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FINAL SITE CLOSEOUT REPORT FOR OPERABLE UNIT 1 RADIOLOGICAL REMEDIATION SHPACK LANDFILL FUSRAP SUPERFUND SITE

Norton/Attleboro, Massachusetts

AUTHORIZED PROJECT UNDER THE
FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM (FUSRAP)

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DECLARATION OF RESPONSE ACTION COMPLETION AND ISSUANCE OF THE SITE CLOSEOUT REPORT FOR THE RADIOLOGICAL REMEDIATION AT THE SHPACK LANDFILL SUPERFUND SITE

The response action for Operable Unit (OU) 1 – Radiological Remediation at the Shpack Landfill Superfund Site in Norton/Attleboro Massachusetts is complete in accordance with the Record of Decision (ROD) signed on 30 September 2004, and in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). As a result of the remedial action at OU-1, no Formerly Utilized Sites Remedial Action Program (FUSRAP) radioactive material, required to be addressed by the ROD, remains on-site above the cleanup requirements and no further action to address the FUSRAP radioactive contamination will be required on-site with the exception of a few small isolated areas of inaccessible soils around the National Grid utility poles. These few areas contain radionuclides of concern and would warrant further investigation and characterization if this soil is disturbed. Although the Shpack Landfill was designated a Superfund site and added to the National Priorities List (NPL) in June of 1986, Congress also added this site to FUSRAP in January 2002 [Pub. L. 107-117] to address the radioactive contamination at this Superfund site. U.S. Environmental Protection Agency (EPA) Region 1 provided the U.S. Army Corps of Engineers (USACE) a letter on April 4, 2013 stating that the radioactive remediation at the Shpack Landfill Superfund site was in compliance with the ROD (Appendix A). EPA also stated that due to National Grid utility poles being located within the Shpack site, a few small isolated areas of residual radioactive contamination could not be excavated due to restrictions on “right of way” perimeters required by National Grid. EPA stated that National Grid is aware of this issue and will be required by EPA to comply with the Site institutional controls, including a Soil Management Plan, should the need arise to disturb the soil around these utility poles in the future. If National Grid plans to disturb the radioactive contaminated soil around their utility power poles at some future date, they are required to coordinate their planned activities with EPA and MADEP prior to commencement of any onsite actions. This coordination shall also include notification to DOE by EPA or MADEP if there is expected radioactive contamination to determine cost allocation for the response, transportation and disposal of the radioactive contaminated waste. The appropriate regulatory agencies have received the final Remedial Action Completion Report (May 2012) and the Final Status Survey Report (March 2012) and concurred and/or acknowledged that the response action has attained the cleanup requirements specified in the ROD.

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William H. Graham Date
Brigadier General, U.S. Army Commanding

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ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASURE

AEC	Atomic Energy Commission
ALI	Attleboro Landfill, Inc.
AOCs	areas of concern
ARAR	Applicable or relevant and appropriate requirement
β	beta
bgs	below ground surface
BERA	baseline ecological risk assessment
Cabrera	Cabrera Services, Incorporated
cc	cubic centimeter
CD	Consent Decree
CENAE	U.S. Army Corps of Engineers-New England District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	curies
cm^2	square centimeter(s)
COCs	constituents of concern
Conti	Conti Federal Services, Incorporated
COR	Contracting Officer's Representative
cpm	counts per minute
CQCSM	Contractor Quality Control Systems Manager
DCGL	derived concentration guideline level
DCGLemc	derived concentration guideline level - elevated measurement comparison
DCGLw	derived concentration guideline level - wide area average
DFW	definable features of work
DoD	United States Department of Defense
DOE	United States Department of Energy
dpm	disintegrations per minute
EDi	Environmental Dimensions, Inc.
ELCR	excess lifetime cancer risk range
EPA	United States Environmental Protection Agency
FS	feasibility study
FSS	final status survey
FSSP	final status survey work plan
FSSR	final status survey report
ft	foot (feet)
ft^2	square foot (feet)
ft^3	cubic foot (feet)
FUSRAP	Formerly Utilized Sites Remedial Action Program
g	grams
GWS	Gamma Walkover Survey
HHRA	baseline human health risk assessment

ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASURE (continued)

HI	hazard index
LLRW	Low Level Radioactive Waste
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MADEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MED	Manhattan Engineer District
m	meter(s)
m^2	square meters
m^3	cubic meters
mrem	milliroentgen equivalent man
mrem/yr	milliroentgen equivalent man per year
NAUL	Notice of Activity and Use Limitation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NRC	United States Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
PCB	polychlorinated biphenyls
PCOR	Preliminary Site Close Out Report
pCi/g	picoCuries per gram
PD	Performing defendants
PRP	Potentially responsible parties
QA	Quality Assurance
QC	Quality Control
RA	Remedial Action
Ra-226	radium-226
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RCOCs	radioactive contaminants of concern
ROCs	radionuclides of concern
ROD	Record of Decision
RPM	Remedial Project Manager
Site	Shpack landfill site
SLERA	Screening level ecological risk assessment
SNM	Special nuclear material
SOR	sum of ratios
SSC	Shpack Steering Committee
SRLs	site remedial limits
SUs	survey units
SVOCs	semi-volatile organic compounds
TERC	Total Environmental Restoration Contract
U-nat	natural uranium
U-234	uranium-234

ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASURE (continued)

U-235	uranium-235
U-238	uranium-238
µCi/mL	microcurie(s) per milliliter
µR/hr	microroentgens per hour
USACE	United States Army Corps of Engineers
UU/UE	unlimited use and unrestricted exposure
yd^3	cubic yards

EXECUTIVE SUMMARY

The Shpack Landfill Superfund Site is a 9.4 acre former industrial landfill located on the border of Norton and Attleboro, Massachusetts. The landfill operated from 1946 through the early 1970's, accepting domestic and industrial waste, including inorganic and organic chemical waste, as well as radioactive waste. The site was proposed for placement on the National Priorities List (NPL) by U.S. Environmental Protection Agency (EPA) in October of 1984 and the site was officially added to the NPL in June of 1986.

In 1978, the U.S. Nuclear Regulatory Commission (NRC) conducted radiological surveys at the Shpack landfill after being contacted by a concerned citizen who had detected elevated radiation levels in the landfill area. The NRC's investigations identified radioactive materials, primarily radium and uranium, within the landfill area. The outcome of the NRC and other investigations resulted in the Shpack landfill being added to the Formerly Utilized Sites Remedial Action Program (FUSRAP). The U.S. Atomic Energy Commission (AEC), which was the predecessor agency for U.S. Department of Energy (DOE), established FUSRAP in March 1974 to evaluate radioactive contamination at sites where work was performed to develop the nation's nuclear weapons and early atomic energy program. In 1977, administration and execution of FUSRAP was assumed by DOE, whose initial task was to identify potential FUSRAP sites that might require additional cleanup. The designation of the Shpack Landfill as a FUSRAP site was made by DOE in December of 1980. In 1997, Congress transferred responsibility for the administration and execution of FUSRAP from the DOE to the U.S. Army Corps of Engineers (USACE) with the Fiscal Year 1998 Energy and Water Development Appropriations Act, [Pub. L. 105-62.]

An investigation into the nature and extent of the contamination at the Shpack landfill site was begun by the Performing Defendants (PDs) in 1990 after they entered into an Administrative Order on Consent (AOC) with EPA. USACE and DOE are not identified as PDs under the consent decree. The AOC required the investigation and subsequent activities to be performed by the PDs in accordance with Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Through sampling and characterization of soil, sediments, surface water and groundwater, the investigations defined the contaminants of concern (COCs) for the site. Over the next decade, a Phase IA and Phase IB Remedial Investigation (RI) and Feasibility Study (FS) were conducted, focusing on the chemical and radiological contaminants in the soil, groundwater and nearby residential wells. The Phase IA RI activities were performed by the PDs, with oversight by EPA between 1991 and 1992 and investigated non-radioactive constituents of concern (COCs) in soil, groundwater, sediment and surface water at the site. In 1999, the PDs in conjunction with EPA, USACE, and Massachusetts Department of Environmental Protection (MADEP) began preparation of the work plans to implement Phase IB of the RI which focused on sampling and monitoring groundwater, surface water, and sediment. The Phase IB activities were completed in 2003. A number of investigation programs were conducted

by various agencies (USACE, EPA, PDs) during this time period and the results of which were utilized for completion of the RI/FS by the PDs and the Human Health and Ecological Risk Assessments by EPA's contractor.

USACE, under their congressionally assigned FUSRAP authority, conducted surveys and sampling of the radiological contamination at the site in 2000 and 2002 to develop a final cleanup plan for the radioactive contaminated materials and discovered radioactive contamination that was not from the early atomic energy program. Therefore remediation of this contamination was outside USACE authority. FUSRAP eligibility questions on the specific types of radioactive contamination found at the Shpack landfill were addressed by special legislation passed by Congress in January of 2002 in the DoD and Emergency Supplemental Appropriations Act, Section 8143, subsection (a) of Pub. L. 107-117. The act authorized USACE to clean up radioactive contamination at the Shpack landfill site.

The PD group completed the RI/FS in June 2004 and a public informational meeting was held in Norton, MA on June 23, 2004 to discuss the results of the RI/FS and to announce the availability of the Proposed Plan (PP). The Public Hearing for the PP was held on August 4, 2004. On September 30, 2004, EPA Region 1 signed the Shpack Landfill Superfund Site Record of Decision (ROD). Construction of the remedial action (RA) for the selected remedy was implemented in two parts with the FUSRAP RA to address the radioactive contaminated materials at the Shpack site and this was referred to as Operable Unit (OU) 1. The second part was the CERCLA RA to address non-radiological contamination (OU 2) by the PDs following completion of the FUSRAP RA.

This site closeout report addresses only the FUSRAP RA that was taken by USACE and its contractors to remediate the radioactive contamination at the Site (OU 1). The U.S. Army Corps of Engineers – New England District (CENAE) was tasked by headquarters USACE to implement and execute the FUSRAP response action at the Shpack Landfill Superfund Site for the radioactive contaminated materials in accordance with the ROD. Conti Environment and Infrastructure, Inc. (Conti) was tasked by CENAE, under an existing Remedial Action Contract (RAC), to execute the activities associated with the remediation of the radioactive contamination at the Shpack landfill.

Conti contracted Environmental Dimensions, incorporated (EDi) to provide radiological support services for the remediation of the OU 1 radioactive contaminated waste. Site mobilization activities were conducted in August 2005. Upon commencing excavation operations, USACE and Conti found the limits of radiological contamination at the Site extended deeper than the estimated three feet below ground surface (bgs) outlined in the ROD to a maximum of 17.5 feet in survey unit 8 (see Table 3) and expanded horizontally outside of known areas of radiological contamination, called grids. As a result of deeper excavation operations and a high groundwater level, earth shoring support and dewatering systems were required. A large volume increase of radiological contaminated waste and site conditions resulted in a change to the original scope of work outlined in the ROD. Due to financial restraints, site operations halted in July 2006. In June 2007, site operations resumed under a Total Environmental

Restoration Contract (TERC) contract and continued until jobsite completion in October2011. No field operations were performed during winter months due to freezing temperatures and a high groundwater table.

Excavated materials were mechanically screened and segregated into three physical sized waste streams (one inch minus, one to four inch & four inch plus). Waste streams were divided into stockpiles which consisted of approximately 110 cubic yards of material. Each individual stockpile was characterized for contaminants of concern (COC) to determine off-site disposal requirements. Stockpiles exceeding radiological Site Remedial Limits (SRLs) were packaged and shipped to an approved and NRC licensed Low Level Radioactive Waste (LLRW) disposal facility. Stockpiles which did not exceed radiological SRLs but exceeded chemical SRLs were stockpiled on-site for containment and management during the PD's chemical remediation phase. Stockpiles which did not exceed radiological and chemical SRLs were cleared for on-site backfill. In total, approximately 57,805 cubic yards of material were excavated, screened and characterized of which 50,908 cubic yards were shipped off-site to Energy Solutions, Utah primarily as LLRW.

Cabrera Services Inc. (Cabrera), an independent consultant to USACE, performed the Final Status Survey (FSS) for the OU 1 site between August 2005 and October 2011 in accordance with the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM). The FSS activities were to demonstrate that the radiological cleanup activities performed by USACE's RA contractor were conducted in accordance with the *Remedial Action Plan* (Conti 2005) and achieved the site soil cleanup levels established by the ROD in Table L-1. Cabrera performed post-remedial action FSS for the sidewalls and bottoms of the excavated areas in accordance with the Site *Final Status Survey Work Plan* (Cabrera 2008). The *Final Status Survey Report* (Cabrera 2012) concluded that all survey units met the release criteria as set forth in the Shpack ROD (EPA 2004b) for unrestricted release for the adjacent resident scenario and can be released from radiological controls. Cabrera noted that the residual concentrations of the radionuclides of concern (ROCs), residual concentrations of Th-232, and residual discrete radioactive items do not contribute additional dose and represent a minimal concern for future excavation. However, any future operations by the property owner that disturb residual soils around the National Grid utility poles or at depth at any location within the footprint of the Site should include analyses for the ROCs to control worker exposures to radioactivity. Any soil that would be excavated from the few small isolated areas of residual radioactive contamination around the National Grid utility poles would require proper characterization. Soil characterization would be performed with respect to the known sources of contamination at the Site, and to ensure compliance with the DCGLs as specified in the ROD (EPA, 2004) for soils allowed to remain in place or sent offsite for disposal. If National Grid plans to disturb the radioactive contaminated soil around their 12 remaining on-site utility power poles at some future date, they are required to coordinate their planned activities with EPA and MADEP prior to commencement of any onsite actions. The coordination would also include notification to DOE to determine cost allocation for the response, transportation and disposal costs of the radioactive contaminated material.

The *Preliminary Close Out Report* (PCOR) prepared by EPA Region 1, and signed on 18 September 2014 by Mr. James T. Owens, III, Director of Office of Site Remediation and Restoration explains that the USACE's remedial project manager and

engineering contractor (Cabrera) were responsible for verifying the quality assurance and quality control (QA/QC) of the FUSRAP RA. Verification of the cleanup criteria for radiological contaminants that were achieved in the excavation was performed by Cabrera in accordance with MARSSIM. Field oversight and weekly construction meetings verified that the other remedial activities were performed in accordance with the approved plans. Based on the above, the RA contractor performed the work in accordance with the USACE and EPA-approved remedial designs and remedial work plan (EPA 2014).

The appropriate regulatory agencies have received the final Remedial Action Completion Report (May 2012) and the Final Status Survey Report (FSSR) (March 2012) and concurred and/or acknowledged that the response action has attained the cleanup requirements specified in the ROD.

EPA states in their PCOR, that hazardous substances remain at this Site above levels which would allow for unlimited use and unrestricted exposure (UU/UE). EPA also stated in their PCOR that there were a number of remaining activities associated with the Site completion that needed to be performed for the site to be completed. It is important to note that none of the tasks identified by EPA in the PCOR were the responsibility of USACE or DOE.

There remains a requirement for institutional controls (ICs) for the few small isolated areas of residual radiological contamination around some National Grid utility poles that could not be excavated due to the “right of way” restrictions. EPA has stated that National Grid will be responsible for adhering to the ICs for these isolated areas and will be required to develop a soil management plan if these areas must be disturbed in the future. O&M, and five-year reviews for the inaccessible radioactive contamination at the Site are not required by USACE or DOE to ensure the protectiveness of the final remedy. The EPA remedial project manager (RPM) for the site confirmed in a follow-up message that USACE and DOE do not have any O&M, five-year review, or ICs responsibilities for the Shpack site in accordance with the PCOR. However, should EPA require assistance with implementing either the O&M or five-year reviews, EPA retains the right to request assistance (See Appendix D). Therefore, long-term actions required by the DOE for the privately-owned Shpack Landfill Superfund Site will be records management, technical assistance to regulators for the FUSRAP RA work that was performed and technical and financial support to address any residual radioactive contaminated soil around the twelve National Grid utility poles that become accessible.

No further response is needed from USACE or DOE to protect the human health and the environment from the FUSRAP radioactive contaminants of concern at the Shpack site with the exception of the inaccessible soil around the National Grid utility poles. DOE, upon notification by EPA or MADEP, may be requested to provide additional technical and financial support if the inaccessible soil with radioactive contamination around the National Grid utility poles will be disturbed in the future.

1.0 INTRODUCTION

The Shpack Landfill Superfund site has been successfully remediated for radioactive contamination under the Formerly Utilized Sites Remedial Action Program (FUSRAP) by the United States Army Corps of Engineers (USACE). The site is located on the border of Norton and Attleboro, Massachusetts. Soils contaminated with Low-Level Radioactive Waste (LLRW) were excavated and shipped offsite for disposal to a NRC licensed disposal facility. The implemented remedy for the FUSRAP remedial action (RA) achieved the degree of cleanup and protection specified in the Record of Decision (ROD) (EPA 2004) for the radioactive contaminated material (OU 1) for all of the pathways of exposure. No further response is needed to protect human health and the environment from the project radioactive contaminants of concern (RCOCs). The chemical contamination at the site is being addressed by U.S. Environmental Protection Agency (EPA) and the Performing Defendant (PD) group and is not a part of this Site Closeout Report. USACE and U.S. Department of Energy (DOE) were not identified or a signatory to the consent order for the remainder of the non-radiological contamination at the Shpack Landfill Superfund Site. This report is intended to provide a final overall summary of response actions taken at the site to address only the FUSRAP radioactive contamination.

The U.S. Atomic Energy Commission (AEC), the predecessor agency for the U.S. Department of Energy (DOE), created FUSRAP in 1974 to identify, investigate and clean up or control residual contamination remaining at sites where work had been performed as part of the Nation's early atomic energy and weapons programs. Activities at these historical sites were performed by DOE's predecessor Federal agencies, the Manhattan Engineer District (MED) (1944-1946) or the Atomic Energy Commission (AEC) (1947-1975). Generally, sites that became contaminated through uranium and thorium operations were decontaminated and released under the regulations in effect at the time of closure. Since then, more stringent standards or regulations have been promulgated and applied by the regulators as well as improved detection instrumentation which resulted in a need to re-examine some of the previously closed FUSRAP sites. FUSRAP provided a source of funds for the additional investigation and sometimes cleanup required to bring these sites into compliance with today's environmental standards.

In 1997, Congress transferred responsibility for the administration and execution of FUSRAP from the DOE to USACE with the Fiscal Year 1998 Energy and Water Development Appropriations Act, [Pub. L.105-62]. Provisions in the Appropriations Acts for FY 1999 and FY 2000 [Pub. L. 105-245 and 106-60] clarified congressional intent and required as a matter of law that USACE will conduct cleanup work at FUSRAP sites and shall be "subject to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. § 9601 et seq.), and the National Oil and Hazardous Substances Pollution Contingency Plan (40 C.F.R. Part 300)." See, Pub. L. 106-60, § 611(b).

2.0 SUMMARY OF SITE CONDITIONS

2.1 SITE LOCATION AND DESCRIPTION

The Shpack landfill site (Site) is a 9.4 acre former industrial landfill located on the border of Norton and Attleboro, Massachusetts (see Figure 1). Approximately 6 acres are located within the Town of Norton, and the remainder located in the City of Attleboro. The Site is bordered to the north and northwest by Peckham Street (City of Attleboro) and Union Road (Town of Norton); to the west and southwest by an approximately fifty-five acre ,Attleboro Landfill Inc. (ALI) facility on the western boundary and the Chartley Swamp, a wooded swamp, on the North & Eastern boundaries (See Figures 1 and 4).

Approximately 40,000 people live within a three mile radius of the Site. Municipal water supplies for both townships did not extend to the immediate area around the Site. Therefore, residents in this area used private drinking water wells, most of which are withdrawn from the bedrock aquifer. The nearest residential well was approximately 150 feet from the site prior to the initiation of the FUSRAP remedial action (RA). The EPA *Preliminary Close Out Report* (EPA 2014) states that Union Road House #2 (former Shpack residence) has been razed and the well decommissioned in 2007 in conjunction with the FUSRAP RA. The property for this house is now zoned as conservation by the Town of Norton. The Union Road House #1, located northeast of the site was razed in August 2012 and the well was decommissioned in September 2012 during the PD's RA (EPA 2014). The 2004 ROD states there were twenty-seven private wells within one mile of the Site that served 103 people prior to the initiation of the FUSRAP RA and the PD's RA. There are two municipal water supply well fields (shallow aquifer) for the town of Norton located three miles east and five and a quarter miles northeast of the area. Municipal well fields for the city of Attleboro also are completed into the shallow aquifer and are located 12,000 feet and 24,000 feet west of the Site (Conti 2012).

The landfill materials are thickest in the western portion of the Shpack landfill site and thinnest in the eastern portions of the Shpack landfill site. Organic silts and peat consist of highly permeable, loose organic silt with variable plant fiber content. Glaciofluvial and glaciolacustrine deposits comprise the majority of the unconsolidated aquifer at Shpack Site and consist of well sorted fine to coarse sand, silt and gravel. Bedrock consists of very fine to medium-grained, quartz-rich, gray sandstone and siltstone with interbedded coarse-grained conglomerate.

The Shpack landfill and its isolated wetlands are located in an area of groundwater recharge. However, due to seasonal variability, the interior wetlands may also serve as a secondary groundwater discharge area. The groundwater flow pattern between the ALI landfill and the Shpack Site involves shallow and deep overburden groundwater flow from the ALI landfill onto the Shpack Site, near the Tongue Area, and along the boundary between the ALI Landfill and the Shpack Site towards the north and northwest. The discharge point for shallow and deep groundwater is Chartley Pond and its adjacent wetlands (ERM 2004).

2.2 CURRENT AND FUTURE LAND USE

The land use surrounding the Site is predominantly rural and low-density residential in nature. The 55-acre ALI landfill is located directly west of the site. Prior to initiation of the FUSRAP RA for the site, groundwater was used as drinking water by two residential properties in close proximity to the Site. This is consistent with the State's use and value determination that designated this groundwater as "high" use and value based primarily upon the fact that this groundwater was being used for drinking water at these two residential properties (EPA 2004b). However, the groundwater is no longer being used by the two residences close to the Site since both houses have been razed and the wells have been decommissioned (EPA 2014).

