EPA guidance more applicable to commercial buildings is available.

Evaluation of system performance and optimization efforts was documented in the following:

- *Zone 3 2004 Annual Report* (MWH, 2005),

- *Zone 3 2005 Annual Report* (MWH, 2006),

- *Zone 3 2006 Annual Report* (URS, 2007),

- *Zone 3 2007 Annual Report* (URS, 2008), and

- *Zone 3 2008 Annual Report* (URS, 2009).

Long-term monitoring is described in the *Zone 3 Long-Term Monitoring Plan, Revision 2* (MWH, 2004b).

Source area containment, extracted groundwater treatment, and subsurface discharge have been successful for the Site 32 TI zone. In addition, the dissolved-phase downgradient plume emanating from both Sites 32 and 36 has decreased in magnitude and extent. These successes are documented in the reports noted above.

7.6.4 Technical Assessment

The following section discusses the effectiveness of the remedy and describes how the RAOs have been met.

7.6.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

Site 32 hydraulic containment has been effective at containing the source area within the TI zone and, coupled with natural attenuation downgradient, concentrations have significantly decreased since implementation of the groundwater extraction/treatment. Discharge goals have consistently been met by the treatment system.

7.6.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: The treatment goals (TGs) for extracted groundwater specified in the *Site 32/36 ROD* were based on a combination of ARARs (i.e., MCL values), to be considered (TBCs) criteria (i.e., NHDPHS values), and risk-based values, with a preference for ARARs. While the *Site 32/36 ROD* (Weston, 1995b) indicated a preference for ARARs when establishing TGs, many of the listed treatment goals were actually NHDPHS values, which are TBCs, not promulgated standards. Changes in ARARs for the COCs at Site 32/36 are summarized in the following table.

Constituent	Site 32/36 ROD - Treatment Goal for Discharge to Groundwater (µg/L) / Basis	ARAR Changes (µg/L) / Basis*
Chloromethane	3 / NHDPHS	30 / NHAGQS
Dichlorodifluoromethane	1,000 / NHDPHS	1,000 / NHAGQS
1,1-Dichloroethane	81 / NHDPHS	81 / NHAGQS
Isopropylbenzene	89.1 / Risk-based	280 / NHAGQS
Trichlorofluoromethane	2,000 / NHDPHS	2,000 / NHAGQS
1,2,4-Trimethylbenzene	70 / unknown	330 / NHAGQS
Acenaphthene	2,190 / Risk-based	420 / NHAGQS
Benzoic acid	28,000 / NHDPHS	28,000 / NHAGQS
Dimethylphthalate	313,000 / unknown	50,000 / NHAGQS
2,4-Dimethylphenol	730 / Risk-based	140 / NHAGQS
Di-n-butyl phthalate	3,650 / Risk-based	800 / NHAGQS
2-Methylnaphthalene	13.4 / Risk-based	280 / NHAGQS
4-Methylphenol	350 / NHDPHS	40 / NHAGQS
Naphthalene	20 / NHDPHS	20 / NHAGQS
Arsenic	50 / MCL	23** / NHAGQS
Boron	620 / NHDPHS	620 / NHAGQS
Nickel	100 / NHDPHS	100 / NHAGQS
Potassium	35,000 / NHDPHS	35,000 / NHAGQS

* - Source: NHAGQS from Env-Or 600 (NHDES, 2007)

** - A background value of 23 µg/L for arsenic has been established at the former Pease AFB.

In most cases, the NHDPHS values are the same as the current NHAGQS, as shown above. The current NHAGQS for the following organic compounds are lower than the ROD treatment goals: acenaphthene; dimethylphthalate; 2,4-dimethylphenol; di-n-butylphthalate; and 4-methylphenol. However, these organic compounds are no longer detected in the Site 32 GWTP influent samples and the treated effluent being discharged meets all current NHAGQS.

Zone 3 groundwater CGs, as specified in the *Zone 3 ROD* (Weston, 1995a), were generally based on ARARs or TBCs (i.e., MCLs or NHDPHS values); a few CGs were based on background concentrations (aluminum and manganese), an EPA lifetime health advisory value (vanadium), or were risk-based (2-methylnaphthalene, phenanthrene, sec-butylbenzene, and cadmium) (Table 7.6-2). The CGs for Zone 3 groundwater were updated and termed RGs (Table 7.6-3) in the *Zone 3 ROD Amendment* (MWH, 2003a). Some COCs from the *Zone 3 ROD* were omitted from the *Zone 3 ROD Amendment* RGs because cleanup levels had been attained throughout Zone 3. The *Zone 3 ROD Amendment* RGs were based primarily on

ARARs (MCLs or NHAGQS); however, two background concentrations (arsenic and manganese) and two risk-based concentrations (sec-butylbenzene and vanadium) were also used. The ARARs and background concentrations used to define the RGs stated in the *Zone 3 ROD Amendment* remain current. An ARAR is also now available for sec-butylbenzene (NHAGQS = 260 µg/L), which had a risk-based RG of 7.3 µg/L in the *Zone 3 ROD Amendment*.

There have been no changes in standards that would affect the protectiveness of the remedy.

<u>Changes in Exposure Pathways:</u> Since completion of the last Five Year Review, additional guidance, including NHDES' *Vapor Intrusion Guidance* (NHDES, 2006; revised 2007), have been developed to aid in evaluating the potential for human exposure from the vapor intrusion pathway. EPA has also recently updated generic risk screening levels presented in the *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (EPA, 2002) for several compounds.

To address the issue of possible soil vapor intrusion pathways, a comparison of Zone 3 groundwater data against EPA and NHDES screening levels will be forthcoming shortly and the results presented in a draft report for review by EPA and NHDES. The information provided in the report will be used to determine locations for air sample collection and will aid the Air Force, EPA, and NHDES in evaluating future ASN requests that include the construction of habitable structures within Pease GMZs/URZs.

<u>Changes in Toxicity and Other Contaminant Characteristics:</u> Risk-based groundwater RGs were included in the *Zone 3 ROD Amendment* for sec-butylbenzene and vanadium. As was stated above, an ARAR is now available for sec-butylbenzene. Groundwater contamination remains contained within the GMZ; therefore, changes in toxicity and other contaminant characteristics have not impacted the protectiveness of the remedy.

<u>Changes in Risk Assessment Methods:</u> The original HHRAs were conducted following then current EPA and EPA Region 1 guidance. The health protectiveness of the original TGs/CGs/RGs would not be expected to change because the groundwater TGs/CGs/RGs were established primarily using ARARs and background values. With the exception of vanadium, risk-based TGs/CGs/RGs currently have ARARs available.

Risk assessments are performed somewhat differently now than they were at the time of the last Five-Year Review and especially since the time of the various RODs. Guidance documents/risk assessment tools that have been issued include:

- Background guidance (2002), which changed the way background comparisons are performed for metals.
- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.
- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.
- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.
- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.
- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

Expected Progress Toward Meeting RAOs: The Site 32/36 remedy is achieving the stated RAO of source control. Reductions in groundwater COC concentrations outside the TI zone indicate that natural attenuation is reducing concentrations, indicating progress toward Zone 3 RGs.

7.6.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that would call into question the protectiveness of the remedy.

7.6.4.4 Technical Assessment Summary

The remedy at Site 32/36 is functioning as intended. Hydraulic control has successfully contained the source area within the TI zone meeting the RAO of source control. Concentrations of COCs have significantly decreased outside the TI zone since implementation of the groundwater extraction/treatment system and are progressing towards Zone 3 RGs. Additionally, discharge goals have consistently been met by the treatment system. While minor changes in ARARs have affected groundwater treatment goals, these changes have not impacted the protectiveness of the remedy. Examination of potential soil vapor intrusion pathways has begun and air sampling will likely be performed in late 2009. If soil vapor mitigation efforts are warranted, they should be implemented prior to the next Five-Year Review. The potential exposure pathways at Site 32/36 have not changed and LUC/ICs are in place and performing as expected. The remedy remains protective.

7.6.5 Issues

Issues identified for Zone 3, Site 32/36 include:

- ARARs are now available for numerous COCs assigned TGs that were risk-based or based on TBC values in the *Site 32/36 ROD*.

- An ARAR is also now available for sec-butylbenzene (NHAGQS = 260 µg/L), which had a risk-based RG of 7.3 µg/L in the *Zone 3 ROD Amendment*.

- The evaluation of soil vapor intrusion pathways needs to be completed.

7.6.6 Recommendations and Follow-up Actions

Routine long-term monitoring should continue throughout Zone 3. Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess performance of the Site 32 groundwater extraction system and progress toward RGs, and to identify opportunities to optimize remedial activities. System operation and monitoring at the Site 32 GWTP should also be assessed to identify opportunities to optimize extraction to reduce the time to achieving the RGs and increase the cost effectiveness of system operation. Discharge TGs for the the Site 32 GWTP should be updated to match NHAGQS and the Pease AFB background value for arsenic. The availability of ARARs (NHAGQS) for several site COCs should be documented in future long-term monitoring reports. Additionally, based on information provided in the forthcoming VI screening report, locations will be identified for air sampling to assess potential soil vapor intrusion pathways.

7.6.7 Protectiveness Statement

The combination of groundwater extraction and treatment, institutional controls, and long-term monitoring ensures that the remedy at Site 32/36 is protective of human health and the environment.

7.6.8 References

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7.7 ZONE 3, SITES 34/39

7.7.1 Background

Zone 3 is located in the central portion of the former Pease AFB and occupies approximately 440 acres (see Figure 7.6-1). The zone contains numerous buildings with adjacent paved parking areas, a network of roads, and the flightline area. A large section of Zone 3 covers the flightline area of the base, which includes portions of the runway, aircraft parking apron, and the grassy infield between the aircraft parking apron and the runway. The aircraft parking apron is a major feature of the base, covering nearly one third of the zone. Zone 3 encompasses eight individual IRP sites, including Site 32 (Building 113), Site 33 (Building 229), Site 34 (Building 222), Site 35 (Building 226), Site 36 (Building 119), Site 38 (Building 120), and Site 39 (Building 227). The locations of these sites are shown on Figure 7.6-2. Sites 32 and 36 were previously discussed in Section 7.6 of this *Five-Year Review*. Sites 34 and 39 (and Sites 33, 35, and 38) are discussed in the following sub sections.

Site 73 (Building 234), another IRP site located in Zone 3, is addressed in Section 7.11 of this document. In addition, Site 49 (Building 22), located outside of the zone boundary but included in *Zone 3 Record of Decision ROD Amendment* (MWH, 2003a), is addressed in Section 7.12 of this document. Other Zone 3 Sites not included in this section, such as the brooks and ditches that are associated with the zone, have been included in Section 8.0 and 9.0 of this *Five-Year Review*.

7.7.1.1 <u>Site Descriptions</u>

Site 33

Site 33 consists of the Aircraft Maintenance Squadron hangar (Building 229) (see Figure 7.6-2). Operations in the building included cleaning and repairing aircraft fuel systems and tanks. In 1964, an oil/water separator was installed to receive wastes from the building floor drains. Activities of concern at the site include the past use of TCE and a possible fuel/oil spill near the building. The principal area of concern is the former location of the oil/water separator and associated sump in the southwestern corner of the building; these items were removed in October 1991.

In May 1996, 235.27 tons of soil were excavated and removed west of Building 229. Additional information on the removal is included in the *Zone 3 Excavations Remedial Action Report* (Bechtel, 1998a). Since 1999, COC concentrations in groundwater have been below CGs at this site (URS, 2009).

Site 34

The Jet Engine Test Cell (JETC) was used to test the performance of jet engines over complete power ranges (see Figure 7.6-2). Liquid generated from activities at the JETC potentially contained PAHs, fuel, hydraulic fluid, and solvents. Before 1989, waste liquid from Building 222 drained directly to the Test Cell Ditch, which forms the uppermost section of Grafton Ditch. In 1989, the test cell bay effluent was discharged to an oil/water separator prior to its discharge to the Test Cell Ditch, while the effluent from the exhaust stack was discharged directly to the Test Cell Ditch. After modification of the test cell in December 1989, only the effluent from the wash-down of the intake stack and the building storm water drains discharged to the Test Cell Ditch. The rest of the effluent was containerized for disposal. Other sources of contamination at Site 34 are the former locations of the 5,000 gal UST that was used to store jet fuel, the oil/water separator, and two No. 2 heating fuel USTs. Since 2005, COC concentrations in groundwater have been below CGs at this site (URS, 2009).

Site 35

Building 226, referred to as the Industrial Wastewater Treatment Plant, was built in 1956 to house a dissolved air flotation water treatment system (see Figure 7.6-2). The system operated from 1956 to 1975, processing aircraft wash water and wastewater from Buildings 119 and 227. During this period, treated water was discharged to the sanitary sewer system. In 1973, an oil/water separator was installed next to Building 226 to replace the dissolved air flotation system. Beginning in 1974, wastewater that passed through the oil/water separator was discharged into the storm sewer system. In 1989, the oil/water separator discharge was rerouted to the base sanitary sewer system. Building 226 was removed in 1992 and the building foundation was removed in the spring of 1993 and then paved over.

In addition to the oil/water separator, areas of concern at Site 35 include the former 15,000 gal UST and the Hazardous Material Storage Area (HMSA). The UST was used to store solvents and was located next to the oil/water separator between Buildings 226 and 227. The UST and the oil/water separator were removed in October 1991. The HMSA was used for temporary drum storage between 1982 and 1990 and was located on the asphalt area between Building 226 and Dover Avenue. Since 2002, COC concentrations in groundwater have been below CGs at this site (URS, 2009).

Site 38

Site 38 consists of several maintenance shops (Building 120) that were used for a variety of purposes when the base was in operation (see Figure 7.6-2). The shops include a sheet metal shop, paint shop, welding shop, battery shop, and a nondestructive testing area. The sources of contamination at Site 38 were the drum storage area and the floor drain pipeline adjacent to the eastern corner of the building.

In April 1997, excavation of contaminated soil was performed on the northwestern and southeastern sides of Building 120 (Bechtel, 1998a). A total of 418.22 tons of soil was removed from the site. Since 2002, COC concentrations in groundwater have been below CGs at this site (URS, 2009).

Site 39

Site 39 (Building 227 Area) (see Figure 7.6-2) includes the largest hangar at the former Pease AFB and served as a major maintenance area for aircraft. The hangar was historically used for a variety of general maintenance activities, including degreasing, paint stripping, and minor repairs, and to wash down aircraft. The northern quarter of the hangar housed a wash rack area and a container storage area for hazardous waste. The floor drains in that area were connected to the Building 226 Industrial Wastewater Treatment Plant (Site 35) (1956 to 1974) and later to the oil/water separator (1974 to 1991). From 1956 to 1974, the floor drains for the other sections of the building (along with the roof drains) connected directly into the flightline storm water sewer system, which crosses the flightline before discharging into McIntyre Brook. In 1974, a low-flow bypass line was constructed to connect these drains with the Building 226 oil/water separator. Between 1974 and 1991, wastewater from the Building 227 floor drains emptied into the flightline storm sewers only during rainstorms when the wastewater was highly diluted.

The soil and groundwater adjacent to and underneath the building have been the primary areas of concern. Sources of contamination in groundwater are suspected to be solvent, oil, and fuel spills on the floors or outside the building and wastewater discharged to the flightline storm sewers. Figure 7.6-3 depicts the locations where COC concentrations in groundwater at this site exceeded CGs in 2008 (URS, 2009).

Zone Wide Geological, Hydrogeological and Groundwater Flow Descriptions

The shallow subsurface beneath Zone 3 generally consists of five stratigraphic units. Unconsolidated strata include the US, MCS, LS, and GT. The bedrock underlying these units is either the Kittery or Eliot formation, depending on the specific Site location within Zone 3. The thickness of the overlying unconsolidated units varies across the site. In addition, the elevation of the bedrock interface is highly variable which is likely a result of the region's glacial history.

Regional groundwater flow is to the south-southeast within Zone 3 under static conditions (i.e., when the Haven Well is not being used). Depending upon the season, localized flow vectors may also exist at each of the Sites. A more detailed description of the geologic, hydrogeologic, and hydrologic characteristics of Zone 3 can be found within the *Zone 3 ROD* (Weston, 1995a).

Groundwater contaminant plumes extending beyond the identified source areas have been delineated at IRP Sites 34, 35, 38, and 39. The identified contaminant plumes are primarily HHCs with the most extensive groundwater contaminant plume originating from IRP Site 39 (see Figure 7.6-3). The current nature and extent of groundwater contamination at each of the sites within Zone 3 is discussed in the *Zone 3 2008 Annual Report* (URS, 2009).

7.7.1.2 Initial Response

Site 34

All the USTs at Site 34 were removed in September 1992. Several other interim remedial measures (IRMs) were performed at Site 34. These measures also included sediment removal from a portion of the Test Cell Ditch and operation of a pilot groundwater extraction and treatment system. The purpose of the extraction system was to provide management of the dissolved-phase benzene groundwater plume specifically associated with Site 34.

7.7.1.3 Basis for Taking Action

The Air Force has been conducting an environmental cleanup program at the former Pease AFB since 1983. This program was executed according to the guidelines of the Air Force IRP and the NHDES UST program. The Air Force conducted investigations in Zone 3 in four separate stages between January 1984 and July 1993.

Remedial Investigation (1983 -1993): In 1983, an IRP Phase 1 Problem Identification/Records Search was conducted at Pease AFB (report submitted in January 1994). A summary of the investigation reports generated from the various stages of the RI is detailed in the *Zone 3 ROD* (Weston, 1995a). Data collection during the latter part of stage four was used to complete the baseline risk assessment and Zone

3 FS. A more detailed description of each of the sites is presented in the previous subsections and the *Zone 3 Draft Final RI Report* (Weston, 1993a).

Feasibility Study (1993 - 1995): Several RI and FS reports have been prepared for Zone 3 and sites within or associated with Zone 3, these are summarized below:

- McIntyre Brook and Lower Newfields Ditch Remedial Investigation/Feasibility Study (Weston, 1993a and Weston, 1993b), for details Section 8.0;

- *Zone 3 Draft Final Feasibility Study Report* (Weston, 1993c) includes FSs to evaluate source controls for Sites 31, 33, 35, 38, and 39;

- *Installation Restoration Program Stage 3C, Site 34 Feasibility Study, Pease AFB, NH*, (Weston, 1992).

- *Zone 3 Remedial Investigation Report, Addendum 1, Site 65 Site Investigation* (Weston 1994).

7.7.2 Remedial/Removal Actions

7.7.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy(s):

Record of Decision For a Source Area Remedial Action At Site 34 (1993): The Air Force's preferred alternative for remediation as stated in the *ROD For a Source Area Remedial Action at Site 34* (Weston 1993c) involved excavation and off-base disposal of contaminated soils.

Explanation of Significant Differences for Remedial Action at Site 34 (1995): The Air Force issued an Explanation of Significant Differences (ESD) in May of 1995 outlining a change to the method of soil disposal from offsite treatment and disposal to onsite disposal at Landfill 5.

Zone 3 ROD (1995): The Air Force's preferred alternative for remediation as stated in the *Zone 3 ROD* (Weston, 1995a) involved the excavation of contaminated soils and sediments, extraction of contaminated groundwater at selected source areas, and natural attenuation of dissolved-phase contaminant plumes.

Zone 3 ROD Amendment (2003): The *Zone 3 ROD Amendment* (MWH, 2003a) presented a modified Zone 3 cleanup approach to improve the long-term effectiveness of the remedy and document cleanup actions for sites that were not addressed in the 1995 *Zone 3 ROD*.

7.7.2.2 Remedial Action Objectives

The Air Force's preferred alternative for remediation as stated in the *Zone 3 ROD* (Weston, 1995a) involved the excavation of contaminated soils and sediments, extraction of contaminated groundwater at selected source areas, and natural attenuation of dissolved-phase contaminated plumes. RAOs identified in the *Site 34 Remedial Action ROD* (Weston, 1993c), *Zone 3 ROD* (Weston, 1995a), and the *Zone 3 ROD Amendment* (MWH, 2003a) have been summarized below:

Site 34 ROD

The remedy selected in the *Record of Decision for a Source Area Remedial Action at Site 34 (Site 34 ROD)* (Weston, 1993c) was developed to satisfy the following Remedial Response Objective:

- Minimize leaching of contaminants from the source area soils to groundwater or surface water, thereby reducing the potential for the public to ingest or directly contact contaminated groundwater or surface water that presents a health risk (cumulative cancer risk greater than 10^{-4} to 10^{-6}, or hazard index greater than 1 for each COC).

Zone 3 ROD

The remedy selected in the 1995 *Zone 3 ROD* was developed to satisfy the following RAOs:

<u>Sediment in Upper Newfields and Upper Grafton Ditches (Sites 19 and 20)</u>

- Protect ecological receptors from direct contact with, or ingestion of, sediment containing contaminants at concentrations that may present a potential unacceptable risk (See also Section 8.0).

Soil at Sites 33, 38, and 39

- Minimize leaching of contaminants from soil to groundwater or surface water that would result in groundwater or concentrations of surface water contamination that may present an unacceptable health risk.

Zone 3 Overburden and Bedrock Groundwater

- Protect human receptors from ingestion of, or direct contact with, contaminated groundwater that may present an unacceptable health risk;

- Comply with chemical-specific ARARs;

- Prevent discharge of contaminated groundwater to surface water bodies where such discharges may cause unacceptable risks to human health and the environment; and

- Prevent contaminant migration toward the Haven Well.

Zone 3 ROD Amendment

The first three RAOs for overburden and bedrock groundwater are unchanged. The fourth RAO was revised to allow for increased demand for water from the Haven well.

- Minimize contaminant migration toward the Haven Well should increased water demand require pumping the Haven Well at the maximum safe yield.

7.7.2.3 Remedy Description

Site 34 ROD

The remedy selected for the *Site 34 ROD* (Weston, 1993c) included the following components:

- Excavation of the JETC soils that contained contaminant concentrations exceeding the site-specific CGs. A mobile laboratory was to be set up on site to confirm the removal of contaminated material. The excavated material was to be temporarily stored and dewatered on-site, prior to removal to the off-site facility.

- The excavation was to be backfilled with clean fill to a level that matched existing grade at the site.

- Excavated contaminated materials were to be transported to a treatment facility/disposal location as soon as scheduling allowed. The type of disposal facility was to be chosen (i.e., asphalt batch, RCRA TSD, Subtitle D landfill, on base thermal desorption unit, or other) at the time of remedial design based on cost and other factors.

- Groundwater extracted as part of the excavation and/or dewatering process was to be treated at the existing pilot GWTP. Holding tanks were to be provided for storage of groundwater prior to treatment.

- Prior to completion of remedial activities, EPA and NHDES were to conduct a review as part of the regulatory approval process to ensure that the soil remedial CGs had been met.

- Based on analytical results from sampling performed on the stockpile of excavated soils from the Site 34 soil removal efforts and concurrent changes to the NHDES soil policy guidance, the Air Force issued an ESD in May 1995 to change the location of soil disposal from off-base to on-base. The ESD called for using the Site 34 soils as fill material on Landfill 5 at the former Pease AFB prior to its closure with a RCRA hazardous waste cap.

Zone 3 ROD

Specifically, the selected remedy for Zone 3 included the following remedial action components:

- Excavation and removal of sediment exceeding cleanup goals from Upper Newfields and Upper Grafton Ditches [completed 1997, (Bechtel, 1998a)].

- Excavation and removal of soil exceeding cleanup goals at Sites 33, 34, 38, and 39 [completed 1997, (Bechtel, 1998a)].

- Groundwater extraction from Sites 32, 34, 35, and 39 and vicinity and treatment at the Site 32 GWTP [Ongoing] and the Site 34/39 GWTP [shut down in October of 2002].

- Natural attenuation and biodegradation of the dissolved-phase contaminant plume emanating from Zone 3 sites and from the Site 32/36 source area outside the TI containment zone [Ongoing].

- Protect human receptors from exposure to contaminated groundwater by implementing institutional controls, such as establishing a Zone 3 GMZ [Ongoing].

- Long-term environmental performance monitoring in Zone 3, consisting of groundwater sampling (including water level measurement) and analysis for GMZ maintenance, groundwater extraction system performance monitoring, and process monitoring at both groundwater treatment facilities [Ongoing].

Zone 3 ROD Amendment

As noted earlier, the *Zone 3 ROD* has been amended (MWH, 2003a); the modified cleanup approach was designed to improve the long-term effectiveness of the remedy and document cleanup actions for sites that were not addressed in the 1995 *Zone 3 ROD* (Weston, 1995a).

Major components of the modified remedy include:

- Construction of a contingency wellhead treatment system for the Haven Well [completed 2005, (MWH, 2006a)];

- Optimization of the Site 39 source area groundwater extraction system with monitored natural attenuation of the down-gradient plume [Ongoing];

- Termination of groundwater extraction to control contaminant migration southwest of Sites 34 and 39 [GWTP shut down in October of 2002]; and

- Modification of the Zone 3 long-term monitoring program (ongoing) to measure the performance of the selected remedy, which includes monitoring of Haven sentry wells to ascertain if migration of potentially contaminated groundwater will impact the Haven Well.

Ongoing components of the Zone 3 remedies include groundwater extraction at Sites 32 and 39, as well as optimization, and long-term monitoring of groundwater throughout Zone 3. A summary of the CGs for Zone 3 as listed in both the original *Zone 3 ROD* (Weston, 1995b) and as amended in the *Zone 3 ROD Amendment* (MWH, 2003a) are presented as Tables 7.7-1 (soil and sediment CGs defined in the *Site 34 ROD* and *Zone 3 ROD*), 7.6-2 (groundwater CGs defined in the *Zone 3 ROD*), and 7.6-3 (groundwater RGs defined in the *Zone 3 ROD Amendment*).

7.7.2.4 Remedy Implementation

Soil and Sediment Remedial Actions. Soil and sediment remedial actions required under the original *Zone 3 ROD* were completed in 1996. To achieve the sediment RAOs, the Air Force excavated and disposed off-base 465 tons of sediment from Upper Grafton Ditch and 345 tons of sediment from Upper Newfields Ditch that exceeded remediation goals for PAHs and several metals.

The Air Force excavated and disposed off-base 235 tons of soil from Site 33 that exceeded soil remediation goals for arsenic and 418 tons of soil from Site 38 that exceeded remediation goals for PAHs. In August 1996, 181.15 tons of contaminated soil were removed from two areas at the southwest corner of Building 227 (Site 39) (Bechtel, 1998a). However, waste characterization sampling of the removed soils did not clearly indicate that the source of the TCE contamination detected in groundwater had been located (Bechtel, 1998a). No compounds were detected at or above applicable cleanup standards. The reported contaminants found in the removed soils consisted primarily of HHCs, BETX compounds, and PAHs.

A soil removal action was also performed under the *Site 34 ROD* (Weston, 1993c) in July 1994 to excavate contaminated overburden soils. Approximately 10,700 tons of contaminated soil were excavated from the site. An ESD for the *Site 34 ROD* was completed in May 1995 to change the location of soil disposal from off base to on base. The ESD called for using the Site 34 soils as fill material on Landfill 5 at the former Pease AFB prior to its closure with a RCRA hazardous waste cap.

Overview of Groundwater Remedial Actions. To achieve *Zone 3 ROD* groundwater RAOs, initial activities included installation or reconfiguration of eleven wells to extract groundwater for treatment at one of the two groundwater treatment systems constructed under the Site 32/36 and Zone 3 remedies. Three of these wells were to be used for extraction at the Site 39 source area, one well was to be used for extraction at the Site 35 source area, two wells were for extraction at the Site 34 source area, and five wells were for hydraulic control of groundwater flow southwest of Sites 34 and 39. As part of the remedial design process, the pumping strategy was determined based on numerical groundwater flow modeling for optimization of groundwater extraction.

In addition to the construction of the groundwater extraction and treatment systems, the Air Force prohibited the installation of drinking water wells at the former Pease AFB and imposed a 300 gallons per minute (gpm) pumping limit on the Haven Well to prevent groundwater withdrawal from interfering with the contamination migration control system to be implemented as part of the Zone 3 remedy. The pumping limitation was based on groundwater modeling results that indicated that the Zone 3 groundwater extraction systems would prevent plume migration toward the Haven Well when it pumped at 300 gpm or less. The 300 gpm limit was further defined by the Air Force as averaged over a 24-hour period. Groundwater extraction and treatment at Sites 32, 34 and 39 has been underway since 1997 to meet Zone 3 groundwater RAOs.

The Zone 3 groundwater model was updated in April 2000 (Bechtel, 2000a) and recommendations were made in the *Zone 3 Optimization Evaluation* (Bechtel, 2000b) to modify the pumping scheme to pump from only 2 wells between Site 34 and the Haven Well. The reduction from pumping five wells to pumping two wells was made on August 31, 2000.

The *Zone 3 ROD* (Weston, 1995a) specified that groundwater would be pumped from Site 39 as part of the selected remedy for Zone 3. The extraction of groundwater at Site 39 began in June 1997 from well 39-5153 in the flightline. The extracted groundwater was treated at the Site 34/39 GWTP and treated water was discharged at a groundwater recharge trench on the western side of the base runway. The pumping scheme at Site 34/39 was adjusted to extract groundwater from an additional well at Site 39 (well 39-5152) on August 31, 2000 based on the recommendations in the *Zone 3 Optimization Evaluation* (Bechtel, 2000b).

On October 28, 2002, in accordance with an agreement between the Air Force, NHDES and EPA, extraction and treatment from wells 39-5152 and 39-5153 was discontinued on a pilot basis. The decision to discontinue groundwater extraction in the apron area between Site 39 and the Haven Well was formalized in the *Zone 3 ROD Amendment* (MWH, 2003a). The amendment requires groundwater extraction near Site 39 to contain the source area and protect the Haven Well if it is pumped at higher rates. It was determined in the amendment that the groundwater RAOs for Site 34 and Site 35 had been met and pumping was no longer required.

Groundwater extraction from wells 39-39-MWE4S, 39-MWE3S, and 39-MW3S in the suspected source area at Site 39 began in June 1999. Well 39-MWE3S was abandoned in 2003 and replaced with well 39-MWRE3S located within the US in the historic source area of Site 39. Operation of the Site 34/39 GWTP was terminated in October 2002 with concurrence from the EPA and NHDES; all extracted groundwater from Site 39 is currently treated at the Site 32 GWTP. Under the *Zone 3 ROD Amendment* (MWH, 2003a), the Site 39 groundwater extraction remedy has been optimized to include extraction from a newly installed (August 2003) hybrid lower sand/shallow bedrock well (39-MWE10), which began extracting groundwater in May 2004; all groundwater extraction at Site 39 is currently performed by pumping at well 39-MWE10.

