United States Environmental Protection Agency
Region 1

Decision Document

Central Impact Area
Soil and Groundwater Operable Units

Camp Edwards
Massachusetts Military Reservation
Cape Cod, Massachusetts

March 2012

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PART I: DECLARATION FOR THE SAFE DRINKING WATER ACT DECISION DOCUMENT

A. SITE NAME

The subject site is the Central Impact Area (also referred to as "the Site"), which is located at Camp Edwards at the Massachusetts Military Reservation (MMR).

B. STATEMENT OF BASIS AND PURPOSE

This Decision Document presents the selected response actions for the Central Impact Area. The selected response action was chosen in accordance with Section 1431(a) of the Safe Drinking Water Act (SDWA), 42 USC § 300i(a), as amended, and the Administrative Order (AO) concerning response actions issued there under, U.S. Environmental Protection Agency Region 1 (EPA) Administrative Order No. SDWA-1-2000-0014 (AO3). The authority to select the necessary response action(s) has been delegated to EPA Region 1's Regional Administrator pursuant to EPA Delegation No. 9-17 (1200-TN-350) dated May 11, 1994 and further delegated to EPA Region 1's Director, Office of Site Remediation and Restoration, pursuant to a redelegation of authorities dated April 6, 2010.

This decision is based on the Administrative Record, which has been developed in accordance with AO3 and with a previous EPA Administrative Order, SDWA 1-97-1019 (AO1), including consideration of the substantive cleanup standards of the Massachusetts Contingency Plan (MCP) 310 CMR 40.0000. The Administrative Record is available for review at the Impact Area Groundwater Study Program (IAGWSP) office, PB0516 West Outer Road, Camp Edwards, MA.

C. ASSESSMENT OF THE SITE

On July 13, 1982, EPA determined that the Cape Cod Aquifer is the sole or principal source of drinking water for Cape Cod, Massachusetts, and that the Cape Cod Aquifer, if contaminated, would create a significant hazard to public health (47 Fed. Reg. 30282). Contaminants from the Training Ranges and Impact Area at MMR are present in and may enter and migrate in the aquifer. The response actions selected in this Decision Document are necessary to protect the Cape Cod Aquifer, an underground source of drinking water on which the public relies.

D. DESCRIPTION OF COMPREHENSIVE RESPONSE ACTIONS

This Decision Document sets forth the selected response actions taken and to be taken for addressing the source areas contributing to groundwater contamination, and the groundwater contamination at and emanating from the Site. The source areas include both soil contamination and unexploded ordnance (UXO), also referred to in this Declaration and Decision Document as unexploded ordnance/discarded military munitions/munitions constituents, or UXO/DMM/MC, or UXO that may be in or on the soil. There may be additional areas on the site where UXO and the soil beneath may pose public safety risks, ecological risks, dermal contact risks, and/or soil ingestion risks. These potential UXO-related risks are not addressed by this Decision Document, which was issued pursuant to Administrative Order No. SDWA-1 -2000-0014 and Section 1431(a) of the SDWA, and which focuses on potential endangerment to the health of persons deriving from contaminants present in or likely to enter the underground source of drinking water.

While the response actions taken to date have addressed known areas of soil contamination and varying degrees of UXO removal have occurred over 56 acres of the CIA source area, there is an estimated 4,000 to 9,000 UXO items remaining within Central Impact Area. These remaining munitions items pose a potential long term threat to the groundwater and require a Long Term Source Area Response Plan to address this threat. This Long Term Source Area Response Plan will be developed by the EPA, the Army, the NGB and MassDEP and will be implemented by the Army/NGB in a phased approach.

Based on groundwater sampling results, EPA, in consultation with the Massachusetts Department of Environmental Protection (MassDEP), deemed it necessary to develop and evaluate a range of potential response actions to address contaminants detected in groundwater associated with the Central Impact Area. The feasibility study identified the explosive hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) and perchlorate as the Contaminants of Concern (COCs) for groundwater.