Based upon EPA's review of the Site, and input from the community and local Town officials, the reasonably anticipated future use of the Site was identified in the 2004 ROD to be either a recreational scenario or the adjacent resident scenario. A number of comments were received by EPA during the remedy selection process with the community supporting the recreational scenario. However, because there was an adjacent resident in existence and the area was zoned to allow that use to continue, EPA stated at the time the ROD was signed that this scenario was the most realistic future use scenario. EPA felt this decision was consistent with the wishes expressed by many in the community that the Site should be cleaned up to allow recreational use in the future. The adjacent resident scenario assumes greater exposure to contamination than the recreational scenario and, therefore, would require greater quantities of waste material to be addressed by the remedy. As a result, by cleaning up the Site to an adjacent resident scenario and addressing unacceptable ecological risks, the selected remedy will be sufficiently protective to allow recreational uses. EPA also determined that on-site residential use of the site is highly unlikely based upon several factors. First, a large portion of the Site consists of wetlands which are not conducive to residential development. In addition, the Site is adjacent to the ALI Landfill and the site is bisected by high voltage power lines. All of these factors make residential development undesirable and therefore not realistic for residential future use (EPA 2004b). The 2014 *Preliminary Close Out Report* (PCOR) confirmed that EPA's assumptions actually became reality when Union House #2 (McGinn house) was razed during the FUSRAP RA in 2007 and Union House #1 was razed in 2012 by the PD's RA.

Pursuant to the ROD (EPA, 2004b), the implementation of institutional controls to restrict future use of property and groundwater were required for the Site:

1. Implement restrictions to prevent residential use or other uses that present unacceptable risk.

2. Implement groundwater restrictions for the site and for Union Road House 1 and Union Road House 2 in the form of deed restrictions.

3. Conduct a review within five years of initiation of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

3.0 SITE HISTORY

The Shpack landfill operated from 1946 through the early 1970's, accepting domestic and industrial wastes, including inorganic and organic chemical waste and low-level radioactive waste. The filled areas, where the wastes were dumped, were overgrown and enclosed by a chain link fence for a significant portion of the Site. DOE implemented a removal action in October 1981, which is discussed in Section 4.1 to repair, replace and add security fencing around the Shpack landfill site.

The proposed plan (PP) for the Shpack Landfill Superfund site provides a brief summary on the history of the Site. In 1946, Attleboro's burning dump opened on land adjacent to the border with Norton on Union Road and Peckham Street. Beginning in 1951, Mr. Isadore Shpack started accepting waste on his land across the border in Norton, MA. A large explosion and fire at the Thompson Chemical Co. in 1964 resulted in the cleanup debris being placed into the Shpack landfill. In 1965, the Attleboro burning dump along with the Shpack landfill discontinued open burning (EPA 2004a).

A series of on-site investigations by the Nuclear Regulatory Commission (NRC) were initiated by a phone call from a concerned Attleboro citizen in September 1978. Subsequent investigations by the NRC and DOE, resulted in the Shpack Landfill being added to the Formerly Utilized Sites Remedial Action Program (FUSRAP) in 1980. Additional detail on the NRC and DOE investigations and actions is provided in Section 4.1 of this report. In 1984, EPA evaluated the Site to determine if it should be listed on the National Priorities List (NPL). The site was proposed for the NPL on October 14, 1984 (49 FR 40320) and on June 14, 1986 (51 FR 21054), EPA added the Site to the NPL.

In 1990, a group of Potential Responsible Parties (PRP) formed the Shpack Steering Committee (SSC) and, pursuant to Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) regulation, entered into an Administrative Consent Order with the United States Environmental Protection Agency (USEPA). The 14 PRPs that signed the consent decree for the non-radiological contamination at the Shpack landfill are identified by EPA as the Performing Defendants (PDs) (EPA 2014). Over the next decade, a Phase IA and Phase IB Remedial Investigation (RI) and Feasibility Study (FS) were conducted, focusing on the chemical and radiological contaminants detected in the soil and groundwater. A number of investigation programs were conducted by various agencies (USACE, USEPA, PRPs) during this time period and the results were utilized for completion of the RI/FS, and the Human Health and Ecological Risk Assessments. The results of the RI/FS were presented for public review in June 2004.

In September 2004, the U.S. Environmental Protection Agency Region 1 Shpack Landfill Superfund Site Record of Decision (ROD) was signed. The ROD for the Site was comprised of two parts for the remedial action: 1) Operable Unit (OU) 1 – FUSRAP

RA of the radioactive contaminated waste in the Shpack landfill to be remediated by USACE; and 2) Operable Unit 2 – RA by the PDs of non-radioactive chemical contaminated waste after completion of the FUSRAP RA.

4.0 PREVIOUS INVESTIGATIONS AND ACTIONS

4.1 NRC AND DOE INVESTIGATIONS AND ACTIONS.

The Nuclear Regulatory Commission (NRC) initiated an investigation of the Shpack landfill site on November 14, 1978 after receiving a telephone call from a concerned citizen from Attleboro, MA. The NRC's investigation, which included interviews and site visits, concluded that radioactive material had been disposed at this private landfill. Their investigation concluded that trash and other material including burned zirconium ashes, associated with nuclear fuel operation from about 1957 to 1966 had been disposed at the site. Other possible sources of the radioactive material could not be determined because of the limited amount of radioactive physical evidence found at the Shpack site (NRC 1979a). In a follow-up NRC report (NRC 1979b), it was concluded by the NRC that M&C Nuclear, Inc., a totally owned subsidiary of the Metals & Controls, Inc. (now owned by Texas Instruments) worked with the three types of material found at the Shpack landfill. The December 1978 investigation by the NRC found large quantities of depleted uranium and small quantities of normal and enriched uranium at the landfill site. The NRC concluded from their investigation that the probable source of the uranium materials found and identified at the Norton landfill site were from contract work performed by M&C Nuclear Inc. for the Atomic Energy Commission (NRC 1979b).

In August of 1979, DOE authorized an aerial radiological survey of the Site as a follow-up to the initial ground Site surveys performed by the NRC. Results of the aerial survey concluded that the radiological data taken over the area surrounding the Shpack property dump site indicated that the terrestrial radioisotopes and associated gamma ray exposure rates were consistent with the natural background normally found within areas having similar geological bases. Although slightly elevated amounts of naturally occurring radioisotopes were observed, the conclusion was that "No man-made radioactive material was evident in the survey data taken at a 45 meter altitude" (EG&G 1979).

DOE initiated a radiological survey of the Shpack landfill in August of 1980. The survey was performed by the Oak Ridge National Laboratory (ORNL) on behalf of DOE and was conducted during the period of August through October of 1980 (ORNL 1981). The results of the survey indicated the presence of radioactive materials throughout the landfill area. The distribution of the contamination was found to be uneven and spotty, both horizontally and vertically, and in many cases, extended into the groundwater. The primary radioactive contaminants found on site included Ra-226 and Uranium (U-238 and U-235). The radium and uranium appeared to occur independently of each other indicating independent origins. The Ra-226 appeared to be associated with objects such as glass bead and rings suggesting an industrial source. The uranium on the other hand appeared to be in a variety of forms and was found to occur as depleted,

natural and enriched uranium (ORNL 1981). During this radiological survey, DOE also conducted a voluntary action under their regulatory authority to remove 800 to 900 pounds of drummed radioactive waste material that was found at the landfill. This waste was removed for disposal to protect human health and the environment because it contained enriched uranium (EPA 2004a & Conti 2012).

A DOE letter/memorandum dated January 29, 1981 from Sheldon Meyers, Deputy Assistant Secretary for Nuclear Waste Management, Office of Nuclear Energy, to R. J. Hart, Manager, Oak Ridge Operations Office, documents formal notification that the Shpack site was designated for remedial action by Ruth C. Clusen, the Assistant Secretary for Environment. The DOE memorandum states that the Site had been assigned the 'highest priority' of any site in the FUSRAP program. DOE also stated that radiological surveys and analyses of samples had confirmed the presence of enriched uranium. As an interim measure, the DOE suggested that a fence be constructed to prevent inadvertent entry to the areas of the site contaminated with uranium (DOE 1981).

In October 1981, a security fence was installed around the Site on behalf of DOE to prevent unauthorized access to the landfill area. Portions of the fence were repaired or replaced and new fencing was added around the Tongue Area portion of the Site. The 1981 fence remains at the Site today. The only portion of the Site not fenced is the outer portion of the Inner Rung area, abutting Chartley Swamp (EPA 2014).

Between August and September of 1982, Bechtel National, Incorporated (BNI) and Eberline Instrument Corporation performed a radiological characterization survey of the Site for DOE. The results of this effort are documented in the *Radiological Survey of the Former Shpack Landfill (BNI 1984).* The findings concluded that "the distribution of contamination on the Shpack Landfill Site is spotty and uneven, both horizontally and vertically…since the Shpack Landfill is not presently used for either residential or agricultural purposes and no such uses are expected in the foreseeable future, and since the Site is fenced to control accidental access, remedial action to reduce radioactive contamination at the Site may be deferred without harmful effect to individuals, the public and the environment" (BNI 1984).

Department of Energy (DOE) formalized the transfer of the FUSRAP program execution responsibilities from DOE to the Department of Defense (DoD) in a memorandum dated October 10, 1997 from the Honorable Federico Pena to the Honorable William S. Cohen. This was in response to the congressional action taken in the Energy and Water Development Appropriations Act of 1998 (DOE 1997).

4.2 USACE INVESTIGATIONS AND ACTIONS

In 2002, the U.S. Army Corps of Engineers - New England District (CENAE) initiated a detailed gamma walkover survey and environmental sampling and analysis effort to characterize the types and concentrations of radiological contaminants of concern at the Site. CENAE procured the services of Cabrera Services, Inc. (Cabrera)

to perform the survey and prepare the report. Results were documented by Cabrera in the *Focused Site Inspection: Characterization Surveys for Radiological Contaminants of Concern*, Shpack Landfill SUPERFUND Site, Norton/Attleboro, Massachusetts (Cabrera 2003a). The additional plans (e.g. Health and Safety Plan, Sampling and Analysis Plan, Quality Assurance Project Plan), and the Derived Concentration Guideline Level Development for Radiological Contaminants of Concern, associated with this task are identified in the *Final Status Survey Report Shpack FUSRAP Superfund Landfill Site (Cabrera 2012).*

As a result of the site investigations that were conducted at the Shpack landfill site, USACE identified a concern about FUSRAP eligibility and their authority under FUSRAP to address all the radioactive contamination that was being discovered at the site. Congress responded to the FUSRAP eligibility question with the passage in 2002 of Section 8143, subsection (a), of the U.S. Department of Defense (DoD) Appropriations Act. This Act was modified to include the following language:

> "the Secretary of the Army, acting through the Chief of Engineers under the FUSRAP shall undertake the functions and activities in order to (1) clean up radioactive contamination at the Shpack Landfill Site located in Norton and Attleboro, Massachusetts."

USACE has interpreted this legislation as authorization for the cleanup of all radiological contaminants of concern at this Site under FUSRAP.

In April of 2005, CENAE issued Conti a Delivery Order under the CENAE Remedial Action Contract (RAC), contract number DACW33-01-D-003 to complete a remedial action at the Shpack landfill site (Remedial Action OU 1 – Radiological Remediation) authorized through the FUSRAP program. Conti commenced - Phase I operations at the Site in August 2005. Activities included mobilization of equipment and personnel, installation and construction of temporary facilities, site infrastructure, test pitting, excavation and characterization of wastes, earth shoring support, post-excavation confirmatory sampling, backfilling with clean sand, packaging of Low Level Radioactive Waste (LLRW), and off-site transportation and disposal of the LLRW. After excavation began, it was determined that the horizontal and vertical extent of radiological contamination was more extensive than estimated in the ROD. Phase I cleanup operations by Conti were suspended in July 2006 based on insufficient funding to cover the increased volume of radioactive waste (Conti 2012 & EPA 2014).

In March of 2007, Conti received a Request for Proposal from CENAE under the Total Environmental Restoration Contract (TERC), contract number DACA31-02-D-0015, to complete the FUSRAP remedial action initiated at the Shpack landfill site for OU 1-Radiological Remediation. Phase II operations by Conti were started at the Site in June 2007 and resumed the RA activities originally initiated under Phase I. FUSRAP cleanup operations were completed in October 2011. A total of 57,805 cubic yards of material was excavated, of which 50,908 cubic yards were transported off-site for

disposal. The primary waste class generated during the FUSRAP RA was LLRW (EPA 2014).

5.0 SELECTED REMEDY

The selected remedy in the ROD was identified as Alternative SC-3B. The remedy included excavation and off-site disposal of material exceeding cleanup levels. The selected remedy eliminated the exposure pathways to soil and sediment. The selected remedy is a comprehensive remedy for the Site based upon EPA's determination that groundwater will not be addressed at this Site for the reasons outlined in Section D of the ROD. EPA selected the excavation and offsite disposal remedy because it believes this cleanup plan is cost-effective yet still protective. The selected remedy achieves the best balance among the criteria used by EPA to evaluate alternatives. The selected remedy provides both short-term and long-term protection of human health and the environment, attains all Federal and State applicable or relevant and appropriate environmental requirements, reduces the volume and mobility of contaminated soil and sediment, utilizes permanent solutions to the maximum extent practicable, by removing contaminated material exceeding site cleanup levels off-site for disposal (EPA 2004b).

The Shpack ROD encompasses two response actions: one managed by the USACE under FUSRAP and the other managed by EPA under CERCLA (EPA 2014). The special legislation previously discussed in Section 4.2 authorized USACE to conduct the cleanup of all the radiological contamination at the Site. EPA remained responsible for remediation of the non-radiological contamination at the Site which was to be addressed by a group of potentially responsible parties. The potentially responsible parties (PRPs), also referred to by EPA as the Performing Defendants (PDs) after the 14 parties signed a Consent Decree (CD) with EPA in June 2008, agreed to perform the Site-wide cleanup of non-radiological contaminants. USACE and DOE were not included in this CD for the non-radiological contamination. As previously stated, this Site Closeout Report is focused on the FUSRAP RA activities performed by USACE and their contractors even though information is included that pertains to the RA performed by the Performing Defendants.

5.1 BASELINE RISK ASSESSMENT

On behalf of EPA, Metcalf & Eddy completed a baseline human health risk assessment (HHRA), a Screening Level Ecological Risk Assessment (SLERA) and a Baseline Ecological Risk Assessment (BERA) for the Site. The HHRA and SLERA evaluated both carcinogenic and non-carcinogenic risks to human health and the environment associated with contaminants of potential concern (COPCs) detected in soil, groundwater, sediment, and surface water. In addition, the HHRA evaluated risks associated with radionuclides detected at the Site. A detailed description of risk assessment assumptions, methods and calculations can be found in the SLERA and HHRA.

The HHRA analyzed multiple scenarios where exposure to chemicals exceeded the EPA acceptable risk range. The scenarios evaluated exposures to human receptors associated with future recreational use, future on-site residence, future adjacent residence (with and without groundwater usage), and on-site construction workers. The most likely future use exposure scenario (adjacent resident without groundwater consumption) was used in the development of the ROD. Project specific cleanup goals were established in the ROD for the following radionuclides of concern (ROC): total uranium, uranium-234, uranium-235, uranium-238, and radium-226.

The BERA evaluated the likelihood and magnitude of potential ecological effects associated with exposure to site contamination. The BERA evaluated the potential for contaminants in soil, surface water, and sediment to impact ecological receptor populations within six distinct exposure areas: the Tongue Area, combined field and shrub land, onsite seasonal wetlands, hardwood forest, Chartley Swamp, and Chartley Pond. In the hardwood forest, risk to small mammals and songbirds is not actionable because no COCs exceed upper risk thresholds. In Chartley Swamp, only the inner rung scenario demonstrated actionable risk to semi-aquatic mammals, waterfowl, bottom dwelling fish, and benthic macro invertebrates (risk driven by inorganics). In the onsite seasonal wetlands, risk to small mammals, wetland songbirds, and benthic invertebrates was associated with concentration of semi-volatile organic compounds (SVOCs), pesticides/PCBs, and inorganics, which exceeded upper risk thresholds (ERM 2004).

5.2 REMEDIAL ACTION OBJECTIVES

The 2004 ROD identified the following remedial action objectives (RAOs) which pertained to the FUSRAP (radiological RA) and the Performing Defendants (PD) (non-radiological RA) response actions (EPA 2004b):

5.2.1 Source Control.

a. Soil

- Prevent ingestion/direct contact with soil having non-carcinogens in excess of a Hazard Index (HI) of 1 or with soil having carcinogens posing excess cancer risk above 1×10^{-4} to 1×10^{-6} and meet Applicable or Relevant and Appropriate Requirements (ARARs);
- Prevent inhalation of carcinogens posing excess cancer risk levels above 1×10^{-4} to 1×10^{-6} or a HI of 1.0 and meet ARARs; and
- Prevent exposure to contaminants in soil that present an unacceptable risk to the environment.

b. Sediment

- Prevent exposure to sediment having carcinogens posing excess cancer risk above 1 x 10^{-4} to 1 x 10^{-6} or a HI of 1.0; and
- Prevent exposure to contaminants in sediment that present an unacceptable risk to the environment.

c. Surface Water

- Prevent migration of contamination from site to surface water to reduce, to the extent practicable, the contribution of contamination from the site to surface waters of contamination that presents an unacceptable risk to human health and the environment.

5.2.2 Management of Migration.

- Prevent ingestion of groundwater having carcinogens in excess of Maximum Contaminant Levels (MCLs), non-zero MCL Goals (MCLGs), and a total excess cancer risk for all contaminants in groundwater greater than 1 x 10^{-4} to 1 x 10^{-6}.
- Prevent ingestion of groundwater having non-carcinogens in excess of MCLs or non-zero MCLGs or a HI of 1.0.
- Prevent exposure to contaminants in groundwater that present an unacceptable risk to the environment.

5.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The Remedial Investigation (RI) and the Feasibility Study (FS) examined the potential applicable or relevant and appropriate requirements (ARARs) for the different remedial alternatives for the Site. The ROD established the Action-Specific, Location-Specific and the Chemical-Specific ARARs for the Shpack Landfill Superfund site for the selected remedy. The selected remedy (Alternative SC-3B) for the Site was excavation and offsite disposal. The ARARs for the selected remedy are in Table L-1 of the ROD are included in Appendix B of this report. The primary ARARs that were identified for cleanup of the Site soil included the Massachusetts's 10 millirem per year (mrem/yr allowable dose limit (105 CMR part 120) and the Federal Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192). The bench mark dose from 10 CFR 40, Appendix A, I, Criterion 6(6) was also used as a "To be Considered (TBC)" for the Site. Discharges from the onsite water treatment plant that was treating surface and groundwater (i.e. dewatering activities) were required to meet MADEP surface water quality standards (314 CMR 4.00).

5.4 CLEANUP CRITERIA

The ROD identified total uranium, uranium-234 (U-234), uranium-235 (U-235), uranium-238 (U-238), and radium-226 (Ra-226) as radiological contaminants of concern (RCOCs) in the Site soils. Table 1 provides the soil cleanup levels established in the

ROD. The selected remedy was designed to be in compliance with all Federal requirements, and any State requirements designated as applicable or relevant and appropriate requirements (ARARs). Components of the selected remedial alternative in the ROD were:

- Excavation and off-site disposal of approximately 34,445 cubic yards of soil and 1,111 cubic yards of sediment, which exceed the radiological and chemical cleanup levels.
- Restoration or replication of impacted wetlands.
- Extension of the public water supply line to two residences adjacent to the site.
- Implementation of institutional controls to restrict future use of the property and groundwater.
- Implementation of a traffic control plan to manage the increased volume of truck traffic associated with transporting contaminated material off-site. The USEPA closely coordinated these activities with local, state and federal partners prior to beginning the cleanup.

Table 1: Soil Clean up Levels, Shpack Landfill Superfund Site

Contaminant	Cleanup Level[1]	Rationale
Total Uranium	**1100 ppm**	**HI = 1**
Radium-226	**3.1 pCi/g**	**10^{-5} excess cancer risk**
Uranium-234	**220 pCi/g**	**“**
Uranium-235	**52 pCi/g**	**“**
Uranium-238	**110 pCi/g**	**“**
Arsenic	12 ppm	“
Benzo (a) anthrocene	28 ppm	“
Benzo (a) pyrene	2.8 ppm	“
Benzo (b) fluoranthene	28 ppm	“
Dibenz (a,h) anthracene	2.8 ppm	“
Lead	1400 ppm	Blood Level Modeling for an adult Exposure
Nickel	7000 ppm	HI = 1
Dioxin (TEQ)	1.0 ppb[2]	EPA Directive 9200.4-26

Footnotes:

[1]Table 1, derived from Table L-1 of the ROD, provides the COC and required soil cleanup levels for the Site remedial action (**radiological contamination in bold**).

[2]In accordance with the April 13th 1998 OSWER Directive 9200.4-26, “one ppb is to be generally used as a starting point for setting cleanup levels for CERCLA removal sites and as a cleanup level for remedial sites for dioxin in surface soil involving a residential exposure”.

USACE’s independent consultant (Cabrera) developed the Derived Concentration Guideline Levels (DCGLs) for several future use scenarios for the Site using Argonne National Laboratory’s Residual Radioactivity computer code, version 6.21(Cabrera 2003b). The future use scenarios included resident farmer, resident child, recreationalist, off site adjacent neighbor, and construction worker. In consultation with USACE, EPA developed cleanup levels for ROCs without groundwater consumption that are consistent with both EPA’s acceptable risk of 1×10^{-5} Excess Lifetime Cancer Risk (ELCR) and Massachusetts Department of Environmental Protection (MADEP)’s 10 millirem per year (mrem/yr) allowable dose limit (105 Code of Massachusetts

Regulations [CMR] part 120.291) and the ARARs for an unrestricted site release for the adjacent resident scenario. As documented in the ROD (EPA, 2004b), the remedy EPA selected is based upon a future scenario in which a resident living next to the Site (adjacent resident) is connected to a public water supply and does not drink the groundwater at the Site (i.e., Adjacent Resident without Groundwater Consumption). EPA's selected remedy was excavation and off-site disposal of contaminated soil and sediment exceeding project-specific cleanup goals. In addition, institutional controls prevent disturbance of the landfill site which allows the release of the site from radiological controls.

Cabrera, using the DCGLw values that were developed for USACE and EPA, determined what the Excess Lifetime Cancer Risk (ECLR) values were for the individual ROCs. This information is provided in Table 2 and is also included in the Final Status Survey (Cabrera 2012). It is important to note that all the ELCR values met EPA's acceptable risk of 1×10^{-5}.