Other extracted groundwater treated at the Site 32 GWTP has historically been from Site 35. A concrete recovery extraction well (CREW) was installed in the southeastern corner of the foundation excavation for potential free product recovery. Pumping from the Site 35 CREW began in June 1997 and the extracted groundwater was treated at the Site 32 GWTP and discharged to a groundwater recharge trench on the west side of the base runway.

The *Zone 3 Semi-Annual Status Report* (Bechtel, 2001) recommended suspending groundwater extraction from Site 35. Extracted groundwater had met the Zone 3 groundwater RGs for organics for the previous two years and the CREW had minimal impact on the groundwater flow near Site 35. This recommendation was implemented and extraction from the CREW well at Site 35 ceased in 2001. In response to recommendations in the *Zone 3 2002 Annual Report* (MWH, 2003b) and correspondence with the EPA, groundwater monitoring at Site 35 continued in 2003. Active extraction and treatment at Site 35 remains off line and groundwater monitoring has continued through 2008.

Current Status of Groundwater Remedial Actions

Site 33

The primary COC associated with Site 33 has historically been TCE. Monitoring of wells at Site 33 has continued since the implementation of the selected remedy. Since 1999, COC concentrations in groundwater have been below CGs at this site (URS, 2009); the Zone 3 groundwater RGs have been achieved at Site 33. As agreed to with EPA and NHDES, long-term monitoring at Site 33 has been reduced under the *Zone 3 Long-Term Monitoring Plan, Revision 2* (MWH, 2004b).

Site 34

Extraction from these wells was terminated during October 2002 under the approval of EPA and NHDES. The *Zone 3 ROD Amendment* (MWH, 2003a) concluded that the groundwater RAOs have been met and formalized the termination of groundwater extraction at Site 34. COC concentrations in groundwater have been below CGs at this site since 2005 (URS, 2009).

Site 35

The *Zone 3 ROD Amendment* (MWH, 2003a) concluded that the groundwater RAOs have been met and formalized the termination of groundwater extraction at Site 35. It was recommended in the *Zone 3 2002 Annual Monitoring Report* (MWH, 2003b) that annual sampling of the wells at Site 35 continue in 2003 in accordance with the *Zone 3 Revised LTMP* (Bechtel, 1999). Only minimal groundwater monitoring is required at Site 35 under the current *Zone 3 LTMP, Revision 2* (MWH, 2004b). COC concentrations in groundwater have been below CGs at this site since 2002 (URS, 2009).

Site 38

As with most of Zone 3, the primary contaminants associated with Site 38 are TCE and its degradation byproducts (cis-1,2-DCE and VC). It was recommended in the *Zone 3 2002 Annual Monitoring Report* (MWH, 2003b) that monitoring of this site continue in accordance with the *Revised Zone 3 LTMP* (Bechtel, 1999). The Zone 3 RGs have been achieved at Site 38 and EPA and NHDES concurred with the reduced monitoring program required at Site 38 under the current *Zone 3 LTMP, Revision 2* (MWH, 2004b). COC concentrations in groundwater have been below CGs at this site since 2002 (URS, 2009).

Site 39

The configuration of the optimized Site 39 system was agreed upon by the AFRPA, the EPA, and the NHDES, after regulatory review of the *Technical Memorandum: Site 39 Groundwater Investigation Phase III* (MWH, 2003c). Currently, all groundwater extraction at Site 39 is performed by pumping hybrid deep overburden/shallow bedrock extraction well 39-MWE10 at an average flow rate of approximately 20 - 25 gpm (Figure 7.7-1).

Analytical sampling at Site 39 is conducted in accordance with the *Zone 3 LTMP, Revision 2* (MWH, 2004b). Figure 7.6-3 depicts the locations where COC concentrations in groundwater at this site exceeded CGs in 2008 (URS, 2009). TCE, cis-1,2-DCE, and VC were variously detected at concentrations exceeding RGs in 2008 in Site 39 source area wells 39-MWRE3S [US], 39-MWE2D [LS], and 39-MWE7 [SBR]. No exceedances of the RGs for 1,1-dichloroethene (DCE) or trans-DCE occurred at Site 39 in 2008. The observed COC concentrations in the source area are orders of magnitude higher than those observed crossgradient and downgradient of the source area.

Since extraction began at 39-MWE10 in May 2004, COC concentrations in wells downgradient of Site 39 have steadily decreased and are currently below their RGs (URS, 2009). Figures 7.7-1 and 7.7-2 provide plots of cis-1,2-DCE and TCE concentrations in wells located in the downgradient Site 39 plume. Wells 39-MWE1D [LS] and 34-6040 [DBR], located approximately 350 ft downgradient of the Site 39 source area, displayed increasing TCE and cis-1,2-DCE concentrations prior to the startup of groundwater extraction at Site 39 (Figure 7.7-1). TCE and cis-1,2-DCE concentrations have gradually decreased in both wells subsequent to the startup of groundwater extraction at Site 39, likely due to cutoff of the source and to natural attenuation in the downgradient plume. TCE and cis-1,2-DCE concentrations in both wells were below RGs in 2008. The TCE RG has now been met at well 34-6040 for seven of the last eight sampling events, indicating the success of natural attenuation at this location. Source cutoff and natural attenuation even appear to have successfully influenced contaminant concentrations at wells farther downgradient. Concentrations of TCE and cis-1,2-DCE in wells 32-4254 [LS] and 34-7245 [LS], located 900 or more feet downgradient of the Site 39 source area, have declined below RGs and been relatively asymptotic since 2003 (Figure 7.7-2).

<u>Haven Well Protection</u>

To provide protection of the Haven Well as required by *Zone 3 ROD Amendment* (MWH, 2003a), quarterly sampling of a sentry well network is included in the *Zone 3 LTMP, Revision 2* (MWH, 2004b). The Plume 13/14 fuel spill site is located in close proximity to the Haven Well and quarterly sampling of a sentry and sentinel well network associated with this site, specified in *Appendix B "Long-Term Monitoring Plan"* of the *Plume 13/14 Remedial Action Plan* (MWH, 2006b), is also performed to provide protection of the Haven Well. The objective of the sentry-sentinel well network is to monitor contaminant migration and to ensure that any contaminant migration that might potentially threatening the Haven Well is detected in a timely manner and that appropriate responses are triggered. The sentry-sentinel well monitoring network is composed of existing, new, and replacement wells; the new and replacement wells were installed in late 2004 and 2005. The locations of the Haven Well sentry and sentinel wells are shown in Figure 7.7-3. The sentry wells are located approximately 100 feet to 300 feet from the Haven Well and the Plume 13/14 sentinel wells are located approximately 800 feet to 1,100 feet from the Haven Well.

When the Haven well is active, quarterly sampling (spring, summer, fall, and winter) of the sentry-sentinel wells is prescribed, as well as monthly sampling of the Haven Well. Sampling results are compared to threshold values in two decision trees to determine if contingency responses are warranted. Contingency responses range from more intensive monitoring to initiation of the wellhead treatment system. The decision trees are located in the *Zone 3 LTMP, Revision 2* (MWH, 2004b) and in *Appendix B "Long-Term Monitoring Plan"* of the *Plume 13/14 Remedial Action Plan* (MWH, 2006b); the decision tress are presented in Figures 7.7-4 and 7.7-5. A proposal to make minor modifications/clarifications to this decision tree has recently been submitted for regulatory agency approval.

The Haven wellhead contingency treatment system was constructed in August 2005 and went on-line in September 2005 (MWH, 2006a). The wellhead contingency treatment system was designed to be capable of treating extracted water from the Haven Well potentially contaminated with VOCs. The treatment system maximum design flow rate of 1,000-gpm flow rate was based upon the Haven Well pump capacity. The process equipment is designed to remove VOCs from water entering the treatment plant at an influent concentration of 10 µg/L of TCE and 50 µg/L of benzene and an effluent concentration of 2.5 µg/L for both COCs. Vapor treatment has been sized based upon the requirements of the airflow rate of the air stripping equipment (1,250 standard cubic feet per minute [scfm]), as well as effluent gas concentrations.

LUC/ICs were specified in the *Zone 3 ROD* (Weston, 1995a) and are in place for Zone 3 in the form of restrictions in the deed. All Zone 3 property has been transferred by the Air Force to PDA via quitclaim deed. LUC/ICs include a GMZ prohibiting use of groundwater (except for the Haven well) and a URZ prohibiting both residential use and establishment of childcare facilities, playgrounds, athletic fields, or elementary/secondary schools. Any activity that will adversely impact the integrity of the monitoring wells, treatment facilities, piping, and other facilities is prohibited. The Zone 3 GMZ and URZ are ASNs requiring concurrence from the Air Force for any development within the GMZ or URZ and specifically prohibits any activity that could disturb ongoing remedies. Observations are made during the performance of LTM activities in Zone 3 to ensure that LUC/ICs have not been violated; these observations are documented in the *Zone 3 Annual Reports*. The ASN and PDA dig permit review processes, both requiring Air Force review and approval, also aid in LUC/IC enforcement. With the exception of ongoing remedial systems, groundwater extraction inside the Zone 3 GMZ is limited to the Haven Well. The ongoing use of the property conforms to the restrictions of the URZ and this is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.7.3 Implementation of Recommendations from Last Five-Year Review

The second *Five-Year Review Report* (MWH, 2004c) concluded that the remedy at Zone 3 remained protective of human health and the environment. Recommendations in the *Five-Year Review Report* included:

- Routine long-term monitoring should continue throughout Zone 3.

- Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess performance of the Site 39 groundwater extraction system, to assess the potential need to operate the Haven wellhead treatment system, to evaluate progress toward RGs, and to identify opportunities to optimize remedial activities.

- The change in the NHAGQS for sec-butylbenzene should be noted in future long-term monitoring reports.

Long-term monitoring has been performed since 2004 in accordance with the *Zone 3 LTMP, Revision 2* (MWH, 2004b) to meet the recommendations presented above. Evaluation of these monitoring results and minor adjustments to the long-term monitoring program were presented in the following documents:

- *Zone 3 2004 Annual Report* (MWH, 2005),

- *Zone 3 2005 Annual Report* (MWH, 2006c),

- *Zone 3 2006 Annual Report* (URS, 2007),

- *Zone 3 2007 Annual Report* (URS, 2008), and

- *Zone 3 2008 Annual Report* (URS, 2009).

As documented in the *Zone 3 2008 Annual Report* (URS, 2009), groundwater at Sites 33, 35, and 38 has met the Zone 3 groundwater CGs/RGs established in the *Zone 3 ROD* (Weston, 1995b) and *Zone 3 ROD Amendment* (MWH, 2003a).

7.7.4 Technical Assessment

The following section discusses the effectiveness of the remedy and describes how the RAOs have been met.

7.7.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the decision documents, as described below:

Site 33 soils were excavated and disposed of offsite; the site has met groundwater restoration goals and limited groundwater LTM is required at the site under the *Zone 3 LTMP, Revision 2* (MWH, 2004b). Site 34 soils were excavated and disposed of; the site has met groundwater restoration goals and groundwater monitoring associated with Site 34 was eliminated in the *Zone 3 LTMP, Revision 2*. Site 35 has met the groundwater restoration goals and limited groundwater LTM is required at the site under the *Zone 3 LTMP, Revision 2*. Site 38 soils were excavated and disposed of; groundwater restoration goals have been met and limited groundwater LTM is required at the site under the *Zone 3 LTMP, Revision 2*. The optimized extraction and treatment system at Site 39 appears to meet the source area hydraulic control objective of the *Zone 3 ROD Amendment*. Since extraction began at 39-MWE10 in May 2004, COC concentrations in wells downgradient of Site 39 have steadily decreased and are currently below their RGs.

All extracted groundwater in Zone 3 is now treated at the Site 32 GWTP. The Site 32 GWTP was discussed in Section 7.6 of this *Five-Year Review Report.*

All Zone 3 COCs were contained within the Zone 3 GMZ from 2004 through 2008. The Haven wellhead contingency treatment system was constructed as required under the *Zone 3 ROD Amendment* (MWH, 2003a) and is currently maintained to ensure its operability. In monthly samples collected from the

Haven Well between 2004 and 2008, there were no contaminants detected at concentrations above thresholds that would trigger initiation of wellhead treatment.

Surface water and sediment cleanup goals associated with Zone 3 are addressed in Section 9.5 of this document.

7.7.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: Zone 3 groundwater CGs, as specified in the *Zone 3 ROD* (Weston, 1995a), were generally based on ARARs or TBCs (i.e., MCLs or NHDPHS values); a few CGs were based on background concentrations (aluminum and manganese), an EPA lifetime health advisory value (vanadium), or were risk-based (2-methylnaphthalene, phenanthrene, sec-butylbenzene, and cadmium) (Table 7.6-2). The CGs for Zone 3 groundwater were updated and termed RGs (Table 7.6-3) in the *Zone 3 ROD Amendment* (MWH, 2003a). Some COCs from the *Zone 3 ROD* were omitted from the *Zone 3 ROD Amendment* RGs because cleanup levels had been attained throughout Zone 3. The *Zone 3 ROD Amendment* RGs were based primarily on ARARs (MCLs or NHAGQS); however, two background concentrations (arsenic and manganese) and two risk-based concentrations (sec-butylbenzene and vanadium) were also used. The ARARs and background concentrations used to define the RGs stated in the *Zone 3 ROD Amendment* remain current. An ARAR is also now available for sec-butylbenzene (NHAGQS = 260 µg/L), which had a risk-based RG of 7.3 µg/L in the *Zone 3 ROD Amendment*.

There have been no changes in standards that would affect the protectiveness of the remedy.

Changes in Exposure Pathways: The future increased usage of the Haven Well will draw more water from Zone 3 and the Haven aquifer. The sentry well monitoring system and Haven contingent well treatment system will ensure that the remedy remains protective.

Since completion of the last Five Year Review, additional guidance, including NHDES' *Vapor Intrusion Guidance* (NHDES, 2006; revised 2007), have been developed to aid in evaluating the potential for human exposure from the vapor intrusion pathway. EPA has also recently updated generic risk screening levels presented in the *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway* *from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (EPA, 2002) for several compounds.

To address the issue of possible soil vapor intrusion pathways, a comparison of Zone 3 groundwater data against EPA and NHDES screening levels will be forthcoming shortly and the results presented in a draft report for review by EPA and NHDES. The information provided in the report will be used to determine locations for air sample collection and will aid the Air Force, EPA, and NHDES in evaluating future ASN requests that include the construction of habitable structures within Pease GMZs/URZs.

<u>Changes in Toxicity and Other Contaminant Characteristics:</u> Risk-based groundwater RGs were included in the *Zone 3 ROD Amendment* for sec-butylbenzene and vanadium. As was stated above, an ARAR is now available for sec-butylbenzene.

<u>Changes in Risk Assessment Methods:</u> The original HHRAs were conducted following then current EPA and EPA Region 1 guidance. The health protectiveness of the original CGs/RGs would not be expected to change because the groundwater CGs/RGs were established primarily using ARARs and background values. With the exception of vanadium, risk-based CGs currently have ARARs available.

Risk assessments are performed somewhat differently now than they were at the time of the last Five-Year Review and especially since the time of the various RODs. Guidance documents/risk assessment tools that have been issued include:

- Background guidance (2002), which changed the way background comparisons are performed for metals.
- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.
- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.
- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.
- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.
- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens*

(EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

Expected Progress Toward Meeting RAOs: Implementation of the remedy is currently meeting all RAOs except compliance with ARARs in groundwater. Progress toward this RAO is documented throughout Zone 3 and it is expected that RGs will eventually be achieved throughout Zone 3, with the exception of the TI Zone at Site 32.

7.7.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that would call into question the protectiveness of the remedy.

7.7.4.4 Technical Assessment Summary

The remedy for Zone 3 is functioning as intended. Soil removal actions were performed at Sites 33, 34, 38, and 39 and groundwater RGs have been met at Sites 33, 34, 35, and 38. The Site 39 extraction and treatment system appears to be meeting the source area hydraulic control objective of the *Zone 3 ROD Amendment*. There has been no violation of the GMZ between 2004 and 2008. The Haven wellhead contingency treatment system was constructed in 2005 as required under the *Zone 3 ROD Amendment* and is currently maintained to ensure its operability. In monthly samples collected from the Haven Well between 2004 and 2008, there were no contaminants detected at concentrations above thresholds that would trigger initiation of wellhead treatment. While minor changes in ARARs have affected groundwater cleanup levels, these changes have not impacted the protectiveness of the remedy. Increased use of the Haven Well is planned in the future; however, the sentry-sentinel well monitoring network and wellhead contingency treatment system will ensure that the remedy remains protective. No other information has come to light that would call into question the protectiveness of the remedy.

7.7.5 Issues

An ARAR is now available for sec-butylbenzene (NHAGQS = 260 µg/L), which had a risk-based RG of 7.3 µg/L in the *Zone 3 ROD Amendment*.

7.7.6 Recommendations and Follow-up Actions

Routine long-term monitoring should continue throughout Zone 3. Routine monitoring of groundwater flow conditions and trends in groundwater quality should be performed to assess performance of the Site 39 groundwater extraction system, to assess the potential need to operate the Haven wellhead treatment system, to evaluate progress toward RGs, and to identify opportunities to optimize remedial activities. The availability of an ARAR (NHAGQS) for sec-butylbenzene should be noted in future long-term monitoring reports. Additionally, based on information provided in the forthcoming VI screening report, buildings may be identified for air sampling to assess potential vapor intrusion pathways.

7.7.7 Protectiveness Statement

Active remedial measures (groundwater extraction and treatment; contingency wellhead treatment), long-term monitoring of remedial performance, and enforcement of LUC/ICs ensure that the remedy in Zone 3 is protective of human health and the environment.

7.7.8 References

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MWH, 2003c. *Technical Memorandum: Site 39 Groundwater Investigation Phase III*. November.

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Weston, 1994. *Zone 3 Remedial Investigation Report, Addendum 1, Site 65 Site Investigation*. November.

Weston, 1995a. *Record of Decision for Zone 3*. September.

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7.8 ZONE 4, LANDFILL 6

7.8.1 Background

7.8.1.1 Site Description

LF-6 is a former landfill that covered approximately 3 acres on the southeastern margin of Pease AFB (Figure 6.1-1). The site of the former landfill is bordered by Grafton Ditch and associated wetlands to the north, woodlands and Construction Rubble Dump 2 (CRD-2) to the east, and wetlands and woodlands to the west and south (Figure 7.8-1 and 7.8-2).

LF-6 reportedly received domestic and industrial solid wastes during the 1970's. These wastes may have also included spent paint thinners and solvents as well as medical waste from the former base clinic. The primary contaminants identified at Landfill-6 were aromatic hydrocarbons (BTEX and dichlorobenzene), PAHs, TPHs, and metals (Weston, 1995). The refuse was buried in the landfill using trench and fill methods (Weston, 1993a).

Groundwater flow in the overburden at LF-6 is generally toward the east. However, historical monitoring has shown that seasonal variation of groundwater elevations influences groundwater flow in both a northeasterly (spring) and southeasterly (summer) direction. Groundwater flow in the bedrock at LF-6 appears to be oriented to the east during times of high groundwater potential (spring) and to the east-southeast during times of low groundwater potential (fall). Generally, topography and the nearby surface water features (Grafton Ditch and associated wetlands) influence groundwater flow patterns in this area.

7.8.1.2 Initial Response

No remedial action was performed at LF-6 prior to the finalization of the *Zone 4 Record of Decision* (Weston, 1995).

7.8.1.3 Basis for Taking Action

Remedial Investigation and Feasibility Study (1993): IRP investigations associated with Zone 4 began in 1983 with a Phase I investigation and culminated in 1993 with the completion of the remedial investigation and feasibility study (Weston, 1993a and 1993b). The remedial investigation found that contamination was widespread within the landfill. In general, it was found that the eastern portion of the landfill contained more industrial solid waste and that the western portion contained more organic contaminants with some medical waste.

7.8.2 Remedial/Removal Actions

The following subsections describe regulatory actions and remedial actions performed at LF-6.

7.8.2.1 Regulatory Actions

Record of Decision for Zone 4 (1995): The *Zone 4 ROD* (Weston, 1995) documented the selection of Alternative 4, which included landfill excavation with on-base disposal at LF-5, on-zone groundwater treatment for excavation dewatering, discharge of treated water to the local Public Owned Treatment Works (POTW), wetland creation, natural attenuation of residual contaminated groundwater, long-term environmental monitoring, and institutional controls.

7.8.2.2 Remedial Action Objectives

The *Zone 4 ROD* (Weston, 1995) identified the following RAOs for LF-6:

- Protection of ecological receptors from direct contact with landfill soils/wastes at concentrations that could pose an unacceptable risk;
- Remediation of contaminated landfill soil and solid waste to prevent leaching to surface water and groundwater that could pose an unacceptable risk;
- Compliance with ARARs and background levels, as appropriate, for soil and groundwater; and
- Protection of human receptors from ingestion of contaminated groundwater that could pose an unacceptable risk.

7.8.2.3 Remedy Description

The remedy selected in the *Zone 4 ROD* (Weston, 1995) included the following:

- Excavation and removal of all landfill soil and solid waste from LF-6 and disposal of excavated soil and solid waste in LF-5 prior to final closure of LF-5 with a RCRA cap. All landfill soil and solid waste would be screened during excavation to separate out drums, stained soils, or pockets of visually differing materials. A hazardous waste determination, in accordance with 40 CFR Part 261-Identification and Listing of Hazardous Waste, would be made on suspect materials.

Materials classified as hazardous would be disposed of off base at an appropriate treatment/disposal facility.

- Dewatering of the LF-6 excavation area, as necessary, during the excavation process (i.e., the groundwater table to be artificially lowered in the immediate vicinity of excavation rendering the area to be excavated dry). Any groundwater extracted as part of the dewatering process would be treated in an on-zone mobile treatment unit to meet site-specific groundwater treatment objectives. Treated groundwater would be discharged to the local POTW via the sanitary sewer.

- Creation, re-establishment, and enhancement of wetland within the footprint of LF-6 on completion of excavation activities.

- Natural attenuation and biodegradation of residual contaminated groundwater. Contaminant transport modeling performed for LF-6 groundwater estimated that approximately 10 years through natural attenuation. Benzene was considered an accurate predictor of the attenuation rates for LF-6 groundwater contaminants.

- Management of the Zone 4 groundwater release would be implemented through a groundwater management permit in accordance with the New Hampshire regulations contained in Env-Ws 410 (now Env-Or 600).

- Placement of deed restrictions on the use of groundwater at LF-6.

- Long-term environmental monitoring in the zone, including groundwater, surface water, and sediment sampling and analysis.

Groundwater clean-up goals established for LF-6 are summarized in Table 7.8-1. Surface water and sediment monitoring requirements associated with LF-6 (Lower Grafton Ditch) are described in Section 9.5 of this *Five-Year Review Report*.

7.8.2.4 Remedy Implementation

Remedial activities associated with the IRP for LF-6 were initiated in March of 1995 and completed in August of 1996. The remedial action included excavation and the removal of all landfill soil and solid waste from LF-6 and disposal of the non-hazardous portion of the excavated material in LF-5 before the landfill was closed. The hazardous portion of the excavated material was disposed off base at an appropriate treatment/disposal facility.

Wetlands were created within the footprint of LF-6 to offset wetland impacts that occurred with the construction of the cap at LF-5. Natural attenuation was selected as the mechanism to remediate the contaminated groundwater.

Remediation work at LF-6 commenced in early spring of 1995 with the construction of an access road, a berm around the existing wetland at LF-6, and the excavation of the contaminated materials. The wetland's restoration work commenced per plans approved by the EPA and the New Hampshire Wetlands Bureau in August 1995. These plans were a modification of the technical memorandum developed by CH2M Hill (CH2M Hill, 1994). All completed zones of the wetland mitigation area were seeded in September 1995, with the exception of the area around the berm, which was partially removed and graded during the late summer in 1996. Planting of woody materials and emergents was completed during the summer of 1996. Replanting occurred in 1998.

Environmental monitoring has been performed at LF-6 as required under the *Zone 4 ROD* (Weston, 1995). Groundwater monitoring is described in the following paragraphs; surface water/sediment monitoring requirements are included in Section 9.5 of this *Five-Year Review Report.*

In 2000, a *Demonstration of Remedial Actions Operating Properly and Successfully* (AFBCA, 2000) was submitted for LF-6 documenting decreasing trends in groundwater contaminants. In accordance with the *Landfill 6 LTMP, Revision 2* (MWH, 2003), groundwater samples are currently collected on an annual basis during the spring sampling event from 5 GMZ perimeter monitoring wells and analyzed for VOCs (Figure 7.8-2). Samples from 5 interior GMZ wells are collected on a triennial (every third year) basis in the spring for VOC and total metals analyses to characterize contaminant levels inside the GMZ and track the progress of natural attenuation processes. Semiannual visual inspections of the LF-6 site are performed concurrently with the spring sampling and also in the fall.

Since removal of the contaminant source was completed in 1995, the frequency of CG exceedances at overburden and bedrock wells for both the organic and inorganic COCs has decreased. LTM data show that the removal of the contaminated soil and landfill debris appears to have eliminated any further releases of contamination into groundwater, resulting in a significant beneficial effect on groundwater quality beneath the landfill and elsewhere in Zone 4. These data also provide supporting evidence that natural attenuation processes are actively reducing the concentrations of groundwater contamination that previously migrated from LF-6.

Based on 2006 data (i.e., the most recent triennial sampling event of interior wells within the GMZ), benzene was the only organic COC reported at a concentration above its CG (5 µg/L) in one well (9 µg/L in 06-5552); benzene concentrations in this well have generally shown a decreasing trend since 1998 (Figure 7.8-3). Data collected in 2008 showed no organic COCs being reported in the GMZ boundary wells (URS, 2009).

During 2006 (i.e., the most recent triennial sampling event of interior wells within the GMZ), arsenic concentrations in four interior wells exceeded the CG of 23 µg/L (background). Detected concentrations in these wells ranged from 35.2 µg/L in well 06-533 to 731 µg/L in well 06-5553 (Figure 7.8-3). Arsenic concentrations have consistently exceeded the CG at these interior wells in the footprint of LF-6. Nickel was also detected in well 06-5553 (113 µg/L) at a concentration slightly above its CG of 100 µg/L; however, this detection appears to be an anomalous spike when compared to previous analytical results. The LF-6 GMZ compliance boundary monitoring wells are not currently analyzed for metals.

LUC/ICs were specified in the *Zone 4 ROD* (Weston, 1995) and are in place LF-6 in the form of restrictions in the deed that was executed between the Air Force and the current owner of the property (PDA). The deed implemented a GMZ prohibiting use of groundwater. The LF-6 GMZ has been established as an ASN requiring concurrence from the Air Force for any development (i.e., digging, excavation, or construction) within the GMZ and specifically prohibits any activity that could disturb ongoing remedies, monitoring, or the integrity of the landfill cover system. The semiannual visual inspections performed as part of the LTM at LF-6 also serve to verify that LUC/ICs have not been violated; inspection results are documented in the *Landfills and CRDs Annual Reports*. The ASN and PDA dig permit review processes, both requiring Air Force review and approval, also aid in LUC/IC enforcement. The ongoing use of the property conforms to the restrictions of the GMZ and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.8.3 Implementation of Recommendations from Last Five-Year Review

The second *Five-Year Review Report* (MWH, 2004), concluded that the remedy for LF-6 remained protective of human health and the environment. The following recommendations were included in the *Five-Year Review* (MWH, 2004):

- Routine evaluation of environmental monitoring results should continue, with data analysis including identification of opportunities to streamline monitoring and reporting; and

- Monitoring frequency should be significantly reduced, once arsenic is the only COC present above cleanup goals.

Annual evaluation of system performance, progress toward CGs, and optimization efforts were documented in the following:

- *Landfills and Construction Rubble Dumps 2004 Annual Report* (MWH, 2005),

- *Landfills and Construction Rubble Dumps 2005 Annual Report* (MWH, 2006),

- *Landfills and CRDs 2006 Annual Report* (URS, 2008a),

- *Landfills and CRDs 2007 Annual Report* (URS, 2008b), and

- *Landfills and CRDs 2008 Annual Report* (URS, 2009).

Based on remedy performance, long-term monitoring was not adjusted during this Five-Year Review period

7.8.4 Technical Assessment

7.8.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The LF-6 remedy is functioning as intended. No source material remains in the landfill. Semi-annual inspections are performed and maintenance is performed as needed. LUC/IC are maintained, including a GMZ, to prevent potential exposures. LTM analytical results indicate that concentrations of only one organic COC (benzene) in groundwater remain above CGs in the former source area. No organic constituents are present at concentrations above CGs at the GMZ boundary. Arsenic is the only inorganic COC that is still present at concentrations above CGs, but also does not exceed CGs at the GMZ boundary. However, arsenic concentrations have remained stable over time, and do not exhibit a decreasing trend, indicating that cleanup goals are not likely to be met in the near term.

7.8.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

Changes in Standards : With the exception of one constituent (1,2,4-trimethylbenzene was risk-based), *Zone 4 ROD* groundwater CGs for LF-6 were based on Federal Safe Drinking Water Act MCLs, New Hampshire Drinking Water Quality Standards (MCLs) (Env-Ws 316 and 317), and NHAGQS (Env-Ws 410). New Hampshire Drinking Water Quality Standards Env-Ws 316-317 have been superceded by Env-Ws 310-316 (effective November 30, 2005). Env-Ws 410 was superceded by Env-Wm 1403 (effective February 24, 1999) which was superceded by Env-Or 600 (effective February 1, 2007), which presents the current NHAGQS (NHDES, 2007). The LF-6 CGs are consistent with current standards, with the exceptions noted below:

Arsenic: On January 22, 2001, EPA adopted a new Federal MCL for arsenic (changed from 50 µg/L to 10 µg/L). Similarly, the New Hampshire MCL was reduced from 50 µg/L to 10 µg/L on February 8, 2002, which was incorporated into the revised NHAGQS (NHDES, 2007). However, definitions in Env-Or 602.07 and Env-Or 602.23 exempt naturally occurring substances at naturally occurring or background levels. Background concentrations of arsenic at the former Pease AFB have been documented as 23 µg/L (Weston, 1993c), which is greater than the arsenic NHAGQS value; therefore, the enforceable standard at Pease AFB is that of background.

1,2,4-Trimethylbenzene. A NHAGQS was not established for 1,2,4-trimethylbenzene at the time of the *Zone 4 ROD* and the ROD included a risk-based CG (19.8 µg/L) for this compound. However, as of February 1, 2007, New Hampshire established a NHAGQS of 330 µg/L for this compound (NHDES, 2007).