These COCs were used to develop and evaluate a range of potential response actions for the Site. Groundwater modeling was used to determine the feasibility of the alternatives and because the perchlorate and RDX plumes are co-located, the selected response action was based on the remediation of the RDX plume. The cleanup objectives for the Central Impact Area are to restore the useable groundwater to its beneficial use, wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site; to provide a level of protection in the aquifer that takes into account that the Cape Cod Aquifer, including the Sagamore Lens, is a sole source aquifer that is susceptible to contamination; and to prevent the ingestion and inhalation of groundwater containing the COCs, in excess of federal Maximum Contaminant Levels (MCLs), Health Advisories (HA), Drinking Water Equivalent Levels (DWELs), applicable State standards or unacceptable excess lifetime cancer risk or non-cancer Hazard Index (HI).

There currently is no federal drinking water standard for perchlorate. However, in December 2008, EPA issued an Interim Drinking Water Health Advisory for exposure to perchlorate in water of 15 µg/L. Also, the Massachusetts Department of Environmental Protection (MassDEP) has promulgated a Massachusetts Maximum Contaminant Level (MMCL) for perchlorate of 2 µg/L.

The lifetime federal Health Advisory for RDX in drinking water is 2 µg/L, the Massachusetts Contingency Plan (MCP) GW-1 standard is 1 µg/L, and the 10^{-6} risk-based concentration that results in an increased lifetime cancer risk of one in a million is currently 0.6 µg/L.

The EPA, in consultation with MassDEP, has selected a response action in the Central Impact Area groundwater plumes under which the aquifer, that has been designated a Sole Source Aquifer by the EPA and a Potentially Productive Aquifer by the MassDEP, will be restored. The groundwater response actions will ensure that the groundwater containing RDX at concentrations greater than the 10^{-6} risk-based level and/or perchlorate greater than 2 µg/L is restored to protective levels.

The selected response action of Focused Extraction with Monitored Natural Attenuation, with source controls and Land Use Controls (LUCs) provides the best balance of the criteria used to evaluate cleanup alternatives.

The selected alternative (Focused Extraction with Monitored Natural Attenuation, and Land Use Controls for groundwater and a phased approach for UXO removal) achieves cleanup goals in a reasonable timeframe and protects human health through the use of extraction and groundwater monitoring to ensure that groundwater modeling predictions regarding the reduction and migration of contamination are correct and that contamination levels continue to decline. Human health will be further protected through the implementation and verification of LUCs. These LUCs will prevent use of contaminated portions of the aquifer at the Site for drinking water purposes until groundwater data confirms that contamination has been reduced to below risk-based levels.

The major components of the source and groundwater response actions are:

- The development and implementation of a Long Term Source Area Response Plan to address the estimated 4000 to 9000 munitions items and related soil contamination located throughout the CIA. The plan will be developed by the EPA, the Army, the NGB and MassDEP and will be implemented by the Army/NGB in a phased approach. The first phase will consist of UXO clearance of an additional 30 acres of the CIA over a 3 year period followed by a second phase consisting of UXO clearance of an additional 20 acres of the CIA. The development and implementation of additional phases, if necessary, will be based on the results of these first two phases. A Work Plan for the first phase shall be developed by the Army/NGB within sixty (60) days of the issuance of this Decision Document and submitted to the EPA and MassDEP for review. The work plan shall be approved by EPA, in consultation with MassDEP. A Work Plan for the second phase shall be developed by the Army/NGB within sixty (60) days of the completion of the first phase. The work plan for the second phase will take into account information gathered from the first phase and will be submitted to the EPA and MassDEP for review. The work plan shall be approved by EPA, in consultation with MassDEP. The plans for the first two phases will employ techniques to minimize habitat destruction while maximizing the reduction of UXO with a goal to remove

75% to 95% of the UXO within the fifty acres covered by the first two phases.