Table 2 Shpack ROD Derived Concentration Guideline Levels$_w$

Radionuclide of Concern	Derived Concentration Guideline Level$_w$ (DCGL$_w$)	Excess Lifetime Cancer Risk (ELCR)
Ra-226	3.1 pCi/g*	9.25×10^{-6}
U-234	220 pCi/g	1.34×10^{-7}
U-235	52 pCi/g	9.95×10^{-6}
U-238	110 pCi/g	4.43×10^{-6}

* pCi/g = picoCuries per gram

The limits listed in Table 2 do not imply that ROCs may be collectively present in surface soils at the individual concentrations specified in the ROD (Table L-1) or Table 2. The concentrations represent a potential dose of 10 mrem/yr for each individual ROC (i.e., soil containing the ROCs at the concentrations above could represent a potential dose of 40 mrem/yr). ROCs concentrations were combined for each soil sample by calculating a sum-of-ratios (SOR) for the ROCs to compare the combined dose above background to 10 mrem/yr for each sample point (Cabrera 2012).

6.0 REMEDIAL ACTION SUMMARY

6.1 REFERENCE COORDINATE SYSTEM

Various site reference grid systems were established during previous investigations. A 20-meter square reference grid was established utilizing North American Datum 1983 in meters tied to the Massachusetts State Plane Coordinate System (MSP), Mainland Zone (Fipszone, 2001) for the gamma walkover survey (GWS) completed in April and May of 2000. This grid was reused during FSS operations with the objective of collecting spatially correlated data at locations that could be readily reproduced in the future. Global positioning system (GPS) receivers were used during FSS operations to provide positional accuracy for measurement locations. Through use of GPS, measurement locations have been referenced to the site grid and to the MSP (Cabrera 2012).

6.2 PRE-FINAL STATUS SURVEY TASKS

6.2.1 Mobilization

Cabrera initially mobilized to the Site on September 13, 2005 to provide support to Conti on an as-needed basis. Cabrera undertook FSS operations on site during September and October 2005, conducting GWS, sampling/laboratory analysis, and data evaluation following Conti's completion of remediation in individual SUs. Cabrera personnel were also onsite full-time from November 2005 to May 2006 to conduct FSS and provide other radiological support to USACE during Conti's Phase I remediation efforts. Cabrera remobilized to the Site and resumed FSS and radiological support to USACE on an as-needed basis during Conti's Phase II remediation performed between July and December 2007, July to November 2008, May to December 2009, July to December 2010, and May 2011 to October 2011 (Cabrera 2012).

6.2.2 Establish Site Reference Coordinate Grid

Cabrera established a 20-meter square reference grid tied to the MSP coordinate system to assist site personnel in tracking the progress of FSS operations, establishing systematic soil sampling locations, etc. The corners of SU, systematic soil sampling locations, and biased sampling locations were marked as allowed by site conditions. The presence of excavations, standing water, staging areas for construction equipment, and other obstructions often precluded Cabrera personnel from marking these features (Cabrera 2012).

6.2.3 Reference Area

A Reference Area was established in September 2005 (located north of Union Road opposite the landfill and near the northwest margin of SU 16 in an area approximately 45 meters (m) wide by 45 m long [about 2,000 square meters (m^2)]) to determine background activity concentrations for application to systematic and biased soil samples and comparative information for the GWS. Selection of a representative Reference Area was complicated by the presence of the adjacent ALI landfill and areas of swampland surrounding most of the remaining areas around the Site. This area was

flat, with no standing water, large tree stumps, trash, or debris to hinder the GWS, and therefore served as the best choice for a Reference Area. Vegetation within the Reference Area was cut and cleared to the lowest practically achievable level prior to performing FSS operations. Cutting was performed by Conti on September 26, 2005 in a manner compliant with City of Attleboro guidelines (Cabrera 2012).

6.3 REMEDIAL ACTION

The construction activities associated with the remedial action at the Site were divided into five main processes; 1) Earth support, 2) Excavation, 3) Material segregation and characterization, 4) Bagging/ Packaging of low-level radioactive waste (LLRW), and 5) off-site transportation of LLRW. All construction activities were conducted in accordance with the ROD and approved Site construction plans which included: Remedial Action Work Plan (RAWP), Quality Assurance Project Plan (QAPP), Site Safety and Health Plan (SSHP), Materials Management Plan (MMP) and the Storm Water Pollution Prevention Plan (SWPPP). It should be noted that the radioactive waste and the chemical waste were often commingled and therefore managed together under Operable Unit 1 RA activities (Conti 2012). Additional detail on all aspects of the FUSRAP RA activities can be found in the May 2012 *Remedial Action Completion Report* (RACR) prepared by Conti, the RA contractor (Conti 2012).

Conti was responsible for the excavation, temporary stockpiling, and removal of materials (soil mixed with landfill debris, including steel drums, waste containers, and miscellaneous materials from domestic and industrial dumping) from designated Class 1 areas on site (Conti, 2012). Class 1 areas are areas that prior to remediation had a potential for radioactive contamination above the DCGLw or known radioactive contamination above the DCGLw (i.e., DCGL used for residual radioactivity evenly distributed over a wide area; MARSSIM, [NRC, 2000]). Conti subcontracted to EDi to conduct real-time radiological screening to verify that any remaining residual radioactivity in each Class 1 area satisfied the predetermined criteria for release set forth in the ROD (EPA, 2004) – i.e., that those materials do not have radiological characteristics statistically elevated relative to the ROD (EPA, 2004b) cleanup criteria. Real time radiological screening included an on-site gamma spectroscopy laboratory and gamma walkover surveys. Cabrera was responsible for performing the FSS in Class 1 areas cleared by EDi (Conti 2012).

Conti constructed a 1-acre paved staging area and lay down pad in Phase I of the FUSRAP RA under the RAC contract to facilitate materials handling and processing and the staging of radiological contaminated material before off-site transportation to the LLRW disposal facility. This staging area was increased under Phase II (TERC) approximately 105 ft. x 55 ft. This expanded pad allowed EDi field technicians to perform walk-overs of the screened material to detect and locate discrete radiological materials (Conti 2012).

A temporary groundwater treatment system was constructed as a part of the FUSRAP RA during Phase I to meet the requirements of MADEP's GW-3 groundwater standards (310 CMR 40.0974(2)) and the surface water discharge limits. The treatment

system consisted of settling tanks, sand filtration vessels and bag filters and was used to filter groundwater and surface water collected during excavation and dewatering operations. In 2005, excessive high groundwater levels and rainfall precipitation created difficulty maintaining the GW-3 groundwater discharge limits. Therefore, with concurrence from the MADEP, all pumped groundwater was sent through settling tanks for sediment settlement prior to on-site infiltration into site soils. During Phase II, all groundwater was pumped into a series of two weir tanks to facilitate total suspended solids settlement prior to discharge into an upper and lower detention basin. Detention basins were constructed, up gradient from the excavation zone, in order to manage groundwater encountered during excavation operations (Conti 2012).

Excavated materials from the FUSRAP RA were mechanically screened and segregated into three physical sized waste streams (one inch minus, one to four inch & four inch plus). Waste streams were divided into stockpiles which consisted of approximately 110 cubic yards of material. Each individual stockpile was characterized for COCs and ROCs, as outlined in the ROD, to determine the proper disposal requirements. Stockpiles exceeding radiological SRLs [equivalent to DCGLw's] were packaged and shipped to an approved and licensed LLRW disposal facility (Energy Solutions in Clive, Utah). Stockpiles which did not exceed radiological SRLs but exceeded chemical SRLs were stockpiled on-site for containment and management during the subsequent PD's non-radiological remediation phase. Stockpiles which did not exceed radiological and chemical SRLs were cleared for on-site backfill (Conti 2012).

The ROD identified thirteen grid areas, approximately eighty feet by eighty feet, to be excavated to a depth of 0-3 feet. The size of the Class 1 excavated areas varied throughout the project. The excavations were expanded laterally in pursuit of radiologically contaminated material. The depth of excavations varied with the depth of radiologically contaminated materials at the Site. Excavations were typically expanded vertically until a layer of native "peat" soil was encountered (i.e., dark brown clayey silt with a trace of fine-grained sand and organics), which served as a confining layer encountered at depth across most of the footprint of the site. Peat was typically overlain by deposits referred to as "Shpack fill;" this material contained almost 100% of the discrete radioactive items recovered during remediation and distributed ROC concentrations encountered in soil and was therefore the target of remediation operations and correlates to the contaminated zone modeled in the ROD (EPA, 2004b). The Shpack fill consisted of clayey silt to coarse sand with various debris material interspersed. The remedial response action was conducted from August 2005 through October 2011. During remedial operations, it was determined that the limits of radiological contamination extended deeper than three feet in many areas, and expanded horizontally outside of known areas of radiological contamination. Table 3 below provides a summary of the classification of the Survey Units and the maximum depth of excavation for each SU.

The extent of radiological contamination was determined based on visual observation of Shpack fill material and using gamma walkover survey techniques. The survey results were confirmed by on-site and off-site laboratory analysis. Areas

classified as “Class 1” were areas suspected to have radiological contamination above the DGCL. “Class 2” areas were not expected to have radiological contamination above the DGCL. See Figure 2 for a depiction of the 17 Survey Units (SU) at the Site and the classification of each unit. The soil was removed in lifts until the residual contamination was measured to be below soil cleanup levels. Average depths of excavations for most Survey Units were from 4-6 feet below ground surface. The maximum depth of contamination for most Survey Units was from 6-10 feet, with excavations reaching 17 feet in SUs 4 and 8.

Table 3 – Maximum Depth of Excavation for Each Survey Unit

Survey Unit Number (SUs)	MARSSIM Classification	Maximum Depth of Excavation (feet Below Grade Surface)
1	1	7.5
2	1	9.5
3	1	7.5
4	1	17.0
5	1	8.0
6	1	7.0
7	1	7.0
8	1	17.5
9	1	6.5
10	1	7.0
11	1	11.0
12	1	7.5
13	1	12.5
14	1	7.0
15	1	10.0
16	2	0.0
17	2	0.0

SUs 18-23, not included in Table 3, were established on top of existing SUs and were used for material processing. The excavated soils were sampled and analyzed to determine if the excavated soil could be re-used on site, or if it needed to be sent off-site for disposal. The FS originally estimated that approximately 34,445 cubic yards would be sent offsite for disposal. However USACE and the FUSRAP RA contractor’s records indicate 57,805 cubic yards of soil was excavated, with approximately 50,908 cubic yards shipped off-site for disposal. In addition to the contaminated soil, debris (6,449 cubic yards) also exceeded site radiological cleanup levels and required off-site disposal. All material segregated for off-site disposal was packaged in lift-liners, intermodal containers and gondolas, and shipped to Energy Solutions Disposal Facility in Clive, Utah (Conti 2012.)

Final status surveys began in September 2005 during the backfill operations of the FUSRAP RA. During September and October 2005, backfilling in SUs 1 and 4 occurred immediately upon completion of the GWS without waiting for the GWS data to be processed, due to the field conditions that are described in the RACR in Section 4.1 (Conti 2012). Backfilling in SU 4 occurred immediately upon completion of the GWS in November 2005 as deemed necessary by USACE in order to ensure that asphalt was poured to establish the staging and sorting area onsite prior to the onset of colder weather. Since the asphalt pad was intrinsic in facilitating remedial operations for the entire site, USACE made the decision to expedite backfilling in SU 4. These actions were taken with the understanding that areas of residual contamination that had not been clearly delineated within SU 4 would be rendered inaccessible once backfilling had occurred. The western margin of the SU was revisited in September 2010 as adjoining areas to the west (SU 2) were remediated and operations carried over into the footprint of SU 4. These operations provided the data necessary to complete the FSS of the SU.

The majority of the Site was backfilled by Conti using a tan-colored fine to medium-grained sand backfill obtained from a nearby off-site borrow source. Some portions of the Site were backfilled using on-site soil that was excavated and screened, and then sampled for waste characterization by EDi to ensure compliance with Table L-1 values in the ROD (EPA, 2004b). Orange construction fence was utilized across the entire excavation footprint of the Site prior to backfilling; this fence coincided with the final depth of excavation and would be encountered when excavating to this final depth at any point within the excavation footprint of the Site (Conti 2012).

6.4 COMMUNITY INVOLVEMENT

An important consideration of any project should include an assessment of the extent to which stakeholder expectations are met. Involving all project stakeholders during the planning stage of the project lifecycle, and understanding their issues and concerns, helps to define the requirements that are needed. Furthermore, since the Shpack Landfill Superfund Site is on the NPL, EPA concurrence is needed for the USACE close out process. It is also important that the MADEP concurs with the site close out findings since the NCP requires State concurrence on EPA's proposed deletion noticein order for a site to be delisted from the NPL.

The local information repository that contained the reports and studies that made up a part of the administrative record for the selection of the final remedy for the Shpack Landfill Superfund Site was maintained at the Norton Public Library located at 68 Main Street, Norton, MA 02766. The official administrative record was maintained at the EPA Records Center, 1 Congress Street Boston, MA 02114. A public information meeting on the Proposed Plan (PP) was held on June 23, 2004. EPA also had a public meeting during the public comment period for the Shpack Landfill Superfund project on July 21, 2004. EPA, MADEP and USACE also had an information meeting to update the public on the status of the project on June 21, 2005. USACE informed the public they expected to begin excavation of the radioactive contamination at the site that was

scheduled to begin that summer. All meetings were held at the J.C. Solmonese School in Norton, MA. All comments received during the comment period were addressed in the responsiveness summary of the ROD (EPA 2004b). The ROD also includes a summary of the community involvement and concerns that had been identified for this site.

The public citizen's group and the local town officials were involved in the Shpack project from the initial phase of planning and throughout the FUSRAP RA activities. The public expressed their initial concerns associated with the RA activities which included protection of the public during construction activities, perimeter air monitoring, trucking of wastes over public roadways, emergency response planning, and timely communication and progress updates to members of the public.

These concerns were satisfactorily addressed and communicated to the public and town officials. A perimeter air monitoring program was established prior to commencing intrusive operations and no exceedances were recorded during the FUSRAP RA. Trucking was limited to a designated route as approved by town officials and packaging of radiological wastes was completed in accordance with DOT regulatory requirements for a hazardous material. No trucking incidents were recorded during the FUSRAP RA. USACE and Conti provided Radiological Worker II training to the Norton Fire Department for preparedness in the event of an on-site or off-site incident requiring emergency response (Conti 2012).

USACE facilitated several meetings with the local officials and the public to keep them informed of what was going to happen during FUSRAP remediation activities. The intent of the meetings was to present a schedule of upcoming activities for the project and to provide a summary of progress completed to date. In addition to regular town and public briefings, USACE prepared and distributed weekly summary reports. An Internet based file-sharing website was also set up to facilitate access to the approved project work plans and documents. EPA attended several of the meetings in representation of the project pursuant with the Superfund regulatory process, specifically, those activities associated with the future chemical remedial actions consistent with the ROD (Conti 2012).

Meetings were held at the Norton town hall, Norton Public Library (public meetings) and Norton Middle School. The Shpack community involvement group led by Ms. Heather Graf advertised the public meetings. A list of the public meetings, including the meeting description and date are as follows:

- Project Initiation Meeting, 21 June 2005
- Project Status Briefing, 21 December 2005
- Project Status Briefing, 07 February 2006
- Project Status Briefing, 21 June 2006
- Project Status Briefing, 10 March 2009
- Project Status Briefing, 19 July 2011

Following each meetings a question and answer session was conducted between the public, the community involvement group, USACE, and Conti (Conti 2012).

7.0 MONITORING RESULTS

At the base of the excavation, a Final Status Survey was conducted in accordance with the MARSSIM. The FSS was utilized to demonstrate that the median radiological concentrations in each survey unit met radiological cleanup levels established for the site. The FSS consisted of three components: Gamma Walkover Survey, Systemic Soil Samples, and Biased Soil Samples. The Gamma Walkover Survey results were utilized to provide an overall assessment of the Survey Unit after excavation, and to identify locations for biased soil sampling. The biased soil sampling was used to confirm the presence of elevated radiological contamination, and make decisions regarding additional soil excavation. Systemic sampling was also utilized to assess residual radiological contamination at the base of the Survey Unit. A comprehensive discussion on all aspects of the FSS process is provided in the *Final Status Survey Report Shpack FUSRAP Superfund Landfill Site* that was prepared by USACE's independent consultant, Cabrera (Cabrera 2012). See Figures 2 and 3 for a layout of the remediation survey units at the Shpack site and a summary of the sampling point locations within the SUs. The excavations were backfilled to the existing grade surface once the site soil cleanup levels were achieved.

The FSS process was conducted in accordance with MARSSIM. As part of the closeout process, the following activities were performed for all areas of the site:

- Gamma walkover surveys (GWS) to measure surface gamma radiation, with results plotted against geographic locations. The grid was reused during FSS operations with the objective of collecting spatially correlated data at locations that could be readily reproduced in the future.

- Global positioning system (GPS) receivers were used during FSS operations to provide positional accuracy for sample locations. The raw GWS measurement data (in counts per minute [cpm]) were plotted and color-coded for visual review and evaluation, and to identify anomalies in the distribution of measurement data. The average and standard deviation of the data for each SU was calculated, and the coordinates of the highest activity measurement(s) were identified.

- Quality Assurance (QA) checks of the GWS scans by USACE.

- Analysis of systematic and biased soil samples at an offsite USACE–validated laboratory.

- Data validation by an independent agency (Environmental Data Services, Inc.) on ten percent of all post excavation verification analytical reports.

- Statistical analysis to demonstrate that the majority of residual concentrations of ROCs in soils and soil-like materials at the Site meet the DCGLs.

- Data packages to demonstrate that each survey unit did not exceed the site cleanup criteria.

Table 4: Survey Unit Summary

Survey Unit Number	*Survey Unit Area (square meters)*		*(acres)*	*MARSSIM Classification*	*No. of Systematic Measurements*	*No. of Biased Measurements*
Reference Area	2,010	/	0.50	Non-Impacted	24	0
1	1,989	/	0.49	1	36	46
2	1,931	/	0.48	1	28	21
3	1,944	/	0.48	1	31	34
4	1,967	/	0.49	1	37	20
5	1,951	/	0.48	1	31	16
6	1,959	/	0.48	1	28	16
7	1,995	/	0.49	1	31	10
8	1,981	/	0.49	1	29	13
9	1,971	/	0.49	1	29	23
10	1,957	/	0.48	1	26	14
11	1,981	/	0.49	1	27	1
12	1,996	/	0.49	1	31	6
13	1,921	/	0.47	1	29	7
14	1,989	/	0.49	1	30	12
15	1,751	/	0.43	1	31	42
16	7,143	/	1.77	2	23	42
17	5,068	/	1.25	2	24	0
18	8,139	/	2.01	1	23	5
19	1,984	/	0.49	1	24	14
20	892	/	0.22	1	41	1
21A	720	/	0.18	1	24	0
21B	720	/	0.18	1	24	0
21C	720	/	0.18	1	24	0
22	35,631	/	8.80	-	0	5
23	1,935	/	0.48	1	215	2

Note: Results summary of survey units 22 & 23 were not included in Table 5 because the Final Status Survey Report (Cabrera 2012) did not have any systematic measurements for SU 22 and did not provide summary tables for the systematic measurements of SU 23.

The Final Status Survey Work Plan (FSSP) was modified as follows (Cabrera 2012):

1. Gamma walkover survey data gaps were addressed by collecting extra biased samples to fill gaps where no scan survey data was collected. The FSS contractor (Cabrera) designed a method to determine when additional bias soil samples were required to fill gaps in GWS based on the DCGL for small areas of elevated radioactivity.

2. Assessment and excavation was not feasible around fourteen on-site utility poles. These areas were sampled using a protocol that assigned a heightened

sample density around these poles to compensate for the limited ability to collect GWS data. National Grid was notified of the potential for residual soil contamination around the utility poles, and will be required to implement soil management protocols should invasive work be required in the future.

3. There is an area along the southwest margin of the Site covered by trash (as deep as 9 feet bgs) from the adjacent ALI property. Test pits were excavated at each Class 1 systematic sampling location to the depth at which native peat soil was encountered and all materials excavated from this area were scan surveyed in lifts.

4. Adjoining properties, which comprise portions of SU 1 and SU 16, were surveyed by means of collecting subsurface samples using a direct push technology probe to sample intervals containing Shpack fill materials and suspected of being contaminated.

5. Survey units were vertically stacked in several areas of the Site where backfill materials were placed over materials that had already been released.

6. Two on-site asphalt pads utilized in the course of remedial operations were surveyed through use of a floor monitor to scan for beta radioactivity above a surface contamination DCGLw.

The GWS was completed for 41,462 square meters (10.25 acres) for the on-site areas and the additional areas adjacent to the Site property line (reference Table 4 in Section 4.2 and Figure 7) of the FSS (Cabrera 2012) for additional details. Results from each area surveyed are broken into ranges of raw GWS count rates and calculated z scores, and are summarized in Table 6 of the FSS report by the percentage of data points within each range. These ranges of GWS count rates were selected arbitrarily as round numbers that would allow for a degree of universal review of the GWS count rate data from one SU to the next.

Table 5 provides a summary of the 23 SUs that are provided in Appendix C. Survey units that exceeded an SOR of 1 were further evaluated following MARSSIM criteria for elevated measurement comparisons (EMC) that is outlined in the FSSP (Cabrera 2012). The decision rules that were used to evaluate the sample results are included in the FSSP. All survey units that required additional evaluation had a SOREmc of less than 1. Table 5 also provides a summary of the minimum, maximum and average concentration of the ROCs for the 23 SUs. It should be noted that the Sum of Rations (SOR) for the 23 SUs which represents the DCLGs achieved at each SU is less than 0.5 (must be less than 1.0) and all but 5 SUs have an SOR less than 0.20 which demonstrates the Site cleanup levels for the ROCs have met the requirements of the ROD.

Table 5 did not include any systematic measurements for SU #22 because only 4 biased measurements were taken. Systematic measurements were collected at 215 points for SU #23 but a Systematic Soil Sampling Summary table was not prepared in the Final Status Survey Report (Cabrera 2012). All 215 measurements were below the gross activity DCGLw of 1,586 dpm/100 cm^2.