These changes in ARARs do not affect the protectiveness of the remedy. While arsenic is reported in site monitoring wells at concentrations above the new MCL, it is not present in GMZ boundary wells at concentrations above Pease AFB background. The NHAGQS established for 1,2,4-trimethylbenzene is more than an order of magnitude higher than the risk-based standard established in the *Zone 4 ROD* (Weston, 1995). 1,2-4-Trimethlybenzene has not been reported in groundwater at the site at concentrations above the ROD risk-based CG since 1993.

Changes in Exposure Pathways: There have been no changes in potential exposure pathways. Since completion of the last Five Year Review, additional guidance, including NHDES' *Vapor Intrusion Guidance* (NHDES, 2006; revised 2007), have been developed to aid in evaluating the potential for human exposure from the vapor intrusion pathway. EPA has also recently updated generic risk screening levels presented in the *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (EPA, 2002) for several compounds.

To address the issue of possible soil vapor intrusion pathways, a comparison of LF-6 groundwater data against EPA and NHDES screening levels will be forthcoming shortly and the results presented in a draft report for review by EPA and NHDES. There is no current vapor intrusion to indoor air pathway at LF-6 as there are no habitable structures nearby. The indoor air VI screening report will aid the Air Force, EPA, and NHDES in evaluating future ASN requests that include the construction of habitable structures within Pease GMZs/URZs.

Changes in Toxicity and Other Contaminant Characteristics: 1,2,4-Trimethylbenzene was the only groundwater COC with a risk-based CG in the *Zone 4 ROD*. The recently established NHAGQS for 1,2,4-trimethylbenzene was based on up to date toxicity information.

Changes in Risk Assessment Methods: The original HHRA was conducted following then current EPA and EPA Region 1 guidance. The health protectiveness of the original CGs would not be expected to change because the groundwater CGs were established almost entirely using ARARs. Also, the risk-based CG currently has an ARAR available.

Risk assessments are performed somewhat differently now than they were at the time of the last Five-Year Review and especially since the time of the *Zone 4 ROD*. Guidance documents/risk assessment tools that have been issued include:

- Background guidance (2002), which changed the way background comparisons are performed for metals.
- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.
- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.

- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.

- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.

- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

Expected Progress Toward Meeting RAOs: Only benzene and arsenic are consistently detected in groundwater in the former source area of LF-6 at concentrations above CGs. Benzene is only detected at one location at concentrations above it CG and these concentrations have exhibited a decreasing trend since 1997 (Figure 7.8-3); no organic COCs were detected in the 2008 samples from the LF-6 GMZ boundary wells. Arsenic concentrations in groundwater in the former source area of LF-6 have not demonstrated downward trends, suggesting that the CG for arsenic will not be achieved in the near term (Figure 7.8-3). The LF-6 GMZ compliance boundary monitoring well groundwater samples are not currently analyzed for metals.

7.8.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

7.8.4.4 Technical Assessment Summary

As is described in Section 7.8.4.1 through 7.8.4.3 above, the remedy is generally functioning as intended at LF-6 to protect human health and the environment. While minor changes in ARARs have affected groundwater cleanup levels, these changes have not impacted the current protectiveness of the remedy, based on site-specific groundwater monitoring data. No changes in exposure pathways are affecting the protectiveness of the remedy. The remedy is currently progressing toward achievement of RAOs, with the exception of the lack of significant downward trends in arsenic concentrations in groundwater. LUC/ICs are in place and performing as expected. The remedy remains protective.

7.8.5 Issues

Issues identified for LF-6 include:

- Decrease in Arsenic Federal MCL and State NHAGQS (2/1/07) from 50 µg/L to 10 µg/L.

- An ARAR is also now available for 1,2,4-trimethylbenzene (NHAGQS = 330 µg/L), which had a risk-based CG of 19.8 µg/L in the *Zone 4 ROD.*

The revised NHAGQS for arsenic does not affect the short-term protectiveness of the groundwater remedy at LF-6.

7.8.6 Recommendations and Follow-up Actions

Remedial measures at LF-6 remain protective of human health and the environment under current exposures. Routine evaluation of environmental monitoring results should continue, with data analysis including identification of opportunities to streamline monitoring and reporting. The change in the regulatory standards for arsenic and 1,2,4-trimethylbenzene should be noted in future monitoring reports. It is recommended that the LF-6 GMZ compliance boundary monitoring well groundwater samples be analyzed for metals. No changes will be made to LF-6 long-term monitoring until a revised draft LTMP is submitted, reviewed, and approved by EPA and NHDES.

7.8.7 Protectiveness Statement

Because all landfill wastes have been excavated and disposed of at LF-5 and a GMZ and other ICs have been established and maintained, the remedial action at LF-6 remains protective of human health and the environment.

7.8.8 References

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EPA, 2001. *Comprehensive Five-Year Review Guidance*, OSWER No. 9355.7-03B-P, EPA 540-R-01-007. June.

EPA, 2002. *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance),* EPA 530-D-02-004. November.

EPA, 2005a. *Guidelines for Carcinogenic Risk Assessment,* EPA 630-P-03-001F. March.

EPA, 2005b. *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), EPA 630-R-03-003F. March.

MWH, 2003. *Landfill 6 Long-Term Monitoring Plan, Revision 2*. July.

MWH, 2004. *5-Year Review Report (1999-2004), Former Pease Air Force Base, Portsmouth, New Hampshire*. September.

MWH, 2005. *Landfills and Construction Rubble Dumps 2004 Annual Report*. January.

MWH, 2006. *Landfills and Construction Rubble Dumps 2005 Annual Report*. March.

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NHDES, 2007. *Env-Or 600 Contaminated Site Management.* Effective February 1, 2007.

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Weston, 1993a. *Zone 4 Remedial Investigation Report*. September.

Weston, 1993b. *Zone 4 Feasibility Study Report*. November.

Weston, 1993c. *Background Values for Soil, Groundwater, Surface Water, and Sediment at Pease Air Force Base*. February.

Weston, 1995. *Record of Decision for Zone 4*. January.

7.9 ZONE 5, SITE 8

7.9.1 Background

7.9.1.1 Site Description

Site 8, the former Fire Department Training Area (FDTA 2), is located in the northern portion of Pease AFB in the area designated as Zone 5 (Figure 7.9-1). Site 8 is bounded in the southeast by Site 11, the Field Maintenance Squadron (FMS) Equipment Cleaning Area. Northwest of Site 8 is Site 9, the CRD-1. The town of Newington Center is north of the site and Taxiway D is located to the south. Undeveloped forested land, including the Newington Town Forest, is located along the eastern Site 8 boundary. The onsite offices of URS and the Pease Administrative Record are housed in buildings/trailers located at the Site 8 treatment facility (Figure 7.9-2).

Site 8 was an active fire training area from 1961 to 1988. The majority of fire training exercises were performed in a large circular pit area located in the southeastern section of the site. Small and large aircraft crash fires were simulated using up to 1,000 gal of jet fuel (JP-4). Prior to 1971, mixed waste oils, solvents, and fuels were also disposed of at Site 8. The pit area was pre-saturated with water and then the waste oils, solvents, and fuels were poured on top of the water and onto a mock aircraft. The mixture was allowed to burn for one to two minutes before being extinguished. In the mid-1970's, the practice of mixing waste oils and solvents with fuel for training fires ceased and only JP-4 was used (Weston, 1994).

Site 8 slopes toward the north from a high of approximately 117 ft above MSL in the southeast to approximately 50 ft above MSL to the north-northeast. Less than 10 ft of relief exists across the former burn areas. A bedrock outcrop exists in the southeastern part of the site (Weston, 1992).

The overburden beneath Site 8 is comprised of approximately 70 ft of glacial deposits. The overburden glacial deposits consist primarily of the US interfingering with the MCS, where the MCS is present (Weston, 1994).

Groundwater is present in the overburden and in the bedrock. With the installation of the groundwater recovery/hydraulic containment system (See Section 7.9.2.3), overburden groundwater flows northeast toward the groundwater extraction wells. Depth to groundwater in the overburden of the source area is approximately 25 ft bgs.

Two groundwater capture zones are present in the overburden due to the pumping of three overburden groundwater recovery wells. Total drawdown in the capture zones varies depending upon seasonal fluctuation in the water table. Despite seasonal water table fluctuations, groundwater capture is maintained throughout the year, ensuring that contaminated groundwater is hydraulically contained and prevented from migrating northward and offsite.

Both metasedimentary and igneous bedrock underlies Site 8 and the bedrock consists primarily of metamorphosed sedimentary rocks of the Eliot Formation. The bedrock consists of weathered and/or fractured rock at shallow depth and competent deeper bedrock. Groundwater in the bedrock flows toward the west and northwest across the Site. Competent bedrock in the vicinity of the site has negligible primary porosity; thus movement of groundwater in the competent bedrock is directly related to the bedrock structural fabric (bedding planes separations, foliation patterns, and fracture and joint sets).

7.9.1.2 Initial Response

Several IRMs were implemented at Site 8 prior to execution of the record of decision. In February and March of 1990, approximately 262 tons of contaminated soil were removed from the drainage ditch located in the northeastern corner of the site. This drainage ditch received surface runoff from the former main burn pit. The soil removal was performed to avoid migration of contaminants from this highly contaminated soil to deeper soil and to groundwater. In August of 1990, a pilot groundwater extraction system was installed. The system was designed to mitigate offsite VOC migration and evaluate the pump and treat technique as a potential source control measure. Subsequent to the FS, a pilot scale SVE study was performed at Site 8 to evaluate the effectiveness of this technology to remediate site soils. Results were promising and were later used to establish design criteria for a full-scale system (Weston, 1994).

7.9.1.3 Basis for Taking Action

Remedial Investigation (1984-1992): In 1983, an IRP Phase 1 Problem Identification/Records Search was conducted at Pease AFB. As a result of the Phase 1 report and subsequent pre-survey work, a RI was conducted at Site 8 in accordance with CERCLA requirements. The RI was conducted in three stages from 1984 through 1992. Included in the third stage investigation were the IRMs discussed above, including removal of contaminated soil from the drainage ditch, a pilot-scale SVE study, and a pilot-scale groundwater remediation system (Weston, 1994).

Feasibility Study (1993): The Site 8 FS estimated a total of 59,000 yd^3 of contaminated soil. The FS estimate was comprised of two components: in situ contaminated soil associated with two former burn pits areas (delineated using RI/FS soil sampling data); and LNAPL contaminated soils associated with the smear zone (estimated using the more laterally extensive LNAPL plume). The FS determined that 42,000 yd^3 of soils were associated with the former burn pits (each a column with 80 ft diameter and a vertical thickness of 20 ft) and an additional 17,000 yd^3 were estimated to be present in the LNAPL smear zone (5 ft vertical thickness) outside the burn pits (Weston, 1993).

7.9.2 Remedial/Removal Actions

The following subsections describe remedial actions at Site 8.

7.9.2.1 Regulatory Actions

Record of Decision for Site 8 (1994): The *Site 8 ROD* (Weston, 1994) documented the selection of Alternative 4 that focused on source control and management of migration.

7.9.2.2 Remedial Action Objectives

RAOs were developed in the *Site 8 ROD* to mitigate the existing and future potential threats to human health and the environment via source control (i.e., SVE and free product recovery) and management of migration of contaminated groundwater. The RAOs for Site 8 include:

- Protect ecological receptors from direct contact with, or ingestion of, soil containing contaminants in concentrations that may present an unacceptable risk;

- Prevent leaching of contaminants from soil to groundwater that would result in groundwater contamination that may present a health risk (total carcinogenic risk greater than 10^{-4} to 10^{-6} or a hazard index greater than 1);

- Protect human receptors from ingestion of contaminated groundwater that may present a health risk (total carcinogenic risk greater than 10^{-4} to 10^{-6}, or a hazard index greater than 1); and

- Prevent discharge of contaminated groundwater to surface water bodies where it may present increased risks to human health and the environment.

7.9.2.3 Remedy Description

The Site 8 remedy as described in the *Site 8 ROD* (Weston, 1994) included the following components:

- In situ SVE treatment of source area soil contaminated at concentrations exceeding CGs and treatment of extracted soil vapor for removal of volatized organics.

- Construction of an asphaltic concrete cap to minimize rainfall and snowmelt infiltration into the area of SVE treatment. The cap would help to minimize the moisture content of the soil to be treated by SVE.

- Recovery and offsite disposal of free-phase product floating on the water table in the source area.

- Management of migration in the downgradient overburden water-bearing zone. Overburden recovery wells are located upgradient of the zone where contaminated overburden groundwater appears to migrate to the bedrock water-bearing zone. The groundwater recovery system was designed to capture overburden groundwater that is contaminated above CGs to prevent migration into the bedrock water-bearing zone.

- Construction of an onsite GWTP for long-term treatment of recovered groundwater. Treated groundwater is discharged to subsurface recharge trenches.

- Environmental monitoring during remedial operations, including groundwater sampling, groundwater elevation monitoring, surface water (including wetlands) monitoring, and soil contamination monitoring.

- Long-term environmental monitoring, including groundwater, surface water, and sediment sampling and analysis.

Site 8 soil and groundwater CGs are summarized in Tables 7.9-1 and 7.9-2, respectively.

7.9.2.4 Remedy Implementation

The start-up date for the Site 8 Remediation Facility was September 20, 1995 (pilot scale), with full-scale operation beginning on October 5, 1995. The Site 8 remedial action consists of hydraulic containment with groundwater treatment and SVE. Both extraction remedies have aboveground treatment facilities.

The groundwater extraction and treatment system includes:

- 6 overburden extraction wells north and downgradient of the source area;

- A GWTP (oil/water separation, green sand filtration [only on an as-needed basis, or immediately after performing system maintenance], air stripping, and carbon adsorption); and,

- 5 subsurface trenches used to discharge the treated effluent.

Figure 7.9-3 presents a flow diagram for the Site 8 treatment system.

The SVE system consists of:

- 189 extraction wells;

- 121 passive air supply vents (ASVs);

- An extensive above-ground pipe manifold;

- 4 moisture separators;

- 3 vacuum blowers;

- A catalytic oxidation unit (now bypassed); and,

- 2 vapor-phase granular activated carbon units.

Figure 7.9-4 presents the SVE remedial system layout for Site 8.

Performance data are collected and analyzed on an annual basis to estimate mass removal by the remedial system at Site 8. Figure 7.9-5 summarizes performance data for the period 1996 through 2008 (URS, 2009a). As Figure 7.9-5 indicates, contaminant recovery has experienced a nearly exponential decrease since 1996. This decline is typical of remediation system progress.

Soil sampling was performed during 2001 to characterize the current extent of soil contamination. Based on the 2001 soil sampling effort, 22,375 yd^3 of contaminated soil were estimated to be remaining at Site

8, representing a 62 percent reduction in the volume of contaminated soil reported in the FS. The greatest reduction in contamination has been associated with the vertical extent of soil contamination. Year 2001 soil boring logs and photoionization detector (PID) headspace readings for volatile organics indicated that the unsaturated soils at Site 8 are generally clean and that a one to two order of magnitude reduction in VOCs has typically occurred within a couple feet above the groundwater interface. These data suggest that the SVE system at Site 8 has successfully cleaned unsaturated soils. Therefore, residual contamination at Site 8 is associated with saturated soils and the smear zone near the LNAPL plumes. Numerous system modifications and operational changes were made through the years to optimize recovery of contamination (See operations reports listed in Section 7.9.3 below). However, it appeared that most practical optimizations of the system as it was configured had been made and that the rate of contaminant removal had leveled off.

In 2002, a dual-phase extraction (DPE) pilot test was conducted on well 08-7959 during May through November 2002. This pilot study utilized pneumatically powered total fluids pumps installed in existing wells. A portion of the LNAPL was collected and recovered in the liquid state and a portion was volatilized and captured by the SVE system. Preliminary trials indicated that the DPE could significantly enhance mass removal rates. The DPE pilot was then expanded to three additional wells within the source. Because of cold weather and freezing risks to the aboveground piping, the pumps were removed for the season on November 26, 2002 and were replaced in the wells on April 21, 2003. DPE pumps operated continuously throughout the 2003 season until they were removed on November 5, 2003. Analysis of the data indicated that the DPE wells represented approximately 6 percent of the operating wells and provided less than 2 percent of the vapor mass removal during the time of operation. DPE did not appear to have been successful, but it may merit future consideration for spot removal of LNAPL.

In 2005, a *Site 8 Alternatives Analysis* (AA) was developed to evaluate remedial measures to address residual source area contamination at Site 8 in groundwater, saturated soil, and as floating free-product (MWH, 2005a). The AA recommended installation and operation of an AS system to provide treatment of contaminated soils below the water table and reduce the amount of floating free-product. Volatile compounds stripped from the saturated zone by the AS system would subsequently be collected by the SVE system. The less volatile, less mobile, higher molecular weight contaminants also would receive treatment as a result of accelerated biodegradation due to increased oxygen levels in the subsurface.

AS pilot tests were conducted in 2006 to provide a conceptual understanding of in situ airflow and to estimate off-gas concentrations during air sparging. A discussion of the test methodology, locations, and results is presented in the *Site 8 Eleventh-Year Operations Report* (URS, 2007). The pilot test data were evaluated to identify indicators of infeasibility, characterize subsurface air distribution to the extent practicable, and identify any safety hazards to be addressed during full-scale design of an AS system. Three separate tests were performed, one test located within a sand stratum and two tests located within a till stratum. Results indicated that AS is feasible in saturated sections of the sand and that the till exhibited significant anisotropy, which resulted in variable air channel development and limited distribution of subsurface air. Based on the pilot test results, a *Remedial Design Work Plan for Air Sparge System* (URS, 2008a) was prepared.

Construction began on the AS system in February 2008 and continued through February 2009. The AS system consists of 113 injection wells, located in areas where a sufficient saturated thickness of US/LS units was present, that are connected to a blower system with a total combined capacity of 800 standard cubic feet per minute (scfm) at a gauge pressure of 22 pounds per square inch (psig). Figure 7.9-6 provides a layout of the AS wells.

A *Remedial Process Optimization Plan Using Focused Product Recovery and Enhanced Aerobic Bioremediation* (URS, 2008b) was developed to treat contaminated soil in the saturated zone and zone of water table fluctuation in areas that were not amenable to AS. Focused recovery of LNAPL and enhanced aerobic bioremediation of contaminated soil (i.e. oxygen-releasing compounds applied to existing wells and air supply vents) was proposed for these areas. Three areas were identified where the optimization program would be implemented: 1) the southeast section of the former fire training area, 2) the southwest section of the former fire training area, and 3) a wooded section north of the former fire training area and south of Arboretum Drive.

The AS system, along with the aforementioned product recovery/bioremediation action, should be operating by mid-2009. Details regarding the AS system construction/start-up and planned product recovery/bioremediation action are included in the *Site 8 Construction Completion Report for Air Sparge System and Bioremediation Activities* (URS, 2009b) and the *Site 8 Operation, Maintenance and Monitoring Plan* (URS, 2009c).

The *Site 8 LTMP, Revision 2* (MWH, 2003b) requires sampling of 32 groundwater monitoring wells for VOCs and intrinsic remediation (IR) parameter analyses; samples from three of those locations are also analyzed for target metals. The Air Force recommended discontinuing monitoring for IR parameters in the *Site 8 Eighth-Year Operations Report* since the data showed little variation throughout the monitoring period (MWH, 2004a); the recommendation was approved and IR parameter laboratory analyses were discontinued at the end of 2004. Surface water and sediment monitoring at Knights and Pickering Brooks is also specified in the *Site 8 LTMP* to meet the ROs of the Site 8 ROD; these activities are described in Section 9.6 of this *Five-Year Review Report*.

The extent of free-product detected at Site 8 in 2008 is presented on Figures 7.9-4 and 7.9-7, with historical LNAPL distribution between 1998 and 2008 being shown on Figure 7.9-7. LNAPL persists in small localized areas in the southern and western sections of the site and north of the site within a wooded area south of Arboretum Drive. Compared to previous years, the extent of LNAPL measured in 2008 was smaller.

In 2008, the detected concentrations of benzene, 1,2,4-TMB, naphthalene, cis-1,2-DCE, vinyl chloride, arsenic, and manganese in groundwater exceeded CGs in 6 wells located within the GMZ (4 overburden wells and 2 bedrock wells -- see Figure 7.9-8) (URS, 2009a). These CG exceedances have generally been limited to the source area and the area of groundwater extraction and have been contained within the GMZ boundary. No GMZ boundary or downgradient offsite wells contained greater than trace concentrations of organic constituents, confirming that the site remediation is successfully preventing offsite migration.

VOC contaminant trends in the overburden water-bearing zone have been decreasing since the remediation systems were started in 1996 (Figure 7.9-9). VOC contaminant concentrations in the bedrock water-bearing zone have either decreased, remained stable, or are negligible (Figure 7.9-10). TCE has not been detected in source area wells and downgradient wells since 1999 and cis-1,2-DCE and VC concentrations have been decreasing or non-detect (Figure 7.9-11 and 7.9-12). These decreasing contaminant concentration trends are attributed to reductive dechlorination processes and mass removal by the extraction systems.

LUC/ICs were specified in the *Site 8 ROD* (Weston, 1994) and are in place for Site 8 in the form of restrictions in the deed that was executed between the Air Force and the current owner of the property (PDA). The deed implemented several LUC/IC measures. These include a GMZ prohibiting use of groundwater and a URZ prohibiting both residential use and establishment of childcare facilities, playgrounds, athletic fields, or elementary/secondary schools. The deed established the Site 8 GMZ and URZ as ASNs requiring concurrence from the Air Force for any development (i.e., digging, excavation, or construction) within the GMZ or URZ and specifically prohibits any activity that could disturb ongoing remedies. URS' offices are located at Site 8, so daily observations made during the performance of LTM activities at Site 8 ensure that LUC/ICs have not been violated; LUC/IC compliance is documented in the *Site 8 Annual Operations Reports*. The ASN and PDA dig permit review processes, both requiring Air Force review and approval, also aid in LUC/IC enforcement. The ongoing use of the property conforms to the restrictions of the URZ and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.9.3 Implementation of Recommendations from Last Five-Year Review

The second *Five-Year Review Report* (MWH, 2004b) concluded that the remedy for Site 8 remained protective of human health and the environment. The following recommendations were included in the *Five-Year Review* (MWH, 2004b):

- Routine long-term monitoring and groundwater extraction at Site 8 should continue;

- An alternatives analysis will be prepared by the Air Force during calendar year 2004 to evaluate methods of remediating remaining LNAPL and saturated zone contamination that is difficult to remove with the current SVE system;

- Routine data evaluation of groundwater flow conditions, trends in groundwater quality and the occurrence of LNAPL should be performed to assess system performance and optimize long-term monitoring activities; and,

- The changes in the regulatory standards for Site 8 COCs should be noted in future long-term monitoring reports.

Annual evaluation of system performance, progress toward cleanup goals, and optimization efforts were documented in the following documents:

- *Site 8, Fire Department Training Area (FDTA) 2, Alternatives Analysis* (MWH, 2005a),

- *Site 8, FDTA 2, Remediation System Ninth-Year Operations Report* (MWH, 2005b),

- *Site 8 Air Sparging Pilot Test Work Plan* (URS, 2006),

- *Site 8, FDTA 2, Remediation System Tenth-Year Operations Report* (MWH, 2007),
- *Site 8, FDTA 2, Remediation System Eleventh-Year Operations Report* (URS, 2007),
- *FINAL Site 8, FDTA 2, Remedial Design Work Plan for Air Sparge System* (URS, 2008a),
- *FINAL Site 8, FDTA 2, Remedial Process Optimization Plan Using Focused Product Recovery and Enhanced Aerobic Bioremediation* (URS, 2008b),
- *Site 8, FDTA 2, Remediation System Twelfth-Year Operations Report* (URS, 2008c),
- *Site 8, FDTA 2, Remediation System Thirteenth-Year Operations Report* (URS, 2009a), and
- *Site 8 Construction Completion Report for Air Sparge System and Bioremediation Activities* (URS, 2009b).

7.9.4 Technical Assessment

7.9.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

A review of performance and long-term monitoring data collected for Site 8 since the last 5-year review indicates that the components of the remedy at Site 8 are functioning as intended. The hydraulic containment and GMZ components of the remedy have successfully ensured that contaminants are not migrating outside of Site 8 to downgradient receptors and restricted groundwater use within the areas affected by Site 8 contaminants. Additionally, the SVE system has successfully removed soil contamination and free product from the vadose zone at Site 8 and there has been substantial improvement in groundwater quality at the site.

7.9.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: The Site 8 groundwater CGs, as specified in the *Site 8 ROD* (Weston, 1994), were generally based on ARARs or TBCs (i.e., MCLs or NHDPHS values); a few CGs were risk-based or based on a background concentration (vanadium) or an EPA lifetime health advisory value (bromochloromethane). ARARs are now available for several groundwater COCs that were assigned TBC or risk-based CGs in the *Site 8 ROD.* These changes are summarized in the following table.

Constituent	**ROD Cleanup Goal (µg/L)/Basis**	**ARAR (µg/L) Change/Basis**
Sec-butylbenzene	7.3 /Risk-based	260 / NHAGQS
1,2-Dibromoethane	0.000501 /Risk-based	0.05 / NHAGQS
Isopropylbenzene	89.1 / Risk-based	280 / NHAGQS
2-Methylnaphthalene	12.4 /Risk-based	280 /NHAGQS
4-Methylphenol	350 /NHDPHS	40 /NHAGQS
1,2,4-Trimethylbenzene	19.8 /Risk-based	330 /NHAGQS
4,4'-DDD	0.177 /Risk-based	0.1 /NHAGQS
Phenanthrene	12.4 /Risk-based	210 /NHAGQS
Arsenic	50 /MCL	10 /MCL*

* - A background value of 23 µg/L for arsenic has been established at the former Pease AFB.

The risk-based CGs listed in the ROD have already been met for sec-butylbenzene, 1,2-dibromoethane, isopropylbenzene, 2-methylnaphthalene, 4,4'-DDD, and phenanthrene. The TBC-based goal for 4-methylphenol has also been met, with no detections in 2008 (URS, 2009a). Based upon recent groundwater monitoring data, the current ARAR for 1,2,4-TMB would be achieved upon its adoption, whereas exceedances of the ROD-specified risk-based CG for this compound have occurred at Site 8.

The MCL for arsenic was reduced from 50 µg/L to 10 µg/L, which was incorporated into the revised NHAGQS (NHDES, 2007). However, definitions in Env-Or 602.07 and Env-Or 602.23 exempt naturally occurring substances at naturally occurring or background levels. Background concentrations of arsenic at the former Pease AFB have been documented as 23 µg/L (Weston, 1993c), which is greater than the arsenic NHAGQS value; therefore, the enforceable standard at Pease AFB is that of background.

There have been no changes in standards that would affect the protectiveness of the remedy.

Changes in Exposure Pathways: There have been no changes in physical site conditions, land use, or exposure pathways that would affect the protectiveness of the remedy.

Since completion of the last Five Year Review, additional guidance, including NHDES' *Vapor Intrusion Guidance* (NHDES, 2006; revised 2007), have been developed to aid in evaluating the potential for human exposure from the vapor intrusion pathway. EPA has also recently updated generic risk screening levels presented in the *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (EPA, 2002) for several compounds.

To address the issue of possible soil vapor intrusion pathways, a comparison of Site 8 groundwater data against EPA and NHDES screening levels will be forthcoming shortly and the results presented in a draft report for review by EPA and NHDES. The information provided in the report will be used to determine locations for air sample collection and will aid the Air Force, EPA, and NHDES in evaluating future ASN requests that include the construction of habitable structures within Pease GMZs/URZs.

Changes in Toxicity and Other Contaminant Characteristics: *Site 8 ROD* soil CGs are based on a leaching model designed to be protective of groundwater. The values shown in the *Site 8 ROD* are conservative when compared to current published values for soil (i.e., NHDES *Contaminated Sites Risk Characterization and Management Policy* [RCMP] Method 1 NH S-1 soil standard values).

As noted above, ARARs (e.g., NHAGQS) are now available for several of the groundwater COCs for which risk-based CGs were listed in the *Site 8 ROD.*

Changes in Risk Assessment Methods: The original HHRA was conducted following then current EPA and EPA Region 1 guidance. The health protectiveness of the original CGs would not be expected to change because the groundwater CGs were established primarily using ARARs. Also, risk-based CGs currently have ARARs available.

Risk assessments are performed somewhat differently now than they were at the time of the last Five-Year Review and especially since the time of the *Site 8 ROD*. Guidance documents/risk assessment tools that have been issued include:

- Background guidance (2002), which changed the way background comparisons are performed for metals.
- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.

- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.

- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.

- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.

- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

<u>Expected Progress Toward Meeting RAOs:</u> The current remedial system (hydraulic containment with groundwater treatment and SVE) is meeting RAOs associated with removal of contaminants from the vadose zone and preventing exposure to contaminants at concentrations of concern. However, the rate of contaminant mass removal has declined and it would likely take a significant amount of time to achieve cleanup goals with this remedial system. An AS remedial system was installed in 2008/2009 and its operation, in combination with enhanced product recovery/bioremediation activities, should expedite the timeframe for achieving RAOs.

7.9.4.3 <u>Question C</u>

Question C: Has any other information come to light that could call into questioned the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

7.9.4.4 <u>Technical Assessment Summary</u>

As described above, the components of the Site 8 remedy are functioning as intended. While changes in groundwater ARARs have occurred, these changes have not impacted the current protectiveness of the remedy, based on site-specific groundwater monitoring data. Current concentrations of the organic constituent 1,2,4-TMB exceed the *Site 8 ROD* risk-based CG, but are less than the ARAR that now exists for this compound. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. While the rate of contaminant mass removal has declined, the recent addition of an AS system to the remedy, in combination with enhanced product recovery/bioremediation activities, should expedite achievement of RAOs. LUC/ICs are in place and performing as expected. No other information has come to light that would call into question the protectiveness of the remedy.

7.9.5 Issues

Performance of the recently installed AS system and progress toward achieving RAOs will need to be evaluated. ARARs (i.e., NHAGQS) are now available for several groundwater COCs for which TBCs or risk-based values were used to set CGs in the *Site 8 ROD.* Current concentrations of the organic constituent 1,2,4-TMB are above the ROD risk-based CGs, but are less than the ARAR that now exists for this compound.

7.9.6 Recommendations and Follow-up Actions

Conduct O&M on the recently installed AS system, in conjunction with the existing groundwater extraction/treatment and SVE systems. Perform the recommended enhanced product recovery/ bioremediation activities. Routine LTM at Site 8 should continue including evaluation of groundwater flow conditions, trends in groundwater quality, and LNAPL occurrence to assess system performance, optimize LTM activities, and to assess the impact of the revised remedial efforts upon remaining LNAPL/contamination. The changes in the regulatory standards for Site 8 COCs listed in Section 7.9.4.2 should be noted in future long-term monitoring reports. Additionally, based on information provided in the forthcoming VI screening report, buildings may be identified for air sampling to assess potential vapor intrusion pathways.