- A 550 gallon-per-minute (gpm) pump and treat system consisting of three extraction wells to contain groundwater with concentrations of RDX greater than 2 ppb at Burgoyne Road which will use the Demolition Area 1 treatment system and injection wells
- Development and implementation of a long-term monitoring program to verify that the groundwater is being restored as predicted and to determine if additional source removal work is needed. Implementation of land use controls to prevent access to and use of the contaminated portions of the aquifer for drinking water, and maintain the integrity of any current or future groundwater monitoring wells and treatment systems,
- Five year reviews to determine if the groundwater treatment system is still protective and achieving the goals established, to determine if additional or more expedited source response actions are necessary to protect groundwater and to determine if improved technologies are available.

E. DETERMINATIONS

The response actions selected in this Decision Document will protect the public health from any endangerment which may be presented by the presence or potential migration of COCs from the Site into the underlying Sole Source Aquifer. The response action selected in this Decision Document, issued pursuant to AO3 and Section 1431 of the SDWA, addresses the unacceptable threats to the groundwater aquifer from the Site. In this Decision Document, EPA is making no determination regarding any remaining public safety risk, ecological risk, dermal contact risk, and/or soil ingestion risk posed by any remaining contamination at the Site.

As required by AO3, the selected alternative for the Site (Focused Extraction with Monitored Natural Attenuation, and Land Use Controls for groundwater and a phased approach for UXO removal) provides a level of protection to the aquifer underlying and downgradient of the Site commensurate with the aquifer's designation as a Sole Source Aquifer and a Potentially Productive Aquifer and is protective of human health.

In addition to annual reports on groundwater monitoring and verification of land use controls, the selected response actions include periodic reviews at frequencies not to exceed five years. The

scope of each review will include, but not be limited to, sampling data, modeling data, and other relevant data. EPA, in consultation with MassDEP, will review this and any other relevant information to determine if additional measures are necessary for the protection of human health. This will include information acquired after the implementation of the selected response actions (such as new regulatory requirements or changes in the environmental conditions of the Site).

F. SUPPORTING DATA

Detailed information on the Site is included in the *Final Central Impact Area Feasibility Study* dated July 20, 2011 and the *Final Central Impact Area Source Report* dated July 20, 2011. An overview of the Site, including decision factor(s) that led to selecting the groundwater and source response actions, is included in the Decision Summary section of this document. The Decision Summary section also includes information on RDX, the respective concentrations, the baseline risk, the cleanup levels established and the basis for the levels, current and future land and groundwater use assumptions used in the baseline risk screening and Decision Document, land and groundwater use that will be available at the Site as a result of the selected response action, and decision factor(s) that led to selecting the remedy. Additional information can be found in the Administrative Record for the Site.

G. AUTHORIZING SIGNATURE

This Decision Document documents the selected response actions for remediation of the Central Impact Area within Camp Edwards at the MMR. These response actions were selected by EPA under the authority of the SDWA. The MassDEP concurs with this decision.

U.S. Environmental Protection Agency

By: _____ Date: 3/9/12

James T. Owens, III
Director, Office of Site Remediation and Restoration
Region 1

PART II: THE DECISION SUMMARY

A. SITE DESCRIPTION

The Impact Area is located on Camp Edwards on the Massachusetts Military Reservation on Cape Cod in Massachusetts (Figure 1). The Central Impact Area is a 330-acre portion of the Impact Area where targets were concentrated. The delineation of the 330 acres was based on historical and current site use, a review of historical aerial photographs, airborne magnetometer (AIRMAG) results, firing fans and unexploded ordnance discoveries, groundwater plumes and particle backtracks, and explosives detections in soil.

The site is generally comprised of scrub oak barrens (Quercus ilicifolia), reforestation of previous cleared areas, and the remnants of burned areas. The remainder of the Impact Area that surrounds the site includes vegetated pitch pine (Pinus rigida) and scrub oak forest. The ground surface is relatively flat and generally slopes from the northwest to the south and east.