TABLE 5 –Results Summary for Class 1 and 2 Final Status Survey

FSS Unit	Number of FSS Samples	Ra-226 (pCi/g)			U-234 (pCi/g)			U-235 (pCi/g)			U-238 (pCi/g)			Average SOR (DCGL)
		MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	
1	36	0.04	0.85	3.63	0.08	0.76	2.46	-0.10	0.04	0.32	-0.01	0.69	1.24	0.14
2	28	0.00	0.55	1.76	0.04	0.51	2.41	-0.11	0.04	0.29	0.01	0.44	1.94	0.07
3	31	0.02	0.96	1.83	0.19	1.93	26.30	0.00	0.09	0.99	0.11	1.17	5.20	0.18
4	37	-0.07	0.95	3.38	0.06	11.53	88.00	-0.08	0.65	5.94	0.06	2.53	14.60	0.26
5	31	-0.08	0.21	0.60	-0.06	1.20	19.80	-0.13	0.08	1.32	-0.09	1.22	28.00	0.02
6	28	0.02	0.46	2.24	-0.10	0.82	5.80	-0.09	0.06	0.33	-0.06	0.45	1.98	0.08
7	31	-0.11	0.47	1.55	0.21	10.10	64.00	0.01	0.44	3.24	0.09	3.06	35.60	0.14
8	29	-0.02	0.58	2.04	0.06	16.14	**284.00**	0.01	0.88	12.90	0.04	1.69	6.28	0.10
9	29	-0.18	0.25	1.10	0.15	3.46	65.00	-0.05	0.14	2.52	0.04	1.28	17.80	0.06
10	26	-0.03	0.21	0.91	0.04	0.37	2.41	-0.04	0.02	0.16	0.02	0.22	0.91	0.02
11	27	0.02	0.52	1.12	0.07	6.23	60.80	-0.03	0.27	2.50	-0.02	1.59	21.60	0.08
12	31	-0.07	0.32	1.04	0.34	10.86	**202.00**	-0.08	0.47	7.70	0.27	3.45	35.20	0.11
13	29	-0.40	0.32	1.82	0.45	13.55	**234.00**	0.01	0.54	8.00	0.43	5.60	25.60	0.16
14	30	-0.15	0.27	1.24	0.11	1.84	8.30	0.00	0.10	0.43	0.02	3.18	19.50	0.06
15	31	-0.09	0.29	0.76	0.04	1.09	3.66	-0.01	0.08	0.31	0.03	1.37	10.90	0.05
16	23	0.08	0.49	2.14	0.16	1.51	10.10	-0.12	0.08	0.34	0.36	1.60	17.30	0.06
17	24	0.04	0.45	2.13	0.83	16.40	112.00	0.04	0.60	3.62	0.61	3.98	15.90	0.17
18	23	0.14	0.67	1.45	0.13	1.05	2.05	-0.12	0.09	0.40	0.32	1.00	2.09	0.09
19	24	0.33	0.64	1.30	0.55	3.55	11.30	-0.08	0.21	1.11	0.38	4.47	48.60	0.11
20	41	0.03	0.87	3.68	0.29	19.36	83.00	-0.08	0.76	3.80	0.44	7.20	27.60	0.28
21A	24	0.39	0.76	1.51	4.90	30.59	114.00	0.06	1.50	5.30	3.30	14.94	30.60	0.38
21B	24	0.37	0.79	1.57	6.80	33.33	132.00	0.13	1.40	6.40	4.70	13.21	22.00	0.38
21C	24	0.31	0.84	1.66	5.60	31.78	96.00	0.23	1.48	3.50	4.00	13.84	23.90	0.40

Note: Results summary of survey units 22 & 23 were not included in Table 5 because the Final Status Survey Report (Cabrera 2012) did not have any systematic measurements for SU 22 and did not provide summary tables for the systematic measurements of SU 23.

8.0 DEMONSTRATION OF CLEANUP QUALITY QA/QC

USACE and the remediation contractors routinely performed many different QA/QC (Quality Assurance/ Quality Control) activities on the FUSRAP RA. This began with review and approval of the remedial design, remedial action work plan, and construction drawings and specifications. Verification that cleanup criteria for radiological contaminants were achieved in the excavations was performed by Cabrera as USACE's independent contractor, in accordance with requirements of the MARSSIM. Quality control activities included confirmation sampling of excavation bottoms and sidewalls as necessary, use of electronic survey methods to record the limits of excavation, testing of excavation material for disposal characterization, and adherence to approved plans and standard operating procedures. Field oversight and weekly construction meetings verified that other remedial activities were performed in accordance with the approved plans. Based on the above, the RA contractor (Conti) performed the work in accordance with the USACE and EPA-approved remedial designs and remedial work plan (EPA 2014).

The three-phase system of quality control which included the preparatory, initial, and follow-up phases was implemented for each definable features of work (DFW) associated with the Remedial Action.

Preparatory phase meetings were conducted by the Contractor Quality Control Systems Manager (CQCSM) and the USACE Contracting Officer's Representative (COR) or their designee (i.e., the Resident Engineer and/or Construction Inspector). All project stakeholders, including the USEPA and MADEP project representatives, were invited to attend preparatory meetings and offer input prior to commencing the defined activities. Initial phase and follow-up phase inspections were conducted by the CQCSM and the USACE COR representative to ensure that all CQC objectives were met. Agency representatives (USEPA and MADEP) made periodic progress inspections over the course of the work and provided comments to the USACE. Also, daily QC checks were made for the field instruments used, including radiation detectors and GPS units, to ensure that they were performing within acceptable parameters. Instrument calibration records were kept for review and inspection.

As per the QAPP, post excavation samples required verification and validation steps in order to ensure data quality. These steps included specific levels of data review and data validation. As part of field and laboratory QC measures, quality indicator samples (QIS) were also collected for soil and were submitted for analysis.

The FSSR concluded that the Shpack split sample comparison demonstrates a precision that is acceptable for the type of sampling and analyses conducted. Data produced for this project demonstrates that it is appropriate for its intended purpose, is of known and acceptable precision and accuracy, and is technically defensible. Data integrity has been documented through proper implementation of QA and QC measures (Cabrera 2012).

All survey units achieved the FSS objectives and met the EPA's acceptable risk of 1×10^{-5} Excess Lifetime Cancer Risk (ELCR) release criteria as set forth in the ROD (EPA, 2004) for restricted site use (no residential use) for the landfill but unrestricted for the adjacent residential future use. Therefore, the Site can be released from radiological controls. Any future remediation operations that disturb residual soils around National Grid utility poles, or at depth at any location within the footprint of the Site, should include analyses for the ROCs. The data should be used to determine if measures are required to control worker exposures to radioactivity, characterize soils for disposal, and ensure compliance with the Derived Concentration Guideline Levels (DCGLs) as specified in the ROD (EPA, 2004b) for soils allowed to remain in place.

9.0 SUMMARY OF OPERATIONS AND MAINTENANCE

The applied remedial alternative does not require operation and maintenance actions for the radioactive contamination that was addressed by the FUSRAP RA. Institutional controls (ICs) are required for the Shpack site due to the non-radioactive contamination that was addressed by the Performing Defendants (PDs) and for the few isolated areas where residual radioactive contamination around the utility poles could not be addressed within the National Grid "right of way". EPA has assigned the responsibility of complying with the ICs for the few areas of residual radioactive contamination to the National Grid. EPA is in the process of drafting a Notice of Activity and Use Limitation (NAUL) and are planning to finalize them in the next couple of months. ICs have not been implemented to date and are not scheduled for completion until the summer of 2016 (Appendix D & EPA 2014). The responsible parties for developing and implementing the ICs are the Performing Defendants (PDs) and the MADEP. USACE and DOE are not identified as PDs in the consent order for the non-radiological contamination at the Shpack landfill.

10.0 SUMMARY OF REMEDIAL COSTS

The remedial action at the OU-1 Site was funded by two different contracts; CENAE Remedial Action Contract (RAC) contract number DACW33-01-D-0003 and Total Environmental Restoration Contract (TERC) contract number DACA31-02-D-0015.

- The RAC contract had a work performance period from July 2005 thru July 2007. The final contract amount was $7,582,880.
- The TERC contract had a work performance period from July 2007 thru December 2011. The final contract amount was $40,017,452.

Operation and maintenance costs are not expected due to the remedial action selected for the site (Adjacent Resident without Groundwater Consumption SC-3B) and the results of the FSS which indicated the landfill site is protective and may be released from radiological controls.

Table 6: Summary of Remedial Action Costs

Contract	Estimate in 2004 ROD	Total Remediation Costs
	(millions of dollars)	
Remedial Action Contract (RAC) July 2005-July 2007	43[1]	7.58
Total Environmental Restoration Contract (TERC) July 2007-Dec 2011		40.02
Total	**43**	**47.6**

Footnote:

[1] The original estimate in the Feasibility Study and the 2004 ROD for the selected remedy (Alternative SC-3B) was $55,553,000. However, EPA revised their estimated cost of the selected remedy in the ROD to $43,034,000 based on projected lower transportation and disposal cost.

The overall cost for the Shpack OU 1 is a total of $70,725,464.32 and FUSRAP has provided $54,958,502.38 of the total cost. The remainder of $15,766,961.94 was funded under the American Recovery and Reinvestment Act (ARRA) of 2009 (Pub.L. 111-5). The RA work is one component of the overall cost for the FUSRAP RA. In addition, the total FUSRAP cost for the Site includes management and oversight by CENAE and their independent consultant responsible for performing the FSS in accordance with MARSSIM.

11.0 FIVE-YEAR REVIEW

In consultation with USACE, EPA developed cleanup levels for ROCs without groundwater consumption that are consistent with EPA's acceptable risk of $1x\ 10^{-5}$ ELCR and MADEP's 10 millirem per year (mrem/yr) allowable dose limit (105 CMR part 120.291) applicable or relevant and appropriate requirements (ARARs) for unrestricted site release for the adjacent resident without groundwater consumption as the future use. EPA provided a letter to USACE on April 4, 2013 which states that EPA has reviewed the document [2012 FSSR for the radioactive remediation] and believes that USACE has complied with the requirements in the ROD for the cleanup of the radiological contamination. However, it was noted in EPA's letter that due to the National Grid utility poles being located on the site, a few isolated, small areas of residual radioactive contamination could not be excavated due to restrictions on "right of way" perimeters required by National Grid. National Grid is aware of this issue and will

be required by EPA to comply with institutional controls, including a Soil Management Plan, should the need occur to excavate utility poles in the future (Appendix A). If National Grid plans to disturb the radioactive contaminated soil around their utility power poles at some future date, they are required to coordinate their planned activities with EPA and MADEP prior to commencement of any onsite actions. The coordination would also include a notification to the DOE Legacy Office from EPA or MADEP to determine cost allocation for the response, transportation and disposal of the radioactive contaminated material (Appendix D).

EPA and USACE agree that there may be small isolated areas of residual radiological contamination around the National Grid utility poles which do not meet unrestricted site release. However, EPA has stipulated in their April 4, 2013 letter that they are going to require National Grid to adhere to the specific ICs that will be established for this situation and will require National Grid to follow a Soil Management Plan if the area is disturbed. USACE and DOE's Legacy Office will not be required to monitor the effectiveness of the ICs and will not be responsible for performing five-year reviews of the Shpack landfill site in the future (EPA 2014 & Appendix D).

EPA states in their PCOR, that hazardous substances remain at this Site above levels which would allow for UU/UE. Furthermore EPA states that they must conduct the initial and future five-year reviews pursuant to CERCLA, Section 121(c) and the NCP (40 CFR 340.430(f)(40(ii)), as provided in the current guidance on Five Year Reviews (OSWER Directive 9355.7.03B-P), Comprehensive Five-Year Review Guidance. The first Statutory Five-Year Review Report will be completed prior to June 12, 2018, which is five years from the initiation of construction of the remedy. The EPA PCOR states in Section IV-Schedule of Activities for Site Completion that EPA will perform the first five-year review and all subsequent five-year reviews (EPA 2014).

12.0 INSTITUTIONAL CONTROLS

The ROD required implementation of institutional controls (ICs) necessary to restrict future use of the property and groundwater, and monitoring compliance with institutional controls (EPA 2004b). Prior to completion of the RA by the PDs, an interim set of ICs in the form of easements, restrictions, and non-interference agreements consistent with the requirements of the Consent Decree (CD) and Statement of Work (SOW) were placed on five properties. The five properties where ICs were implemented are described below and identified on Figure 5 with the corresponding numerical designations (EPA 2014).

Following completion of the RA, a Grant of Environmental Restriction and Easement (GERE) and/or other type of deed restriction will be recorded for each of the properties and the interim ICs will be terminated. The GERE prohibits activities and use of the Site that may present an unacceptable risk to human health as well as providing Site access to the Performing Defendants for associated monitoring and O &M activities. The EPA RPM indicated that EPA is currently drafting a Notice of Activity and Use Limitation (NAUL) with the PDs and MADEP. EPA expects to finalize the NAUL in the next couple of months which would be the summer of 2016 (See Appendix D).

EPA stated in their Memorandum, dated April 4, 2013, that due to National Grid utility poles being located on the site, a few isolated, small areas of residual radioactive contamination could not be excavated due to restrictions on “right of way” perimeters required by National Grid. National Grid is aware of this issue and will be required by EPA to comply with ICs for the site, including a Soil Management Plan, should the need occur to excavate around the utility poles in the future. The few areas of residual radioactive contamination, around the existing utility poles, will be the responsibility of National Grid to coordinate through EPA and MADEP, with DOE if the utility poles are disturbed.

13.0 SITE TRANSFER RESPONSIBILITES

Per the MOU between USACE and DOE (DOE and USACE 1999), USACE will provide the DOE with a signed copy of the declaration of response action completion and Site Closeout Report (SCOR) for the Shpack Landfill Superfund Site –Operable Unit 1 - Radiological Remediation. The signature date of this Shpack Landfill SCOR officially starts the two-year short-term O&M period, for which USACE is responsible. Ninety days before the end of the two-year short-term O&M period, USACE will notify DOE with the effective date the USACE will no longer have program responsibility for the Shpack Landfill FUSRAP Site. Accompanying this notification will be a complete electronic copy of the Administrative Record.

As discussed in Sections 7, 8 and 12, the soil sampling results were evaluated and the recommendation by USACE’s independent consultant (Cabrera) and concurred with by EPA was that all survey units meet the release criteria as set forth in the ROD (EPA 2004b). The majority of the Site area is deemed protective for unrestricted use for radioactive contamination for the adjacent residential use and can be released from radiological controls. There remains a requirement for institutional controls for the few small isolated areas of residual radiological contamination around some National Grid utility poles that could not be excavated due to the “right of way” restrictions. EPA has stated that National Grid will be responsible for adhering to the ICs for these isolated areas and will be required to develop a soil management plan if these areas must be disturbed in the future. O&M, and five-year reviews for the radioactive contamination at the Site are not required by USACE or DOE to ensure the protectiveness of the final remedy. Therefore, long-term actions required by the DOE for the privately-owned Shpack Landfill Superfund Site will be limited to records management for the FUSRAP RA work that was performed.

During the two-year programmatic O&M period, USACE will inform DOE of any changes in schedules or events/issues which might impact the DOE’s future responsibilities at the Site.

14.0 SITE COMPLETION SUMMARY

14.1 USACE FUSRAP RA

The implemented remedy for the FUSRAP RA achieved the degree of cleanup and protection specified in the 2004 ROD for the Shpack Landfill site for all pathways of exposure. The ROD states that institutional controls are required to restrict future use of the property and groundwater for the site due to hazardous substances remaining on-site above levels that allow for UU/UE. Residual contamination (below soil cleanup levels) is at a depth ranging from 3-8 feet below grade surface. All areas of concern have been addressed. All ROD Remedial Action Goals have been achieved. EPA provided USACE a letter dated 4 April 2013 stating that the radiological contamination at the Shpack Landfill has been remediated in compliance with the ROD. EPA also stated in their letter that the remaining cleanup of the Shpack Landfill Superfund Site was officially transferred from the Corps to EPA and the Responsible Parties (Appendix A). The few isolated areas around the National Grid utility poles that could not be remediated due to “right of way” restrictions are included under the institutional controls for the Site and will require National Grid to take the necessary steps to prepare a Soils Management plan. The plan should ensure worker protection, proper management and disposal of any potentially radioactive contaminated soil as a result of disturbing the soil around the impacted utility poles (Appendix A).

EPA stated in their 2014 PCOR that there were a number of remaining activities associated with the site completion that needed to be performed for the Site to be completed. It is important to note that none of the tasks identified by EPA in the PCOR were the responsibility of USACE or DOE. The table from the PCOR is included for informational purposes only.

TABLE 7 – Schedule of Activities for Site Completion

Task	Date	Responsible Organization
Final Inspection	September 2014	EPA, MADEP
Institutional Controls Implemented	Winter 2015	Performing Defendants, MADEP
Final Remedial Action Report	Winter 2014-2015	Performing Defendants
Operation, Maintenance and Monitoring (including fencing, groundwater and surface water, flood-abatement structures, institutional controls)	2014 – 2044	City of Attleboro
Wetland Monitoring and Maintenance	2014 – 2020	City of Attleboro
First Five-Year Review	Approximately 2018 (and every 5 years thereafter)	EPA
NPL Site Deletion	To be Determined	EPA

Note: Table is from 2014 EPA PCOR.

14.2 PERFORMING DEFENDANTS RA.

The information in this paragraph is included only for information since it does not directly relate to the FUSRAP RA. The remediation of the chemical contamination by the PDs group began at the Site in June 2013 and was completed in December 2013. The CERCLA RA by the PDs shipped 27,083 tons of non-radioactive waste offsite for disposal. The material included the following waste classifications: Special Nuclear Material (SNM) non-hazardous; hazardous waste characteristic for cadmium; non-hazardous waste; asbestos in soil, and non-hazardous asbestos-containing building materials.

The PCOR (EPA 2014) states that a large fraction (approximately 43 percent) of the waste transported off-site for disposal during the PRP's RA was classified as SNM because of very low levels of radioactive materials, below both radiological cleanup criteria and LLRW classification levels. SNM-classified wastes were trucked off-site in lift liners or inter-modal containers, transferred to the appropriate rail cars at the railhead and shipped to the US Ecology disposal facility in Grand View, Idaho. All of the SNM wastes, shipped from the Site under the CERCLA remedial action were classified as non-hazardous.

In addition to the SNM-classified material, soils classified as hazardous waste (leachable cadmium), non-hazardous, and asbestos in soil were also shipped by rail to the US Ecology facility because of radiation levels below the criteria for SNM classification, but above background levels. Overall, approximately 79 percent of the wastes removed from the Site were transported by rail to the Idaho facility for disposal. The US Ecology Idaho facility is permitted to accept RCRA hazardous wastes, low activity radioactive wastes (not licensed by the NRC), PCB-contaminated materials, and asbestos-containing materials for disposal.

Most of the remaining wastes (approximately 20 percent of the total) were classified as non-hazardous and were transported by truck to the Waste Management Turnkey Landfill in Rochester, New Hampshire (a facility licensed to accept non-hazardous waste, including CERCLA waste). The remaining wastes (less than 1 percent) were classified as asbestos in soil or as non-hazardous, asbestos-containing building materials. The asbestos-soils were trucked to the Waste Management, Crossroads Landfill in Norridgewock, Maine (a solid waste landfill); the asbestos-containing building materials were trucked to the Minerva Landfill in Waynesboro, Ohio (a construction and demolition-debris landfill licensed to accept asbestos).

15.0 REFERENCES

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Cabrera Services, Inc. (Cabrera 2003a), *Final Letter Report, Focused Site Inspection: Characterization Survey for Radiological Contaminants of Concern, Shpack FUSRAP Superfund Landfill Site, Norton/Attleboro, Massachusetts.* Cabrera Services, Inc., April 2003.