7.9.7 Protectiveness Statement

The current remedy at Site 8 is protective of human health and the environment and prevents unacceptable exposures through groundwater containment and LUC/ICs.

7.9.8 References

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7.10 ZONE 7, SITE 45

7.10.1 Background

7.10.1.1 Site Description

The Old Jet Engine Test Stand (OJETS) was constructed (circa 1958) near the southwestern edge of the runway at the former Pease AFB (Figure 7.10-1). The OJETS encompasses approximately 0.6 acres, and is located in IRP Zone 7 and the PDA natural resource protection zone. The facility consisted of a partially enclosed test stand, an engine control room, a transformer, an in-ground exhaust crib, and a 2,500-gal fuel storage tank (Figure 7.10-2).

In the mid-1960s, the test stand operated at full capacity for the majority of the time. During testing, the engine exhaust was directed out of the northern end of the containment structure toward the rock crib, which was designed to deflect the engine exhaust. Petroleum products, hydraulic fluids, and solvents were reportedly used extensively at the facility before the OJETS was taken out of service in 1976. After the OJETS was removed from service, the engine control room, aboveground fuel storage tank, and transformer were removed. In 1992, as part of the RI, the OJETS building, concrete pad, and rock crib were also removed.

Site 45 was included in the deeded transfer of Parcel E to PDA in 2003 (Figure 6.1-1). Part of this land was used to expand the 18-hole Pease Golf Course to 27 holes. The nine-hole expansion impacted an area of approximately 100 acres, including Site 45 (Figure 7.10-1). A newly constructed fairway adjacent to the site now covers the western portion of the Site 45 GMZ (Figure 7.10-3). To accommodate the new land use, Site 45 monitoring wells were retrofitted to be flush with the ground surface and re-surveyed. No change from this land use is expected within the foreseeable future.

Site 45 is located on the western edge of a broad, topographically high ridge of unconsolidated sands and gravels that trends northwest-southeastward across the Newington Peninsula (Weston, 1995). Groundwater is encountered at the site within the US-LS and glacial till units. These two hydrostratigraphic units are separated over most of the site by the MCS aquitard that is generally thin (< 6 feet) and locally sandy. Where the aquitard is totally absent, there is less resistance to vertical groundwater flow; consequently, the US-LS and glacial till units may act as a single hydrostratigraphic unit. However, upward vertical hydraulic gradients between the LS and US appear to limit downward contaminant migration.

Groundwater flow within the US unit is westward. The flow pattern is consistent with the regional topography and similar to the west-northwestward groundwater flow direction observed at other Pease AFB sites in the area (MWH, 2003).

7.10.1.2 Initial Response

No remedial actions were performed at Site 45 prior to the finalization of the *Site 45 Record of Decision* (Weston, 1995).

7.10.1.3 Basis for Taking Action

Remedial Investigation/Feasibility Study (1992-1993): Under the IRP, a site inspection (SI) and RI/FS (Weston, 1993) were conducted at Site 45 between October 1992 and January 1993. An evaluation of the organic contamination distribution in soil suggested that the source of contamination was leakage of aviation gasoline (AVGAS) and the exhaust of combustible by-products during testing. Soil contamination occurred predominantly in the northern and western part of the former OJETS building site. The principal organic contaminants detected in soil were petroleum hydrocarbons: benzene, toluene, ethylbenzene, and xylenes (BTEX), 2-methylnaphthalene, and naphthalene. Also detected in the soil were three chlorinated VOCs: tetrachloroethene (PCE), TCE, and chlorobenzene. The irregular distribution and low concentrations of chlorinated VOCs implied that only minor amounts of degreasing solvents were used to clean jet engine parts and that only small quantities of these solvents were spilled or otherwise released. Soil contamination was shallow (less than 5 feet deep), except for a lenticular area centered under the former OJETS building that was contaminated to a depth of approximately 20 feet. The estimated volume of organics-contaminated soil was approximately 7,000 yd^3.

Metals-contaminated soil was confined to an area adjacent to the OJETS, directly beneath the rock crib, and reached a depth of 2 feet below ground surface (bgs). The total estimated volume of soil contaminated with inorganic constituents was 120 yd^3 (Weston, 1993a). Engine testing was also considered a potential origin of metals contamination that has been identified in surface soil; the actual source is undetermined.

Groundwater contamination was detected in the US unit. Contamination was concentrated near the water table in the US and consisted of halogenated and aromatic VOCs. Compounds detected at concentrations above MCLs in groundwater included benzene, ethylbenzene, TCE, cis-1,2-DCE, and vinyl chloride.

Treatability Study (1994): A pilot-scale SVE/AS treatability study was conducted at Site 45 between September 12 and November 3, 1994. The objectives were to evaluate the effectiveness of SVE/AS as a cleanup method at the site and establish design criteria for a full-scale system. The results of the pilot test indicated that SVE and AS were effective technologies for remediation of the soil at the site.

7.10.2 Remedial/Removal Actions

The following subsections describe regulatory actions and remedial actions performed at Site 45.

7.10.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy.

Site 45 Record of Decision (1995): The *Site 45 ROD* (Weston, 1995a) documented selection of Alternative 3, which included removal of contaminated soils, air sparge/soil vapor extraction, and institutional controls.

7.10.2.2 Remedial Action Objectives

RAOs identified in the *Site 45 ROD* (Weston, 1995a) include:

- Protect ecological receptors from ingestion of surface soils and vegetation containing contaminants at concentrations that may present an unacceptable risk;

- Protect human receptors from ingestion of contaminated groundwater that may present an unacceptable health risk in exceedance of EPA's risk range of 10^{-4} to 10^{-6} (total cancer risk) for a future off-base resident, or a hazard index greater than 1; and

- Comply with location- and action-specific ARARs, TBC criteria, and/or established background levels for specific contaminants in soil, as appropriate.

7.10.2.3 Remedy Description

The Site 45 remedy was designed to remove soil contaminants that had the potential to leach to, and contaminate, groundwater. In summary, the remedy included the following actions:

- Excavation and off-site disposal of approximately 120 yd^3 of source area surface soil with concentrations of inorganic contaminants in excess of cleanup goals;

- In situ AS of approximately 4,000 yd^3 of saturated contaminated soil to enhance volatilization and biodegradation of organic contaminants in soil and groundwater;

- In situ SVE treatment of approximately 3,000 yd^3 of unsaturated contaminated soil to extract VOCs and to enhance biodegradation of organic contaminants;

- Installation of a low-permeability membrane on the ground surface over the area to be treated by SVE/AS to minimize the potential for short circuiting of atmospheric air to the SVE vents;

- Natural attenuation of residual contamination remaining in groundwater after excavation and in conjunction with SVE/AS treatment; and

- Institutional controls, including placement of security fence and monitoring of site groundwater until CGs have been attained.

CGs for soil and groundwater, as established in the *Site 45 ROD* (Weston, 1995), are summarized in Table 7.10-1 and Table 7.10-2, respectively. The design of the Site 45 SVE/AS system is detailed in the *Remediation System Basis of Design* (Weston, 1995b) and *Remediation Management Plan* (Bechtel Environmental, Inc. [Bechtel], 1996).

7.10.2.4 Remedy Implementation

Following completion of the treatability study, operation of the pilot AS/SVE system was continued on an interim basis through May 1995. The purpose of the interim operation was to continue remediation of the soils in areas known to be within the pilot system's radius of influence (ROI).

AS and SVE well installation activities for full-scale operation were performed during November and December 1995. The SVE system consisted of one horizontal and eight vertical wells. The AS system consisted of 30 vertical wells. The mechanical and emission treatment systems were installed during June and July 1996.

System startup was initiated in August 1996. The remedial system operated for approximately two months before it was shut down in October 1996 due to high water table conditions. In July 1997, two soil borings were completed in the most highly contaminated areas of the site. Results from the analysis of those samples, as well as the results obtained during installation of the AS and SVE wells, indicated that soil remediation objectives had been attained.

The Air Force recommended the abandonment and dismantling of the AS/SVE remedial system in the *Site 45 1999 Status Report* (Bechtel, 2000). NHDES and EPA concurred with this recommendation and the AS/SVE remedial system was dismantled in September 2000. Details of the system abandonment and dismantling were presented in the *Remedial System Closure Report* (Bechtel, 2001).

To monitor the natural attenuation of residual contamination remaining in groundwater, LTM of groundwater at the site began in accordance with the *Startup and Long-Term Monitoring Plan* (Bechtel, 1996a); this LTMP specified groundwater flow, groundwater quality, and IR parameter monitoring using a network of 13 monitoring wells. By the year 2000, the detected concentrations of five compounds (benzene, cis-1,2-DCE, isopropylbenzene, 1,2,4-trimethylbenzene, and naphthalene) had been consistently below the cleanup goals in all 13 monitored wells for at least six sampling rounds. These compounds were temporarily removed from the LTM analyte list via a revision to the LTMP (*Site 45 Revised Long-Term Monitoring Plan*, Montgomery Watson, 2001). Additional changes made to the original LTMP by the 2001 revision included elimination of IR analytical parameters, the reduction of the boundary monitoring requirements for the GMZ, and the reduction of groundwater sampling frequency to once annually in the spring. Therefore, water quality LTM in the *Revised Long-Term Monitoring Plan* (Montgomery Watson, 2001) consisted of sampling 8 wells annually for sec-butylbenzene, 2-methylnaphthalene, and manganese analyses.

Based upon additional attenuation of organic contaminant concentrations in groundwater, further revisions to the Site 45 groundwater monitoring program were recommended in the *Site 45 2004 Annual Report* (MWH, 2004a), including: reducing the number of groundwater quality monitoring locations from 8 wells to 4 wells; and reducing the number of analytes from three (sec-butylbenzene, 2-methylnaphthalene and manganese) to one (manganese). These recommendations were approved and incorporated into the current *Site 45 Old Jet Engine Test Stand Long-Term Monitoring Plan*, *Revision 2* (*LTMP*, *Rev. 2*; MWH, 2004b).

Unlike the organic compound concentrations that have steadily declined to levels below CGs, manganese concentrations in Site 45 monitoring wells continue to exceed the ROD CG of 1,500 µg/L. Manganese was not an apparent constituent of any wastes or spills associated with historical activities at the OJETS facility. Historical groundwater analytical data indicates that elevated manganese concentrations are associated with the area of suspected active biodegradation (i.e., the source area and the area immediately downgradient from the source area). Since 2000, all exceedances for manganese have occurred in source area wells (45-7628 and 45-7890) and downgradient wells (45-5116 and 45-MW13) (NOTE: These are the 4 groundwater quality monitoring locations specified in *LTMP, Rev. 2*). This suggests that the manganese levels observed at Site 45 are a by-product of natural attenuation at the Site. Re-equilibration of the groundwater system downgradient of the attenuation zone is projected to reduce manganese concentrations to below the CG.

Historical manganese concentrations at source area wells 45-7628 and 45-7890 have gradually decreased at Site 45; a declining manganese trend also appears to be developing in downgradient well 45-MW13 (Figure 7.10-4). In 2008, the concentration of manganese in well 45-7890 (1,420 µg/L) was below the ROD CG of 1,500 µg/L. As suggested by the results of a statistical analysis presented in the *Site 45 2003 Annual Report (MWH*, 2003), manganese concentrations are not likely to decrease below the CG for a substantial amount of time (estimated at 2014). Monitoring of groundwater quality and water levels will continue under the guidance of *LTMP, Rev. 2* (MWH, 2004b) until manganese concentrations have reached the CG. At that time, monitoring activities necessary to achieve site closure would be negotiated and implemented.

LUC/ICs were specified in the *Site 45 ROD* (Weston, 1995a) and are in place for Site 45 in the form of restrictions in the deed that was executed between the Air Force and the current owner of the property (PDA). The deed implemented several LUC/IC measures. These include a GMZ prohibiting use of groundwater and a URZ prohibiting both residential use and establishment of childcare facilities, playgrounds, athletic fields, or elementary/secondary schools. The deed established the Site 45 GMZ and URZ as ASNs requiring concurrence from the Air Force for any development (i.e., digging, excavation, or construction) within the GMZ or URZ and specifically prohibits any activity that could disturb ongoing remedies. Observations are made during the performance of LTM activities at Site 45 to ensure that LUC/ICs have not been violated; these observations are documented in the *Site 45 Annual Reports*. The ASN and PDA dig permit review processes, both requiring Air Force review and approval, also aid in LUC/IC enforcement. The ongoing use of the property conforms to the restrictions of the URZ and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.10.3 Implementation of Recommendations from Last Five-Year Review

The second *Five-Year Review Report (1999-2004)* (MWH, 2004c), concluded that the remedy for Site 45 remained protective of human health and the environment. The following recommendations were included in the *Five-Year Review Report (1999-2004)*:

- Remedial measures at Site 45 remain protective of human health and the environment under current exposures. Routine evaluation of environmental monitoring results should continue, with data analysis including identification of opportunities to streamline monitoring and reporting.

LTM data and progress toward CGs have been documented in the following:

- *Site 45 2004 Annual Report* (MWH, 2004a),
- *Site 45 2005 Annual Report* (MWH, 2006),
- *Site 45 2006 Annual Report* (URS, 2007),
- *Site 45 2007 Annual Report* (URS, 2008), and
- *Site 45 2008 Annual Report* (URS, 2009).

LTM optimizations were documented in the *Site 45 Old Jet Engine Test Stand Long-Term Monitoring Plan, Revision 2* (MWH, 2004b).

7.10.4 Technical Assessment

The technical assessment portion of the Five-Year Review evaluates the protectiveness of the remedy. The following subsections address the specific questions outlined in EPA's *Comprehensive Five-Year Review Guidance* (EPA, 2001).

7.10.4.1 <u>Question A</u>

Question A: Is the remedy functioning as intended by the decision documents?

Based on a review of documents, ARARs, and risk assumptions, the remedy at Site 45 is functioning as intended. Soil CGs were attained by the AS/SVE system (Bechtel, 2001). Organic constituents in groundwater have declined to concentrations below ROD-specified CGs. Manganese concentrations in the source area remain above the ROD-specified CG, with most wells exhibiting a downward trend. ICs, including a GMZ, are in place and maintained; these should ensure protectiveness until the groundwater CG for manganese is attained.

7.10.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards:

Soil Cleanup Goals. Soils at Site 45 were remediated to the CGs specified in the *Site 45 ROD.* There have been some minor changes to the standards used to derive the Site 45 CGs for soil. In all cases, the revised standards are less stringent than those specified in the ROD. These changes were the result of NHDES policy changes and do not affect the protectiveness of the remedy.

Groundwater Cleanup Goals. Groundwater CGs in the *Site 45 ROD* were based on ARARs, except where ARARs were not available. Of the nine constituents for which CGs were established, ARARs were used for benzene, cis-1,2-DCE, naphthalene, and lead. ARARs cited in the the *Site 45 ROD* included Federal Safe Drinking Water Act MCLs, New Hampshire Ambient Groundwater Quality Standards (Env-Ws 410), and NHDPHS (manganese only). There have been updates to the ARARs used to derive the CGs in the *Zone 45 ROD*, but the *Site 45 ROD* groundwater CGs that were based on ARARs (benzene, cis-1,2-DCE, naphthalene, and lead) are consistent with the current NHAGQS (NHDES, 2007).

NHAGQS (NHDES, 2007) have been established for COCs in the *Site 45 ROD* that had risk-based CGs: sec-butylbenzene, isopropylbenzene, 2-methylnaphthalene, and 1,2,4-trimethylbenzene. The current NHAGQS (260 µg/L, 800 µg/L, 280 µg/L, and 330 µg/L, respectively) are significantly higher than the risk-based levels included in the *Site 45 ROD* (see following table).

Constituent	ROD Risk-Based Cleanup Goal (µg/L)	Current NHAGQS (µg/L)
sec-butylbenzene	7.3	260
isopropylbenzene	88.1	800
2-methylnaphthalene	13.4	280
1,2,4-trimethylbenzene	19.8	330

Groundwater monitoring data collected prior to 2004 indicate that concentrations of sec-butylbenzene, isopropylbenzene, 2-methylnaphthalene, and 1,2,4-trimethylbenzene at Site 45 were below their ROD-specified CGs and were well below the recently revised ARARs (NHAGQS). Therefore, these changes in groundwater ARARs do not have a negative impact on the protectiveness of the remedy.

The current NHAGQS for manganese is 840 µg/L (NHDES, 2007). However, definitions in Env-Or 602.07 and Env-Or 602.23 exempt naturally occurring substances at naturally occurring or background levels. Background concentrations of manganese at the former Pease AFB have been documented as 942 µg/L (Weston, 1993), which is greater than the NHAGQS value; the enforceable standard at Pease AFB would be the established background manganese concentration.

<u>Changes in Exposure Pathways:</u> PDA expanded the 18-hole Pease Golf Course to 27 holes. The nine-hole expansion impacted an area of approximately 100 acres, including Site 45 (Figure 7.10-3). Because site soils were remediated to concentrations below the current residential NHDES S-1 standards, and because groundwater use is restricted by the GMZ, the protectiveness of the remedy is not impacted by the current site use.

Since completion of the last Five Year Review, additional guidance, including NHDES' *Vapor Intrusion Guidance* (NHDES, 2006; revised 2007), have been developed to aid in evaluating the potential for human exposure from the vapor intrusion pathway. EPA has also recently updated generic risk screening levels presented in the *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (EPA, 2002) for several compounds.

To address the issue of possible soil vapor intrusion pathways, a comparison of Site 45 groundwater data against EPA and NHDES screening levels will be forthcoming shortly and the results presented in a draft report for review by EPA and NHDES. There is no current vapor intrusion to indoor air pathway at Site 45 as there are no habitable structures nearby. The indoor air VI screening report will aid the Air Force, EPA, and NHDES in evaluating future ASN requests that include the construction of habitable structures within Pease GMZs/URZs.

Changes in Toxicity and Other Contaminant Characteristics: Recently revised NHAGQS for sec-butylbenzene, isopropylbenzene, 2-methylnaphthalene, and 1,2,4-trimethylbenzene are higher than their ROD-specified CGs. Therefore, changes in toxicity and other contaminant characteristics do not negatively impact the protectiveness of the remedy.

Changes in Risk Assessment Methods: The original HHRA was conducted following then current EPA and EPA Region 1 guidance. The health protectiveness of the original CGs would not be expected to change because the groundwater CGs were established primarily using ARARs. Also, risk-based CGs currently have ARARs available.

Risk assessments are performed somewhat differently now than they were at the time of the last Five-Year Review and especially since the time of the *Site 45 ROD*. Guidance documents/risk assessment tools that have been issued include:

- Background guidance (2002), which changed the way background comparisons are performed for metals.
- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.
- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.
- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.
- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.
- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

Expected Progress Toward Meeting RAOs: The remedy has achieved CGs in soil and, therefore, has achieved RAOs associated with preventing unacceptable exposure to soils. The remedy has currently achieved CGs for organic constituents in groundwater. It is expected that over time the remedy will attain the remaining inorganic CG for manganese in groundwater. ICs, including a GMZ, are in place and maintained; these should ensure protectiveness until the groundwater CG for manganese is attained.

7.10.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

7.10.4.4 Technical Assessment Summary

The remedy at Site 45 is functioning as intended. Soil CGs were attained by the AS/SVE system (Bechtel, 2001). Organic constituent concntrations in groundwater have declined below ROD-specified CGs and are significantly below updated groundwater ARARs (NHAGQS). ICs, including a GMZ, are in place and maintained; these should ensure protectiveness until the groundwater CG for manganese is attained. No changes in exposure pathways are affecting the protectiveness of the remedy. No other information has come to light that would call into question the protectiveness of the remedy.

7.10.5 Issues

ARARs are now available for several groundwater COCs that were assigned risk-based CGs in the *Site 45 ROD*. The *Site 45 ROD* CG for manganese in groundwater (1,500 µg/L) is higher than the current NHAGQS for manganese (840 µg/L) and the Pease AFB background value (942 µg/L). No other issues were identified for Site 45.

7.10.6 Recommendations and Follow-up Actions

Remedial measures at Site 45 remain protective of human health and the environment under current exposures. Routine evaluation of environmental monitoring results should continue, with data analysis including identification of opportunities to streamline monitoring and reporting. Upon receipt of data indicating that manganese concentrations in groundwater are below the CG, the Air Force should consult with EPA and NHDES regarding monitoring activities necessary to achieve site closure. The availability of ARARs (NHAGQS) for several site COCs and the Pease AFB background value for manganese (942 µg/L) should be documented in future long-term monitoring reports.

7.10.7 Protectiveness Statement

Because of the remedial action at Site 45 (implementation of the AS/SVE system) and ICs, including the GMZ, the site is protective of human health and the environment. The site is expected to be protective in the future, as progress is made toward achievement of the CG for the remaining groundwater COC (manganese).

7.10.8 References

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Weston, 1995b. *Site* 45 *(Old Jet Engine Test Stand) Remediation System Basis of Design.* August.

7.11 ZONE 3, SITE 73

7.11.1 Background

7.11.1.1 Site Description

Site 73 is located in Zone 3 in the central portion of the former Pease AFB (See Figure 7.11-1). Site 73 includes former Building 234 and surrounding driveways and grassy areas, as well as areas associated with a groundwater chlorinated VOC plume. Former Building 234 (demolished in 2007), where the plume begins, was located on Airline Avenue between Exeter Street to the south and Site 76 to the north. (See Figure 7.11-2). Adjacent sites include Building 239 (UST Site 79), the Base Motor Pool (UST Site 72), and Building 136 (UST Site 81); the airport passenger terminal is located across Airline Avenue. Land use in the area of the downgradient plume includes airport terminal parking and private commercial properties. Site 73 lies within the Zone 3 GMZ and land use is restricted as described in the *Zone 3 Record of Decision Amendment* (MWH, 2003a).

Building 234 was constructed in 1959 and was originally used as a liquid oxygen plant. In 1978, it was converted to house a water demineralization plant. Air Force records for Site 73 indicate that PCE and TCE were used as solvents and degreasers at Building 234. TCE was in common use at Pease AFB and was reportedly used at Building 234 from about 1956 until 1978. Cleaning and degreasing operations were conducted in the vicinity of the concrete area northeast of Building 234, with discharges to the environment apparently occurring in the form of minor spills or runoff associated with these operations (Weston, 1996).

The overburden at the site is comprised of a 1 to 14 ft thick layer of silty sandy fill underlain primarily by sand representing the undifferentiated US and LS units that occur across the former Pease AFB. The MCS unit that typically separates the two sand units elsewhere at Pease AFB is absent in the vicinity of the Site 73 source area, but the unit is present in downgradient areas of the plume. The MCS thickens to the east, to the point where it replaces the US and LS units near the eastern terminus of the plume. Glacial till underlies the US/LS/MCS units and is comprised of a poorly sorted mixture of gravel, sand, and silt. Where present, the till unit ranges in thickness up to 10 ft. The underlying bedrock consists of metamorphic phyllite and diabase intrusive rocks and is variably fractured and weathered in its upper 10 to 15 ft.

Groundwater at Site 73 is encountered at a depth of approximately 6 ft bgs. Historical groundwater elevation data have indicated that groundwater flows in a southerly direction in the vicinity of the Site 73 source area and permeable reactive barrier (PRB) and then flow direction changes to a southeasterly or even easterly direction in the downgradient portion of the plume. Horizontal linear groundwater velocities for both the overburden soils and shallow bedrock hydrogeologic units near the Building 234 range from 0.12 to 0.96 ft per day (ft/day). Shallow bedrock linear velocity ranges from 0.25 to 0.31 ft/day (MWH, 2004b).

7.11.1.2 Initial Response

Site 73 was originally investigated under the UST program at the former Pease AFB. The site contained two 1,000-gal fuel oil tanks; one tank was removed in 1989 and the other in 1991. Remedial activities under the UST program included the excavation and disposal of approximately 150 tons of contaminated soil from the areas surrounding the former USTs. Because of the presence of chlorinated VOC compounds in groundwater, the site was transferred to the IRP. Site 73 was under investigation at the time of the *Zone 3 ROD* (Weston, 1995). Remedial actions at Site 73 were later documented in the *Zone 3 ROD Amendment* (MWH, 2003a).

7.11.1.3 Basis for Taking Action

Zone 3 Remedial Investigation Report, Addendum 2, Site 73 Site Investigation (SI) (1994): SI activities focused on identifying the source and extent of chlorinated VOCs in soil and groundwater at Site 73 (Weston, 1994). The SI concluded that impacted soils had been removed during UST investigations and the SI and indicated the need for additional trenching and sampling along a former drainage ditch near the suspected source area. A single extraction well was installed as an IRM for impacted groundwater.

Site 73 Remedial Investigation and Feasibility Study (RI/FS) (1996): The RI/FS was completed in 1996 (Weston, 1996) as part of the CERCLA process. The Site 73 groundwater plume was found to be composed primarily of TCE and its degradation products. From the vicinity of Building 234, the plume extends southward, beneath Airline Avenue to the parking lot of the airport passenger terminal and continues south beyond Exeter Street to a wooded area containing a wetland and remnants of an abandoned water supply well field (circa 1940). Beneath the wooded area, the plume turns eastward, passing along the southern boundary of Site 81 and between Buildings 229 and 123. South of Building 123, the plume historically turned slightly northeastward before ending in a wooded area north of Building 122. The total length of the plume was historically approximately 2,200 feet. However, the most recent analytical data (2008) indicate that groundwater with COC concentrations above the *Zone 3*

ROD Amendment RGs are limited to an area approximately 300 ft downgradient of Building 234 (URS, 2009a).

7.11.2 Remedial/Removal Actions

The following subsections describe regulatory actions and remedial actions performed at Site 73.

7.11.2.1 Regulatory Actions

Presented below are the documents affecting remedy selection at Site 73:

Zone 3 Record of Decision Amendment (2003): The *Zone 3 ROD Amendment* (MWH, 2003a) formally documented the response action implemented at Site 73 to be consistent with CERCLA of 1980, as amended, and NCP. The response action activities documented in the ROD Amendment included:

- In-situ groundwater treatment with a zero-valent iron PRB;
- Monitored natural attenuation of the groundwater contaminant plume downgradient of the PRB; and
- Implementation of a long-term performance monitoring plan.

7.11.2.2 Remedial Action Objectives

The *Zone 3 ROD Amendment* (MWH, 2003a) identified the following general Zone 3 RAOs relevant to Site 73:

- Protect human receptors from ingestion of, or direct contact with, contaminated groundwater that may present an unacceptable health risk;
- Comply with chemical-specific ARARs; and
- Prevent discharge of contaminated groundwater to surface water bodies where such discharges may cause unacceptable risks to human health and the environment.

Groundwater RGs for groundwater at Site 73, as presented in the *Zone 3 ROD Amendment* (MWH, 2003a), are listed in Table 7.11-1.

7.11.2.3 Remedy Description

The response action activities documented in the *Zone 3 ROD Amendment* included:

- In-situ groundwater treatment with a zero-valent iron PRB;
- Monitored natural attenuation of the groundwater contaminant plume down-gradient of the PRB; and
- Implementation of a long-term performance monitoring plan.

In addition, the *Zone 3 ROD Amendment* (MWH, 2003a) noted the implementation of ICs as a component of the Site 73 remedy. ICs are the non-technical non-engineering actions, which support or complement the implementation of cleanup actions required by the remedy. Implementation, monitoring, and enforcement of the selected ICs are used to ensure protection of human health and the environment at property encompassed by Site 73. The goals of the ICs are designed to be protective of human health and the environment and include:

- Prevent exposure to contaminated soil;
- Prevent exposure to contaminated groundwater;
- Protect the integrity of the Site 73 PRB and monitoring well networks.

7.11.2.4 Remedy Implementation

A limited groundwater quality profiling investigation was performed in the summer of 1996 (Johnson, 1996) to determine the extent of the chlorinated solvent plume from Site 73. Supplemental profiling was performed in the fall of 1996 in an unsuccessful attempt to define the downgradient edge of the plume (Johnson, 1997). Bechtel continued to perform additional characterization activities in 1997 to investigate the potential for DNAPL in the source area (none was found), characterize shallow bedrock groundwater conditions, and to define the downgradient portions of the plume. Results from this supplemental characterization activity were used to evaluate remedial alternatives and it was determined that a PRB would be a technically feasible remedial option at Site 73.

A siting study was completed in March 1999 to provide a detailed understanding of the hydraulic, geotechnical, and geologic conditions at the proposed PRB location as needed to support the design and installation of the PRB. Results from this effort, which involved the collection of data to quantify soil engineering properties, hydraulic parameters in the soil and bedrock, lithology, and contaminant distribution, were presented in the *Technical Memorandum for the Permeable Reactive Wall Siting Study* (Bechtel, 1999a). Additionally, Bechtel performed groundwater flow measurements in the vicinity of the PRB following the conclusion of remedial activities at Site 73. The results are discussed in the *Technical Memorandum for Groundwater Flowmeter Measurement Results at Pease AFB* (Bechtel, 2001a).

In 1999, the 150 ft long by 2.5 ft wide PRB containing zero-valent iron (Fe^0) was constructed approximately 125 ft downgradient of the Site 73 source area; the PRB was constructed to a depth of approximately 34 ft bgs (overburden/weathered bedrock interface). After construction of the PRB was completed in August 1999, a one-year performance-monitoring program was conducted to evaluate the PRB. Groundwater potentiometric and analytical data were collected in accordance with the *Site 73 Permeable Reactive Wall Technology Demonstration, Performance Monitoring Plan* (Bechtel, 1999b). These data were presented and evaluated on a preliminary basis in a series of quarterly reports and a comprehensive evaluation of the data was presented in the *Site 73 Permeable Reactive Wall Technology Demonstration, Technology Evaluation Report* (Bechtel, 2001b). At the same time, characterization of the downgradient plume at Site 73 was investigated and reported in the *Technical Memorandum for the Investigation of the Downgradient Portion of the Site 73 Chlorinated Solvent Plume* (Bechtel, 2000).

The *Site 73 Permeable Reactive Wall Technology Demonstration, Technology Evaluation Report* (Bechtel, 2001b) presented a comprehensive summary and evaluation of performance monitoring data collected during the one-year demonstration period. The performance program determined that the PRB was successfully capturing and treating 100% of the contaminated groundwater plume within the overburden. However, it was determined that a portion of the plume was reaching the overburden/bedrock interface upgradient of the PRB and a small portion of the total plume underflows the PRB. It was estimated in the Technology Evaluation that this portion of the contaminant plume that is underflowing the PRB represents less than 2% of the total contaminant mass within the plume. Consequently, it was concluded that the PRB was performing as designed and the Air Force prepared and submitted a *Site 73 Draft Long-Term Monitoring Plan (LTMP)* (Bechtel, 2001c).