B. SITE HISTORY AND ENFORCEMENT ACTIVITIES

1. History of Site Activities

The Central Impact Area has been used as an impact area for artillery and mortar firing from the late 1930s until 1997 (Ogden 1997). During the late 1940s, the Central Impact Area also contained Navy air-to-ground rocket ranges that utilized inert 2.25-inch rockets. Various types of munitions including 37 millimeter (mm), 40mm, 75mm, 90mm, 105mm, and 155mm artillery projectiles and 50mm, 60mm, 70mm, 81mm, 3-inch, and 4.2-inch mortars have been fired into the Central Impact Area (USACE 2001). These munitions include high explosives (HE) charges designed to explode upon impact, and practice rounds, which do not contain an HE charge but may contain a spotting charge designed to emit smoke upon impact.

The predominant HE charge used in pre-World War II munitions contained 2,4,6-trinitrotoluene (TNT). Post World War II artillery and mortar munitions used Composition B for the HE charge, which is a mixture of hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) and TNT. The low-intensity training round (LITR) is an artillery practice projectile that was introduced in 1982 to reduce the

noise associated with HE explosions. The LITR includes a spotting charge containing perchlorate. The use of HE artillery projectiles ceased in 1989, and the firing of all munitions into the Central Impact Area was discontinued in 1997.

HE munitions that did not explode or that partially functioned (low order) have accumulated within the Central Impact Area during its use. Unexploded ordnance located along roadways or at other locations that presented a safety hazard due to human access have historically been blown-in-place (BIP) using an explosive donor charge. BIP operations were also used to clear areas for site investigation starting in 1997.

Historical information indicates that in the past, several portions of the Central Impact Area have undergone a variety of uses and in some cases have been mechanically cleared of vegetation. Among the previously developed areas within the Central Impact Area are the following (Figure 2):

- Sub-Caliber Aircraft Rocket (SCAR) Sites – two approximately 10-acre sites used by Naval aircraft in the 1940s for target practice with inert 2.25-inch rockets.
- Eastern Test Site – a 4.5 acre area in the northern portion of the Central Impact Area believed to have been used for artillery and mortar targeting.
- Tank Alley – a cleared area which developed around 1965 and afterward used extensively as a target area.
- Chemical Spill 19 (CS-19) – an area in the west-central region of the Central Impact Area where ordnance testing and disposal activities occurred.

Investigations of the CS-19 area were conducted under the Installation Restoration Program (IRP) by the Air Force Center for Engineering and the Environment (AFCEE).

2. History of Investigations and Response Actions

Remedial investigations were conducted at the Central Impact Area to investigate the nature and extent of contamination in soil and groundwater resulting from past military activities (Figure 3). Data collected as part of these investigations were used to characterize the nature and extent of groundwater contamination emanating from the site, any continuing sources of

contamination including soil contamination and potential contamination from unexploded ordnance (UXO), and to provide a basis for the evaluation of risk(s) posed by the site.

A brief summary of the investigations and response actions performed is provided below. A more detailed discussion can be found in Sections 3.0 and 4.0 of the July 2011 Feasibility Study.

Source Investigations and Results

Approximately 3,800 soil samples were analyzed for explosives. Approximately 3,724 (98%) were analyzed by EPA Method 8330 while approximately 76 (2%) of the samples were collected and analyzed using EPA Method 8330B. In addition, approximately 671 samples were analyzed for perchlorate by EPA Method 314. Among the explosives compounds, discussion is focused particularly on RDX considering its dominant impact on groundwater. The number of samples analyzed for explosives was about seven times greater than the number analyzed for perchlorate, since the latter became a chemical of interest after RDX.