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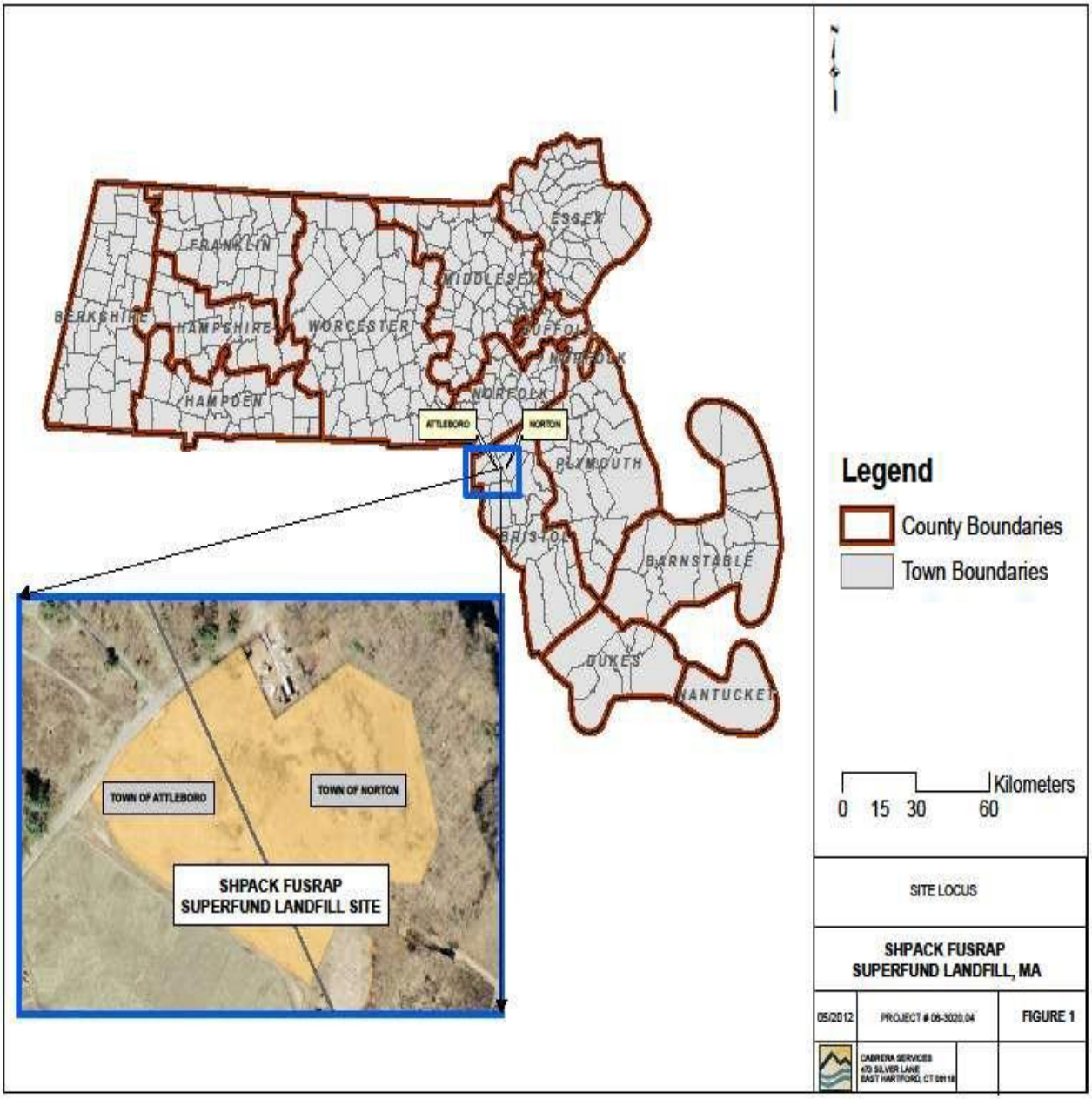
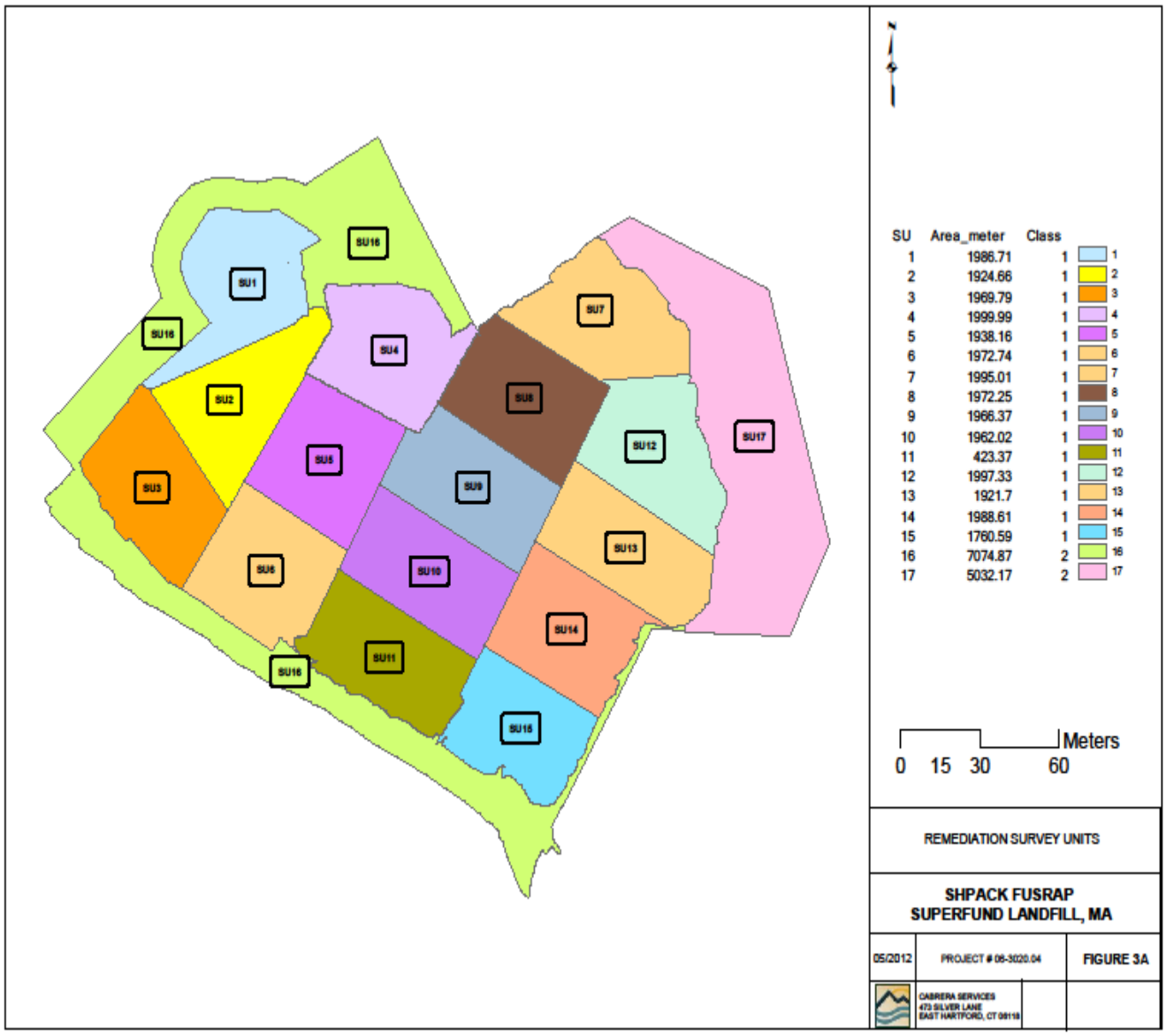
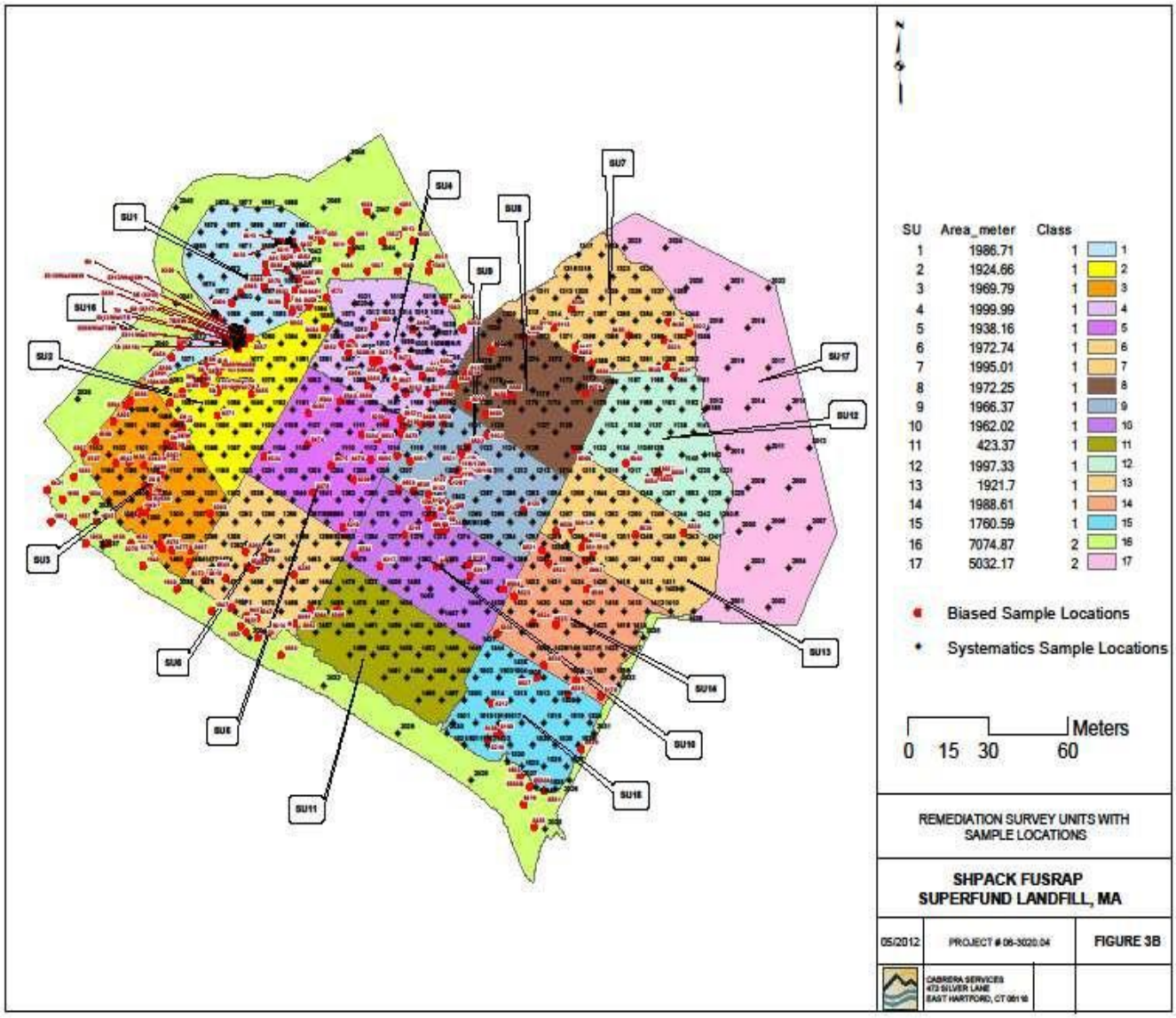


Figure 1 - Site Location



Note: Figure 5 shows the overlay of Survey Units (SU) #19, #20 and #21 on the other identified SUs in this figure and is provided in the *Final Status Survey Report* (FSSR) (Cabrera 2012).

Figure 2 – Remediation Survey Units



Reference: Figure 3 from *Final Status Survey Report* (FSSR) (Cabrera 2012).

Figure 3 – Final Status Survey Sample Points

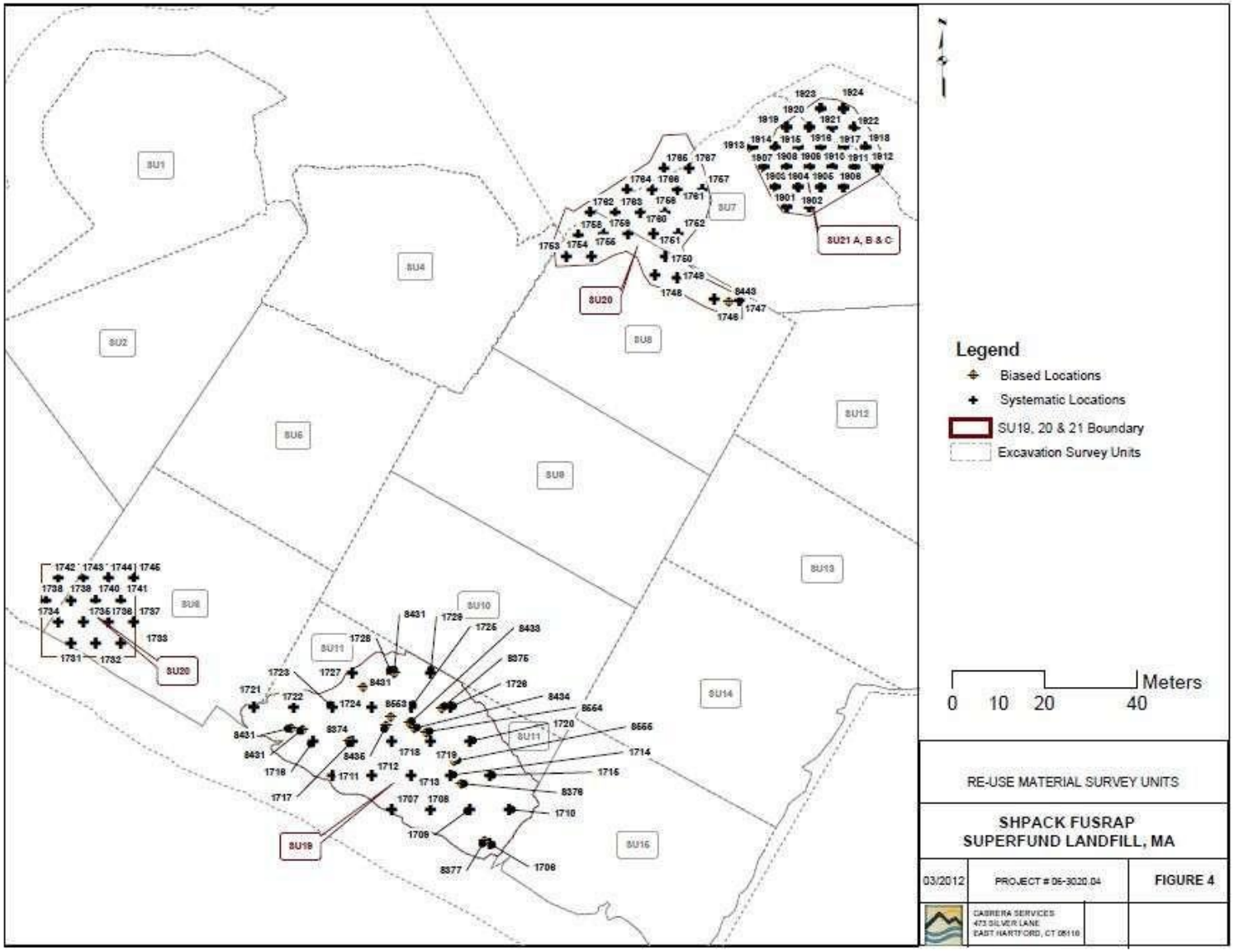


Figure 4: Re-Use Material Survey Units (SU) 19, 20 & 21 (Cabrera 2012).

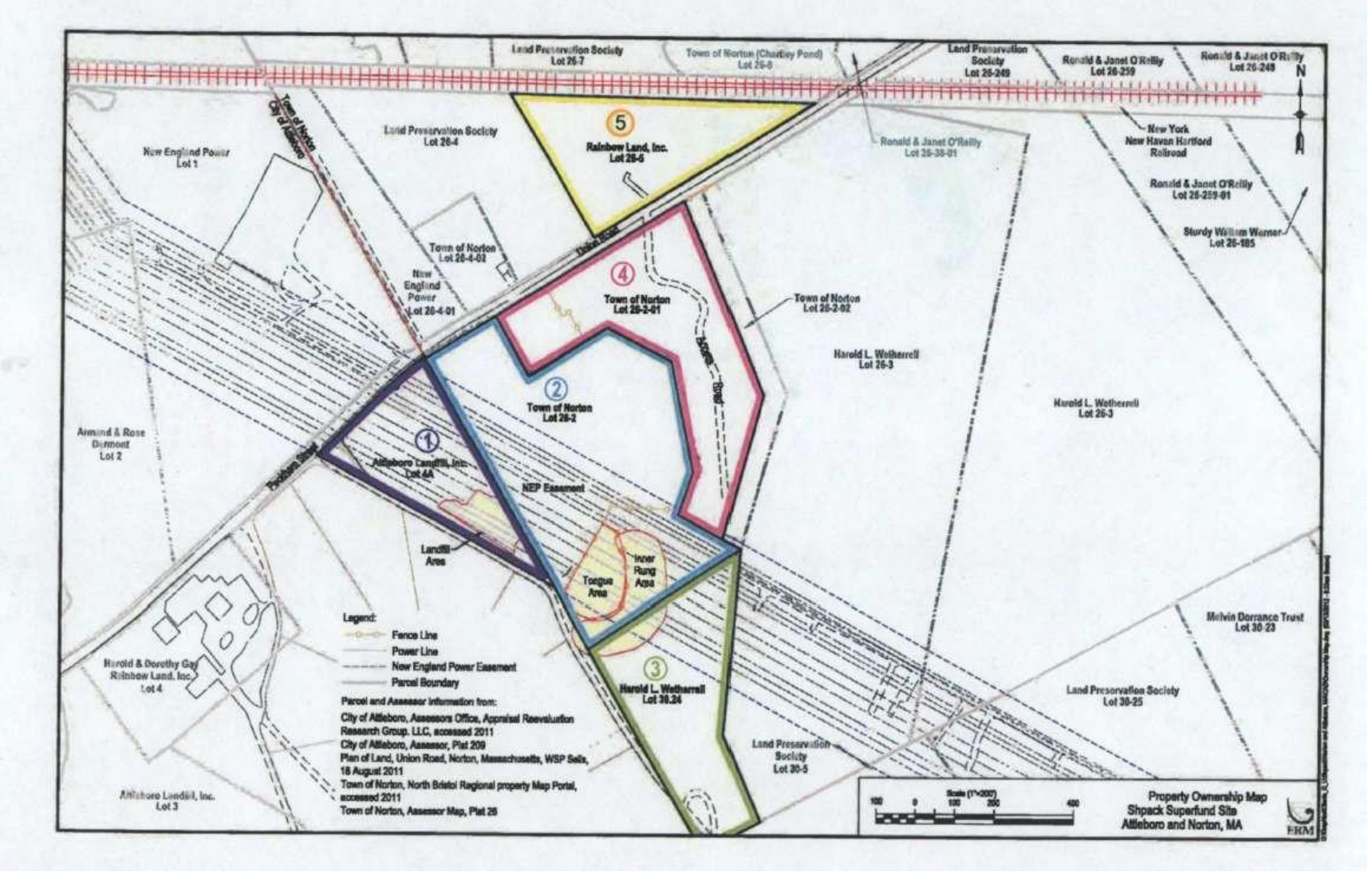


Figure 5 – Institutional Control Locations at Five Properties (EPA 2014)

Appendix A

Regulatory Correspondence

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

April 4, 2013

Mr. William C. Scully
Deputy District Engineer for Programs & Project Management
US Army Corps of Engineers – New England
696 Virginia Road
Concord, MA 01742

Re: Shpack Landfill Superfund Site

Dear Mr. Scully,

Under the provisions of the 2004 Record of Decision (ROD) for the Shpack Landfill Superfund site, the Corps of Engineers were tasked, under the FUSRAP program, to remediate radioactive contaminants in the soil above criteria set forth in the ROD. This letter acknowledges that the Corps cleanup at the Site is in compliance with the ROD and the remaining cleanup is officially transferred from the Corps to EPA and the Responsible Parties (Respondents and Settling Federal Agencies).

EPA developed radiological cleanup goals for soil that are consistent with EPA's acceptable risk range of 1×10^{-5} Excess Lifetime Cancer Risk Range (ELCR). EPA also developed non-radiological cleanup goals for soils and sediments that either exceeded the ELCR, a non-cancer Hazard Index of 1, or ecological benchmarks. These soils will be cleaned up by the Responsible Parties under the January 2009 Remedial Design/Remedial Action Consent Decree.

The Corps completed the radiological remedial work at the Site in October 2011 and submitted to EPA a Final Status Survey, in accordance with MARSSIM (Multi-Agency Radiation Survey and Site Investigation Manual) in May 2012. EPA has reviewed this document and believes that the Corps has complied with the requirements in the ROD. It is understood; however, that due to National Grid utility poles being located on the site, a few isolated, small areas of residual radioactive contamination could not be excavated due to restrictions on "right of way" perimeters required by National Grid. National Grid is aware of this issue and will be required by EPA to comply with institutional controls, including a Soil Management Plan, should the need occur to excavate utility poles in the future.

Should you have any further questions, please do not hesitate to contact Melissa Taylor of my staff, at either 617-918-1310 or Taylor.MelissaG@EPA.gov.

Sincerely yours,

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

Appendix B

Applicable, Relevant and Appropriate Requirements (ARARS)

These ARAR tables were copied from the 2004 Record of Decision for the Shpack Landfill Superfund Site. The EPA Identification number for this site is MAD980503973 and EPA has identified the Site identification number as 0100655. The tables were copied and edited to enhance the readability without changing the content of the tables.

Alternative SC-3B - Excavation/Off-Site Disposal (Adjacent Resident Without Groundwater Consumption)
Potential Chemical-Specific ARARs
Shpack Landfill Superfund Site
Norton/Attleboro, Massachusetts

Medium	Requirements	Status	Synopsis of Requirements	Meet or Attain ARAR
STATE REGULATORY REQUIREMENTS				
Soil/ Groundwater	Massachusetts Regulations for Control of Radiation (105 CMR 120)	Relevant and Appropriate	Establishes standard for radiation related activities.	*
FEDERAL REGULATORY REQUIREMENTS				
Non-Environmental Materials	Department of the Army, USACE EM-385-1-80, Table 6-4	To be Considered	This USACE Radiation Protection Manual table sets acceptable surface contamination levels for U-nat, U-2.35, U-238 and associated decay products for release of equipment and non-environmental materials (e.g., old kitchen appliances)	*
Soil	Domestic Licensing of Source Material (10 CF'R 40, Appendix A, I, Criterion 6(6))	Relevant and Appropriate	Establishes benchmark approach for setting clean-up levels for radionuclides.	*
	Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR Part 192)	Relevant and Appropriate	Establishes concentration limits for clean-up of Ra-226, Ra-228 and thorium in soil.	*
	Use of Soil Clean-up Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites, Directive No. 9200.4-25, February 12, 1998.	To be Considered	Addresses use of soil clean-up criteria in 40 CFR 192 in setting remediation levels for subsurface soil at CERCLA sites with radioactive contamination.	*
	Remediation Goals for Radioactively-Contaminated CERCLA Site Using the Benchmark Dose Clean-Up Criteria in 10 CFR 40, Appendix A, I, Criterion 6(6), Directive No. 9200-4-35P, April 11, 2000.	To be Considered	Addresses the use of the soil and structure clean-up criteria in 10 CFR 40, Appendix A, I, Criterion 6(6) with setting remediation goals at CERCLA sites with radioactive contamination.	*
Sediment	Ontario Ministry of the Environment Sediment Quality Guidelines	To be Considered	The Sediment Quality Guidelines present scientific data and guidance on the environmental effects of pollutants. The criteria contribute to establishing requirements that govern impacts to sediment quality.	*

Notes

Applicable: Addresses a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at the site.

Relevant and Appropriate: Not directly applicable to the site, but addresses situations similar enough to be relevant and appropriate.

To be Considered: Non-promulgated Federal or State criteria, advisories or guidance do not have ARAR status, however, they may be considered in determining cleanup levels protective of public health or the environment.

* Will be met through excavation and off-site disposal of radiological and chemical waste.