Draft versions of the Site 73 Long-Term Monitoring Plans were submitted in 2001 (Bechtel, 2001c) and 2002 (MWH, 2002b). EPA Region 1 stated in comments on the 2001 LTMP that additional assessment to better understand the portion of the VOC contaminant plume passing underneath the PRB was required. These comments noted the importance of determining whether high concentration areas immediately downgradient of the PRB were the result of portions of the contaminant plume underflowing the PRB or were the result of original plume contamination that had yet to flow to the downgradient monitoring points.

The Air Force continued to collect performance monitoring data during 2001 and 2002 that were reported in the *Site 73 2001 Status Report* (MWH, 2002a) and the *Site 73 2002 Status Report* (MWH, 2003a). The performance monitoring included:

- Collection of analytical samples for VOC, intrinsic remediation, and field parameters annually from 41 wells;

- Collection of water elevation data semi-annually (spring/fall) from 56 monitoring points;

- Collection of continuous water elevation data at eight monitoring points adjacent to and within the PRB; and,

- Annual reporting of data, interpretations, and recommendations.

Based upon this performance data, the Air Force concluded that the PRB is effectively capturing and reducing chlorinated VOCs in groundwater in the source area and is fostering the reduction of chlorinated VOCs in the downgradient plume area. The Air Force recommended in the *Site 73 2002 Status Report* (MWH, 2003a) that a demonstration of remedial actions operating properly and successfully, to allow for transfer of deed of the Site 73 portion of Zone 3 and a new LTMP, be prepared and submitted in 2003. The *Draft Demonstration of Remedial Actions Operating Properly and Successfully (OPS)* (MWH, 2003b) report was submitted for review in June 2003 and the *Site 73 LTMP* (MWH, 2004c) was submitted for review in January 2004.

When it was determined that the *OPS Demonstration* and the *LTMP* would not be finalized in 2003, the Air Force submitted the *Fall 2003 Site 73 Permeable Reactive Wall Performance Monitoring Fieldwork Notification* (MWH, 2003c) in August 2003 to propose additional performance monitoring during the review period of *the OPS Demonstration* and the preparation period of the *LTMP*. The analysis of this performance data was included in the *Site 73 2003 Status Report* (MWH, 2004b). Concurrent with these site-specific regulatory activities, the *Zone 3 ROD Amendment* (MWH, 2003a) was finalized in December 2003 and included formal documentation of the Site 73 remedy. The *OPS Demonstration* was finalized in March 2004 (MWH 2004a) and the *LTMP* was finalized in April 2004 (MWH, 2004c).

Figures 7.11-3, 7.11-4, and 7.11-5 show the current and historical chlorinated VOC concentrations in monitoring wells immediately upgradient and downgradient of the PRB for the shallow overburden, deep overburden, and hybrid/shallow bedrock hydrogeologic zones, respectively (URS, 2009a). Figures 7.11-6 and 7.11-7 show the current and historical chlorinated VOC concentrations in monitoring wells located in the more distal downgradient portions of the Site 73 plume. Chlorinated VOC concentrations in monitoring wells located in the residual source area and upgradient of the PRB show decreasing trends due to natural attenuation processes. As shown in these figures, the PRB has had a significant impact on the groundwater quality downgradient of the PRB since its installation noted by the decrease in downgradient VOC concentrations. Treated groundwater and recharge from infiltration are flushing contamination and allowing for restoration of groundwater within the overburden and hybrid/shallow bedrock zones downgradient of the PRB. Concentrations of chlorinated VOCs downgradient of the PRB have substantially been reduced to levels below the RGs established for Site 73 in the *Zone 3 ROD Amendment* (MWH, 2003b). During 2008 long-term monitoring activities, downgradient chlorinated VOC concentrations exceeded RGs only in hybrid wells 73-5813, 73-5814 and 73-5815, which are located immediately downgradient of the PRB, and marginally in deep overburden well 73-5618 and shallow bedrock well 73-6520, also located just downgradient of the PRB.

LUC/ICs were specified in the *Zone 3 ROD Amendment* (MWH, 2003a) and are in place for Zone 3, including Site 73, in the form of restrictions in the deed. All Zone 3 property has been transferred by the Air Force to PDA via quitclaim deed. LUC/ICs include a GMZ prohibiting use of groundwater and a URZ prohibiting both residential use and establishment of childcare facilities, playgrounds, athletic fields, or elementary/secondary schools. The Zone 3 GMZ and URZ are ASNs requiring concurrence from the Air Force for any development (i.e., digging, excavation, or construction) within the GMZ or URZ and specifically prohibits any activity that could disturb the ongoing remedy (PRB). Observations are made during the performance of LTM activities in Zone 3 to ensure that LUC/ICs have not been violated; these observations are documented in the *Zone 3 Annual Reports*. The ASN and PDA dig permit review processes, both requiring Air Force review and approval, also aid in LUC/IC enforcement. The ongoing use of the property conforms to the restrictions of the URZ and this use is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.11.3 Implementation of Recommendations from Last Five-Year Review

The second *Five-Year Review Report* (MWH, 2004d) recommended that routine long-term monitoring should continue. Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess PRB performance and optimize long-term monitoring activities.

Long-term monitoring and progress toward cleanup goals were documented in the following:

- *Site 73 PRB 2004 Status Report* (MWH, 2005),
- *Site 73 PRB 2005 Status Report* (MWH, 2006),
- *Site 73 PRB 2006 Status Report* (URS, 2007),
- *Site 73 PRB 2007 Status Report* (URS, 2008), and
- *Site 73 PRB 2008 Status Report* (URS, 2009a).

As agreed to by NHDES and USEPA, the *Site 73 LTMP* (MWH, 2004c) will be amended to harmonize the IR parameter sampling to once every three years in all LTM wells/piezometers to permit assessment of a sitewide snapshot of these data. Chloride will be added to the IR parameter analyte list. The next IR parameter analyses for Site 73 will be performed in 2010. The *Site 73 LTMP, Revision 1* (URS, 2009b [in preparation]) is currently being prepared to incorporate these changes.

7.11.4 Technical Assessment

The technical assessment component of the Five-Year Review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (EPA, 2001).

7.11.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

A review of documents, ARARs, and the results of annual monitoring indicate that the remedy is functioning as intended. Long-term monitoring data indicate that the PRB is successfully capturing and remediating a substantial portion of the contaminant plume within the overburden, thus supporting natural attenuation of the downgradient plume. The PRB is allowing groundwater quality downgradient of the PRB to progress towards attainment of the site-specific RGs and prevents the migration of contaminants offsite to downgradient groundwater discharge areas. The most recent sampling data from Site 73 indicate that chlorinated VOCs were detected at only one monitoring location in the downgradient plume area and at concentrations only slightly above (same order of magnitude) the Site 73 RGs. LUC/ICs are being maintained and monitored to prevent potentially unacceptable human exposure to site contaminants in groundwater.

7.11.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: Groundwater RGs for Site 73 were established in the *Zone 3 ROD Amendment* (MWH, 2003a). The RGs were based on Federal Safe Drinking Water Act MCLs and NHAGQS (Env-Wm 1403). Env-Wm 1403 was superceded by Env-Or 600 (effective February 1, 2007), which presents the current NHAGQS (NHDES, 2007). There were no changes to the NHAGQS for Site 73 COCs: the *Zone 3 ROD Amendment* RGs are consistent with the current NHAGQS. There have been no changes in standards that would affect the protectiveness of the remedy.

Changes in Exposure Pathways: Since completion of the last Five Year Review, additional guidance, including NHDES' *Vapor Intrusion Guidance* (NHDES, 2006; revised 2007), have been developed to aid in evaluating the potential for human exposure from the vapor intrusion pathway. EPA has also recently updated generic risk screening levels presented in the *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (EPA, 2002) for several compounds.

To address the issue of possible soil vapor intrusion pathways, a comparison of Site 73 groundwater data against EPA and NHDES screening levels will be forthcoming shortly and the results presented in a draft report for review by EPA and NHDES. The information provided in the report will be used to determine locations for air sample collection and will aid the Air Force, EPA, and NHDES in evaluating future ASN requests that include the construction of habitable structures within Pease GMZs/URZs.

Changes in Toxicity and Other Contaminant Characteristics: The Site 73 groundwater RGs were based upon ARARs that are still current. There have been no changes in toxicity or other contaminant characteristics that would affect the protectiveness of the remedy.

Changes in Risk Assessment Methods: The original HHRA was conducted following then current EPA and EPA Region 1 guidance. The health protectiveness of the *Zone 3 ROD Amendment* RGs would not be expected to change because the groundwater RGs were established using ARARs that are consistent with the current NHAGQS.

Risk assessments are performed somewhat differently now than they were at the time of the last Five-Year Review and the *Zone 3 ROD Amendment*. Guidance documents/risk assessment tools that have been issued include:

- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.
- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.
- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.
- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.
- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

Expected Progress Toward Meeting RAOs: The RAO of protecting human receptors from ingestion of, or direct contact with, contaminated groundwater that may present an unacceptable risk is currently being met by the successful implementation of the ICs identified in the *Zone 3 ROD Amendment*. The capture/remediation of the contaminant plume by the PRB prevents any potential surface water discharge of contaminants. The only RAO that has yet to be achieved at Site 73 is compliance with chemical-specific ARARs. However, LTM activities have documented the progress towards attainment of ARARs. The PRB is facilitating progress towards the attainment of the remaining RAO by successfully capturing and remediating a substantial portion of the contaminant plume within the overburden and allowing for restoration of the groundwater within the overburden and hybrid/shallow bedrock zones downgradient.

7.11.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No information has come to light at this time that would call into question the protectiveness of the remedy.

7.11.4.4 Technical Assessment Summary

As described above, the remedy at Site 73 is functioning as intended by successfully capturing and remediating a substantial portion of the remaining groundwater contaminant plume within the overburden, thus supporting natural attenuation of the downgradient plume. Additionally, LUC/ICs are in place and performing as expected. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. The remedy is currently progressing toward achievement of RAOs and no other information has come to light that would call into question the protectiveness of the remedy.

7.11.5 Issues

In comments on the *Site 73 PRB 2008 Status Report* (URS, 2009a), EPA expressed concern that 2008 groundwater contour maps may show apparent groundwater mounding behind the PRB wall. The Air Force is currently discussing this potential issue with EPA and NHDES.

7.11.6 Recommendations and Follow-up Actions

Routine LTM should continue until groundwater ARARs are achieved. Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess PRB performance and optimize LTM activities. Additionally, based on information provided in the forthcoming VI screening report, buildings may be identified for air sampling to assess potential vapor intrusion pathways.

7.11.7 Protectiveness Statement

The remedial action at Site 73 (installation of the PRB, establishment of the Zone 3 GMZ with LTM, and LUC/ICs on the property) is protective of human health and the environment and will remain so in the future as groundwater RGs are achieved.

7.11.8 References

Bechtel, 1999a. *Technical Memorandum for the Permeable Reactive Wall Siting* Study. March.

Bechtel, 1999b. Site 73 *Permeable Reactive Wall Technology Demonstration Construction Report, Volume I—Text and Appendix A (Performance Monitoring Plan).* October.

Bechtel, 2000. *Technical Memorandum for the Investigation of the Downgradient Portion of the Site 73 Chlorinated Solvent Plume*. July.

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Bechtel, 2001c. *Draft Site 73 Long-Term Monitoring Plan*. March.

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EPA, 2005b. *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), EPA 630-R-03-003F. March.

Johnson, 1996. *Site 73 Supplemental Groundwater Quality Profiling Rep*ort. October.

Johnson, 1997. *Supplemental Groundwater Profiling – Phase II—at Pease Air Force Base Site 73.* January.

MWH, 2002a. *Site 73 Permeable Reactive Barrier 2001 Status Report*. February.

MWH, 2002b. *Revised Draft Site 73 Long-Term Monitoring Plan*. February.

MWH, 2003a. *Zone 3 Record of Decision Amendment*. December.

MWH, 2003b. *Site 73 Permeable Reactive Barrier 2002 Status Report*. February.

MWH, 2003c. *Draft Demonstration of Remedial Actions Operating Properly and Successfully, Site 73*. June.

MWH, 2003d. *Fall 2003 Site 73 Performance Monitoring Fieldwork Notification*. August.

MWH, 2004a. *Demonstration of Remedial Actions Operating Properly and Successfully*. March.

MWH, 2004b. *Site 73 Permeable Reactive Barrier 2003 Status Report*. April.

MWH, 2004c. *Site 73 Long-Term Monitoring Plan*. April.

MWH, 2004d. *5-Year Review Report (1999-2004), Former Pease Air Force Base, Portsmouth, New Hampshire*. September.

MWH, 2005. *Site 73 Permeable Reactive Barrier 2004 Status Report*. July.

MWH, 2006. *Site 73 Permeable Reactive Barrier 2005 Status Report*. June.

NHDES. 2006. *Vapor Intrusion Guidance*. July (revised February 1, 2007).

NHDES, 2007. *Env-Or 600 Contaminated Site Management.* Effective February 1, 2007.

URS, 2007. *Site 73 Permeable Reactive Barrier 2006 Status Report*. December.

URS, 2008. *Site 73 Permeable Reactive Barrier 2007 Status Report*. November.

URS, 2009a. *Site 73 Permeable Reactive Barrier 2008 Status Report*. January.

URS, 2009b. *Site 73 Long-Term Monitoring Plan, Revision 1*. (in preparation)

Weston, 1994. *Zone 3 Remedial Investigation Report, Addendum 2, Site 73 Site Inve*stigation. May.

Weston, 1995. *Zone 3 Record of Decision.* December.

Weston, 1996. *Site 73 Remedial Investigation Report/Feasibility* Study. September.

7.12 ZONE 3, SITE 49

7.12.1 Background

7.12.1.1 Site Description

Site 49 is approximately 5 acres in size and is located at the intersection of Pease Boulevard and International Drive. Figure 7.12-1 shows the location of Site 49. The site was formerly occupied by Building 22 (a former communications building) and consists of the location of the former building, surrounding driveways and grassy areas, and downgradient areas associated with the groundwater contaminant plume. Building # 22 has been demolished and the site has been redeveloped with a privately owned office building. Construction of an additional commercial office building and parking garage was completed on the parcel of land located to the west of Site 49 in 2002, including the construction of a stormwater retention basin located approximately 300 feet to the southwest of the Site (MWH, 2003a). Figure 7.12-2 shows the location of specific site features at Site 49.

Air Force records for Site 49 indicate that PCE and TCE were used as solvents and degreasers at Building 22. TCE was in common use at Pease AFB from 1956 until 1973 and was reportedly used at Building 22 until 1978. Cleaning and degreasing operations were conducted in the vicinity of the south wing area of Building 22, with discharges to the environment apparently occurring in the form of minor spills or on-site disposal associated with the normal daily operations. These discharges resulted in releases of TCE and PCE to the soils and groundwater in the vicinity of the building. A groundwater contaminant plume has been defined as originating outside of the location of the south wing of former Building 22 and extending in an easterly direction toward International Drive. The resulting VOC plume is being treated with a zero-valent iron (Fe^0) PRB.

In general, the geology at Site 49 consists of sandy/silt backfill material and a native gravelly sand overburden overlying fractured phyllite bedrock. The site subsurface is comprised of three interconnected hydrogeologic zones whose depth and thickness vary throughout the site. These are, in order of increasing depth:

Zone 1: Overburden – The overburden consists mainly of fill material, silty sand, and glacial till comprised of a poorly sorted mixture of gravel, sand, and silt from ground surface to a varying depth of 15 to 20 ft bgs in the area immediately downgradient of former Building #22.

Zone 2: Shallow Bedrock - A highly fractured zone of weathered phyllite bedrock underlies the overburden and has a thickness range of 1 to 5 ft in the area immediately downgradient of former Building #22. Fractured bedrock is encountered at depths ranging from approximately 14 to 20 ft bgs across the site.

Zone 3: Deep Bedrock – Site investigations have indicated that bedrock becomes increasingly competent with depth. Competent bedrock has been generally encountered at depths ranging from 16 to 24 ft bgs in the area immediately downgradient of the former Building #22 and at depths ranging from 24 to 32 ft bgs in the downgradient plume.

Groundwater level measurements collected during investigations and monitoring activities indicate that groundwater is generally encountered at a depth of 4 to 8 ft bgs across the site. Potentiometric surface mapping has indicated that groundwater horizontal flow is generally in an easterly direction across the site.

Horizontal groundwater seepage velocity for the overburden (Zone 1) is calculated as ranging from 1.0 ft/day to 2.4 x 10^{-4} ft/day. Horizontal groundwater seepage velocity for the shallow bedrock (Zone 2) is calculated as ranging from 0.26 ft/day to 1.1 x 10^{-2} ft/day. These ranges of values were obtained by using the reported K values, an average hydraulic gradient of 0.03 and a porosity value of 0.3 for overburden soils and 0.2 for shallow bedrock.

Figures 7.12-3, 7.12-4, 7.12-5 and 7.12-6 show the wells in the LTM network and the area of historic groundwater contamination.

7.12.1.2 Initial Response

In 1997, approximately 800 cubic yards of contaminated soil were removed. In 1998, a crushed drum and approximately 3 cubic yards of impacted soil were removed east of former Building #22. Post-removal sampling concluded that the majority of the impacted soils were removed (Bechtel, 1999).

7.12.1.3 Basis for Taking Action

The *Zone 3 Record of Decision (ROD)* (Weston, 1995) did not include Site 49. Previous investigations of Site 49 by R.W. Gillespie & Associates (1997), Bechtel (1997), and TN & Associates, Inc. (1999) identified chlorinated organics in both soils and groundwater. The primary contaminants include TCE, PCE, and their associated degradation products. The source of the contamination is presumed to be the former maintenance activities in the vicinity of the garage of former Building #22.

In November and December of 1999, a supplemental site characterization was conducted by Versar, (Versar, 2000a) to optimize the location and geometry of the proposed remedial action (a PRB containing Fe^0). Results of soil samples collected from the overburden soil indicated that no VOC compounds exceeded the New Hampshire S-3 Soil Standards. Results of overburden groundwater samples identified PCE, TCE, 1,1-DCE, cis-1,2-DCE, and vinyl chloride as COCs with concentrations that exceeded the applicable NHAGQS. The major contaminant detected was TCE with a maximum value of 491 µg/L, which exceeded the NHAGQS of 5 µg/L. Bedrock groundwater sample results identified PCE, TCE, DCA, 1,1-DCE, cis-1,2-DCE, and vinyl chloride as COCs with concentrations above their respective NHAGQS. TCE was the major contaminant detected with a maximum value of 2,440 µg/L, exceeding the NHAGQS of 5 µg/L.

In June 2000, the Air Force issued the *Site 49 Remedial Action Decision, Consensus Statement* (AFBCA, 2000) documenting the remedial action decision for Site 49, which included the installation of an in-situ remediation system using zero-valent iron in a PRB to restore contaminated groundwater downgradient of the PRB. This conceptual remediation model works on the basis of groundwater flowing through the PRB under natural gradient and degrading the chlorinated VOCs through the process of reductive dehalogenation.

7.12.2 Remedial/Removal Actions

7.12.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy.

Site 49 - Action Memorandum for a Non-Time-Critical Removal Action (2000):

In February 2000, the Air Force issued an *Action Memorandum for a Non-Time-Critical Removal Action* for Site 49 (TN & Associates, Inc. 2000). This document outlined the selection of a PRB as the removal action to be implemented at the site to address contaminated groundwater.

Zone 3 Record of Decision Amendment (2003):

The *Zone 3 ROD Amendment* (MWH, 2003b) formally documented the response action implemented at Site 49 to be consistent with CERCLA of 1980 and NCP. The response action activities documented in the ROD Amendment included:

- In-situ groundwater treatment with a zero valent iron PRB;
- Monitored natural attenuation of the groundwater contaminant plume down-gradient of the PRB;
- Implementation of a long-term performance monitoring plan; and
- Establishment of a GMZ in accordance with New Hampshire regulations.

7.12.2.2 Remedial Action Objectives

The *Zone 3 ROD Amendment* (MWH, 2003b) identified the following general Zone 3 RAOs relevant to Site 49:

- Protect human receptors from ingestion of, or direct contact with, contaminated groundwater that may present an unacceptable health risk;
- Comply with chemical-specific ARARs; and
- Prevent discharge of contaminated groundwater to surface water bodies where such discharges may cause unacceptable risks to human health and the environment (MWH, 2003b).

RGs for groundwater at Site 49, as presented in the *Zone 3 ROD Amendment* (MWH, 2003b), are listed in Table 7.12-1.

7.12.2.3 Remedy Description

The response action activities documented in the ROD Amendment included:

- In-situ groundwater treatment with a zero valent iron PRB;

- Monitored natural attenuation of the groundwater contaminant plume down-gradient of the PRB;
- Implementation of a long-term performance monitoring plan; and
- Establishment of a GMZ in accordance with New Hampshire regulations.

In addition, the *Zone 3 ROD Amendment* (MWH, 2003b) noted the implementation of ICs as a component of the Site 49 remedy. ICs are the non-technical non-engineering actions that support or complement the implementation of cleanup actions required by the remedy. Implementation, monitoring, and enforcement of the selected ICs are used to ensure protection of human health and the environment at property encompassed by Site 49. The goals of the ICs are designed to be protective of human health and the environment and include:

- Prevent exposure to contaminated soil;
- Prevent exposure to contaminated groundwater;
- Protect the integrity of the Site 49 and Site 73 PRBs, groundwater treatment systems, and monitoring well networks.

Specific components of the ICs include deed restrictions, engineering controls, lease restrictions, notice of the deeded transfer of property, monitoring, and enforcement of the ICs.

7.12.2.4 Remedy Implementation

In June-July of 2000, Versar installed the PRB at Site 49 with both a shallow and deep component. Figure 7.12-2 shows the location of these components of the PRBs. The PRB component installations are summarized below and detailed in the *Shallow and Deep PRB Construction Installation Report* (Versar, 2000b).

The shallow PRB was placed in the overburden at a location downgradient of the highest VOC groundwater concentrations. Upon completion, the shallow PRB measured approximately 150 ft in length and had an average depth and thickness of 15 ft and 2.5 ft, respectively. The shallow PRB component was designed as a continuous wall extending from the groundwater surface (approximately 5 ft bgs) to the top of shallow bedrock (average depth 15 ft bgs). The wall thickness was to be determined by the construction method selected and was to be equivalent to 0.75 ft of 100 percent iron as calculated for the specific site conditions by Environmental Technologies, Inc. (ETI), the proprietor of this patent-pending remedial technology (Versar, 2000b). The wall was installed approximately 200 ft downgradient of the suspected source area and along the western edge of the present office building.

The deep PRB consists of 40 shallow bedrock borings, 6 inches in diameter, spaced at 5-ft intervals and backfilled with 100 percent zero-valent iron within the zone of interest, approximately 15 to 30 ft bgs. The deep PRB portion of the wall was placed parallel to the shallow portion and at a 75-degree angle to the groundwater flow direction in order to maintain optimal plume/PRB contact area.

Performance monitoring and groundwater LTM is ongoing at Site 49 as part of the remedial action for the site. A total of sixteen monitoring wells and twelve piezometers were installed in August and September 2000 to augment the set of existing on-site wells. The piezometers were placed in clusters around the PRB to evaluate its performance. Fourteen monitoring wells were placed downgradient of the PRB to expand coverage of the existing monitoring well network, both horizontally and vertically. The remaining two monitoring wells were placed upgradient of the PRB to determine the quality of groundwater entering the PRB.

The U.S. Air Force (USAF) submitted the *Site 49 Groundwater Management Permit Application Substantive Requirements Demonstration* (MWH, 2002) in February 2002 and received written approval of the demonstration from NHDES in May 2002. The approval of the *Substantive Requirements Demonstration* established a GMZ for Site 49 as described in Env-Wm 1403 (Figure 7.12-2).

The *Zone 3 ROD Amendment* (MWH, 2003b) was finalized in December 2003 and included Site 49 to formally document the implemented remedy, consistent with the CERCLA and the NCP. The *Zone 3 ROD Amendment* (MWH, 2003b) established site-specific groundwater RGs for Site 49 (Table 7.12-1).

In July 2008, nine additional piezometers (screened within the site’s shallow overburden) were installed near or west of the GMZ boundary (URS, 2009). Data collected from these piezometers will be used to refine groundwater flow north, south, and west of the site within the shallow overburden .

Performance monitoring at Site 49 is currently performed in accordance with the *Site 49 Performance and Long-Term Monitoring, Sampling and Analysis Plan, Revision 2* (MWH, 2004b). These data support the conclusion that the PRB is functioning and is reducing chlorinated VOC concentrations by truncating the source of chlorinated VOCs, thus allowing the various natural attenuation processes of degradation, dilution, and dispersion to reduce contaminant concentrations downgradient of the PRB. No RG exceedances have occurred at the GMZ boundary wells indicating that groundwater containing VOCs at concentrations above RGs has not migrated outside the Site 49 GMZ boundary. (Figure 7.12-3). Chemical data indicate that natural attenuation is occurring downgradient of the PRB, based on detections of PCE and TCE degradation products cis-1,2-DCE, 1,1-DCE, and VC within the downgradient portion of the plume (Figures 7.12-4 through 7.12-6). However, groundwater contaminant concentrations and plume geometry downgradient of the PRB are relatively stable across the site and only minor concentration decreases are observed. This consistency in concentrations has been attributed to several factors, including:

- A relatively low groundwater seepage velocity found on site, caused by the aquifer's relatively low hydraulic conductivity;

- Installation of the PRB within the existing contaminant plume; and

- Lack of significant recharge both upgradient and downgradient of the PRB due to the buildings and associated parking lots.

- The possibility that the PRB is receiving and treating groundwater from both upgradient and downgradient of the PRB and is transmitting treated groundwater to the aquifer at the southern end of the PRB.

Due to these limiting factors, it is anticipated that it will be some time before groundwater restoration has been achieved at Site 49.

LUC/ICs were specified in the *Zone 3 ROD Amendment* (MWH, 2003b) and are in place for Zone 3, including Site 49, in the form of restrictions in the deed. All Zone 3 property has been transferred by the Air Force to PDA via quitclaim deed. LUC/ICs include a GMZ prohibiting use of groundwater, a URZ prohibiting both residential use and establishment of childcare facilities, playgrounds, athletic fields, or elementary/secondary schools. The Site 49 GMZ and URZ are ASNs requiring concurrence from the Air Force for any development (i.e., digging, excavation, or construction) within the GMZ or URZ and specifically prohibits any activity that could disturb ongoing remedies. Observations are made during the performance of LTM activities at Site 49 to ensure that LUC/ICs have not been violated; these observations are documented in the *Site 49 PRB Annual Reports*. The ASN and PDA dig permit review processes, both requiring Air Force review and approval, also aid in LUC/IC enforcement. The ongoing use of the property conforms to the restrictions of the URZ and this is not expected to change. The LUC/ICs remain protective; no deficiencies have been identified.

7.12.3 Implementation of Recommendations from Last Five-year Review

The second *Five-Year Review Report* (MWH, 2004a) recommended the following:

- Routine long-term monitoring should continue.
- Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess PRB performance and optimize LTM activities.
- Investigation should be performed to confirm the hydraulic characteristics of the PRB and surrounding aquifer.
- Additionally, investigation of the possible soil vapor intrusion pathway should be undertaken when EPA guidance more applicable to commercial buildings is available.

Long-term monitoring and progress toward cleanup goals were documented in the following:

- *Site 49 PRB 2004 Annual Report* (MWH, 2005),
- *Site 49 PRB 2005 Annual Report* (MWH, 2006),
- *Site 49 PRB 2006 Annual Report* (URS, 2007),
- *Site 49 PRB 2007 Annual Report* (URS, 2008), and
- *Site 49 PRB 2008 Annual Report* (URS, 2009).

Performance monitoring requirements for Site 49 are documented in the *Site 49 Performance and Long-Term Monitoring, Sampling and Analysis Plan, Revision 2* (MWH, 2004b). The *Site 49 Performance and Long-Term Monitoring, Sampling and Analysis Plan* is currently being updated to reflect monitoring program changes previously approved by NHDES and USEPA and will be reissued for regulatory agency review in 2009.

Site reconnaissance was performed to investigate changes in groundwater flow patterns observed at the site in recent years. A commercial building was constructed circa 2001 west of and immediately upgradient of the PRB; a stormwater detention basin was also constructed approximately 100 feet southwest of the PRB during the construction of the new commercial building. The stormwater detention basin collects overland flow and storm drain discharge from paved areas to the south, north, and west and itself drains into a larger 36-inch diameter drain line that runs along the south side of Site 49. The basin is the lowest local topographic feature in the vicinity of the PRB and groundwater has been observed seeping into the basin and flowing into the 36-inch diameter drain line. The basin probably normally acts as a groundwater sink, collecting some local groundwater discharge and transporting it away from the site via the storm drain. The basin has likely induced a more southwestward component in overburden groundwater flow upgradient of the PRB.

Horizontal groundwater flow data and chemical data indicate that some contaminated groundwater could be flowing around the southern end of the PRB, especially during periods of high groundwater. Vertical groundwater gradient and chemical data in the fall in the vicinity of the PRB wall also indicate that there is the possibility for some contaminant migration into bedrock or under the wall. However, based upon well analytical data downgradient of the PRB, the small contaminant mass bypassing the PRB does not appear to be significantly impacting the downgradient performance of the remedy.

Beginning with the *Site 49 PRB 2006 Annual Report* (URS, 2007), the soil vapor intrusion pathway at Site 49 has been evaluated annually in accordance with NHDES *Vapor Intrusion Guidance* (NHDES, 2007) by comparing the annual groundwater analytical results for wells within 100 feet (horizontally or vertically) of the office building at Site 49 to the Revised GW-2 groundwater to indoor air screening levels. All GW-2 screening level exceedances have occurred in deep overburden or shallow bedrock monitoring wells/piezometers. Shallow overburden monitoring points are co-located with each of the wells/piezometers where the screening level exceedances occurred and no VOCs have been detected at concentrations exceeding the groundwater to indoor air screening levels at any of the shallow overburden wells/piezometers. Therefore, there appears to be no complete pathway for vapor intrusion into the office building. In addition, the office building at Site 49 was constructed with a sub slab vapor barrier that may help to mitigate vapor intrusion.