Perchlorate and the 18 explosives analytes measured by EPA Method 8330 were detected in one or more soil samples. Thirteen analytes had maximum concentrations exceeding a Soil Screening Level (SSL). Three of these compounds (2,4-dinitrotoluene, RDX, and HMX) were detected at concentrations exceeding MassDEP MCP S-1/GW-1 Soil Standards. As previously stated, approximately 3,800 soil samples were analyzed for explosives (not including semivolatile organic compound [SVOC] samples, which also have three explosives analytes reported) and about 671 were analyzed for perchlorate. The highest frequencies of detection were observed for perchlorate (19.2%), RDX (5.2%), 2A-DNT (4.6%), TNT (4.0%), 4A-DNT (3.9%), and HMX (2.5%).

The types and frequencies of contaminants observed are believed to reflect the munitions fired into the Central Impact Area and munitions release mechanisms, contaminant fate and transport, and soil characterization methods. Perchlorate is an ingredient in the spotting charge used in LITR projectiles fired from 1982 to 1997. RDX and TNT are the main ingredients in HE

charges used after World War II. 2A-DNT and 4A-DNT are breakdown products of TNT, and HMX is an impurity typically present in RDX.

Detections of total explosives, RDX and perchlorate appear to be scattered throughout the Central Impact Area areas sampled, and relatively high detected concentrations are frequently co-located with non-detects. The maximum RDX detection, and a series of smaller co-located detections, was observed at a low order mortar with exposed filler at High-Use Target Area 2 Transect 2. Apart from this detection, and detections at Targets 9 and 11, RDX detections were focused on the areas near Turpentine Road and Tank Alley. Therefore, RDX was determined to be most prevalent in soil in the area where groundwater impacts have occurred.

The results of investigations indicated that explosives contamination in Central Impact Area soils predominantly consists of perchlorate, RDX, TNT and the two amino-DNTs, and HMX. Most of the detections for explosives are located adjacent to non-detects, i.e., contaminant particles are scattered and heterogeneously distributed in soil. RDX levels are higher and more frequently detected in target areas than in other areas. In the immediate vicinity of a target, RDX and other explosive levels generally declined and were less frequently detected with increasing distances from the target. Explosives concentrations and detection frequencies in soil immediately beneath intact unexploded ordnance were generally similar to detections in surface soil. Explosives were generally detected less frequently and at decreasing concentrations with increasing depth.

The predominant HE charge used in pre-World War II munitions fired at MMR contained TNT. Post-World War II artillery and mortar munitions used Composition B for the HE charge, which is a mixture of RDX and TNT. It should be noted that HMX is a common impurity in RDX and therefore is implicit in the formulations of Composition B. The LITR [also used at the Central Impact Area] is an artillery practice projectile that contains perchlorate and was fired starting in 1982. As previously discussed, RDX is the most widespread contaminant in the Central Impact Area and the most persistent contaminant in the current groundwater contaminant plume.

The most common unexploded ordnance items encountered at the Central Impact Area have been 81mm mortars (27%), followed by 155mm projectiles (24%) and 105mm projectiles (15%) (AMEC 2008). Cumulatively, these three ordnance types account for more than 60 percent of all items discovered. The next three most common items observed have been 60mm mortars, 4.2-inch mortars, and 37mm projectiles, which cumulatively account for approximately 14 percent of all items discovered. The remaining 26 percent of unexploded ordnance items consisted of a range of munitions including: 2.25-inch, 2.36-inch, 2.75-inch rockets; 57mm recoilless rifle rounds; and 30mm, 75mm, and 90mm, 7-inch, and 8-inch projectiles. 60 percent of the HE UXO were reported to be within the top foot of soil and almost 90 percent within the top 3 feet. The deepest item reported was at a depth of 68 inches.

A total of 9.8 acres were intrusively surveyed within the Central Impact Area, including targets and other suspected High-Use areas where unexploded ordnance density was expected to be elevated, compared to perimeter transects and low-density test plots where unexploded ordnance density was expected to be low. Beyond the intrusively surveyed areas, unexploded ordnance items have been discovered during a range of investigation activities, including monitoring well pad construction, road/access path construction, and soil sampling. These 'incidental' discoveries account for more than half of the unexploded ordnance items encountered in the Central Impact Area.