Alternative SC-3B - Excavation/Off-Site Disposal (Adjacent Resident Without Groundwater Consumption)
Potential Location-Specific ARARs
Shpack Landfill Superfund Site
Norton/Attleboro, Massachusetts

Medium	Requirements	Status	Synopsis of Requirements	Meet or Attain ARAR
STATE REGULATORY REQUIREMENTS				
Wetland Sediment	Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00).	Applicable	These regulations are promulgated under Wetlands Protection Laws, which regulate dredging, filling, altering or polluting inland wetlands. This requirement regulates work within the wetlands buffer zone, and defines wetlands based on vegetation type and mitigation requirements.	***
	401 Water Quality Certification for Discharge of Dredge or Fill Material (314 CMR 9.00)	Applicable	ARAR if discharge of dredged or fill material occurs.	***
	Massachusetts Endangered Species Act (321 CMR 10.00)	Applicable	Requires that site activities be conducted in a manner that minimizes impact to Massachusetts-listed rare, threatened, or endangered species, and species listed by the Massachusetts Natural Heritage Program.	**
FEDERAL REGULATORY REQUIREMENTS				
Wetland Sediment	Federal Executive Order on Protection of Wetlands (E.O. 11990, 40 CFR Part 6, Appendix A)	Applicable	Requires federal agencies to avoid impacts associated with the destruction or loss of wetlands, minimize potential harm, preserve and enhance wetlands, and avoid support of new construction in wetlands if a practicable alternative exists.	*
	Federal Fish and Wildlife Coordination Act (16 USC 661 et. seq., 40 CFR Part 6)	Applicable	Establishes requirements for a consultation with U.S. Fish and. Wildlife Service and state wildlife agencies to mitigate losses of fish and wildlife that result from modification of a water body.	****
	Federal Clean Water Act (33 USC 1344), US Army Corps of Engineers Nation Wide Permit Program (33 CFR Part 330), "Federal Guidelines for Specification of Disposal Sites" (40 CFR Part 230), Clean Water Act Sections 401 and 404 (33 CFR 26)	Applicable	Under this requirement no activity that adversely affects a wetland shall be permitted if a practicable alternative that has less effect is available. The requirements also describe actions to minimize adverse impacts. Establishes regulations for filling and dredging within wetlands.	*
	Endangered Species Act (50 CFR Parts 17.11-12)	Applicable	Requires site action be conducted in a manner that avoids harming threatened or endangered species or their habitat.	**

Notes:

Applicable: Addresses a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at the site.

Relevant and Appropriate: Not directly applicable to the site, but addresses situations similar enough to be relevant and appropriate.

To be Considered: Non-promulgated Federal or State criteria, advisories or guidance do not have ARAR status, however, they may be considered in determining cleanup levels protective of public health or the environment.

* Because of high levels of contamination exist in wetlands area, there is not practical alternative to excavating wetlands areas. Actions will be taken to minimize impacts to the maximum extent practical.

** Should threatened, protected or endangered species be encountered, the requirements of these regulations will be met.

*** Because excavation is required in the wetlands/buffer zone, all substantive requirements of these regulations will be met.

**** Should this alternative require modification of a water body, the consultation requirement will be conducted.

Alternative SC-3B - Excavation/Off-Site Disposal (Adjacent Resident Without Groundwater Consumption)
Potential Action-Specific ARARs
Shpack Landfill Superfund Site
Norton/Attleboro, Massachusetts

Medium	Requirements	Status	Synopsis of Requirements	Meet or Attain ARAR
STATE REGULATORY REQUIREMENTS				
Air	Massachusetts DEP Air Pollution Control Regulations (310 CMR 7.00)	Applicable	These regulations set requirements for fugitive emissions, dust, and particulates.	*
Non-Environmental Materials	Department of the Army, USACE EM-385-1-80, Table 6-4	To be Considered	This USACE Radiation Protection Manual table sets acceptable surface contamination levels for U-nat, U-235, U-238 and associated decay products for release of equipment and non-environmental materials (e.g., old kitchen appliances).	†
Soil	Domestic Licensing of Source Material (10 CFR 40, Appendix A, I, Criterion 6(6))	Relevant and Appropriate	Establishes benchmark approach for setting clean-up levels for radionuclides.	†
	Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR Part 192)	Relevant and Appropriate	Establishes concentration limits for clean-up of Ra-226, Ra-228 and thorium in soil.	†
	Use of Soil Clean-up Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites, Directive No 9200.4-25, February 12, 1998.	To be Considered	Addresses use of soil clean-up criteria in 40 CFR 192 in setting remediation levels for subsurface soil at CERCLA sites with radioactive contamination.	†
	Remediation Goals for Radioactively-Contaminated CERCLA Site Using the Benchmark Dose Clean-Up Criteria in 10 CFR 40, Appendix A, I, Criterion 6(6), Directive No 9200-4-35P, April 11, 2000.	To be Considered	Addresses the use of the soil and structure clean-up criteria in 10 CFR 40, Appendix A, I, Criterion 6(6) with setting remediation goals at CERCLA sites with radioactive contamination.	†
	Massachusetts DEP Hazardous Waste Regulations (310 CMR 30.00)	Relevant and Appropriate	These regulations describe the requirement for treatment, storage, and disposal of hazardous waste.	**
Water	Massachusetts Surface Water Quality Standards(314 CMR 4.00)	Applicable	Establishes criteria to be met if dewatering activities require surface water discharge.	†
	Certification of Operators of Wastewater Treatment Facilities (257 CMR 2.0)	Applicable	Addresses certification of wastewater treatment operators to be met if dewatering activities require water treatment	†
	Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Discharges (314 CMR 12.00)	Applicable	Addresses operations and maintenance and pretreatment standards for wastewater treatment to be met if dewatering activities require water treatment.	†

Notes:

Applicable: Addresses a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at the site.

Relevant and Appropriate: Not directly applicable to the site, but addresses situations similar enough to be relevant and appropriate.

To be Considered: Non-promulgated Federal or State criteria, advisories or guidance do not have ARAR status, however, they may be considered in determining cleanup levels protective of public health or the environment.

* Excavation activities will be conducted to meet the requirements of these regulations.

** Substantive landfill closure requirements that address clean closure will be met by this alternative.

† Excavation, dewatering, and offsite will be conducted in accordance with these requirements.

Alternative SC·- 3B - Excavation/Off-Site Disposal (Adjacent Resident Without Groundwater Consumption)
Potential Action-Specific ARARs
Shpack Landfill Superfund Site
Norton/Attleboro, Massachusetts

Medium	Requirements	Status	Synopsis of Requirements	Meet or Attain ARAR
FEDERAL REGULATORY REQUIREMENTS				
Air	National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Clean Air Act (40 CFR 61, Subparts H and I)	Relevant and Appropriate	Regulates air emissions and radionuclides.	***
Soil	Federal RCRA Subtitle C (40 CFR Part 264 Subpart G- Closure and Post Closure, Sections 264.111, 264.114, and 264.117) Clean Closure Requirements 40 CFR 264.258	Relevant and Appropriate	Establishes performance standards for closure of hazardous waste piles, disposal facilities, and groundwater monitoring.	*
Water	Clean Water Act (Section 402: NPDES)	Applicable	Establishes criteria to be met if dewatering activities require surface water discharge.	†
Groundwater	Federal Ambient Water Quality Criteria (AWQC) (CWA 303}	Relevant and Applicable[1]	Federal AWQC are health-based criteria which have been developed for certain carcinogenic and non-carcinogenic compounds.	**
	Federal RCRA Subtitle C Regulations, 40 CFR Part 204 Subpart F;- Releases from Solid Waste Management Units, Sections 264.95, 264.96(a) and(c), 264.97, 264.98 and 264.99)	Relevant and Appropriate	Groundwater monitoring requirements and compliance points for determining the need for additional monitoring and corrective action	* **

Notes:

Applicable: Addresses a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at the site.

Relevant and Appropriate: Not directly applicable to the site, but addresses situations similar enough to be relevant and appropriate.

To be Considered: Non-promulgated Federal or State criteria, advisories or guidance do not have ARAR status, however, they may be considered in determining cleanup levels protective of public health or the environment.

* Substantive landfill closure requirements that address clean closure will be met by this alternative.

** These criteria will be used to determine if other activities minimize the contribution of contaminants from the site to surface water.

*** Excavation activities will be conducted to meet the requirements of these regulations.

† Dewatering will be conducted in accordance with these requirements.

[1] The ROD shows "Applicable" but term is typically "Appropriate"

Alternative SC-3B - Excavation/Off-Site Disposal (Adjacent Resident Without Groundwater Consumption) Potential Radiological-Specific ARARs

Shpack Landfill Superfund Site

Norton/Attleboro, Massachusetts

Medium	Requirements	Status	Synopsis of Requirements
STATE REGULATORY REQUIREMENTS			
Soil/ Groundwater	Massachusetts Regulations for Control of Radiation (105 CMR 120)	Relevant and Appropriate	Establishes standards for radiation related activities.
FEDERAL REGULATORY REQUIREMENTS			
Air	National Emission Standards for Hazardous A1r Pollutants (NESHAPs) and Clean Air Act (40 CFR 61, Subparts H and I)	Relevant and Appropriate	Provides guidance on air emissions of radionuclides during cleanup of Federal Facilities and licensed NRC facilities with radioactive contamination.
Groundwater	Ore Mining and Dressing Point Source Category (40 C'FR 440, Subpart C)	Relevant and Appropriate	Regulates effluent limits from facilities that extract/process uranium, radium and. vanadium ores. May be applicable to discharges of radioactive waste to surface water.
	Federal Water Quality Criteria (FWQC) and State Water Quality Standards (Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, April 1, 1986)	To be considered	FWQC are criteria/standards for the protection of aquatic life and/or human health.
	Health and Environmental Protection for Uranium and Thorium Tailings (40 CFR 192, Subpart A, Table I)	Relevant and Appropriate	Standards have been developed under the Uranium Mill Tailings Radiation Control Act (UMTRCA) for sites that are exempt from CERCLA for radium/thorium in soil.
	Federal Safe Drinking Water Act- Maximum Contaminant Levels (MCLs) for Radiological Constituents (40 CFR 141 Subparts B, G and I)	Applicable if non-zero	MCLs have been promulgated for a number of radiological constituents. These levels regulate the concentration of contaminants in public drinking water supplies, but may also be considered appropriate for groundwater aquifers potentially used for drinking water.
Soil	Health and Environmental Protection for Uranium and Thorium Tailings (40 CFR 192.12, 192.32, 192.41)	Relevant and Appropriate	Standards have been developed under the Uranium Mill Tailings Radiation Controls Act (UMTRCA) for sites that are exempt from CERCLA for radium/thorium in soil.
	Licensing Requirements for Land Disposal of Radioactive Waste (10 CFR 61.41)	Relevant and Appropriate	Provides performance objectives for licensed disposal sites containing low level radioactive waste if the waste will be left permanently on site.

Notes:

Applicable: Addresses a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at the site.

Relevant and Appropriate: Not directly applicable to the site, but addresses situations similar enough to be relevant and appropriate.

To be Considered: Non-promulgated Federal or State criteria, advisories or guidance do not have ARAR status, however, they may be considered in determining cleanup levels protective of public health or the environment.

See chemical-, action-, and location-specific ARAR tables for a discussion on how the radiological specific ARARs are addressed, if at all, by this alternative.

Appendix C

Systematic Soil Sampling Results Summary Sheets For the Individual Soil Survey Units

TABLE C-1 Systematic Soil Sampling Results For Survey Unit 1 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1000	0.26	0.57	0.02	0.38	0.09	0.00
1001	0.93	0.90	0.03	0.66	0.31	0.13
1002	0.36	0.39	0.03	0.34	0.12	0.00
1063	0.04	0.36	-0.10	-0.01	0.01	0.00
1066	0.27	0.08	-0.10	0.42	0.09	0.00
1068	0.13	0.41	-0.05	0.41	0.05	0.00
1069	2.18	0.48	0.02	0.45	0.71	0.53
1071	1.70	1.26	0.07	1.16	0.57	0.39
1072	0.81	0.81	0.06	0.70	0.27	0.09
1550	0.23	0.37	0.05	0.84	0.08	0.00
1557	0.24	0.27	-0.02	0.42	0.08	0.00
1562	0.51	0.58	-0.02	0.59	0.17	0.00
1570	0.82	0.47	0.27	0.65	0.28	0.10
1664	1.04	0.47	0.05	0.96	0.35	0.17
1665	0.76	0.63	0.05	0.76	0.26	0.08
1666	1.35	1.14	0.07	0.43	0.45	0.27
1667	0.73	0.76	0.03	0.88	0.25	0.07
1668	0.60	1.07	0.03	0.43	0.20	0.02
1669	0.37	1.32	-0.04	1.24	0.14	0.01
1670	0.18	2.46	0.32	0.97	0.08	0.02
1671	3.63	1.78	0.02	0.78	**1.19**	**1.01**
1672	0.38	1.02	-0.04	0.23	0.13	0.00
1673	0.33	1.08	0.14	0.77	0.12	0.01
1674	0.56	0.45	-0.02	1.21	0.19	0.01
1675	0.40	0.64	0.08	0.61	0.14	0.00
1676	1.57	0.32	0.14	0.82	0.52	0.34
1677	0.47	0.35	0.12	0.79	0.16	0.00
1678	1.22	0.55	-0.02	0.83	0.40	0.22
1679	0.47	0.48	-0.02	0.25	0.16	0.00
1680	0.32	0.64	0.16	1.12	0.12	0.01
1681	0.38	1.04	-0.02	0.89	0.14	0.01
1003-R	1.53	0.55	0.19	0.61	0.51	0.32
1004-R	3.14	1.25	0.13	1.02	**1.03**	0.85
1563A	0.84	1.17	-0.05	1.11	0.29	0.11
1563B	0.52	0.69	-0.02	0.70	0.18	0.00
1564	1.32	0.56	-0.04	0.43	0.43	0.25
MIN	0.04	0.08	-0.10	-0.01		
AVG	0.85	0.76	0.04	0.69		0.14
MAX	3.63	2.46	0.32	1.24		

TABLE C-2 Systematic Soil Sampling Results for Survey Unit 2 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1064	0.17	0.22	-0.02	0.13	0.06	0.00
1065	0.38	0.24	-0.11	0.19	0.12	0.00
1070	1.76	1.73	0.10	1.94	0.60	0.41
1073	0.64	0.16	0.02	0.16	0.21	0.03
1074	0.45	0.35	0.00	0.24	0.15	0.00
1076	0.03	0.21	0.15	0.32	0.02	0.00
1077	0.14	0.24	-0.04	0.06	0.05	0.00
1078	0.12	0.36	0.12	0.51	0.05	0.00
1079	0.06	0.06	0.00	0.10	0.02	0.00
1080	0.12	0.04	0.29	0.15	0.05	0.01
1081	0.00	0.12	-0.03	0.12	0.00	0.00
1083	0.83	1.28	0.07	1.13	0.29	0.10
1087	1.54	0.93	0.08	0.80	0.51	0.33
1088	0.99	0.44	0.06	0.29	0.33	0.15
1089	0.10	0.09	0.00	0.09	0.03	0.00
1090	0.17	0.52	0.01	0.74	0.06	0.00
1094	1.33	1.07	0.09	0.94	0.44	0.26
1095	0.60	0.37	0.02	0.39	0.20	0.02
1096	1.03	0.43	0.06	0.27	0.34	0.16
1097	0.86	2.41	0.12	1.84	0.31	0.13
1098	0.50	0.34	0.01	0.26	0.17	0.00
1192	0.24	0.14	-0.07	0.01	0.08	0.00
1193	1.74	0.93	0.10	0.86	0.58	0.39
1200	0.11	0.20	0.00	0.17	0.04	0.00
1555	0.14	0.19	0.00	0.01	0.05	0.00
1560	0.52	0.60	-0.01	0.29	0.17	0.00
1565	0.06	0.06	0.05	0.07	0.02	0.00
1199	0.64	0.48	0.00	0.17	0.21	0.03
MIN	0.00	0.04	-0.11	0.01		
AVG	0.55	0.51	0.04	0.44		0.07
MAX	1.76	2.41	0.29	1.94		

TABLE C-3 Systematic Soil Sampling Results for Survey Unit 3 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1085	0.45	0.42	0.05	0.51	0.15	0.00
1086	0.64	0.59	0.04	0.54	0.22	0.05
1091	1.58	0.96	0.03	1.02	0.52	0.36
1092	0.84	1.04	0.06	0.94	0.29	0.12
1093	0.57	1.05	0.05	0.93	0.20	0.03
1099	1.57	1.86	0.06	1.29	0.53	0.36
1100	1.23	0.88	0.05	0.82	0.41	0.25
1101	1.22	1.87	0.16	1.76	0.42	0.26
1102	1.08	1.72	0.02	1.61	0.37	0.21
1103	0.65	1.35	0.06	0.94	0.23	0.06
1194	1.57	1.43	0.10	1.48	0.53	0.36
1195	1.32	2.70	0.14	2.53	0.46	0.30
1196	1.15	1.52	0.06	1.28	0.39	0.23
1197	1.83	0.82	0.02	0.91	0.60	0.44
1198	0.33	0.19	0.04	0.11	0.11	0.00
1294	0.02	0.34	0.00	0.24	0.01	0.00
1296	1.31	1.33	0.10	1.31	0.44	0.28
1297	0.49	1.17	0.04	0.78	0.17	0.01
1298	1.36	1.27	0.03	0.99	0.45	0.29
1299	0.30	0.85	0.07	0.89	0.11	0.01
1300	1.43	1.50	0.08	1.46	0.48	0.32
1301	0.28	1.02	0.07	1.54	0.11	0.01
1303	0.16	0.78	0.06	0.74	0.06	0.00
1304	1.46	1.54	0.07	1.47	0.49	0.33
1305	1.04	0.82	0.08	0.76	0.35	0.18
1306	1.54	1.25	0.04	1.23	0.51	0.35
1307	0.99	0.89	0.07	0.74	0.33	0.17
1484	1.01	1.07	0.04	0.88	0.34	0.18
1485	0.86	26.30	0.99	5.20	0.46	0.30
1548	1.07	0.88	0.05	0.75	0.36	0.19
1302	0.33	0.32	0.15	0.66	0.12	0.00
MIN	0.02	0.19	0.00	0.11		
AVG	0.96	1.93	0.09	1.17		0.18
MAX	1.83	26.30	0.99	5.20		

TABLE C-4 Systematic Soil Sampling Results for Survey Unit 4 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1005	0.82	2.80	0.11	1.68	0.30	0.11
1008	2.11	26.20	1.21	4.15	0.86	0.68
1009	0.95	11.20	0.46	3.33	0.40	0.22
1010	1.38	27.90	1.35	5.10	0.64	0.46
1011	3.38	16.80	0.52	4.27	**1.22**	**1.03**
1012	1.15	8.90	0.51	3.77	0.46	0.27
1013	1.32	88.00	5.12	14.60	**1.06**	0.88
1014	0.83	26.30	1.23	5.38	0.46	0.28
1015	0.89	50.40	2.73	11.80	0.68	0.50
1016	1.09	4.44	0.23	1.14	0.39	0.21
1017	0.80	2.74	0.07	0.87	0.28	0.10
1018	2.50	4.21	0.20	2.77	0.86	0.67
1019	0.67	3.56	0.14	1.05	0.24	0.06
1020	0.68	4.89	0.25	1.83	0.26	0.08
1021	1.38	10.40	0.63	6.40	0.56	0.38
1022	0.80	0.75	0.09	0.51	0.27	0.09
1024	1.22	17.50	0.76	4.23	0.53	0.35
1027	1.52	2.53	0.47	0.98	0.52	0.34
1028	0.62	0.70	0.01	0.65	0.21	0.03
1036	0.64	5.25	0.26	1.80	0.25	0.07
1056	3.04	30.00	1.17	2.82	**1.17**	0.98
1058	1.23	70.60	5.94	8.43	0.91	0.73
1183	0.09	0.12	0.00	0.06	0.03	0.00
1184	0.28	0.89	0.03	0.47	0.10	0.00
1185	-0.07	0.06	-0.01	0.06	-0.02	0.00
1186	3.32	0.15	0.01	0.07	**1.07**	0.90
1308	0.10	0.41	0.01	0.09	0.04	0.00
1561	0.25	0.49	-0.08	0.82	0.09	0.00
1566	0.14	0.51	-0.04	0.08	0.05	0.00
1567	0.34	0.95	-0.02	0.09	0.11	0.00
1573	0.00	0.14	0.15	0.14	0.01	0.00
1575	0.28	1.12	0.12	0.58	0.10	0.00
1576	0.27	3.40	0.07	1.54	0.12	0.02
1006-R	0.66	0.52	0.17	0.46	0.22	0.04
1007-R	0.20	0.28	0.15	0.73	0.08	0.00
1026-R	0.09	0.95	-0.02	0.71	0.04	0.00
1057-R	0.35	0.58	0.00	0.20	0.12	0.00
MIN	-0.07	0.06	-0.08	0.06		
AVG	0.95	11.53	0.65	2.53		0.26
MAX	3.38	88.00	5.94	14.60		

TABLE C-5 Systematic Soil Sampling Results for Survey Unit 5 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1082	0.52	0.12	0.06	-0.09	0.17	0.01
1104	0.24	0.43	0.14	0.49	0.09	0.00
1105	0.03	0.15	-0.02	0.14	0.01	0.00
1106	0.32	0.17	0.01	0.01	0.10	0.00
1107	0.21	0.13	-0.13	0.07	0.07	0.00
1109	0.15	-0.06	0.00	0.01	0.05	0.00
1110	0.20	0.23	0.02	0.11	0.07	0.00
1111	0.23	-0.01	0.00	0.06	0.08	0.00
1112	0.34	0.09	0.02	0.11	0.11	0.00
1113	0.36	1.30	0.08	0.85	0.13	0.01
1114	0.60	6.80	0.24	2.10	0.25	0.08
1115	0.44	19.80	1.32	28.00	0.51	0.36
1187	0.20	1.34	0.07	0.59	0.08	0.00
1188	0.11	0.06	0.03	0.44	0.04	0.00
1189	0.07	0.02	-0.02	0.10	0.02	0.00
1191	0.33	0.58	0.04	0.20	0.11	0.00
1201	0.10	0.07	0.10	0.45	0.04	0.00
1202	0.00	-0.02	0.04	0.33	0.00	0.00
1203	0.04	0.33	0.05	0.26	0.02	0.00
1204	0.09	0.27	-0.03	0.08	0.03	0.00
1205	0.46	1.29	0.04	0.63	0.16	0.00
1206	0.30	0.61	0.02	0.20	0.10	0.00
1280	0.00	0.00	-0.02	0.20	0.00	0.00
1281	0.13	0.17	0.00	0.35	0.05	0.00
1282	0.21	0.37	0.00	0.23	0.07	0.00
1285	0.24	0.29	0.03	0.40	0.08	0.00
1540	0.20	0.23	0.27	0.25	0.07	0.01
1541	0.15	0.27	0.20	0.28	0.06	0.00
1568	-0.08	0.24	-0.05	0.11	-0.03	0.00
1569	0.21	0.60	-0.05	0.27	0.07	0.00
1190/8344	0.26	1.32	0.00	0.69	0.10	0.00
MIN	-0.08	-0.06	-0.13	-0.09		
AVG	0.21	1.20	0.08	1.22		0.02
MAX	0.60	19.80	1.32	28.00		