7.12.4 Technical Assessment

The technical assessment component of the Five-Year Review consists of evaluating the protectiveness of the remedy. The technical assessment was performed based on guidance provided in Section 4.0 of the *Comprehensive Five-Year Review Guidance* (EPA, 2001).

7.12.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

A review of documents, ARARs, and the results of performance monitoring indicate that the remedy is functioning as intended. Initial soil removal efforts resulted in source reduction. The PRB is passively capturing and facilitating reductive dechlorination of contaminated groundwater. Some contaminated groundwater may be flowing around or under the PRB; however, the small contaminant mass bypassing the PRB does not appear to be significantly impacting the downgradient performance of the remedy. LTM data indicate that contaminant concentrations are relatively stable across much of the site, groundwater containing concentrations of VOCs above the Site 49 RGs has not migrated outside of the established GMZ, and the most recent sampling data from Site 49 indicate reductions of chlorinated VOCs in several downgradient plume monitoring points. LUC/ICs are maintained and monitored to prevent potentially unacceptable human exposure to site contaminants in groundwater and to prevent land uses that are prohibited under the long-term lease.

7.12.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: Groundwater RGs for Site 49 were established in the *Zone 3 ROD Amendment* (MWH, 2003b). The RGs were based on Federal Safe Drinking Water Act MCLs and New Hampshire Ambient Groundwater Quality Standards (Env-Wm 1403). Env-Wm 1403 was superceded by Env-Or 600 (effective February 1, 2007), which presents the current NHAGQS (NHDES, 2007). There were no changes to the NHAGQS for Site 49 COCs: the *Zone 3 ROD Amendment* RGs are consistent with the current NHAGQS. There have been no changes in standards that would affect the protectiveness of the remedy.

Changes in Exposure Pathways: The second *Five-Year Review Report* (MWH, 2004a) recommended investigating the soil vapor intrusion pathway at Site 49. Since completion of the last Five Year Review, additional guidance, including NHDES' *Vapor Intrusion Guidance* (NHDES, 2006; revised 2007), have been developed to aid in evaluating the potential for human exposure from the vapor intrusion pathway. Beginning in 2006, in accordance with NHDES *Vapor Intrusion Guidance* (NHDES, 2006), the annual groundwater analytical results for wells within 100 feet (horizontally or vertically) of the existing office building at Site 49 have been compared to the Revised GW-2 groundwater to indoor air screening levels. To date all GW-2 screening level exceedances occurred in deep overburden or shallow bedrock monitoring wells/piezometers. Shallow overburden monitoring points are co-located with each of the wells/piezometers where the screening level exceedances occurred and no VOCs were detected at concentrations exceeding the groundwater to indoor air screening levels at any of these shallow overburden wells/piezometers. In addition, the office building at Site 49 was constructed with a sub slab vapor barrier that may help to mitigate soil vapor intrusion. There appears to be no complete pathway for vapor intrusion into the office building and a more detailed examination of the indoor exposure pathway has not appeared warranted (URS, 2009).

EPA has recently updated generic risk screening levels presented in the *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (EPA, 2002) for several compounds. These generic risk screening values will also be used in the future for comparison to the annual groundwater analytical results for wells within 100 feet (horizontally or vertically) of the existing office building at Site 49, which is documented in the *Site 49 PRB Annual Reports*.

To address the issue of possible soil vapor intrusion pathways, a comparison of Site 49 groundwater data against EPA and NHDES screening levels will be forthcoming shortly and the results presented in a draft report for review by EPA and NHDES. The information provided in the report will be used to determine locations for air sample collection and will aid the Air Force, EPA, and NHDES in evaluating future ASN requests that include the construction of habitable structures within Pease GMZs/URZs.

Changes in Toxicity and Other Contaminant Characteristics: The Site 49 groundwater RGs were based upon ARARs that are still current. There have been no changes in toxicity or other contaminant characteristics that would affect the protectiveness of the remedy.

Changes in Risk Assessment Methods: The original human health risk assessment (HHRA) was conducted following then current EPA and EPA Region 1 guidance. The health protectiveness of the *Zone 3 ROD Amendment* RGs would not be expected to change because the groundwater RGs were established using ARARs that are consistent with the current NHAGQS.

Risk assessments are performed somewhat differently now than they were at the time of the last Five-Year Review and the *Zone 3 ROD Amendment*. Guidance documents/risk assessment tools that have been issued include:

- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.
- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.
- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.
- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.
- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

Expected Progress Toward Meeting RAOs: Implementation of the remedy is currently meeting the RAOs of preventing exposure to contaminated groundwater and preventing the discharge of contaminated groundwater to surface water bodies. A longer than anticipated timeframe may be needed to meet groundwater RGs because of site-specific factors (e.g., low hydraulic conductivities, low gradient, limited recharge). Until RGs are met, it is expected that long-term monitoring of groundwater quality and performance of the PRB, as well as implementation of the ICs defined in the *Zone 3 ROD Amendment* (MWH, 2003b), will ensure protection of human health and the environment.

7.12.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No information has come to light that would call into question the protectiveness of the remedy.

7.12.4.4 Technical Assessment Summary

As described above, the remedy at Site 49 is functioning as intended by successfully capturing and remediating a substantial portion of the contaminant plume within the overburden. Additionally, LUC/ICs are in place and performing as expected. No changes in exposure pathways, toxicity, or other contaminant characteristics are affecting the protectiveness of the remedy. Since 2006, the potential soil vapor intrusion pathway has been evaluated using annual groundwater data and vapor intrusion into the onsite office building does not appear to be a pathway of concern at this time. While declining COC trends have developed slowly across downgradient portions of the plume, the remedy is currently progressing toward achievement of RGs. No information has come to light that could call into question the protectiveness of the remedy.

7.12.5 Issues

The interaction between the stormwater detention basin and the upgradient portion of the Site 49 groundwater contaminant plume needs to be evaluated in greater detail.

7.12.6 Recommendations and Follow-up Actions

Routine long-term monitoring should continue. Routine data evaluation of groundwater flow conditions and trends in groundwater quality should be performed to assess PRB performance and optimize long-term monitoring activities. Additionally, annual comparisons of Site 49 groundwater analytical data to NHDES *Vapor Intrusion Guidance* groundwater to indoor air screening values should continue in the future to evaluate potential soil vapor intrusion risks.

The Air Force should obtain the design details for the stormwater detention basin and evaluate if it is functioning as designed. Additional monitoring should be performed to evaluate the interaction between the stormwater detention basin and the upgradient portion of the Site 49 groundwater contaminant plume.

7.12.7 Protectiveness Statement

The remedial action at Site 49 (installation of the PRB, establishment of the GMZ with long-term monitoring, and institutional controls on the property) is currently protective of human health and the environment and will remain so in the future as groundwater RGs are achieved.

7.12.8 References

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Bechtel, 1999. *Five-Year Review Report*, Pease Air Force Base. September.

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EPA, 2005a. *Guidelines for Carcinogenic Risk Assessment,* EPA 630-P-03-001F. March.

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Versar, Inc., 2000b. *Shallow and Deep PRB Construction Installation Report, Site 49 Remedial Action*. February.

Weston, 1995. *Zone 3 Record of Decision*. September.

8.0 CATEGORY 2 SITES, LONG-TERM MONITORING ONLY, SURFACE WATER/SEDIMENT WITH REMEDIAL ACTIONS REQUIRED AND COMPLETED

8.1 MAP

Category 2 sites are those with long-term monitoring with remedial actions required and completed. Category 2 sites addressed in this *Five-Year Review Report* include drainage features associated with Zone 1, Pauls Brook (Drainage Area A) and Zone 1, Railway Ditch and Flagstone Brook (Drainage Area J). The locations of these drainage areas are illustrated in Figure 8.1-1.

Zone 3, McIntyre Brook (Drainage Area F) was a Category 2 site in the second *Five-Year Review Report* (MWH, 2004) (see Figure 8.4-1). However, LTM for all COCs in all McIntyre Brook media was discontinued by 2003 and the second *Five-Year Review Report* recommended that it would serve as the final review of remedial activities at McIntyre Brook and that this site be removed from future Five-Year Reviews. Therefore, McIntyre Brook is not being reviewed in this report.

8.2 DATA SUMMARY TABLE

Table 8.2-1 summarizes information in this *Five-Year Review Report* for sites in Category 2. The columns in this table include the following information:

- Site I.D. – The IRP Zone and site identifier used in the first Five-Year Review Report (Bechtel, 1999).

- Sites Included – A listing of individual IRP sites included under the IRP Zone/site identifier in this Five-Year Review Report.

- Site Chronology – A chronological listing of major documents associated with remedial actions performed at the sites.

- Background – Description of site location and brief history of site activities that may have resulted in the release of hazardous substances to the environment.

- Remedial Actions – Description of cleanup actions performed at the site.

- Implementation of Recommendations From Last Five-Year Review – Summary of IRP actions performed during the reporting period (2004 – 2009).

- Remarks – Primary document(s) governing remedial actions at the site.

8.3 FIVE-YEAR REVIEW OF CATEGORY 2 SITES

Individual subsections are provided to document the Five-Year Review process for each of the sites included in Category 2. These subsections are organized by IRP Zone/site identifier used in the first *Five Year Review Report* (Bechtel, 1999), and include the following:

- Background information: site description, initial responses, and basis for taking action;

- Remedial/removal action description: regulatory actions, RAOs, remedy description, and remedy implementation;

- Implementation of recommendations from last five year review;

- Technical assessment: answers to Questions A, B, and C in the *Comprehensive Five-Year Review Guidance* (EPA, 2001);

- Issues;

- Recommendations and follow-up actions;

- Protectiveness statements; and

- References.

8.4 ZONE 1, PAULS BROOK

8.4.1 Background

8.4.1.1 Site Description

Pauls Brook is the primary drainage feature in Drainage Area A and is shown on Figures 8.4-1 and 8.4-2 (Bechtel 1998a). The drainage collects surface water and sediment from the Bulk Fuels Storage Area (BFSA - Site 13) and a portion of the Paint Can Disposal Area (PCDA - Site 44). Pauls Brook is a relatively small stream with a flow velocity of less than 0.5 ft per second (ft/sec) and the stream bed ranges from 0.8 to 3.8 feet wide and 0.1 to 0.3 feet deep (USAF, 1997). Pauls Brook begins west of Arboretum Drive, slightly north of Site 13, as an emergent wetland dominated by cattails. Surface water runoff from Site 13 is directed through stormwater drains and empties into Pauls Brook before it crosses under Arboretum Drive. On the eastern side of Arboretum Drive, Pauls Brook enters a second, larger, wetland area (the focus of historical remedial action) located between Arboretum Drive and the Spaulding Turnpike (see Figure 8.4-2). Pauls Brook flows through this wetland area and is carried off base through a culvert beneath the Spaulding Turnpike and eventually discharges to the Piscataqua River (Figure 8.4-1).

Potential sources of contamination for Pauls Brook included the PCDA and the BFSA. The PCDA was reportedly operated over a 30-year period and was used to store and dispose of drums that contained paint and paint residues (Weston, 1993a). An intensive test pit operation, performed in 1992, included removal of potential contaminant sources, including grossly contaminated soil and crushed drums. Soil samples collected during the test pit operations identified minor levels of contamination in a limited number of samples. Contamination consisted primarily of: VOCs, including chlorinated solvents and BTEX compounds; SVOCs, comprised of low concentrations of PAHs and benzoic acid; DDT related pesticides and the herbicide 2,4,5-TP (Silvex); and low concentrations of TPHs. No further remedial actions under CERCLA were required for the PCDA (Weston, 1995a).

The BFSA was in operation from 1953 to 1994. Prior to base closure, the site served as the main fuel storage area at the base for both the USAF and the New Hampshire Air National Guard. Petroleum product spills were reported to have occurred at the site (Weston, 1993b).

Pesticide compounds have been detected in Pauls Brook throughout the history of monitoring this drainage. Pesticides detected in Pauls Brook may be the result of routine use of pesticides in the area or from past operational activities at the former Civil Engineering Department complex.

8.4.1.2 Initial Response

No remedial action was performed at Pauls Brook prior to the finalization of the *Brooks and Ditches ROD* (USAF, 1997).

8.4.1.3 Basis for Taking Action

Although Pauls Brook is located within Zone 1, surface water and sediment remedial actions and sampling were separated from the Zone 1 ROD in order to complete remedial actions at Zone 1 without a delay (USAF, 1997). A RI/FS process was undertaken to address surface water and sediment within Pauls Brook (Weston, 1995b). Both pesticides and metals were detected in surface water within Pauls Brook and petroleum, PAHs, pesticides, and metals were detected in sediment within Pauls Brook. The results of human health and ecological risk assessments performed for the *Brooks and Ditches ROD* (USAF, 1997) identified organic and inorganic constituents in sediment within Pauls Brook as posing an unacceptable ecological risk and a remedial alternative was identified in that ROD, as described below.

8.4.2 Remedial/Removal Actions

8.4.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy.

Record of Decision for the Brooks and Ditches Operable Unit (1997): Remedial action for Pauls Brook was addressed in the *Brooks and Ditches ROD* (USAF, 1997). The selected remedy for Pauls Brook included: the removal and off-site disposal of contaminated sediment from the brook; restoration of wetlands impacted or destroyed by sediment excavation; and long-term environmental monitoring of surface water and sediment to monitor conditions in the brook.

8.4.2.2 Remedial Action Objectives

The *Brooks and Ditches ROD* identified and documented the RAO for Pauls Brook as the protection of ecological receptors from direct contact with, or ingestion of, sediment containing contaminants at concentrations that may present an unacceptable ecological risk.

The CGs established in the *Brooks and Ditches ROD* for sediment within the Pauls Brook drainage are included in Table 8.4-1. The *Brooks and Ditches ROD* did not identify CGs for surface water. Surface water data collected during monitoring were compared to relevant New Hampshire Water Quality Criteria for Toxic Substances (WQC).

8.4.2.3 Remedy Description

To meet the *Brooks and Ditches ROD* RAOs described above for Pauls Brook, a remedy was selected which included the following components (USAF, 1997):

- Excavation and removal of sediment exceeding CGs from Pauls Brook;
- Excavated sediment exceeding cleanup goals from Pauls Brook transported off-base for treatment and/or disposal;
- Sediment and erosion control during excavation. Sediment excavations backfilled with clean fill;
- Restoration of wetlands impacted or destroyed by sediment excavation at Pauls Brook;
- Environmental monitoring during remedial operations; and
- Long-term environmental monitoring in Pauls Brook, consisting of sediment and surface water sampling and analysis.

8.4.2.4 Remedy Implementation

A remedial action to remove contaminated sediment from Pauls Brook was completed in the fall of 1997. The excavation limits for the removal action were defined in the *McIntyre Brook and Pauls Brook, Zone 3 Excavation and Construction Work Plan Addendum* (Bechtel, 1997). Excavation was conducted in the flooded perimeter of the brook and resulted in the removal of 2,242 tons of sediment (Bechtel, 1998b). Excavation in the cleanup area proceeded until sediment concentrations of total PAHs, 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, arsenic, cadmium, chromium, copper, lead, nickel, and zinc were below CGs.

Three permanent surface water and sediment monitoring stations (23-8040, 23-8041, and 23-813) were established in Pauls Brook for LTM activities and have been monitored since June of 1991 (Figure 8.4-2). Surface water LTM at Pauls Brook ceased in 2003 since pesticide and metals concentrations in surface water had become stable or were decreasing below New Hampshire WQC for Toxic Substances (MWH, 2003b). LTM of PAHs and pesticides in sediment was also discontinued in 2003 since concentrations of these compounds in sediment were decreasing or below the established CGs and the remaining detections of these compounds were concluded to be the result of non-site related activities (MWH, 2002). The Air

Force received EPA and NHDES concurrence for all monitoring reductions prior to making the changes to the LTM program at Pauls Brook.

Currently, LTM at Pauls Brook is performed in accordance with the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003a) and consists of sediment monitoring for site-specific metals only. Concentration-time trend plots for the site-specific metals of concern at each of the three Pauls Brook sediment sampling stations are included in Appendix C. LTM data indicate that metals concentrations in sediment continue to be detected at relatively stable concentrations above the CGs.

8.4.3 Implementations of Recommendations from Last Five-Year Review

The second *Five-Year Review Report* (MWH, 2004) concluded that the annual monitoring of sediment within Pauls Brook provides little additional information concerning remedial progress at Pauls Brook, given the stable nature of inorganics in sediment, and that the sediment CGs for inorganics within Pauls Brook and the frequency of monitoring should be reevaluated by the BCT.

Annual sediment monitoring has been performed since the last review. Results of the monitoring were reported in:

- *Site 13 Bulk Fuel Storage Area 2004 Annual Report* (MWH, 2005),
- *Site 13 Bulk Fuel Storage Area 2005 Annual Report* (MWH, 2006),
- *Landfills and CRDs 2006 Annual Report* (URS, 2008a),
- *Landfills and CRDs 2007 Annual Report* (URS, 2008b), and
- *Landfills and CRDs 2008 Annual Report* (URS, 2009).

Pauls Brook data collected in 2004 and 2005 were discussed in the corresponding Pease AFB Site 13 annual reports. Pursuant to an agreement between the EPA and AFRPA, post 2005 data collected from Pauls Brook has been discussed in the Landfills and CRDs annual reports (EPA, 2006).

No modifications to the LTM program for Pauls Brook occurred during this Five-Year Review period.

8.4.4 Technical Assessment

8.4.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The remedy at Pauls Brook is functioning as intended by the *Brooks and Ditches ROD* (USAF, 1997). The remedial action to remove contaminated sediment from Pauls Brook was completed during the fall of 1997, with excavation continuing until sediment concentrations of total PAHs, 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, arsenic, cadmium, chromium, copper, lead, nickel, and zinc were below CGs (Bechtel, 1999). Sediment monitoring has been reduced in scope (i.e., PAHs and pesticides were removed as monitoring parameters) because of decreasing trends in contaminant concentrations and/or attainment of CGs. Surface water monitoring was discontinued during 2003 because pesticide and metals concentrations had become stable and/or were decreasing below New Hampshire WQC.

8.4.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

ROD-specified CGs for sediment were based on background values (PAHs, lead, and nickel), National Oceanic and Atmospheric Administration (NOAA) biological effects range low (ER-Ls) values (arsenic, chromium, copper, and zinc) (Long and Morgan, 1990), and ecological risk-based concentrations (4,4'-DDT, 4,4'-DDE, 4,4'-DDD, and cadmium). The background values for PAHs, lead, and nickel are still valid.

Changes in Standards: NOAA ER-Ls were listed as ARARs for sediment in the *Brooks and Ditches ROD* (USAF, 1997). As shown in the following table, there have been some minor changes to the NOAA ER-L sediment screening values that were cited in the *Brooks and Ditches ROD* to derive the CGs for arsenic, chromium, copper, and zinc concentrations in Pauls Brook sediment. The arsenic and copper CGs, while higher than their current ER-L values, still fall within the range of sediment screening values currently listed by NOAA (Buchman, M.F., 2008). These changes do not significantly affect the protectiveness of the remedy.

Constituent	Brooks & Ditches ROD-Specified Sediment Cleanup Goal (mg/kg) (based on NOAA ER-L values)	Current NOAA ER-L Values (mg/kg)
Arsenic	33.0 [a]	8.2 [b]
Chromium	80.0 [a]	81 [b]
Copper	70.0 [a]	34 [b]
Zinc	120.0 [a]	150 [b]

[a] Source: Long and Morgan, 1990. [b] Source: Buchman, M.F., 2008.

<u>Changes in Exposure Pathways:</u> There have been no changes in physical conditions, exposure pathways, and land use that would affect the protectiveness of the remedy.

<u>Changes in Toxicity and Other Contaminant Characteristics:</u> Ecological risk-based concentrations were used to establish cleanup standards for 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD, and cadmium. EPA and NHDES have concurred that monitoring for pesticides in Pauls Brook is no longer warranted because data confirm that the sediment remedy at Pauls Brook was successful.

Unlike human health risk assessments, EPA does not recommend specific toxicity reference doses for constituents in ERAs. The risk-based CG for cadmium in sediment (0.153 mg/kg) was based on modeled risk estimates to short-tailed shrews (Weston, 1995c). The current NOAA ER-L for cadmium is 1.2 mg/kg (Buchman, M.F., 2008) and a freshwater sediment screening benchmark value of 0.99 mg/kg is currently listed by EPA Region 3 (EPA, 2008). Therefore, the 0.153 mg/kg cadmium CG included in the *Brooks and Ditches ROD* (USAF, 1997) appears to be conservative and remains protective.

<u>Changes in Risk Assessment Methods:</u> The original HHRA was conducted following then current EPA and EPA Region 1 guidance. Risk assessments are performed somewhat differently now than they were at the time of the last Five-Year Review and the *Brooks and Ditches ROD*. Guidance documents/risk assessment tools that have been issued include:

- Background guidance (2002), which changed the way background comparisons are performed for metals.
- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.

- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.

- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.

- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.

- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

Ecological Risk Assessment (ERA) procedures have not changed significantly since the last Five-Year Review. However, some ecological screening thresholds have been updated during that period. Methods for calculating 95% UCLs and comparisons to background for metals also have changed. NOAA ER-Ls were listed as ARARs for sediment in the *Brooks and Ditches ROD* (USAF, 1997) and changes to the NOAA ER-L values were discussed above.

<u>Expected Progress Toward Meeting RAOs:</u> Remedial action objectives associated with the sediment removal at Pauls Brook have been attained. LTM has documented that surface water concentrations do not pose a threat to human health or the environment.

Concentrations of inorganic COCs in Pauls Brook sediment continue to be detected at relatively stable concentrations above the CGs and are not expected to decrease substantially in the near term.. The concentrations of COCs in sediment did not appear to be affecting surface water quality within Pauls Brook.

8.4.4.3 <u>Question C</u>

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

8.4.4.4 Technical Assessment Summary

As described above, the remedy at Pauls Brook is functioning as intended. The remedial action objectives associated with the sediment removal at Pauls Brook have been attained. Surface water monitoring has been eliminated from the program as concentrations of COCs in surface water were documented as stable or decreasing. The concentrations of metals in Pauls Brook sediment samples have remained relatively constant over time and it has been concluded that metals concentrations in Pauls Brook sediments are not having an adverse effect upon surface water quality. While minor changes exist in sediment screening data used to establish sediment CGs for Pauls Brook, these changes have not impacted the current protectiveness of the remedy. No other information has been identified that would call into question the protectiveness of the remedy.

8.4.5 Issues

The scope of LTM at Pauls Brook consists of sediment monitoring for site-specific metals, which continue to be detected at concentrations above CGs. The concentrations of inorganic constituents in Pauls Brook sediment are not expected to decrease substantially in the near term. The second Five-Year Review Report (MWH, 2004) recommended that the sediment CGs for inorganics within Pauls Brook and the frequency of monitoring should be reevaluated by the BCT; however, these recommendations were not acted upon.

8.4.6 Recommendations and Follow-up Actions

Since the concentrations of inorganic constituents in Pauls Brook sediment are not expected to decrease substantially in the near term, it is recommended that the sampling frequency for monitoring of sediment within Pauls Brook be reduced from annually to triennially. No changes will be made to Pauls Brook long-term monitoring until a revised draft LTMP is submitted, reviewed, and approved by EPA and NHDES.

8.4.7 Protectiveness Statement

The remedial action at Pauls Brook (excavation of sediment and surface water/sediment LTM) is currently protective of human health and the environment and is expected to remain so in the future.

8.4.8 References

Bechtel, 1997. *McIntyre and Pauls Brook Zone 3 Excavation Construction Work Plan Addendum.* May.

Bechtel, 1998a. *Pease Air Force Base Basewide Surface Water Sediment, and Fish Tissue Monitoring Long-Term Monitoring Plan.* April.

Bechtel, 1998b. *McIntyre Brook and Pauls Brook Remedial Action Report*. October.

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base*. September.

Buchman, M.F., 2008. *NOAA Screening Quick Reference Tables*, NOAA OR&R Report 08-1, Seattle WA, Office of Response and Restoration Division, NOAA. 34 pages.

EPA, 2001. *Comprehensive Five-Year Review Guidance*, OSWER No. 9355.7-03B-P, EPA 540-R-01-007. June.

EPA, 2005a. *Guidelines for Carcinogenic Risk Assessment*, EPA 630-P-03-001F. March.

EPA, 2005b. *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), EPA 630-R-03-003F. March.

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EPA, 2008. *Mid-Atlantic Risk Assessment, Ecological Risk Assessment - Freshwater Sediment Screening Benchmarks.* www.epa.gov/reg3hwmd/risk/eco/btag/sbv/fwsed/screenbench.htm. September 3.

Long, E.R. and L.G. Morgan, 1990. The Potential for Biological Effects of Sediment-sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52.

MWH, 2002. *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report*. June.

MWH, 2003a. *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update*. March.

MWH, 2003b. *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report*. June.

MWH, 2004. *5-Year Review Report (1999-2004), Former Pease Air Force Base, Portsmouth, New Hampshire.* September.

MWH, 2005. *Site 13 Bulk Fuel Storage Area 2004 Annual Report*. June.

MWH, 2006. *Site 13 Bulk Fuel Storage Area 2005 Annual Report*. May.

URS, 2008a. *Landfills and CRDs 2006 Annual Report.* March.

URS, 2008b. *Landfills and CRDs 2007 Annual Report.* May.

URS, 2009. *Landfills and CRDs 2008 Annual Report*. June.

USAF, 1997. *Record of Decision for the Brooks/Ditches Operable Unit*. September.

Weston, 1993a. *Zone 1 Remedial Investigation Report*. October.

Weston, 1993b. *Zone 1 Feasibility Study Report*. December.

Weston, 1995a. *Record of Decision for a Remedial Action at Zone 1*. July.

Weston, 1995b. *Brooks/Ditches Remedial Investigation/Feasibility Study Consolidated Report, Pease Air Force Base*. November.

Weston, 1995c. *Bioaccumulation Risk Assessment for Pauls Brook at Pease Air Force Base, NH*. December.

8.5 ZONE 1, RAILWAY DITCH

8.5.1 Background

8.5.1.1 Site Description

The Railway Ditch and Flagstone Brook represent the primary drainage features in Drainage Area J (Figures 8.4-1 and 8.5-1). This drainage area receives surface water and sediment from LF-5, LF-4, LF-2, the northern portion of the Flightline, a portion of the PCDA, and a small portion of the BFSA.

Flagstone Brook is the primary stream draining Zone 1 (Figure 8.4-1). Flagstone Brook originates as two culverts at the north end of the north apron of the Flightline and flows northward forming the western boundary of LF-5. Railway Ditch flows northward along the eastern border of LF-5, eventually joining Flagstone Brook, approximately 3,000 feet north of LF-5. Flagstone Brook eventually drains to Little Bay to the north of Pease AFB. Figure 8.5-1 shows the Flagstone Brook/Railway Ditch drainage area features and monitoring locations.

Flagstone Brook is a channelized drainage ditch with relatively uniform steep banks and uniform gradient and contains a series of weir dams constructed for erosion and flood control. The average stream depth and width is recorded in the *Brooks and Ditches ROD* (USAF, 1997) as approximately 0.75 feet and 9 feet, respectively. The substrate along most of Flagstone Brook is sand, cobble, and gravel: however areas of silt and clay exist. Water velocity is reported as averaging approximately 0.2 ft/sec (USAF, 1997).

Actions at the Railway Ditch and Flagstone Brook are intimately tied to LF-5 since they are adjacent to the eastern and western borders, respectively, of LF-5. Surface runoff and groundwater discharge from LF-5 contribute to flow in Railway Ditch and Flagstone Brook. LF-5 is discussed in greater detail in Section 7.4 of this report. LF-5 reportedly was used between 1964 and 1975 as the primary base landfill, although some disposal occurred as late as 1979. Most of the material placed in the landfill consisted of municipal-type solid wastes generated from on-base housing, barracks, offices, dining facilities, etc. Industrial wastes were also disposed of in the landfill, including an unspecified quantity of waste oils, solvents, paints, paint strippers and thinners, pesticide containers, empty cans and drums, and sludge from the industrial waste treatment and base wastewater treatment facilities.

8.5.1.2 Initial Response

No remedial action was performed at Railway Ditch and Flagstone Brook prior to the finalization of the *Landfill 5 ROD* (Weston, 1993a) and *Zone 1 ROD* (Weston, 1995).

8.5.1.3 Basis for Taking Action

The *IRP Stage 3C Landfill 5 RI Report* and *Zone 1 RI Report* (Weston, 1992a and 1993b) were completed in April 1992 and October 1993, respectively. The presence of buried wastes and contamination in soil, groundwater, surface water, and sediment in the areas surrounding the landfill was documented in the *IRP Stage 3C Landfill 5 RI Report*. This information was confirmed in the *Zone 1 RI Report* (Bechtel, 1999).

The RI Reports identified the following:

- Three VOCs whose concentrations exceeded the MCLs were identified in groundwater: PCE, TCE, and benzene. Additionally, concentrations of arsenic, beryllium, chromium, and nickel exceeded MCLs.

- The hydraulic gradients across LF-5 indicate that groundwater flows towards Flagstone Brook and the Railway Ditch. These drainage ways also receive surface runoff from LF-5. VOCs were detected in surface water in Flagstone Brook and the Railway Ditch, located west and east of Landfill 5, respectively.

- PAHs and pesticides were detected in sediments in Flagstone Brook and the Railway Ditch. Elevated metals concentrations were detected in the Railway Ditch sediments.

Although Flagstone Brook is located within Zone 1 and surface water and sediment contamination were addressed in the *Landfill 5* and *Zone 1 RODs* (Weston, 1993a and 1995), assessment of risk to human health and ecological receptors was performed in a separate RI/FS process (Weston, 1995) in order to complete remedial actions within Zone 1 without a delay (USAF, 1997).

8.5.2 Remedial/Removal Actions

8.5.2.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy.

Landfill 5 ROD (1993) and Zone 1 Record of Decision (1995): Post-closure maintenance and monitoring activities at Landfill 5 are driven by requirements in the *Record of Decision for a Source Area Remedial Action at Landfill 5 (LF-5 ROD)* (Weston, 1993a) and *Record of Decision for a Remedial Action at Zone 1* (*Zone 1 ROD)* (Weston, 1995). The *LF-5 ROD* primarily addresses soil, debris, surface water, and sediment. The *Zone 1 ROD* primarily addresses contaminated groundwater associated with LF-5. The *LF-5* and *Zone 1 RODs* included LTM of surface water and sediment as specific components of remedial action at LF-5.

Brooks and Ditches Operable Unit Record of Decision (1997): It was concluded during the RI/FS process (Weston, 1995) that the contaminants present in surface water and sediment at Flagstone Brook did not pose an unacceptable risk to human health and ecological receptors and NFA under CERCLA was required. Therefore, the Brooks/Ditches ROD is not one of the governing documents for post-closure care activities at LF-5 or Flagstone Brook.