As discussed in detail in the 2011 Central Impact Area Source Investigation Summary Report (Tetra Tech 2011), unexploded ordnance densities have been estimated for several areas including Post Screening Investigation (PSI) Test Plots. For the PSI Test Plots the estimated average density for the medium/high use test plots was 35 items per acre and for the low use plots 12 items per acre. Extrapolation of unexploded ordnance distribution from the 9.8 acres of intrusively surveyed area to the 330-acre Central Impact Area is difficult considering the heterogeneous distribution of unexploded ordnance. In intrusively surveyed areas, observed unexploded ordnance densities were found to be generally consistent with the working conceptual site model for the Central Impact Area, in which unexploded ordnance are expected to be clustered around targets.

Considerable uncertainty exists regarding the average UXO density for the entire Central Impact Area. High Use Target Area density is not representative of the Central Impact Area density since the targets represent such a small portion of the area (approximately 0.14%). The test plots better represent an average density since they are distributed throughout the Central Impact Area. The average density of all the test plots is 27 HE unexploded ordnance per acre. This would represent a total average number of 8910 HE unexploded ordnance within the entire 330-acre area. The recently completed excavation of the northern area (a higher density area) resulted in the removal of 12 HE UXO from the base of the excavation and it is estimated that an additional 24 HE UXO will be removed. The total estimated number of HE UXO (36) result in a UXO density of approximately 25 per acre. In addition, the excavation of the EM61 Modified Test Plot (CIA grid 48-55) (a medium density area near Tank Alley), resulted in the removal of 7 HE UXO for a density of 28/acre. Thus the total number of HE unexploded ordnance in the Central Impact Area is estimated to be 4,000-9,000. This is generally consistent with the UXO density estimated in the Draft UXO/Source Investigation Report for the Central Impact Area (AMEC 2008) of 7,467 UXO items. Approximately 820 of these have been removed during investigations and response actions.

Groundwater Investigations and Results

Some of the groundwater underlying and downgradient of the Central Impact Area is contaminated by RDX and perchlorate. RDX is the most widespread groundwater contaminant (Figure 4). The RDX plume, which is comprised of multiple parallel and overlapping plumelets, is oriented in a southeast to northwest direction consistent with the regional groundwater flow direction. Many of the plumelets appear to be detached from historic source areas, while others correlate to continuing shallow detections. The furthest downgradient extent of the main plume is located about two miles from its presumed origin. Most of the plume remains on the installation. There is a narrow RDX plume that originated in the Central Impact Area and now passes under the Northwest Corner and has migrated off the installation. There is currently no known exposure pathway to this plume. This narrow RDX plume is monitored as part of the Northwest Corner Decision Document (2010).

RDX within the groundwater plume has been reported up to a maximum concentration of 45 ppb in 2005. The 2010 maximum concentration was 21 ppb and most values now are below 10 ppb

The perchlorate plume is significantly less extensive than that of the RDX contamination. The highest concentration was 10 ppb, detected in 2010.

Because of the inconsistencies of soil detections, potential RDX source areas were identified through water table detections. These source areas determined from water table detections are consistent with other potential source area indicators such as target locations, UXO density, cratering on aerial photographs and particle backtracks from wells with explosives detections. More recent (post-2007) RDX water table data shows declining concentrations. These data suggest that the source area response actions conducted to date have had a positive effect on the groundwater. However, a significant number of UXO items still remain in the Central Impact Area and the long term impacts of these items to groundwater as they corrode are difficult to predict.

Response Actions

Several soil response actions have been undertaken in the Central Impact Area to reduce levels of contamination from certain areas (Figure 5). These include soil and UXO removals at the following areas:

- Armored Personnel Carrier (Target 25) – Approximately 330 tons of contaminated soil were removed and treated in September 2000. One leaking HE UXO was removed.