TABLE C-6 Systematic Soil Sampling Results for Survey Unit 6 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1283	0.27	0.61	0.01	0.14	0.09	0.00
1288	0.09	0.20	-0.02	0.71	0.04	0.00
1289	0.14	-0.03	0.10	0.01	0.05	0.00
1290	0.03	0.14	-0.05	0.26	0.01	0.00
1291	0.28	0.33	0.00	0.10	0.09	0.00
1292	0.12	0.24	-0.04	0.22	0.04	0.00
1293	0.04	0.28	-0.06	0.01	0.01	0.00
1295	0.95	5.80	0.33	1.71	0.36	0.19
1462	0.24	-0.10	0.21	0.07	0.08	0.00
1463	0.11	0.11	0.05	0.02	0.04	0.00
1464	0.03	0.39	0.08	0.01	0.01	0.00
1465	0.60	1.36	0.17	0.70	0.21	0.05
1469	0.72	0.06	0.20	-0.03	0.24	0.08
1470	0.40	0.96	0.00	0.86	0.14	0.00
1471	0.02	0.55	0.05	0.57	0.02	0.00
1472	2.24	2.31	0.11	1.98	0.75	0.59
1473	0.18	0.82	0.10	0.57	0.07	0.00
1474	1.89	3.78	0.18	1.28	0.64	0.48
1475	0.10	1.49	0.03	0.46	0.04	0.00
1476	2.16	0.93	0.05	0.79	0.71	0.55
1477	0.12	0.12	-0.02	-0.06	0.04	0.00
1486	0.99	0.48	0.17	0.69	0.33	0.17
1487	0.06	0.42	-0.02	0.30	0.02	0.00
1538	0.05	0.14	0.05	0.06	0.02	0.00
1539	0.05	-0.07	-0.05	0.18	0.02	0.00
1556	0.48	0.27	-0.05	0.00	0.16	0.00
1286/8298	0.27	0.35	-0.09	0.15	0.09	0.00
1287/8296	0.27	0.93	0.08	0.72	0.10	0.00
MIN	0.02	-0.10	-0.09	-0.06		
AVG	0.46	0.82	0.06	0.45		0.08
MAX	2.24	5.80	0.33	1.98		

TABLE C-7 Systematic Soil Sampling Results for Survey Unit 7 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1311	0.84	1.14	0.32	0.91	0.29	0.18
1313	0.98	0.32	0.24	0.48	0.33	0.21
1315	0.56	1.50	0.18	1.28	0.20	0.09
1316	0.31	0.42	0.04	0.61	0.11	0.00
1317	0.30	0.38	0.06	0.44	0.10	0.00
1318	1.55	32.30	1.53	18.40	0.84	0.73
1319	0.16	0.74	0.07	0.55	0.06	0.00
1323	0.03	3.82	0.10	0.65	0.04	0.02
1324	0.37	5.49	0.17	0.46	0.15	0.04
1327	0.36	0.21	0.01	0.09	0.12	0.01
1328	0.06	35.40	1.48	3.53	0.24	0.21
1329	0.16	7.90	0.36	1.67	0.11	0.05
1330	0.93	1.43	0.05	1.98	0.33	0.21
1349	0.19	1.46	0.06	0.54	0.07	0.00
1350	0.27	64.00	3.24	35.60	0.76	0.67
1351	-0.11	3.74	0.21	0.84	-0.01	0.02
1352	0.49	64.00	2.04	1.94	0.51	0.39
1353	0.69	26.90	0.82	0.95	0.37	0.26
1358	0.59	5.90	0.29	0.38	0.23	0.11
1359	0.36	0.67	0.05	0.44	0.12	0.01
1360	0.33	2.43	0.07	0.83	0.13	0.01
1361	0.25	0.86	0.08	0.42	0.09	0.00
1362	0.90	28.50	1.02	4.16	0.48	0.36
1363	0.44	8.70	0.35	3.71	0.22	0.11
1364	0.26	1.40	0.08	0.56	0.10	0.01
1365	0.28	0.68	0.01	0.10	0.10	0.00
1366	0.34	4.93	0.02	0.35	0.14	0.02
1367	0.47	1.04	0.01	0.26	0.16	0.05
1377	0.62	5.21	0.38	11.60	0.34	0.22
1314	1.14	0.91	0.19	0.98	0.38	0.27
1368	0.39	0.71	0.12	0.17	0.13	0.02
MIN	-0.11	0.21	0.01	0.09		
AVG	0.47	10.10	0.44	3.06		0.14
MAX	1.55	64.00	3.24	35.60		

TABLE C-8 Systematic Soil Sampling Results for Survey Unit 8 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1025	0.54	5.28	0.06	1.77	0.22	0.13
1029	1.74	9.66	0.27	0.79	0.62	0.53
1030	1.03	0.92	0.22	0.97	0.35	0.26
1127	0.04	0.06	0.01	0.04	0.01	0.00
1129	0.02	0.59	0.05	0.14	0.01	0.00
1130	1.87	3.23	0.12	1.95	0.64	0.55
1168	0.26	6.71	0.54	1.23	0.14	0.05
1170	0.30	32.00	1.18	4.51	0.31	0.22
1171	0.10	0.17	0.01	0.24	0.04	0.00
1172	0.35	13.80	0.39	1.38	0.20	0.11
1173	0.57	17.70	0.85	1.65	0.30	0.21
1174	-0.02	0.75	0.03	0.38	0.00	0.00
1175	0.08	0.38	0.03	0.07	0.03	0.00
1176	0.90	284.00	12.90	6.28	**1.89**	**1.80**
1177	0.23	8.02	0.65	3.25	0.15	0.07
1178	1.14	7.50	0.31	2.54	0.43	0.34
1179	0.15	2.23	0.60	1.35	0.08	0.03
1180	0.72	2.20	0.12	0.77	0.25	0.16
1181	0.20	2.97	0.44	0.60	0.09	0.02
1309	2.04	4.58	0.94	3.53	0.73	0.64
1369	0.68	7.09	0.74	4.77	0.31	0.22
1370	0.29	28.60	2.64	4.26	0.31	0.22
1371	0.11	7.00	0.50	0.72	0.08	0.04
1372	0.35	9.87	0.40	1.38	0.18	0.09
1373	0.23	1.41	0.30	0.81	0.09	0.01
1374	0.79	6.21	0.68	1.48	0.31	0.22
1375	0.44	0.70	0.03	0.80	0.15	0.06
1376	1.57	3.50	0.22	0.97	0.54	0.45
1378	0.22	1.06	0.25	0.33	0.08	0.01
MIN	-0.02	0.06	0.01	0.04		
AVG	0.58	16.14	0.88	1.69		0.22
MAX	2.04	284.00	12.90	6.28		

TABLE C-9 Systematic Soil Sampling Results for Survey Unit 9 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1116	0.61	7.70	0.28	5.23	0.29	0.20
1117	0.22	0.48	0.01	0.22	0.08	0.00
1118	0.27	0.51	0.04	0.39	0.09	0.01
1120	0.02	0.56	0.06	0.30	0.01	0.00
1121	0.13	1.10	0.07	0.87	0.06	0.01
1122	0.16	1.95	0.06	0.75	0.07	0.01
1123	-0.05	1.65	0.04	0.32	-0.01	0.01
1124	0.10	0.22	0.01	0.14	0.04	0.00
1126	0.11	0.16	0.02	0.05	0.04	0.00
1182	0.12	0.27	0.05	0.12	0.04	0.00
1207	0.31	1.44	0.07	0.65	0.11	0.03
1209	-0.18	1.30	0.04	0.25	-0.05	0.00
1211	0.70	1.23	0.05	0.70	0.24	0.15
1212	0.43	1.70	0.12	0.80	0.16	0.07
1213	0.45	2.32	0.10	3.06	0.19	0.10
1214	0.67	0.98	0.06	0.33	0.23	0.14
1260	0.42	4.21	0.35	1.59	0.18	0.09
1261	0.07	0.75	0.03	0.52	0.03	0.00
1262	-0.12	0.25	0.01	0.08	-0.04	0.00
1263	0.31	0.46	0.01	0.25	0.11	0.02
1264	0.04	0.31	0.01	0.04	0.02	0.00
1265	0.35	0.42	0.03	0.45	0.12	0.03
1266	0.14	0.15	0.01	0.10	0.05	0.00
1267	-0.13	1.37	0.05	0.46	-0.03	0.00
1269	0.29	1.08	0.02	0.39	0.10	0.02
1271	0.18	0.25	0.01	0.06	0.06	0.00
1543	1.10	65.00	2.52	17.80	0.86	0.77
1554	0.34	1.95	0.10	1.16	0.13	0.04
1119	0.22	0.61	-0.05	0.08	0.07	0.00
MIN	-0.18	0.15	-0.05	0.04		
AVG	0.25	3.46	0.14	1.28		0.06
MAX	1.10	65.00	2.52	17.80		

TABLE C-10 Systematic Soil Sampling Results for Survey Unit 10 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1268	0.12	0.06	0.00	0.05	0.04	0.00
1273	0.31	0.14	0.03	0.18	0.10	0.02
1274	-0.03	0.42	0.01	0.37	0.00	0.00
1275	0.43	2.41	0.09	0.90	0.16	0.07
1276	0.22	0.07	-0.01	0.09	0.07	0.00
1277	0.33	0.73	-0.02	0.44	0.11	0.03
1278	0.55	1.39	0.05	0.42	0.19	0.10
1279	0.03	0.27	-0.04	0.03	0.01	0.00
1284	0.08	0.34	0.16	0.34	0.03	0.00
1381	0.05	0.56	-0.01	0.02	0.02	0.00
1382	0.16	0.16	0.01	0.17	0.05	0.00
1383	0.15	0.22	0.02	0.16	0.05	0.00
1384	0.25	0.10	0.02	0.06	0.08	0.00
1385	0.09	0.21	0.00	0.08	0.03	0.00
1386	0.06	0.08	0.00	0.09	0.02	0.00
1436	0.16	0.37	0.02	0.37	0.06	0.00
1439	0.36	0.21	0.00	0.18	0.12	0.04
1440	0.18	0.04	-0.01	0.03	0.06	0.00
1441	0.11	0.12	0.00	0.07	0.04	0.00
1442	0.09	0.07	0.00	0.05	0.03	0.00
1447	0.13	0.09	0.02	0.05	0.04	0.00
1449	0.30	0.11	0.03	0.07	0.10	0.02
1455	0.06	0.08	0.02	0.04	0.02	0.00
1542	0.18	0.40	0.02	0.42	0.06	0.00
1270/10S/8135	0.91	0.91	0.04	0.91	0.31	0.22
1268	0.12	0.06	0.00	0.05	0.04	0.00
MIN	-0.03	0.04	-0.04	0.02		
AVG	0.21	0.37	0.02	0.22		0.02
MAX	0.91	2.41	0.16	0.91		

TABLE C-11 Systematic Soil Sampling Results for Survey Unit 11 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1379	0.59	0.07	0.03	0.15	0.19	0.04
1445	0.18	2.58	0.16	0.46	0.08	0.01
1446	0.07	0.32	0.01	0.14	0.03	0.00
1448	0.78	1.58	0.07	0.75	0.27	0.10
1451	1.12	2.23	0.04	1.13	0.38	0.22
1452	0.64	5.80	0.11	1.13	0.25	0.08
1453	0.87	4.24	0.19	0.92	0.31	0.15
1454	0.46	3.78	0.08	0.63	0.17	0.02
1456	0.57	0.69	0.00	0.29	0.19	0.03
1457	0.87	6.20	0.28	1.44	0.33	0.16
1458	0.60	3.80	0.26	0.90	0.22	0.06
1459	0.63	2.80	0.12	1.73	0.23	0.07
1460	0.35	52.90	2.02	3.88	0.43	0.31
1461	0.81	3.57	0.14	0.94	0.29	0.12
1466	0.03	0.49	0.18	0.65	0.02	0.00
1467	0.81	1.10	0.07	0.76	0.28	0.11
1478	0.18	0.25	0.03	0.45	0.06	0.00
1479	0.02	0.26	0.16	-0.02	0.01	0.00
1480	0.55	2.34	0.13	1.00	0.20	0.04
1488	0.51	1.15	0.11	0.33	0.18	0.01
1491	0.30	60.80	2.50	21.60	0.62	0.51
1494	0.42	4.29	0.15	0.84	0.17	0.02
1495	0.90	2.24	0.14	0.97	0.31	0.15
1496	0.52	0.93	0.04	0.52	0.18	0.01
1497	0.41	1.89	0.12	0.75	0.15	0.01
1499	0.59	1.36	0.09	0.47	0.20	0.04
1537	0.19	0.44	-0.03	0.18	0.06	0.00
MIN	0.02	0.07	-0.03	-0.02		
AVG	0.52	6.23	0.27	1.59		0.08
MAX	1.12	60.80	2.50	21.60		

TABLE C-12 Systematic Soil Sampling Results for Survey Unit 12 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1132	0.41	16.60	1.08	27.30	0.48	0.36
1133	0.02	0.74	0.08	1.82	0.03	0.01
1134	0.08	0.65	0.03	0.69	0.04	0.00
1135	0.17	25.80	1.45	35.20	0.52	0.46
1136	0.54	0.46	0.01	0.45	0.18	0.07
1137	0.17	1.95	0.09	1.46	0.08	0.02
1138	0.00	0.61	0.03	0.46	0.01	0.00
1139	0.19	0.34	0.03	0.27	0.07	0.00
1140	0.16	4.80	0.27	0.96	0.09	0.03
1141	-0.07	3.22	0.19	1.20	0.01	0.02
1142	0.21	15.40	0.73	0.69	0.16	0.08
1160	0.25	202.00	7.70	8.40	**1.22**	**1.13**
1161	0.22	3.62	0.19	0.48	0.10	0.02
1162	0.05	7.50	0.29	0.58	0.06	0.04
1163	0.67	17.00	0.79	8.10	0.38	0.27
1164	0.22	7.80	0.34	1.01	0.12	0.04
1165	-0.04	1.14	0.05	0.64	0.00	0.00
1166	0.28	0.67	0.02	0.62	0.10	0.00
1167	0.24	0.36	0.04	0.39	0.08	0.00
1169	0.40	9.10	0.46	6.70	0.24	0.13
1217	0.25	1.02	0.05	0.98	0.10	0.01
1218	0.46	0.69	0.05	0.56	0.16	0.04
1219	1.04	0.79	0.07	0.50	0.35	0.23
1220	0.66	1.23	0.08	0.59	0.23	0.11
1221	0.66	0.59	0.01	0.46	0.22	0.11
1225	0.55	2.21	0.11	1.41	0.20	0.09
1226	0.30	3.00	0.12	0.87	0.12	0.02
1242	0.45	5.26	0.32	2.74	0.20	0.09
1247	0.66	0.60	0.04	0.44	0.22	0.11
1553	0.40	0.93	0.05	0.54	0.14	0.03
1240-R	0.38	0.57	-0.08	0.51	0.13	0.02
MIN	-0.07	0.34	-0.08	0.27		
AVG	0.32	10.86	0.47	3.45		0.11
MAX	1.04	202.00	7.70	35.20		

TABLE C-13 Systematic Soil Sampling Results for Survey Unit 13 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1215	-0.07	5.42	0.31	4.23	0.05	0.06
1216	0.16	1.32	0.11	1.01	0.07	0.01
1241	0.30	3.80	0.32	6.40	0.18	0.07
1243	0.61	4.63	0.17	6.90	0.28	0.17
1244	0.33	15.30	0.77	16.50	0.34	0.23
1245	0.38	0.61	0.07	0.74	0.13	0.02
1246	0.94	1.61	0.10	1.98	0.33	0.22
1248	0.09	0.65	0.02	0.59	0.04	0.00
1249	0.51	1.24	0.07	1.25	0.18	0.07
1250	0.12	6.90	0.32	10.30	0.17	0.12
1251	0.32	2.53	0.16	3.78	0.15	0.04
1252	-0.04	0.87	0.04	1.07	0.00	0.01
1253	0.11	0.81	0.03	0.78	0.05	0.00
1254	-0.40	46.60	1.65	10.90	0.21	0.33
1255	0.45	0.52	0.01	0.43	0.15	0.04
1256	0.00	2.60	0.14	3.00	0.04	0.03
1257	0.07	1.30	0.07	1.12	0.04	0.01
1258	-0.09	1.35	0.04	0.77	-0.02	0.01
1390	0.44	6.00	0.28	7.10	0.24	0.13
1391	-0.07	1.48	0.08	1.24	0.00	0.01
1392	0.56	234.00	8.00	25.60	**1.63**	**1.52**
1393	0.18	1.85	0.09	0.82	0.08	0.01
1394	0.66	9.10	0.48	11.00	0.36	0.25
1408	0.40	4.24	0.41	7.00	0.22	0.11
1409	1.82	12.90	0.57	11.20	0.76	0.65
1410	0.62	2.63	0.11	3.26	0.24	0.13
1413	0.26	0.45	0.05	0.58	0.09	0.00
1544	-0.07	7.90	0.33	5.46	0.07	0.08
1411	0.66	14.40	0.92	17.30	0.45	0.34
MIN	-0.40	0.45	0.01	0.43		
AVG	0.32	13.55	0.54	5.60		0.16
MAX	1.82	234.00	8.00	25.60		

TABLE C-14 Systematic Soil Sampling Results for Survey Unit 14 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1259	1.24	0.71	0.12	0.68	0.41	0.32
1387	0.12	0.74	0.04	0.38	0.05	0.00
1388	0.33	2.58	0.14	0.62	0.13	0.04
1389	0.29	0.48	0.17	0.56	0.10	0.02
1412	0.48	8.30	0.43	15.00	0.34	0.25
1414	0.49	0.98	0.03	1.18	0.17	0.09
1415	0.42	0.48	0.03	0.55	0.14	0.06
1416	0.13	0.67	0.05	0.66	0.05	0.00
1417	0.40	0.58	0.03	0.64	0.14	0.05
1418	0.07	8.00	0.41	19.50	0.24	0.21
1419	0.20	5.03	0.19	5.11	0.14	0.06
1420	0.32	0.12	0.03	0.12	0.11	0.02
1421	0.45	1.31	0.07	2.12	0.17	0.08
1422	0.24	1.23	0.03	1.39	0.10	0.01
1423	0.25	2.59	0.12	1.49	0.11	0.02
1424	0.08	0.33	0.00	0.29	0.03	0.00
1425	0.00	0.19	0.01	0.31	0.00	0.00
1426	0.60	2.83	0.14	7.10	0.27	0.19
1430	0.33	3.75	0.21	11.00	0.23	0.14
1431	-0.15	0.51	0.03	0.53	-0.04	0.00
1432	0.03	0.15	0.01	0.19	0.01	0.00
1433	0.05	0.11	0.01	0.23	0.02	0.00
1434	0.11	5.60	0.19	14.80	0.20	0.16
1435	0.06	0.36	0.01	0.80	0.03	0.00
1437	0.19	1.41	0.12	1.24	0.08	0.01
1506	0.10	0.21	0.11	0.02	0.04	0.00
1507	0.33	0.40	0.02	0.81	0.12	0.03
1508	0.44	3.32	0.11	2.15	0.18	0.09
1427-R	0.12	0.34	0.00	0.82	0.05	0.00
1428/14N	0.30	1.97	0.12	5.03	0.15	0.07
MIN	-0.15	0.11	0.00	0.02		
AVG	0.27	1.84	0.10	3.18		0.06
MAX	1.24	8.30	0.43	19.50		

TABLE C-15 Systematic Soil Sampling Results for Survey Unit 15 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1438	0.60	1.40	0.13	2.98	0.23	0.14
1444	0.28	2.39	0.09	1.31	0.12	0.03
1501	-0.09	0.81	0.08	0.64	-0.02	0.00
1502	0.16	3.66	0.10	0.69	0.08	0.02
1503	0.33	1.14	0.06	0.73	0.12	0.03
1504	0.11	0.11	0.01	0.27	0.04	0.00
1505	0.06	0.04	0.15	0.75	0.03	0.00
1509	0.09	0.51	0.09	2.28	0.05	0.02
1511	0.18	2.83	0.22	10.90	0.17	0.11
1512	0.56	0.19	0.02	0.20	0.18	0.10
1513	0.27	0.47	0.05	0.46	0.09	0.01
1514	0.45	1.25	0.08	0.51	0.16	0.07
1515	0.27	2.18	0.13	0.48	0.10	0.02
1516	0.69	2.80	0.12	1.55	0.25	0.16
1517	0.18	0.47	0.03	0.35	0.06	0.00
1518	0.31	0.24	-0.01	0.25	0.10	0.02
1519	0.09	1.37	0.08	2.59	0.06	0.02
1520	0.71	0.42	0.04	0.86	0.24	0.15
1522	0.07	0.22	0.00	0.03	0.02	0.00
1523	0.19	0.09	0.06	0.10	0.06	0.00
1524	0.76	0.19	0.01	0.15	0.25	0.17
1525	0.20	2.84	0.16	2.91	0.11	0.03
1526	0.09	1.06	0.07	2.55	0.06	0.02
1527	0.60	0.47	0.02	0.50	0.20	0.11
1528	0.12	0.46	0.04	0.57	0.05	0.00
1529	0.48	0.79	0.05	1.01	0.17	0.08
1530	0.43	0.53	0.05	0.33	0.15	0.06
1534	0.21	2.01	0.05	4.50	0.12	0.04
1535	0.25	1.34	0.01	0.93	0.10	0.01
1521/8211	0.07	0.37	0.04	0.29	0.03	0.00
1500	0.12	1.19	0.31	0.80	0.06	0.01
MIN	-0.09	0.04	-0.01	0.03		
AVG	0.29	1.09	0.08	1.37		0.05
MAX	0.76	3.66	0.31	10.90		