8.5.2.2 Remedial Action Objectives

The following RAOs specific to Railway Ditch and Flagstone Brook were identified in the *LF-5 ROD* (Weston, 1993a):

- Prevent or minimize risks to ecological receptors resulting from exposure to contaminated sediment in the Railway Ditch and associated wetlands or to contaminated soil and debris associated with LF-5.

- Minimize further migration of contaminants from the LF-5 source area into the groundwater or surface water.

The following RAOs specific to Railway Ditch and Flagstone Brook were identified in the *Zone 1 ROD* (Weston, 1995):

- Long-term environmental monitoring in the zone to allow the continued evaluation of the magnitude of contamination, including groundwater, surface water, and sediment sampling and analysis.

Both the *LF-5* and *Zone 1 RODs* (Weston, 1993a and Weston, 1995) listed media-specific CGs. These goals for surface water and sediment are summarized below:

- **Surface water** – CGs for surface water in the Railway Ditch were presented in the *LF-5 ROD*. No ROD-specified CGs were issued for Flagstone Brook surface water in either the *LF-5* or *Zone 1 ROD* documents (the *Brooks and Ditches ROD* did not identify CGs for either stream in Zone 1). The Railway Ditch surface water CGs are presented in Table 8.5-1. All surface water CGs were based on New Hampshire Water Quality Criteria for Toxic Substances – Protection of Aquatic Life (freshwater chronic criteria) (April 1990).

- **Sediment** – The *LF-5 ROD* identified sediment CGs for the Railway Ditch and Flagstone Brook, which are presented in Table 8.5-2. Sediment exceeding these criteria was excavated from the Railway Ditch.

8.5.2.3 Remedy Description

To meet the RAO described above for the Railway Ditch and Flagstone Brook, a remedy was selected which included the following components:

- Excavation of soils from the Railway Ditch exceeding the cleanup goals established in the *LF-5 ROD*.

- Long-term environmental monitoring in the zone to allow the continued evaluation of the magnitude of contamination, including groundwater, surface water and sediment sampling and analysis.

8.5.2.4 Remedy Implementation

Excavation and relocation of landfill debris, soils, and sediments from LF-2, LF-4, and LF-5 and the adjacent Railway Ditch to LF-5 were performed between December 1993 and June 1995. Additionally, a lined sedimentation basin to receive groundwater, site runoff, and water pumped from the excavation. Relocated waste was consolidated above the predicted seasonal high groundwater level. An intermediate cap was constructed to cover debris as a precursor to Phase II cap construction (IT, 1995).

During a second phase of the LF-5 remedial action, additional debris and waste soils from LF-6, the UST Flightline area, Site 34, and Site 72 were consolidated into LF-5. Following consolidation, LF-5 was capped with a composite-barrier-type final cover system to minimize water infiltration and prevent contact between landfill debris and either human or ecological receptors. After completion of capping, piezometers, landfill gas monitoring probes and vents, and survey monuments were installed as specified in the design. This work was completed between May 1995 and July 1996 (Bechtel, 1996).

Prior to 2001, post-closure surface water monitoring was conducted at 11 stations: six in Railway Ditch and five in Flagstone Brook. The *Basewide Surface Water, Sediment and Fish Tissue Long-Term Monitoring Plan – Year 2000 Update* (Bechtel, 2000) reduced this number to six stations, three in Flagstone Brook (stations 26-8031, 26-8182W and 26-821A) and three in Railway Ditch (26-8119, 26-8073 and 26-827) (see Figure 8.5-1).

Currently, surface water LTM at Drainage Area J is performed in accordance with the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003a) and the *Landfill 5 Post-Closure Maintenance and Monitoring Plan (PCMMP), Revision 3* (MWH, 2003b); these documents call for a combination of biennial analyses for VOCs and annual analyses for target metals (aluminum, arsenic, cadmium, copper, iron, lead, mercury, nickel, thallium, and zinc) at the six surface water sampling stations in Flagstone Brook and Railway Ditch. At the request of NHDES, an additional surface water sample (LF5-827U) has been collected since 2006 in the Railway Ditch upstream of station 26-827 to further evaluate LF-5 impacts on surface water in this drainage (see Figure 8.5-1).

No VOCs were detected in the 2008 surface water samples from Flagstone Brook or Railway Ditch; historically, VOCs have not been significant COCs in these drainages and no CGs were established for VOCs in Flagstone Brook and Railway Ditch. The historical maximum metals concentrations observed in Flagstone Brook surface water have occurred at stations 26-8182W and 26-8031, located in the westerly and easterly branches, respectively, of the headwaters of Flagstone Brook; discharge from the north apron of the Flightline is the likely source for the elevated metals concentrations observed at these locations. Detected metals concentrations at station 26-821A, located downstream from LF-5, have been below New Hampshire WQS since 2005, indicating that LF-5 does not appear to be significantly impacting surface water quality in Flagstone Brook.

Metals detected at concentrations above their respective CGs in the 2008 Railway Ditch surface water samples included: aluminum, arsenic, copper, iron, lead, mercury, and zinc at station 26-8073; and iron at station LF5-827U, which is located downstream from station 26-8073. Concentration-time trend plots for the site-specific metals of concern at each of the four Railway Ditch sediment sampling stations are included in Appendix D. Sporadic metals detections at concentrations exceeding CGs have historically occurred at 26-8073; however, the number and magnitude of the CG exceedances in 2008 were unprecedented. Metals concentrations at the farthest upstream (station 26-8119) and downstream (station 26-827) sampling locations were all below CGs and in most cases below detection limits. With the exception of iron, all metals detected at station LF5-827U (located approximately 600 feet downstream of 26-8073) in 2008 were below CGs and in many cases below detection limits. Future metals concentrations in surface water at station 26-8073 will be monitored closely to determine if the 2008 data were anomalous or indicative of a new source. Efforts will be made to identify and document any seeps or other anomalies along Railway Ditch (especially in the vicinity of or upstream from station 26-8073) that could be potential sources for metals contamination.

Current LTM of sediment within Drainage Area J, performed in accordance with the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003a), consists of sediment monitoring at the three stations in Flagstone Brook for site-specific metals analyses. No sediment monitoring is performed in Railway Ditch since sediment with COC concentrations exceeding *LF-5 ROD* CGs was excavated from Railway Ditch. In 2008, the detected concentration of lead at station 26-8031 in Flagstone Brook exceeded the CG; historical lead concentrations at this location have frequently exceeded the CG. As noted previously, station 26-8031 is located upstream of LF-5 and any impacts observed at the location are likely due to discharge from the north apron of the Flightline. Aluminum, copper, iron, and lead concentrations were also higher at the two upstream stations (26-8031 and 26-8182W) as compared to the downstream station (26-821A) adjacent to LF-5.

Sediment within Flagstone Brook had been historically monitored for select pesticides as well. However, the Air Force recommended in the *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report* (MWH, 2002) to discontinue analysis for pesticides in sediment at Flagstone Brook after the 2002 sampling event. This recommendation was based upon the assertion that pesticides were applied in accordance with manufacturers and Air Force's guidelines and concentrations do not represent evidence of a CERCLA release. The Air Force received EPA and NHDES concurrence on these reductions to long-term monitoring.

8.5.3 Implementation of Recommendations from Last Five-Year Review

The second *Five-Year Review Report* (MWH, 2004) concluded that the remedy at LF-5 remained protective of human health and the environment. Recommendations in the Five-Year Review Report included the following:

- Routine LTM and reporting of surface water and sediment data should continue in accordance with approved plans.

- Routine evaluation of LTM data should be performed to optimize LTM by reducing redundant data points and scope when COCs do not appear to pose a threat to the environment or when CGs are achieved.

- Changes in the applicable regulatory standards for Flagstone Brook and Railway Ditch COCs should be noted in future LTM reports.

Annual LTM has been performed and monitoring results for surface water and sediment associated with the Railway Ditch and Flagstone Brook have been reported in:

- *Landfills and Construction Rubble Dumps 2005 Annual Report* (MWH, 2006),

- *Landfills and CRDs 2006 Annual Report* (URS, 2008a),

- *Landfills and CRDs 2007 Annual Report* (URS, 2008b), and

- *Landfills and CRDs 2008 Annual Report* (URS, 2009).

No modifications to the LTM program for Railway Ditch and Flagstone Brook occurred during this Five-Year Review period, with the exception of collecting (at the request of NHDES) an additional surface water sample (LF5-827U) since 2006 in the Railway Ditch upstream of station 26-827 to further evaluate LF-5 impacts on surface water in this drainage.

8.5.4 Technical Assessment

8.5.4.1 <u>Question A</u>

Question A: Is the remedy functioning as intended by the decision documents?

The chosen remedy at Railway Ditch and Flagstone Brook is functioning as intended by the *LF-5* and *Zone 1 RODs* (Weston, 1993a and Weston, 1995). Landfill debris, soils, and sediments, including sediments from the Railway Ditch, were excavated between December 1993 and June 1996 from various portions of the base and consolidated in LF-5. Post-closure monitoring of surface water and sediment has been conducted in the Railway Ditch and Flagstone Brook. The scope of surface water and sediment monitoring was reduced prior to this Five-Year Review period to focus monitoring activities directly upon contaminants potentially related to LF-5 (VOCs and site-specific metals). Any observed impacts to surface water and sediment quality in Flagstone Brook are believed to be due to an upstream source (i.e., discharge from the north apron of the Flightline), not LF-5. In 2008, one Railway Ditch surface water sample had elevated metals concentrations, but these elevated concentrations were not observed at downstream surface water sampling locations.

8.5.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards:

Surface Water. ARARs (New Hampshire Water Quality Criteria for Toxic Substances [WQC] contained in former Chapter Env-Ws 430; August 1990) were used to establish CGs for metals in surface water in Railway Ditch under the *LF-5 ROD* (Weston, 1993a). Effective December 10, 1999, Env-Ws 430 was readopted with amendments and renumbered Env-Ws 1700. Effective May 21, 2008, Env-Ws 1700 was readopted with amendments and renumbering Env-Wq 1700 (NHDES, 2008).

There are only minor differences between the numerical values and methodologies in Env-Ws 430 (August 1990) that were used to derive the LF-5 ROD-specified CGs for metals and the current numerical values and methodologies used to derive WQC for metals in Env-Wq 1700 (May 2008). The following table shows a comparison of the CGs specified in the *LF-5 ROD* (based upon Env-Ws 430) to current WQC (based upon Env-Wq 1700). The current WQC for aluminum, iron, and lead in Env-Wq 1700 are the same as their respective ROD-specified CGs. The current WQC for arsenic and mercury in Env-Wq 1700 are higher than their respective ROD-specified CGs. The WQC for cadmium, copper, lead (the formula to calculate the lead WQC has not changed from Env-Ws 430 to Env-Wq 1700), nickel, and zinc are calculated using hardness; for comparability, the current hardness dependent WQC were calculated assuming a hardness of 82 mg/L, as was done for the ROD-specific CG. The calculated WQC for copper and zinc are about the same as the ROD-specific CGs and the calculated WQC for cadmium and nickel are lower than the ROD-specific CGs; however, the typical hardness values observed in Railway Ditch surface water samples are higher than 82 mg/L (typically between 100-200 mg/L), which would result in higher calculated WQC values.

Constituent	Railway Ditch ROD-Specified Surface Water Cleanup Goal (µg/L) (LF-5 ROD)	Current New Hampshire WQC (µg/L) (Env-Wq 1700)
Aluminum	87	87
Arsenic	48 (Arsenic V)	150 (total Arsenic)
Cadmium	0.971 [a]	0.234 [b]
Copper	9.98 [a]	7.87 [b]
Iron	1,000	1,000
Lead	2.5 [a]	2.5 [b]
Mercury	0.012	0.77
Nickel	133 [a]	44.1 [b]
Zinc	90 [a]	101 [b]

[a] *LF-5 ROD* CGs for these metals were calculated assuming a hardness of 82 mg/L in Railway Ditch. Current WQC for these metals were also calculated assuming a hardness of 82 mg/L. Actual hardness values vary with each sampling event (typically between 100-200 mg/L), which could yield WQC that vary from those shown above.

Overall, the minor changes in surface water criteria do not have a significant impact on the protectiveness of the remedy.

Sediment. *LF-5 ROD*-specified CGs for Flagstone Brook sediment were based on NOAA ER-L values (Long and Morgan, 1990), which were considered to be TBCs. The antimony and lead ER-L values used to establish the sediment CGs were 2 mg/kg and 35 mg/kg, respectively (Weston, 1993a). The current NOAA ER-L for lead is 46.7 mg/kg and no ER-L value is currently listed by NOAA for antimony (Buchman, M.F., 2008). However, a freshwater sediment screening benchmark value of 2 mg/kg for antimony is currently listed by EPA Region 3 (EPA, 2008) and the reference cited by EPA for this value (Long and Morgan, 1990) is the same TBC cited in the *LF-5 ROD.* Therefore, the *LF-5 ROD* sediment CGs for Flagstone Brook appear to be conservative and remain protective.

<u>Changes in Exposure Pathways:</u> There have been no changes in physical conditions, exposure pathways, and land use that would affect the protectiveness of the remedy.

<u>Changes in Toxicity and Other Contaminant Characteristics:</u> CGs for Railway Ditch and Flagstone Brook were based on ARARs and TBCs. There have been no changes in toxicity or contaminant characteristics that would affect the protectiveness of the remedy.

Changes in Risk Assessment Methods: The original HHRAs were conducted following then current EPA and EPA Region 1 guidance. HHRAs are performed somewhat differently now than they were at the time of the last Five-Year Review and the *LF-5*, *Zone 1*, and *Brook and Ditches RODs*. Guidance documents/risk assessment tools that have been issued include:

- Background guidance (2002), which changed the way background comparisons are performed for metals.
- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.
- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.
- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.
- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.
- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

ERA procedures have not changed significantly since the last Five-Year Review. However, ecological screening thresholds have been updated during that period. Methods for calculating 95% UCLs and comparisons to background for metals also have changed.

Surface water CGs were based on ARARS (New Hampshire WQC) and changes to WQC were discussed above. NOAA ER-Ls were listed as TBCs for sediment in the *LF-5 ROD* (Weston, 1993a) and changes to the NOAA ER-L values were discussed above.

Expected Progress Toward Meeting RAOs: The remedy is meeting RAOs. It is expected that CGs will be achieved in the future.

8.5.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

8.5.4.4 Technical Assessment Summary

As described above, the remedies at Flagstone Brook and Railway Ditch are functioning as intended. The scope of surface water and sediment monitoring has been significantly reduced based on decreasing trends in COC concentrations in these two drainages. Currently, monitoring consists of surface water monitoring for VOCs and metals in both Flagstone Brook and Railway Ditch and sediment monitoring for metals in Flagstone Brook only. While minor changes have occurred to surface water ARARs and sediment TBCs that were used to derive ROD CGs for Railway Ditch and Flagstone Brook, respectively, these changes have not impacted the current protectiveness of the remedy. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. No other information has been identified that would call into question the protectiveness of the remedy.

8.5.5 Issues

Elevated metals concentrations (i.e., aluminum, arsenic, copper, iron, lead, mercury, and zinc) were detected in the 2008 Railway Ditch surface water sample at station 26-8073; however, these elevated concentrations were not observed in surface water samples downstream from 26-8073.

Any observed impacts to surface water and sediment quality in Flagstone Brook are believed to be due to an upstream source (i.e., discharge from the north apron of the Flightline), not LF-5.

Changes have occurred to surface water and sediment ARARs/TBCs that were used to develop CGs in the *LF-5 ROD*, but these changes do not affect the protectiveness of the remedy.

8.5.6 Recommendations and Follow-up Actions

Routine LTM and reporting of surface water and sediment data for Railway Ditch should continue in accordance with approved plans. Due to elevated metals concentrations (i.e., aluminum, arsenic, copper, iron, lead, mercury, and zinc) in the 2008 Railway Ditch surface water sample at station 26-8073, future metals concentrations in surface water at station 26-8073 should be monitored closely to determine if the

2008 data were anomalous or indicative of a new source. Efforts should be made to identify and document any seeps or other anomalies along Railway Ditch (especially in the vicinity of or upstream from station 26-8073) that could be potential sources for metals contamination.

Surface water and sediment monitoring within Flagstone Brook should be discontinued as historical data indicates that metals concentrations in surface water and sediment do not appear to be directly related to LF-5. No changes will be made to Flagstone Brook long-term monitoring until a revised draft LTMP is submitted, reviewed, and approved by EPA and NHDES.

Routine evaluation of LTM data should continue to be performed to optimize LTM by reducing redundant data points and scope when COCs do not appear to pose a threat to the environment or when CGs are achieved. Changes in applicable regulatory standards for COCs should be noted in future LTM reports.

8.5.7 Protectiveness Statement

The remedial action at Railway Ditch and Flagstone Brook (excavation of sediment from Railway Ditch and long-term monitoring of sediment and surface water) is currently protective of human health and the environment and is expected to remain so in the future.

8.5.8 References

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NHDES, 2008. *Env-Wq 1700 Surface Water Quality Regulations.* Effective May 21, 2008.

MWH, 2002. *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report*. June.

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MWH, 2003b. *Landfill 5 Post-Closure Maintenance and Monitoring Plan, Revision 3*. July.

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MWH, 2005. *Landfills and Construction Rubble Dumps 2004 Annual Report*. January.

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URS, 2008b. *Landfills and CRDs 2007 Annual Report.* May.

URS, 2009. *Landfills and CRDs 2008 Annual Report.* June.

USAF, 1997. *Record of Decision for the Brooks/Ditches Operable Unit*. September.

Weston, 1992a. *Landfill 5 Remedial Investigation Report*. April.

Weston, 1992b. *Landfill 5 Feasibility Study*. April.

Weston, 1993a. *Record of Decision for a Source Area Remedial Action at Landfill 5, Pease Air Force Base, New Hampshire*. September.

Weston, 1993b. *Zone 1 Remedial Investigation*. October.

Weston, 1995. *Record of Decision for a Remedial Action at Zone 1*. July.

9.0 CATEGORY 3 SITES, LONG-TERM MONITORING ONLY, SURFACE WATER/SEDIMENT

9.1 MAP

Category 3 sites are those with long-term monitoring only (no remedial action requirement other than long-term monitoring). Category 3 sites addressed in this *Five-Year Review Report* include drainage features associated with: Zone 2, Peverly Drainage System (Drainage Area G); Zone 4, Lower Grafton Ditch (Drainage Area E); and Zone 5, Knights Brook and Pickering Brook (Drainage Areas H and I). The locations of these drainage areas are illustrated in Figure 9.1-1.

9.2 DATA SUMMARY TABLE

Table 9.2-1 summarizes information in this *Five-Year Review Report* for sites in Category 3. The columns in this table include the following information:

- Site I.D. – The IRP Zone and site identifier used in the first *Five-Year Review Report* (Bechtel, 1999).
- Sites Included – A listing of individual IRP sites included under the IRP Zone/site identifier in this *Five-Year Review Report*.
- Site Chronology – A chronological listing of major documents associated with remedial actions performed at the sites.
- Background – Description of site location and brief history of site activities that may have resulted in the release of hazardous substances to the environment.
- Remedial Actions – Description of cleanup actions performed at the site.
- Implementation of Recommendations From Last Five-Year Review – Summary of IRP actions performed during the reporting period (2004 – 2009).
- Remarks – Primary document(s) governing remedial actions at the site.

9.3 FIVE-YEAR REVIEW OF CATEGORY 3 SITES

Individual subsections are provided to document the Five-Year Review process for each of the sites included in Category 3. These subsections are organized by IRP Zone/site identifier used in the first *Five Year Review Report* (Bechtel, 1999), and include the following:

- Background information: site description, initial responses, and basis for taking action;
- Remedial/removal action description: regulatory actions, RAOs, remedy description, and remedy implementation;
- Implementation of recommendations from last five year review;
- Technical assessment: answers to Questions A, B, and C in the Comprehensive Five-Year Review Guidance (EPA, 2001);
- Issues; Recommendations and follow-up actions;
- Protectiveness statements; and,
- References.

9.4 ZONE 2, PEVERLY DRAINAGE SYSTEM

9.4.1 Background

9.4.1.1 Site Description

The Peverly Drainage System is the primary drainage feature in Drainage Area G and is shown in Figure 9.4-1 (Bechtel, 1998). The drainage system consists of Peverly Brook and three man-made impoundments, Upper Peverly Pond, Lower Peverly Pond, and Stubbs Pond (formerly Bass Pond), that discharge into Great Bay. Stubbs Pond is currently being managed as an emergent marsh wetland, being drained after the spring runoff to allow for vegetation/feed to grow during the summer/early fall months and then temporarily flooded during the short bird migration season. The Peverly Brook receives surface water and sediment from LF-1 (Site 1), FDTA-1 (Site 7), Munitions Maintenance Area (Site 12), CRD-1 (Site 9), and MRDDA (Site 43). Figure 9.4-1 shows the Peverly Brook drainage features and monitoring points.

LF-1 was the original base landfill and operated from 1953 to 1961. The landfill covers approximately 7 acres. The landfill includes base construction debris (e.g. concrete and soils), which were covered by native soils. Seeps that discharged to Upper Peverly Pond were identified adjacent to the landfill (Weston, 1995). These seeps had elevated levels of arsenic, cadmium, and iron.

FDTA-1 was the main fire training area between 1956 and 1961. There are no obvious drainage pathways from this site and precipitation has been observed to rapidly infiltrate through the coarse-grained surface soils (Bechtel, 1998).

The Munitions Maintenance Area contained a weapons storage area, two USTs, and a gasoline UST. Closure activities at the site included removal of the USTs (Bechtel, 1998).

CRD-1 served as a soils borrow area and as a disposal site for construction debris (concrete, asphalt, wood, tree stumps, brush, and scrap metal). Investigations at the site did not reveal the presence of contaminant source areas at the site (Weston, 1994).

The MRDDA contained 55-gal drums and 5-gal cans labeled concrete joint sealant. The 55-gal drums were suspected to contain leaded fuel sludge, but no evidence of contamination was found. Potential sources of contamination (drums and cans) were excavated and disposed of at an off-base facility (Bechtel, 1998).

Historical analytical results for surface water and sediment in the Peverly drainage area are discussed in the *Zone 2 ROD* (Weston, 1995). The analytical results indicate that the primary contaminants in the drainage are metals (aluminum, arsenic, iron, lead, manganese, nickel, and zinc) and pesticides (DDT-related compounds and lindane). A source for the metals contamination was not defined in the ROD. Pesticide concentrations were attributed to basewide pesticide usage and to pre-Air Force base activities and were not considered related to Zone 2 activities.

9.4.1.2 Initial Response

No remedial action was performed at Peverly Brook prior to the finalization of the *Zone 2 ROD* (Weston, 1995).

9.4.1.3 Basis for Taking Action

The *Zone 2 ROD* (Weston, 1995) evaluated potential risks to human and ecological receptors for surface water and sediment. The results of this evaluation indicated that human health risks from surface water and sediment posed by the chemicals of concern were within the EPA range of acceptable risks. The *Zone 2 ROD* also states that risk from recreationally caught catfish and bass from Stubbs Pond were evaluated and there was no apparent risk of significant adverse health effects through the ingestion of these species (Weston, 1995).

However, a limited ecological risk was found to be posed by sediment in the drainage. The ERA concluded there was a potential for harmful effects to the Belted Kingfisher from ingestion of contaminated fish. The ERA indicated that the potential risk to the kingfisher was primarily associated with ingestion of fish contaminated with arsenic and zinc from Stubbs Pond (formerly Bass Pond) (Weston, 1993b). Fish ingested from both Upper and Lower Peverly Ponds contributed less than 10 percent to the cumulative hazard indices (Weston, 1993b). Fish tissue sampling was performed in 1992 (limited), 1996, and 2001.

The ROD concluded that because of the limited extent and magnitude of contamination and the potential greater adverse impact that would be caused by excavation of the sediment, no remedial action was proposed other than monitoring of surface water, sediment, and fish tissue in the drainage.

The ROD also addressed the presence of pesticides in the drainage area sediment. It was concluded that the pesticides were the result of basewide application and were not the result of a CERCLA-regulated release. Because of this, no CGs for pesticides in Zone 2 sediments were necessary.

9.4.2 Remedial/Removal Actions

9.4.2.1 Regulatory Actions

Described below is the controlling document that presents the selected remedy.

Zone 2 Record of Decision (1995): The *Zone 2 ROD* (Weston, 1995) concluded that because of the limited extent and magnitude of contamination and the potential greater adverse impact that would be caused by excavation of the sediment, no remedial action was proposed other than monitoring of surface water, sediment, and fish tissue in the drainage.

9.4.2.2 Remedial Action Objectives

The *Zone 2 ROD* (Weston, 1995) identified the following general Zone 2 RAOs relevant to the Peverly Drainage System:

- Surface water and sediment – Monitoring of surface water and sediment quality over time in Upper and Lower Peverly and Bass Ponds (Weston, 1995).

The CGs established in the *Zone 2 ROD* for surface water and sediment within the Peverly Drainage System are included in Table 9.4-1 and Table 9.4-2, respectively.

9.4.2.3 Remedy Description

The *Zone 2 ROD* required monitoring of surface water, sediment, and fish tissue in the Peverly and Bass Ponds drainage system.

9.4.2.4 Remedy Implementation

Surface water and sediment monitoring is performed annually at a total of nine sample stations (24-815, 24-8014, 24-8015, 24-8016, 24-8018, 24-8019, 24-8098, 24-8103A, and 24-8105). The monitoring of surface water at stations 24-8014, 24-8015, 24-8016, 24-8018, 24-8019, 24-8098, 24-8103A, and 24-8105 satisfies the requirements of the *Landfill 1 Groundwater Management Permit* (GMP).

Surface water at Peverly Brook and Upper Peverly Pond has been historically monitored for pesticides and metals. Currently, surface water within the Peverly Brook drainage is monitored for site-specific metals (aluminum, arsenic, iron, lead, manganese, and zinc) as specified in the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003). Metals historically have not been detected at concentrations above the *Zone 2 ROD* CGs at a high frequency in Peverly Brook and Peverly Pond surface water. The detected analyte concentrations in the 2008 surface water samples did not exceed any of the *Zone 2 ROD* CGs for surface water.

Sediment at Peverly Brook and Upper Peverly Pond has been historically monitored for pesticides and metals. Currently, sediment within the Peverly Brook drainage is monitored for site-specific metals (arsenic, lead, nickel, and zinc) and pesticides at select locations as specified in the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003). The pesticide compounds 4,4'-DDE and 4,4'DDD continue to be detected within sediment from the Peverly Brook drainage; however, no CGs were established in the *Zone 2 ROD* for pesticides in Peverly Brook sediments. Site-specific metals have also been detected at concentrations above the ROD-specified CGs during recent monitoring events, primarily at sampling station 24-8015. The concentrations of pesticides and metals in sediment from the Peverly Brook drainage are not expected to decrease substantially in the near term.

Fish tissue sampling was performed in 1992 (limited), 1996, and 2001. However, evaluation of the most recent data indicated ecological risks due to site-related contaminants are likely significantly less than estimated in the Zone 2 ERA in 1993 (MWH, 2002). Additionally, no human health risks were identified in the initial risk assessment and currently no consumption of fish from the drainage areas occurs. Therefore, the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003) recommended discontinuing fish tissue sampling in the Peverly Brook drainage system.

9.4.3 Implementation of Recommendations from Last Five-Year Review

The second *Five-Year Review Report* (MWH, 2004) concluded that the remedies for Zone 2 remained protective of human health and the environment. Annual evaluation of environmental monitoring data was recommended to evaluate opportunities for optimization and progress toward CGs. Surface water and sediment monitoring in the Zone 2 drainage areas has been performed as specified in the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003) and the results of monitoring were documented in:

- *Landfills and CRDs 2005 Annual Report* (MWH, 2006),
- *Landfills and CRDs 2006 Annual Report* (URS, 2008a),
- *Landfills and CRDs 2007 Annual Report* (URS, 2008b), and
- *Landfills and CRDs 2008 Annual Report* (URS, 2009).

No modifications to the LTM program for the Peverly Drainage System occurred during this Five-Year Review period.

The second *Five-Year Review Report* (MWH, 2004) also recommended that the BCT reevaluate the rationale behind establishment of surface water and sediment CGs for Peverly Brook, given that monitoring is the only objective stated in the Zone 2 ROD. This recommendation was not explored.

9.4.4 Technical Assessment

9.4.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The chosen remedy for Peverly Brook is functioning as intended by the *Zone 2 ROD* (Weston, 1995). The *Zone 2 ROD* concluded that neither surface water nor sediment posed unacceptable human health risks and only limited ecological risk. LTM of surface water and sediment has been conducted in Peverly Brook since the adoption of the *Zone 2 ROD*. The scope of surface water monitoring was reduced in 2003 to focus monitoring upon Zone 2 site-specific COCs.

9.4.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards:

Surface Water. *Zone 2 ROD* CGs for surface water were based on ARARs (New Hampshire WQC from Env-Ws 430 [August 1990] were used for arsenic and zinc) and background values (aluminum, iron, lead, manganese). New Hampshire WQC have been revised since the time of the ROD. Effective December 10, 1999, Env-Ws 430 was readopted with amendments and renumbered Env-Ws 1700. Effective May 21, 2008, Env-Ws 1700 was readopted with amendments and renumbering Env-Wq 1700 (NHDES, 2008).

The following table shows a comparison of the CGs specified in the *Zone 2 ROD* (based upon Env-Ws 430) to current WQC (based upon Env-Wq 1700).

Constituent	**ROD-Specified Cleanup Goal (µg/L) (Zone 2 ROD)**	**Current New Hampshire WQC (µg/L) (Env-Wq 1700)**
Aluminum	896*	87
Arsenic	Practical Quantitation Limit	150
Iron	2,890*	1,000
Lead	5*	1.81**
Manganese	1,970*	No WQC
Zinc	72.9**	82.4**

* - Maximum Site Background Level (Weston, 1993a).

** - Calculated based on a hardness of 64.3 mg/L, as in the *Zone 2 ROD*.

As the table indicates, some of the latest New Hampshire WQC are more stringent than their corresponding ROD-specified CGs. However, these changes in New Hampshire WQC criteria do not affect the protectiveness of the remedy because the data from the 2008 surface water sampling event showed only one location (24-815, Peverly Brook) with one COC (iron at 1,070 µg/L) at a concentration above the current New Hampshire WQC (all detected analyte concentrations were below the *Zone 2 ROD* CGs); the background concentration of iron at the former Pease AFB is significantly higher than the current WQC value.

Sediment. *Zone 2 ROD* CGs for sediment were based on background values (lead and nickel) and NOAA ER-Ls values (arsenic and zinc) (Long and Morgan, 1990). The background values are still valid. The arsenic and zinc NOAA ER-L values used to establish the sediment CGs were 33 mg/kg and 120 mg/kg, respectively (Weston, 1995); the current NOAA ER-Ls for arsenic and zinc are 8.2 mg/kg and 150 mg/kg, respectively (Buchman, M.F., 2008). These minor changes in sediment criteria do not have a significant impact on the protectiveness of the remedy.

Changes in Exposure Pathways: There have been no changes in physical conditions, exposure pathways, and land use that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Evaluation of fish tissue data using updated and widely accepted toxicity reference values indicated ecological risks due to site-related contaminants appeared to be significantly less than estimated in the Zone 2 ERA in 1993 (MWH, 2002).

Changes in Risk Assessment Methods: The original HHRA was conducted following then current EPA and EPA Region 1 guidance. HHRA are performed somewhat differently now than they were at the time of the last Five-Year Review and the *Zone 2 ROD*. Guidance documents/risk assessment tools that have been issued include:

- Background guidance (2002), which changed the way background comparisons are performed for metals.
- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.
- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.
- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.
- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.
- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

ERA procedures have not changed significantly since the last Five-Year Review. However, ecological screening thresholds have been updated during that period. Methods for calculating 95% UCLs and comparisons to background for metals also have changed.

Surface water CGs were based on ARARS (New Hampshire WQC) and changes to WQC were discussed above. NOAA ER-Ls were listed as TBCs for sediment in the *Zone 2 ROD* (Weston, 1995) and changes to the NOAA ER-L values were discussed above.

Expected Progress Toward Meeting RAOs: The ROD-specified RAO of monitoring of surface water and sediment quality over time is being achieved.

9.4.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

9.4.4.4 Technical Assessment Summary

As described above, the remedy at Peverly Brook is functioning as intended. The *Zone 2 ROD* required NFA other than monitoring of surface water, sediment, and fish tissue in this drainage. Long-term monitoring of surface water and sediment has been conducted in Peverly Brook since the adoption of the *Zone 2 ROD* meeting the RAO established for the drainage area in the *Zone 2 ROD*. While ARAR changes exist for surface water in Peverly Brook, these changes have not impacted the protectiveness of the remedy. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. No other information has been identified that would call into question the protectiveness of the remedy.

9.4.5 Issues

CGs for surface water and sediment were established for Peverly Brook in the *Zone 2 ROD*. Changes have occurred to surface water and sediment ARARs/TBCs that were used to develop CGs in the *Zone 2 ROD*, but these changes do not affect the protectiveness of the remedy.

No remedial objective was included in the ROD to specifically address surface water and sediment beyond routine monitoring. Metals in surface water continue to be detected at concentrations above the ROD specified CGs for Peverly Brook and Peverly Pond. Long-term monitoring data also indicate that metals in sediment continue to be detected above cleanup goals. It is not anticipated that concentrations of pesticides and metals in Peverly Brook drainage sediment will decrease rapidly over time.

9.4.6 Recommendations and Follow-up Actions

Routine LTM of surface water and sediment should continue. However, the concentrations of pesticides and metals in Peverly Brook drainage sediment are not expected to decrease substantially in the near term. Therefore, it is recommended that the sampling frequency for Peverly Brook drainage sediment be changed from annually to triennially. No changes will be made to Peverly drainage system long-term monitoring until a revised draft LTMP is submitted, reviewed, and approved by EPA and NHDES. Routine evaluation of LTM data should also be performed to optimize LTM activities. Changes in the applicable regulatory standards for COCs should be noted in future LTM reports.

9.4.7 Protectiveness Statement

The remedial action at Peverly Brook (long-term monitoring of sediment and surface water) is currently protective of human health and the environment and is expected to remain so in the future.

9.4.8 References

Bechtel, 1998. *Pease Air Force Base Basewide Surface Water Sediment, and Fish Tissue Monitoring Long-Term Monitoring Plan*. April.

Bechtel, 1999. *Five-Year Review Report, Pease Air Force Base*. September.

Buchman, M.F., 2008. *NOAA Screening Quick Reference Tables*, NOAA OR&R Report 08-1, Seattle WA, Office of Response and Restoration Division, NOAA. 34 pages.

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Long, E.R. and L.G. Morgan, 1990. The Potential for Biological Effects of Sediment-sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52.

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Weston, 1995. *Zone 2 Record of Decision*. September.

9.5 ZONE 4, LOWER GRAFTON DITCH

9.5.1 Background

9.5.1.1 <u>Site Description</u>

Grafton Ditch (upper and lower) is the primary drainage feature in Drainage Area E (Bechtel, 1998a), which is shown on Figure 8.4-1. This drainage area receives surface water and sediment from the former Jet Engine Test Cell (Site 34), the former Auto Hobby Shop (Site 40), LF-6 (Site 6), and CRD-2 (Site 17).

The headwaters of Grafton Ditch are located adjacent to the Jet Engine Test Cell (JETC). The ditch is an open surface drainage for approximately 700 feet until it enters a storm drain. This portion of the ditch is referred to as Upper Grafton Ditch. Surface water flows through the storm drain system for approximately 3,000 feet until it discharges to another open surface drainage east of Grafton Drive. This portion of the drainage is referred to as Lower Grafton Ditch. Lower Grafton ditch converges with Hodgson Creek approximately 500 feet west of Landfill 6 and then flows east and eventually discharges to the Piscataqua River by the way of North Mill Pond. The Grafton Ditch site features and long-term monitoring locations are shown in Figure 9.5-1.

The *Zone 4 ROD* (Weston, 1995a) identified runoff from the industrial areas in Zone 3 and surface water runoff from LF-6 and CRD-2 as the primary impactors on the surface water quality of Grafton Ditch.

The *Zone 3 ROD* indicated that the Jet Engine Test Cell (Site 34) contributed fuel-related compounds, PAHs, and metals to Upper Grafton Ditch. Additionally, aerial fallout of combustion products from aircraft engines and local heating and industrial activities were identified as having contributed to this contamination (Weston, 1995b).

LF-6 reportedly received domestic and industrial solid wastes during the 1970’s. These wastes may have also included spent paint thinners and solvents (Bechtel, 1997). The primary contaminants identified at Landfill-6 were aromatic hydrocarbons (BTEX and dichlorobenzene), PAHs, TPHs, and metals (Weston, 1995a). The history of LF-6 was discussed in greater detail in Section 7.8 of this report.

CRD-2 reportedly received construction debris from 1952 through 1987. Materials including asphalt, concrete, plastic, wood, rubber, cloth, wire, metal, and other construction materials have been observed in the fill (Bechtel, 1997). The primary contaminants identified were PAHs and TPHs (Weston, 1995a).

9.5.1.2 Initial Response

No remedial action was performed at Grafton Ditch prior to the finalization of the *Zone 4 ROD* (Weston, 1995a) and the *Zone 3 ROD* (Weston, 1995b).

9.5.1.3 Basis for Taking Action

The RI report for Zone 4 was completed in September 1993 (Weston, 1993). The RI documented the presence of buried wastes and contamination in soil, groundwater, surface water, and sediment in the areas surrounding LF-6. Both organic and inorganic contaminants were detected in surface water and sediment within the Grafton Ditch drainage during RI activities.

9.5.2 Remedial/Removal Actions

9.5.2.1 Regulatory Actions

Actions in Grafton Ditch are covered by two RODs: the *Zone 4 ROD* covers Lower Grafton Ditch and the *Zone 3 ROD* covers Upper Grafton Ditch.

Record of Decision for a Remedial Action at Zone 4 (1995): The *Zone 4 ROD* (Weston, 1995a) concluded that surface water and sediment in Lower Grafton Ditch did not pose unacceptable risks to human receptors. An ERA indicated that some chemicals posed a marginal risk to ecological receptors; however, these were determined not to be site related. It was concluded that remedial action was not required for Lower Grafton Ditch and there was not a need to establish CGs for surface water and sediment. Surface water and sediment monitoring in Lower Grafton Ditch was included as part of the LF-6 selected remedial alternative.

Record of Decision for Zone 3 (1995): The *Zone 3 ROD* (Weston, 1995b) concluded that neither surface water nor sediment posed an unacceptable risk to human receptors in Upper Grafton Ditch. However, the ROD concluded that both surface water and sediment posed an unacceptable risk to ecological receptors. The selected remedial alternative included excavation and disposal of sediment exceeding CGs from Upper Grafton Ditch. This remedial action was completed in 1996 (Bechtel, 1998b). Following this remedial action, no further monitoring of surface water and sediment in Upper Grafton Ditch was required.

9.5.2.2 Remedial Action Objectives

The *Zone 4 ROD* identified the following general Zone 4 RAOs relevant to Lower Grafton Ditch:

- No remedial action for surface water or sediment in Lower Grafton; and

- LTM of surface water and sediment in Lower Grafton (Weston, 1995a).

The *Zone 3 ROD* identified the following general Zone 3 RAO relevant to Upper Grafton Ditch:

- Protect ecological receptors from direct contact with, or ingestion of, sediment containing contaminants at concentrations that may present a potential unacceptable risk (Weston, 1995b).

No CGs were established for Lower Grafton Ditch surface water or sediment in the *Zone 4 ROD*. However, Lower Grafton Ditch surface water data is evaluated by comparison to New Hampshire WQC (currently Env-Wq 1700, shown in Table 9.5-1). Lower Grafton Ditch sediment data was evaluated by comparison to NOAA ER-L screening values.

9.5.2.3 Remedy Implementation

Remedial actions in the vicinity of Lower Grafton Ditch included excavation and removal of materials from LF-6 between 1995 and 1996 (Bechtel, 1997) and installation of a cap on CRD-2 in 1995 (Weston, 1995b). No surface water or sediment remedial actions were performed in Lower Grafton Ditch. Remedial actions in the vicinity of Upper Grafton Ditch included excavation of sediment exceeding the ROD CGs for sediment and offsite disposal. This work was performed between September and December 1996 (Bechtel, 1998b).

Six permanent monitoring stations (20-810, 20-8185, 20-809, 20-8131, 20-808, and 20-8133) were established in Lower Grafton Ditch (Bechtel, 1998a). However, monitoring of station 20-810 was discontinued after the May 2000 sampling event because it was deemed redundant with station 20-8185. Monitoring at stations 20-809 and 20-8185 and all Lower Grafton Ditch sediment monitoring was discontinued in 2003 at the recommendation of the EPA and as noted in the Agency's comments on the *2001 Annual Report* (MWH, 2002). Currently, LTM within Lower Grafton Ditch is performed in accordance with the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003a) and consists of surface water monitoring for VOCs and metals at locations 20-808, 20-8131, and 20-8133, as shown on Figure 9.5-1.

LTM data for Lower Grafton Ditch surface water samples from 1993 to 2008 indicate no occurrences of VOCs at concentrations exceeding New Hampshire WQC (URS, 2009). However, several metals (aluminum, arsenic, cadmium, copper, iron, lead, selenium, and zinc) have been detected at concentrations above New Hampshire WQC during recent sampling events (URS, 2009).

9.5.3 Implementation of Recommendations from Last Five-Year Review

The second *Five-Year Review Report* (MWH, 2004) concluded that the remedies for Zone 3 and Zone 4 remained protective of human health and the environment. Annual evaluation of environmental monitoring data was recommended to evaluate the effectiveness of the LF-6 remedy and to identify opportunities for optimization of LTM activities. Surface water and sediment monitoring in the Lower Grafton Ditch drainage area has been performed as required and the results of monitoring were documented in:

- *Landfills and CRDs 2004 Annual Report* (MWH, 2005),
- *Landfills and CRDs 2005 Annual Report* (MWH, 2006),
- *Landfills and CRDs 2006 Annual Report* (URS, 2008a),
- *Landfills and CRDs 2007 Annual Report* (URS, 2008b), and
- *Landfills and CRDs 2008 Annual Report* (URS, 2009).

No optimization of LTM activities occurred during this Five-Year Review period.

9.5.4 Technical Assessment

9.5.4.1 Question A

Question A: Is the remedy functioning as intended by the decision documents?

The chosen remedy for Grafton Ditch is functioning as intended by the *Zone 3 ROD* (Weston, 1995b) and the *Zone 4 ROD* (Weston, 1995a). Sediments with COC concentrations exceeding *Zone 3 ROD* CGs were removed from Upper Grafton Ditch between September and December 1996 (Bechtel, 1998b) and materials from LF-6 were excavated and removed between 1995 and 1996 (Bechtel, 1997). LTM of surface water and sediment has been conducted in Lower Grafton Ditch to meet the RAOs for surface water and sediment established in the *Zone 4 ROD*. The scope of surface water and sediment monitoring was reduced in 2000 and again in 2003 to eliminate redundant data points and to focus monitoring upon contaminants directly related to LF-6 activities (i.e., VOCs and metals). All sediment monitoring was discontinued in 2003 because remaining concentrations of COCs were not believed to be the result of LF-6 activities.

9.5.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards:

Surface Water. No surface water CGs were developed for Lower Grafton Ditch in the *Zone 4 ROD*. Lower Grafton Ditch surface water monitoring data are compared to current standards (i.e., NHDES Env-Wq 1700).

Sediment. No sediment CGs were established for Lower Grafton Ditch in the *Zone 4 ROD*; sediment monitoring in Lower Grafton Ditch was discontinued in 2003. Sediments with COC concentrations exceeding *Zone 3 ROD* CGs in Upper Grafton Ditch were excavated in 1996.

Changes in Exposure Pathways: There have been no changes in physical conditions, exposure pathways, and land use that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Risk-based cleanup goals were not established for the sites; therefore, there have been no changes in toxicity or contaminant characteristics that would affect the protectiveness of the remedy.

Changes in Risk Assessment Methods: The original HHRAs were conducted following then current EPA and EPA Region 1 guidance. HHRAs are performed somewhat differently now than they were at the time of the last Five-Year Review and the *Zone 3* and *4 RODs*. Guidance documents/risk assessment tools that have been issued include:

- Background guidance (2002), which changed the way background comparisons are performed for metals.

- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.

- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.

- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.

- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.

- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

ERA procedures have not changed significantly since the last Five-Year Review. However, ecological screening thresholds have been updated during that period. Methods for calculating 95% UCLs and comparisons to background for metals also have changed. Lower Grafton Ditch surface water monitoring data are compared to current standards (i.e., NHDES Env-Wq 1700).

Expected Progress Toward Meeting RAOs: The ROD-specified RAO of monitoring surface water and sediment quality over time is being achieved.

9.5.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

9.5.4.4 Technical Assessment Summary

As described above, the remedy at Grafton Ditch is functioning as intended. Sediment exceeding the *Zone 3 ROD* CGs was removed from Upper Grafton Ditch and LTM of surface water and sediment has been conducted in Lower Grafton Ditch to meet the RAOs for surface water and sediment established in the *Zone 4 ROD*. No changes in exposure pathways or toxicity and other contaminant characteristics are affecting the protectiveness of the remedy. No other information has been identified that would call into question the protectiveness of the remedy.

9.5.5 Issues

No issues were identified for Grafton Ditch.

9.5.6 Recommendations and Follow-up Actions

Routine long-term monitoring and reporting of surface water for metals should continue in accordance with approved plans. However, LTM data for Lower Grafton Ditch surface water samples from 1993 to 2008 indicate no occurrences of VOCs at concentrations exceeding New Hampshire WQC; therefore, it is recommended that VOC monitoring for surface water in Lower Grafton Ditch be discontinued. No changes will be made to Lower Grafton Ditch long-term monitoring until a revised draft LTMP is submitted, reviewed, and approved by EPA and NHDES. Additionally, a routine review of the monitoring objectives and evaluation of the LTM data should be conducted to determine the point at which monitoring can be reduced or discontinued.

9.5.7 Protectiveness Statement

The remedial action at Grafton Ditch (excavation of sediment and LTM of sediment and surface water) is currently protective of human health and the environment and is expected to remain so in the future.

9.5.8 References

Bechtel, 1997. *Construction Rubble Dump-2 Landfill Cap Postclosure Maintenance and Monitoring Plan*. April.

Bechtel, 1998a. *Pease Air Force Base Basewide Surface Water Sediment, and Fish Tissue Monitoring Long-Term Monitoring Plan.* April.

Bechtel, 1998b. *Zone 3 Excavations Remedial Action Report*. March.

EPA, 2001. *Comprehensive Five-Year Review Guidance*, OSWER No. 9355.7-03B-P, EPA 540-R-01-007. June.

EPA, 2005a. *Guidelines for Carcinogenic Risk Assessment*, EPA 630-P-03-001F. March.

EPA, 2005b. *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), EPA 630-R-03-003F. March.

MWH, 2002. *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report*. June.

MWH, 2003a. *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update*. March.

MWH, 2003b. *2002-2003 Basewide Surface Water and Sediment Monitoring Summary Report*. June.

MWH, 2004. *5-Year Review Report (1999-2004), Former Pease Air Force Base, Portsmouth, New Hampshire*. September.

MWH, 2005. *Landfills and Construction Rubble Dumps 2004 Annual Report*. January.

MWH, 2006. *Landfills and Construction Rubble Dumps 2005 Annual Report*. March.

URS, 2008a. *Landfills and CRDs 2006 Annual Report.* March.

URS, 2008b. *Landfills and CRDs 2007 Annual Report.* May.

URS, 2009. *Landfills and CRDs 2008 Annual Report*. June.

Weston, 1993. *Zone 4 Remedial Investigation Report*. September.

Weston, 1995a. *Record of Decision for a Remedial Action at Zone 4*. January.

Weston, 1995b. *Record of Decision for Zone 3*. September.

9.6 ZONE 5, KNIGHTS BROOK AND PICKERING BROOK

9.6.1 Background

9.6.1.1 Site Description

Discussion of Drainage Areas H and I are combined in this report since both drainage features are associated with Site 8 and monitoring within both drainage areas is required by the *Record of Decision for Site 8 (Site 8 ROD)* (Weston, 1994). Both drainage areas are shown in Figure 8.4-1. Pickering Brook receives surface water and sediment from most of FDTA-2 (Site 8), a portion of the FMS Equipment Cleaning Site (Site 11), and a small portion of the northeast corner of the Flightline Area (Figure 9.6-1). Pickering Brook flows off base to the north and joins Flagstone Brook. Flagstone Brook ultimately discharges into the Piscataqua River.

Knights Brook receives surface water and sediment from a small portion of Site 8. The headwaters for Knights Brook originate from both Pickering and Watering Springs. Each of these water bodies is located to the northwest of Site 8, entirely outside the Pease AFB site boundary. Surface water from Watering and Pickering Springs flows into two separate wetlands, which comprise the headwaters for Knights Brook. Drainage from the two wetlands converges and flows north to Little Bay (Figure 9.6-1).

Virtually all of Site 8 is contained in the Pickering Brook drainage; however, it is suspected that groundwater from Site 8 discharges into the Knights Brook drainage. According to the *Site 8 ROD* (Weston, 1994), cis-1,2-DCE and TCE were detected in surface water at Knights Brook and in Site 8 bedrock wells, located upgradient of the brook. The presence of these contaminants has been attributed to past activities conducted at Site 8.

Site 8 was operated as a fire training area from 1961 to 1988; two former BAs are the primary contaminant source areas within the site. Before 1971, mixed waste oils, solvents, and fuels were collected from various locations across the base and burned at Site 8 as one method of disposal. Burning procedures involved saturating the burn pit with water and pouring waste oils, solvents, or fuels on top of the water or a mock aircraft. The mixture was burned for a period of 1 to 2 minutes and then extinguished using an aqueous foam. In the mid 1970s, the practice of mixing waste oils and solvents with fuel for training ceased and only JP-4 was used. At the same time, an underground sprinkler and drainage system was added to the BA so that JP-4 could be sprayed into the pit area through an underground fuel line. Excess fuel was discharged to a drainage ditch located at the north end of Site 8, which drains to Pickering Brook. Additional information regarding Site 8 is provided in Section 7.9 of this report.

9.6.1.2 Initial Response

The RI process at Site 8 was conducted in three stages from 1984 to 1992. As part of the IRMs associated with the RI process, approximately 260 tons of contaminated sediment were removed from the Site 8 drainage ditch in 1990 and were disposed off base at a licensed disposal facility (Weston, 1994).

9.6.1.3 Basis for Taking Action

In 1983, an IRP Phase 1 Problem Identification/Records Search was conducted at Pease AFB. As a result of the Phase 1 report and subsequent pre-survey work, a RI was conducted at Site 8 in accordance with CERCLA requirements (Weston, 1992). The investigation was conducted in three stages from 1984 to 1992. The RI identified areas of free-phase product, soil, and groundwater contamination at Site 8. Pesticides, PAHs, and metals were detected in Pickering Brook and low levels of VOCs and PAHs were detected in the sediment from Knights Brook (Weston, 1994).

9.6.2 Remedial/Removal Actions

9.6.2.1 Regulatory Actions

Described below is the controlling document that present the selected remedy.

Record of Decision for Site 8 (1994): Risk assessments were performed for surface water and sediment in Knights and Pickering Brooks and were presented in the *Site 8 ROD* (Weston, 1994). The risk assessments did not reveal exposures that resulted in unacceptable risks to human or ecological receptors. As a result, CGs were not established for surface water and sediment in Knights and Pickering Brooks.

However, the chosen remedy for Site 8 detailed in the ROD requires monitoring of surface water and sediment in Knights and Pickering Brooks.

9.6.2.2 Remedial Action Objectives

The *Site 8 ROD* did not identify RAOs specific to surface water and sediment in Knights and Pickering Brooks. The following RAO specific to groundwater at Site 8 also affects surface water:

- Prevent discharge of contaminated groundwater to surface water bodies where it may present increased risks to human health and the environment.

9.6.2.3 Remedy Description

The *Site 8 ROD* concluded that neither surface water nor sediment posed unacceptable risks and that CGs were unnecessary for these media. However, the chosen remedy for Site 8 detailed in the ROD requires monitoring of surface water and sediment in Knights and Pickering Brooks (Weston, 1994).

9.6.2.4 Remedy Implementation

Four permanent monitoring stations (99-015, 99-029, 28-8028, and 28-8029) were established in Knights Brook and two permanent monitoring stations (27-8026 and 27-8027) were established in Pickering Brook (Bechtel, 1998). In the *2001 Annual Report* (MWH, 2002), the Air Force proposed: cessation of surface water and sediment sampling at locations 28-8028 and 28-8029 in Knights Brook; cessation of sediment monitoring at location 99-015 in Knights Brook; and cessation of SVOC analyses for sediment samples within Pickering Brook (27-8026 and 27-8027). These recommendations were based upon the fact that the *Site 8 ROD* concluded that neither surface water nor sediment pose unacceptable human or ecological risk. The EPA and NHDES approved these recommendations.

Currently, LTM within Knights and Pickering Brooks is performed in accordance with the *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update* (MWH, 2003a). Surface water monitored within Knights Brook currently consists of annual VOC analysis at location 99-015 (Watering Spring) as a courtesy to the landowner (Figure 9.6-1). Although classified as surface water for data management purposes, the water at station 99-015 (Watering Spring) actually represents groundwater that has recently seeped to the surface. To date, VOCs have not been detected at concentrations above current New Hampshire WQC (Env-Ws 1700, superceded by Env-Wq 1700) at location 99-015; no VOCs were detected in the 2008 sample from 99-015 (URS, 2009).

Within Pickering Brook, surface water and sediment at stations 27-8027 (downstream of Site 8, upper portion of Pickering Brook) and 27-8026 (downstream, middle portion of Pickering Brook) (Figure 9.6-1) are monitored annually for site-specific metals (mercury, nickel, lead, and zinc). Lead is the only site-specific metal that has been detected in surface water at concentrations above the New Hampshire WQC (twice at station 27-8027) during LTM activities at Pickering Brook; none of the detected metals concentrations exceeded the WQC in the 2008 Pickering Brook surface water samples. Since 2005, lead, nickel, and zinc have been detected in Pickering Brook sediment at concentrations above NOAA ER-L values only at station 27-8027 (URS, 2009).

9.6.3 Implementation of Recommendations from Last Five-Year Review

The second *Five-Year Review Report* (MWH, 2004) concluded that the remedies for Site 8 remained protective of human health and the environment. Annual evaluation of environmental monitoring data was recommended to evaluate the effectiveness of the Site 8 remedy and to identify opportunities for optimization of long-term monitoring activities. Surface water and sediment monitoring in the Knights Brook and Pickering Brook drainage areas has been performed as required and the results of monitoring were documented in:

- *Site 8, FDTA-2, Remediation System Ninth-Year Operations Report* (MWH, 2005),
- *Site 8, FDTA-2, Remediation System Tenth-Year Operations Report* (MWH, 2007),
- *Site 8, FDTA-2, Remediation System Eleventh-Year Operations Report* (URS, 2007),
- *Site 8, FDTA-2, Remediation System Twelfth-Year Operations Report* (URS, 2008), and
- *Site 8, FDTA-2, Remediation System Thirteenth-Year Operations Report* (URS, 2009).

No changes to the LTM programs in the Knights Brook and Pickering Brook drainage areas occurred during this Five-Year Review period.

9.6.4 Technical Assessment

9.6.4.1 <u>Question A</u>

Question A: Is the remedy functioning as intended by the decision documents?

The *Site 8 ROD* concluded that neither surface water nor sediment posed unacceptable risks and that CGs were unnecessary for these media, but the *Site 8 ROD* included monitoring of surface water and sediment as a component of the overall Site 8 remedy. Long-term monitoring of surface water and sediment has been conducted in both Knights and Pickering Brooks since the adoption of the *Site 8 ROD*. Reductions in monitoring scope occurred in 2003 based upon lack of detection of organic and inorganic constituents at concentrations above comparison criteria. Monitoring has indicated little impact to these drainage areas from historical Site 8 activities.

9.6.4.2 Question B

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards: No ROD-based CGs were established for surface water and sediment in Knights Brook or Pickering Brook. Knights Brook and Pickering Brook surface water and sediment analytical data are compared to the most current standards (NHDES Env-Wq 1700 for surface water and NOAA ER-L values for sediment).

Changes in Exposure Pathways: There have been no changes in physical conditions, exposure pathways, and land use that would affect the protectiveness of the remedy

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in toxicity values or other contaminant characteristics that would affect the protectiveness of the remedy.

Changes in Risk Assessment Methods: The original HHRA was conducted following then current EPA and EPA Region 1 guidance. HHRA are performed somewhat differently now than they were at the time of the last Five-Year Review and the *Site 8 ROD.* Guidance documents/risk assessment tools that have been issued include:

- Background guidance (2002), which changed the way background comparisons are performed for metals.
- EPA guidance regarding the sources of toxicity values (December 2003) has changed; toxicity values are now generally obtained from EPA Regional Screening Levels tables.
- EPA Risk Assessment Guidance for Superfund (RAGS) Part E (2004), which changed the way dermal risk assessment is performed.
- EPA ProUCL guidance and software (numerous versions of new guidance and software, up through 2008), which changed the way 95% UCLs are calculated.
- EPA RAGS Part F (2008), which changed the way inhalation risk assessment is performed. There are many chemicals with new toxicity values in this document.
- *Guidelines for Carcinogenic Risk Assessment* (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), which provide updated guidance for preparation of cancer risk assessments.

Changes have been made with regard to toxicity values. In particular, provisional toxicity values that EPA previously did not consider valid for use in risk assessments are now considered valid.

Ecological Risk Assessment (ERA) procedures have not changed significantly since the last Five-Year Review. However, ecological screening thresholds have been updated during that period. Methods for calculating 95% UCLs and comparisons to background for metals also have changed.

Knights Brook and Pickering Brook surface water and sediment analytical data are compared to the most current standards.

Expected Progress Toward Meeting RAOs: No specific surface water and sediment RAOs were established for Pickering and Knights Brooks. The Site 8 RAO to prevent discharge of contaminated groundwater to surface water is being met and is expected to be met in the future.

9.6.4.3 Question C

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has been identified that would call into question the protectiveness of the remedy.

9.6.4.4 Technical Assessment Summary

As described above, the remedy at Knights and Pickering Brooks is functioning as intended. Monitoring of surface water and sediment at Knights and Pickering Brooks is performed as a component of the overall Site 8 remedy. Potentially site-related organic and inorganic constituents have rarely been reported at concentrations above comparison criteria, indicating little impact to these drainage areas from Site 8 activities. The Site 8 RAO to prevent discharge of contaminated groundwater to surface water is being met and is expected to be met in the future. No other information has been identified that would call into question the protectiveness of the remedy.

9.6.5 Issues

No issues were identified for Knights Brook and Pickering Brook.

9.6.6 Recommendations and Follow-up Actions

Routine LTM and reporting of surface water data should continue in accordance with approved plans. Additionally, a routine review of the monitoring objectives and evaluation of the surface water LTM data should be conducted to determine when discontinuation of surface water monitoring is warranted, based on demonstrated lack of adverse impact to Knights and Pickering Brooks.

The metals data provided by routine LTM of sediment in Pickering Brook has varied little over the 1991 to 2008 monitoring period. This consistency indicates that current Site 8 activities are not contributing to sediment metals loading and metals in sediment do not appear to be desorbing, impacting surface water quality. Since the Site 8 risk assessments did not reveal unacceptable risks to human or ecological receptors from exposure to Pickering Brook sediment and the sediment LTM data has shown little variation over time, it is recommended that sediment monitoring in Pickering Brook be discontinued. No changes will be made to Pickering Brook long-term monitoring until a revised draft LTMP is submitted, reviewed, and approved by EPA and NHDES.

9.6.7 Protectiveness Statement

LTM of Knights and Pickering Brooks indicates that the remedial activities performed to date at Site 8 have been protective of human health and the environment related to potential exposures to surface water and sediment in these drainage areas. This protectiveness is expected to continue in the future.

9.6.8 References

Bechtel, 1998. *Pease Air Force Base Basewide Surface Water Sediment, and Fish Tissue Monitoring Long-Term Monitoring Plan.* April.

EPA, 2001. *Comprehensive Five-Year Review Guidance*, OSWER No. 9355.7-03B-P, EPA 540-R-01-007. June.

EPA, 2005a. *Guidelines for Carcinogenic Risk Assessment*, EPA 630-P-03-001F. March.

EPA, 2005b. *Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens* (EPA, 2005b), EPA 630-R-03-003F. March.

MWH, 2002. *2001 Basewide Surface Water, Sediment and Fish Tissue Monitoring Annual Report*. June.

MWH, 2003a. *Basewide Surface Water and Sediment Long-Term Monitoring Plan – Year 2003 Update*. March.