TABLE C-16 Systematic Soil Sampling Results for Survey Unit 16 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
2025	0.31	0.60	-0.12	1.05	0.11	0.00
2026	0.65	0.71	0.08	0.36	0.22	0.06
2027	0.22	7.30	0.34	17.30	0.27	0.19
2028	0.24	0.47	0.09	0.42	0.09	0.00
2029	0.43	1.11	0.04	2.90	0.17	0.02
2030	0.31	0.73	-0.02	0.44	0.11	0.00
2031	0.25	0.16	0.10	1.33	0.10	0.01
2032	0.31	10.10	0.04	0.50	0.15	0.04
2033	0.08	2.69	0.19	1.70	0.06	0.02
2035	0.16	1.21	0.01	1.15	0.07	0.01
2036	0.81	0.85	0.06	0.83	0.27	0.11
2037	2.14	0.70	0.19	0.68	0.70	0.54
2038	0.58	1.14	0.05	0.98	0.20	0.04
2039	0.21	0.84	-0.04	1.00	0.08	0.01
2040	0.56	0.58	0.13	0.60	0.19	0.03
2041	0.31	0.58	0.00	0.61	0.11	0.00
2042	0.63	0.43	-0.02	0.49	0.21	0.05
2043	0.69	0.67	0.30	0.98	0.24	0.08
2044	0.42	1.14	-0.03	0.89	0.15	0.01
2045	0.60	1.17	0.21	0.69	0.21	0.05
2046	0.19	0.42	-0.09	0.64	0.07	0.00
2047	0.48	0.64	0.19	0.52	0.17	0.00
2048	0.63	0.38	0.07	0.78	0.21	0.05
MIN	0.08	0.16	-0.12	0.36		
AVG	0.49	1.51	0.08	1.60		0.06
MAX	2.14	10.10	0.34	17.30		

TABLE C-17 Systematic Soil Sampling Results for Survey Unit 17 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
2001	0.58	2.92	0.20	3.90	0.24	0.13
2002	0.24	3.13	0.18	1.16	0.11	0.02
2003	0.29	3.82	0.16	1.17	0.13	0.02
2004	0.58	1.28	0.10	0.74	0.20	0.09
2005	0.68	1.15	0.04	0.89	0.23	0.12
2006	0.37	5.56	0.18	2.96	0.18	0.06
2007	0.24	3.81	0.17	1.56	0.11	0.03
2008	0.38	1.35	0.14	1.07	0.14	0.03
2009	0.14	2.58	0.09	0.98	0.07	0.01
2010	0.48	112.00	3.62	6.00	0.79	0.68
2011	0.61	4.50	0.12	1.12	0.23	0.12
2012	0.36	0.83	0.04	0.61	0.13	0.01
2013	0.47	73.00	2.46	7.20	0.60	0.48
2014	0.04	63.00	2.35	15.90	0.49	0.47
2015	0.51	14.40	0.45	6.70	0.30	0.19
2016	0.54	49.50	1.90	14.30	0.57	0.45
2017	0.92	10.40	0.47	4.62	0.40	0.28
2018	0.06	19.20	0.75	7.50	0.19	0.16
2019	0.16	7.00	0.29	3.36	0.12	0.06
2020	0.33	1.69	0.11	1.28	0.13	0.01
2021	0.18	3.12	0.17	2.22	0.10	0.03
2022	2.13	3.05	0.13	1.97	0.72	0.61
2023	0.28	2.49	0.15	2.13	0.12	0.03
2024	0.18	3.75	0.14	6.20	0.13	0.07
MIN	0.04	0.83	0.04	0.61		
AVG	0.45	16.40	0.60	3.98		0.17
MAX	2.13	112.00	3.62	15.90		

TABLE C-18 Systematic Soil Sampling Results for Survey Unit 18 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
2049	1.33	1.48	0.24	1.55	0.45	0.27
2050	0.14	0.72	0.05	0.63	0.06	0.00
2051	0.44	0.48	0.00	0.72	0.15	0.00
2052	0.60	1.05	-0.02	0.86	0.21	0.03
2053	0.36	0.94	0.14	0.97	0.13	0.01
2054	0.39	0.30	0.05	0.86	0.14	0.00
2055	0.72	0.13	-0.12	0.87	0.24	0.06
2057	0.24	1.22	0.10	0.93	0.09	0.01
2058	0.76	0.77	0.06	0.39	0.25	0.07
2059	0.86	1.41	0.00	1.13	0.29	0.11
2060	1.45	1.80	0.12	1.79	0.50	0.31
2061	1.36	1.47	0.12	1.68	0.46	0.28
2062	0.20	0.78	0.03	0.67	0.08	0.00
2063	0.20	0.82	0.12	0.58	0.08	0.00
2064	0.25	0.41	-0.02	0.63	0.09	0.00
2065	0.80	1.74	0.40	1.22	0.29	0.10
2066	0.58	1.10	0.25	1.11	0.21	0.03
2067	1.19	1.34	0.06	1.39	0.40	0.22
2068	1.01	1.54	0.21	1.64	0.35	0.17
2069	0.36	0.99	-0.02	0.32	0.12	0.00
2070	1.07	2.05	0.05	2.09	0.37	0.19
2071	0.35	0.90	0.03	0.52	0.12	0.00
2072	0.78	0.63	0.14	0.55	0.26	0.08
MIN	0.14	0.13	-0.12	0.32		
AVG	0.67	1.05	0.09	1.00		0.09
MAX	1.45	2.05	0.40	2.09		

TABLE C-19 Systematic Soil Sampling Results for Survey Unit 19 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1706	0.55	1.51	0.18	0.58	0.19	0.01
1707	1.12	7.20	0.26	10.90	0.50	0.32
1708	1.18	5.60	0.35	4.60	0.46	0.27
1709	0.82	3.90	0.53	7.30	0.36	0.18
1710	0.58	5.30	0.06	1.60	0.23	0.05
1711	0.44	3.90	0.11	4.20	0.20	0.05
1712	0.59	1.79	0.09	1.90	0.22	0.04
1713	0.49	11.30	1.11	48.60	0.67	0.51
1714	0.38	4.90	-0.01	1.55	0.16	0.03
1715	0.34	1.44	0.11	0.92	0.13	0.01
1716	0.33	0.63	-0.08	0.75	0.12	0.00
1717	1.30	11.20	0.62	8.10	0.56	0.38
1718	0.39	0.56	0.31	0.86	0.14	0.01
1719	0.70	5.90	0.29	1.62	0.27	0.09
1720	0.37	2.40	0.12	0.85	0.14	0.01
1721	0.71	1.63	0.24	1.51	0.26	0.07
1722	0.85	2.70	0.09	1.77	0.30	0.12
1723	0.96	1.61	0.20	1.24	0.33	0.15
1724	0.34	0.55	-0.01	0.38	0.12	0.00
1725	0.63	1.57	0.05	0.61	0.22	0.04
1726	0.69	6.10	0.13	3.00	0.28	0.10
1727	0.82	1.07	-0.02	1.88	0.29	0.11
1728	0.38	1.53	-0.01	1.34	0.14	0.01
1729	0.41	0.90	0.29	1.30	0.15	0.01
MIN	0.33	0.55	-0.08	0.38		
AVG	0.64	3.55	0.21	4.47		0.11
MAX	1.30	11.30	1.11	48.60		

TABLE C-20 Systematic Soil Sampling Results for Survey Unit 20 Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1733	0.69	2.57	-0.08	0.94	0.24	0.06
1736	0.48	6.90	0.05	1.65	0.20	0.04
1737	1.07	0.64	0.02	0.67	0.36	0.17
1741	0.21	0.29	0.13	1.18	0.08	0.01
1744	0.91	1.09	0.01	0.76	0.31	0.13
1745	0.03	0.82	0.17	0.65	0.02	0.00
1747	0.50	30.30	1.04	1.81	0.34	0.17
1748	0.60	3.80	0.52	1.13	0.23	0.05
1749	0.75	1.62	0.21	0.71	0.26	0.08
1750	0.82	5.00	0.17	1.24	0.30	0.12
1751	0.92	3.00	0.11	0.88	0.32	0.14
1752	0.58	1.14	0.05	0.44	0.20	0.02
1753	0.87	0.78	-0.04	0.57	0.29	0.11
1754	3.68	1.06	-0.05	1.02	**1.20**	**1.02**
1755	1.21	1.71	0.01	1.06	0.41	0.23
1756	0.53	0.73	0.11	0.74	0.18	0.00
1758	0.83	1.28	0.11	1.05	0.29	0.10
1759	1.00	1.12	-0.02	1.02	0.34	0.16
1760	1.09	1.49	0.06	0.84	0.37	0.19
1762	0.61	1.01	0.11	0.64	0.21	0.03
1763	0.96	1.10	-0.05	0.55	0.32	0.14
1764	1.08	9.00	0.74	4.30	0.44	0.26
1766	0.52	0.61	0.26	1.05	0.19	0.01
1731A	0.52	49.50	2.01	16.50	0.58	0.41
1731B	1.12	7.80	0.27	2.78	0.43	0.25
1732A	0.49	48.00	2.11	22.30	0.62	0.45
1732B	0.53	74.00	3.80	27.60	0.83	0.65
1734A	0.72	21.30	0.82	11.00	0.45	0.26
1734B	1.06	1.74	0.05	1.08	0.36	0.18
1735A	0.80	68.00	1.93	26.30	0.84	0.66
1735B	0.70	83.00	2.50	22.20	0.85	0.67
1738A	0.51	35.40	0.83	8.70	0.42	0.25
1738B	2.32	1.40	0.10	1.56	0.77	0.59
1739A	0.59	36.20	1.62	19.70	0.57	0.38
1739B	0.56	34.60	1.22	17.90	0.52	0.34
1740A	0.70	51.80	1.49	13.00	0.61	0.43
1740B	0.87	45.20	1.69	11.20	0.62	0.44
1742A	0.86	65.00	2.42	26.00	0.86	0.67
1742B	1.44	20.30	1.67	22.90	0.80	0.62
1743A	1.57	2.27	0.14	1.50	0.53	0.35
1743B	0.57	71.00	2.78	18.20	0.73	0.54
MIN	0.03	0.29	-0.08	0.44		
AVG	0.87	19.36	0.76	7.20		0.28
MAX	3.68	83.00	3.80	27.60		

TABLE C-21A Systematic Soil Sampling Results for Survey Unit 21A Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1901A	0.45	19.50	0.85	11.10	0.35	0.20
1902A	1.01	17.30	0.95	9.70	0.51	0.33
1903A	0.85	18.30	0.68	11.00	0.47	0.29
1904A	0.51	11.40	0.71	8.80	0.31	0.14
1905A	1.03	10.30	0.39	12.90	0.50	0.32
1906A	0.70	13.90	0.93	11.50	0.41	0.23
1907A	0.40	4.90	0.06	3.30	0.18	0.05
1908A	0.39	17.30	1.10	11.20	0.33	0.19
1909A	0.53	19.40	1.16	9.00	0.36	0.18
1910A	0.51	16.70	0.87	14.40	0.39	0.22
1911A	0.87	13.00	0.93	17.80	0.52	0.34
1912A	0.82	114.00	5.10	21.80	**1.08**	0.90
1913A	0.87	17.40	0.30	8.90	0.45	0.27
1914A	0.45	11.20	0.53	10.20	0.30	0.15
1915A	0.74	11.60	0.91	23.50	0.52	0.34
1916A	0.61	11.20	0.69	6.80	0.32	0.14
1917A	0.83	24.00	1.36	13.00	0.52	0.34
1918A	1.07	84.00	3.60	28.60	**1.06**	0.88
1919A	0.63	9.90	0.82	11.50	0.37	0.19
1920A	0.45	15.20	0.67	14.60	0.36	0.21
1921A	1.05	20.60	1.09	13.00	0.57	0.39
1922A	0.67	107.00	5.30	28.80	**1.07**	0.89
1923A	1.51	62.00	2.90	26.50	**1.07**	0.88
1924A	1.32	84.00	4.00	30.60	**1.16**	0.98
MIN	0.39	4.90	0.06	3.30		
AVG	0.76	30.59	1.50	14.94		0.38
MAX	1.51	114.00	5.30	30.60		

TABLE C-21B Systematic Soil Sampling Results for Survey Unit 21B Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1901B	0.60	11.40	0.61	7.00	0.32	0.14
1902B	0.62	10.10	0.21	10.50	0.35	0.16
1903B	0.66	13.60	0.56	7.20	0.35	0.17
1904B	1.22	18.10	0.95	10.10	0.59	0.41
1905B	0.37	9.90	0.65	11.60	0.28	0.15
1906B	0.93	12.30	0.25	7.80	0.43	0.25
1907B	0.60	6.80	0.13	4.70	0.27	0.09
1908B	0.56	6.90	0.40	9.20	0.30	0.12
1909B	0.47	22.90	1.05	18.60	0.45	0.29
1910B	0.89	11.20	0.95	11.20	0.46	0.28
1911B	0.70	65.00	2.43	18.40	0.74	0.55
1912B	0.65	115.00	3.90	15.70	0.95	0.77
1913B	0.43	8.80	0.20	7.20	0.25	0.10
1914B	0.49	13.10	0.55	13.50	0.35	0.18
1915B	0.64	7.30	0.54	10.00	0.34	0.16
1916B	1.57	13.60	0.70	8.30	0.66	0.48
1917B	1.29	20.70	0.90	22.00	0.73	0.55
1918B	1.26	43.90	2.16	18.40	0.82	0.63
1919B	0.42	14.00	0.45	18.10	0.37	0.23
1920B	0.61	28.60	1.21	15.70	0.49	0.31
1921B	1.45	65.00	2.92	18.50	0.99	0.81
1922B	0.92	132.00	6.40	20.40	**1.21**	**1.02**
1923B	0.72	94.00	3.60	19.00	0.90	0.72
1924B	0.90	55.70	1.91	13.90	0.71	0.53
MIN	0.37	6.80	0.13	4.70		
AVG	0.79	33.33	1.40	13.21		0.38
MAX	1.57	132.00	6.40	22.00		

TABLE C-21C Systematic Soil Sampling Results for Survey Unit 21C Shpack Final Status Survey

Location Point ID	Ra-226 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Sum-of-Ratios (SOR)	Net SOR
1901C	0.80	5.60	0.25	4.00	0.33	0.14
1902C	0.33	21.40	0.97	12.50	0.34	0.22
1903C	0.39	9.70	0.23	7.60	0.24	0.11
1904C	0.31	11.70	0.46	10.80	0.26	0.15
1905C	0.71	10.40	0.54	21.60	0.48	0.30
1906C	1.57	19.20	0.48	7.80	0.67	0.49
1907C	0.65	7.30	0.56	4.70	0.30	0.12
1908C	0.87	10.90	0.35	7.90	0.41	0.23
1909C	0.52	15.90	1.46	16.20	0.42	0.24
1910C	0.46	12.20	0.29	5.00	0.26	0.10
1911C	0.93	45.90	2.10	20.70	0.74	0.56
1912C	1.16	46.00	2.74	17.70	0.80	0.62
1913C	0.76	10.90	0.80	8.50	0.39	0.21
1914C	0.60	11.30	0.74	12.70	0.38	0.19
1915C	0.44	7.00	0.51	7.90	0.26	0.11
1916C	1.29	23.00	1.52	19.20	0.72	0.54
1917C	1.66	34.60	2.03	23.30	0.94	0.76
1918C	0.94	90.00	3.50	14.90	0.92	0.73
1919C	0.70	9.30	0.90	12.00	0.39	0.21
1920C	1.15	96.00	3.50	20.20	**1.06**	0.88
1921C	1.10	86.00	3.10	23.90	**1.02**	0.84
1922C	0.67	50.40	2.43	14.00	0.62	0.44
1923C	1.18	65.00	3.00	20.80	0.92	0.74
1924C	0.85	63.00	3.00	18.30	0.79	0.60
MIN	0.31	5.60	0.23	4.00		
AVG	0.84	31.78	1.48	13.84		0.40
MAX	1.66	96.00	3.50	23.90		

Appendix D

Correspondence with EPA Remedial Project Manager

Waples, Richard J HNC@NWO

From: Taylor, Melissa <Taylor.Melissag@epa.gov>
Sent: Monday, April 04, 2016 10:13 AM
To: Charette, Carol A NAE
Cc: Waples, Richard J HNC@NWO
Subject: [EXTERNAL] Re: Questions that I would like to discuss with Melissa Taylor EPA RPM for Shpack
Attachments: smprecorded.pdf; Exhibit 1_Shpack CD (1).pdf

Good morning Carol. I am available for a conference call but I am providing the soil management plan as recorded and the recorded CD as well.

To answer some of your questions up front:

As to #1 -- DOE/USACE is not required to perform O&M or 5-yr reviews for the Shpack site; however, should EPA require assistance with implementing either of these we retain the right to request assistance.
In addition, it is not DOE/USACE responsibility to implement ICs and while it is not spelled out in any of the IC documentation that notification of DOE is required upon determination that radioactive contamination exists when National Grid disturbs telephone poles, it is required that National Grid notify and coordinate with EPA and MassDEP who will then notify DOE should the need for cost reimbursement occur due to the presence of radioactive contamination.

As to #2 -- EPA is currently in the process of drafting a Notice of Activity and Use Limitation (NAUL) with the Performing Defendants and Mass DEP. We are hoping these will be finalized in the next couple of months, but at this point they are still in draft form.

As to #3 -- Again, as stated in the response to #1, DOE or USACE is not required to implement ICs at the site. We have provided the SMP that has been recorded as a subordination agreement but will likely be submitted by National Grid as a "pre-approved plan" to EPA/DEP for work they will conduct in compliance with the NAUL.

Let me know if this satisfies your questions and if not when you would like to have a call to discuss. Thanks much,
Melissa

From: Charette, Carol A NAE
<Carol.A.Charette@usace.army.mil> Sent: Thursday, March 31, 2016 8:32 AM
To: Taylor, Melissa
Cc: Waples, Richard J HNC@NWO
Subject: Fw: Questions that I would like to discuss with Melissa Taylor EPA RPM for Shpack Melissa,

Would like to have a conf call to discuss the issues in the below email as we are trying to finalize the Shpack Close Out Report.

Please let us know your availability as soon as possible so we can move forward with co.pleting this document.

Sent from my BlackBerry 10 smartphone on the Verizon Wireless 4G LTE network.

Original Message
From: Waples, Richard J HNC@NWO
<Richard.J.Waples@usace.army.mil> Sent:
Wednesday, March 30, 2016 11:55 AM
To: Charette, Carol A NAE
Cc: Clements, Julie A HNC@NWO
Subject: Questions that I would like to discuss with Melissa Taylor EPA RPM for Shpack

Carol,

I understand that you and Ms. Melissa Taylor are very busy but there are a couple of comments that I received from HQ USACE (Ms. Nicki Fatherly) that I would like to verify with Ms. Taylor before I finalize the Site Closeout report for the radioactive contamination at the Shpack Landfill. When I prepared the Final Site Closeout Report for Operable Unit 1 - Radiological Remediation, Shpack Landfill FUSRAP Superfund Site, I based several of my statements on EPA's "Preliminary Close Out Report, Shpack Landfill Superfund Site", Town of Norton and City of Attleboro, Massachusetts dated September 2014 and an EPA Memorandum from James T. Owens, III dated April 4, 2013 to Mr. William C. Scully, USACE. As I revise the report and prepare my response to comments to HQ USACE, I want to verify with Ms. Taylor that I am not misrepresenting any of the future responsibilities for DOE's Legacy Office. I have provided my three questions that I would like to ask Ms. Taylor for your information and comment and to request you forward to Ms. Taylor if you agree with them.

1. HQ USACE (Ms. Fatherly) questioned my statement in the Executive summary and in Sections 11.0 & 13.0 of the FUSRAP Radiological Site Closeout report, that O&M and Five-Year reviews for the radioactive contamination at the Site are not required by USACE or DOE. I based this on two previously mentioned EPA documents:

1) EPA's PCOR (Sept 2014) which states in Section IV that Institutional Controls are the responsibility of the Performing Defendants and MASS DEP; O&M and Monitoring are the responsibility of the City of Attleboro; and the first and future Five-Year Reviews are the responsibility of EPA. USACE and DOE were not identified as Performing Defendants for this site but were responsible for the addressing the radioactive contamination.

2) The second document that I used is EPA's Memorandum from James T. Owens, III which states that "The Corps completed the radiological remedial work at the Site in October 2011 and submitted a Final Status Survey, in accordance with MARSSIM (Multi-Agency Radiation Survey and Site Investigation Manual) in May 2012. EPA has reviewed this document and believes that the Corps has complied with the requirements in the ROD."

Based on these two EPA documents, I understood that USACE and DOE would not be responsible for any long term O&M, monitoring or Five-Year Reviews. The PCOR does not break out the radioactive contamination separately from the Performing Defendants work so I did not find an EPA requirement for the DOE Legacy Office to

perform any future O&M and Five-Year Review for the Shpack Landfill. If this is incorrect, I would request that Ms. Taylor and possibly EPA's attorney correct me if I am mis-representing DOE's Legacy Office future O&M and Five-Year Review responsibilities. We do state in the FUSRAP Site Closeout Report that if National Grid plans to disturb the Power Poles where there might be inaccessible radioactive contamination, that they would not only do the required coordination with EPA and MADEP, but they also would provide a notification to DOE to determine cost allocation of the response, transportation and disposal costs of the radioactive contaminated material.

2. In Section IV, of EPA's PCOR, it states that Institutional Controls would be implemented by the Performing Defendants and Mass DEP in the Winter of 2015. HQ USACE requested that I provide a date when the ICs were actually implemented if this task has been completed.

3. The last point has already been mentioned in item #1 in that National Grid will be responsible for adhering to the ICs in regards to the power poles. DOE would need to be notified if the power poles were going to be disturbed resulting in the need for response action, transportation and disposal of radioactive contaminated soils. In EPA's PCOR (April 4, 2013) it states: "It is understood; however, that due to National Grid utility poles being located on the site, a few isolated, small areas of residual radioactive contamination could not be excavated due to restrictions on "right of way" permeters required by National Grid. National Grid is aware of this issue and will be required by EPA to comply with institutional controls, including a Soil Management Plan, should the need occur to excavate utility poles in the future." There was no mention in the PCOR of USACE or DOE implementing any additional institutional controls separate from the ICs being prepared by the Performing Defendants and Mass DEP.

Please review these 3 questions that I would like to coordinate with Ms. Melissa Taylor. If you don't have any revisions or changes, would you please forward them and ask Ms. Taylor if we could discuss them with her at her convenience?

Thank you,

Rick Waples, P.E.
Regulatory Specialist
USACE EM CX