- Mortar Target 9 – Approximately 577 tons of contaminated soil were excavated in August 2001. Seven HE unexploded ordnance items also were discovered and there were elevated levels of explosives contamination at these locations. Excavated contaminated soil from Mortar Target 9 was treated on site using soil washing.

- Targets 23 and Target 42 – 885 and 1,100 tons of soil, respectively, were excavated and treated on site using low-temperature thermal desorption. 17 and 11 HE UXO, respectively, were removed during the intrusive investigation.

- In 2008 the Air Force Research Laboratory (AFRL) conducted a technology demonstration at the Central Impact Area. This was done to evaluate several methods to clear potential unexploded ordnance from the ranges using remotely controlled equipment. During this demonstration, 30 HE UXO were removed from approximately seven acres.

- In 2010 a second technology demonstration was conducted by AFRL. Contaminated Soil was excavated from a 3 acre area and approximately 12,300 tons of soil were removed. In addition, approximately 140 HE UXO were removed

In summary, soil removal actions have been conducted at several locations and approximately 21,000 tons of contaminated soil has been excavated and treated on-site, disposed of off-site, or is awaiting final disposition.

Major geophysical investigations were also conducted and include an AIRMAG survey, the Sub-Caliber Aircraft Rocket site, the Eastern Test site, the High Use Target Area Phases I and II, UXO Density Estimation Test Plots, and the Robotics Technology Demonstrations.

During the soil removal actions, munitions were nearly completely removed from approximately 5.5 acres. In addition, the majority of munitions were also removed from an area of approximately 4.3 acres during the above-listed geophysical investigations. Thus, near complete munitions removal has been accomplished over an approximately 10 acre area.

Further investigations were also conducted over an area approximately 14 acres in size, with plans for an additional 8 acres to be completed. These areas have been surface cleared and magnetic anomalies discovered to be munitions items have been removed. When completed, approximately 75% of predicted munitions will have been removed from approximately 22 acres.

Approximately 85% of predicted munitions have been cleared from 16 acres for drill pad sites, roads, buffers around removal actions, and support areas for vehicle traffic.

Surface clearance has been performed on approximately eight acres along Tank Alley and Turpentine Road. This surface clearance resulted in approximately 25% of predicted munitions removal from these acres.

In summary, some degree of UXO removal has been completed within approximately 56 acres. As of 2007, approximately 520 known or suspected UXO items containing high explosives had been removed. Approximately 300 additional items have been recovered during more recent investigations, including the robotics work, for a total of approximately 820 HE UXO. However, it is estimated that there are approximately 4,000 to 9,000 HE UXO items still remaining in the Central Impact Area.

3. History of Relevant Federal and State Enforcement Activities

In February 1997, EPA Region 1 issued SDWA Administrative Order 1-97-1019 (AO1) requiring the investigation of the impact of contamination at or emanating from the training ranges and impact area upon the Sole Source Aquifer.

In May 1997, EPA issued Administrative Order 1-97-1030 (AO2), which prohibited all live firing of mortars and artillery, firing of lead from small arms, planned detonation of ordnance or explosives at or near the Training Ranges and Impact Area except for UXO activities, and certain other training-related activities.

In January 2000, EPA issued SDWA Administrative Order 1-2000-0014 (AO3), which required implementation of Rapid Response Actions (RRAs) and Remedial Actions (RAs) to address contamination from past and present activities and sources at and emanating from the training ranges and impact area. The RRAs specifically required by AO3 addressed elevated concentrations of contaminants in soil and have been completed. The comprehensive response action component of AO3 requires that a feasibility study, remedial design and response action be completed for several areas of concern.

C. COMMUNITY PARTICIPATION

Throughout the Site's history, the IAGWSP, EPA and MassDEP have kept the community and other interested parties apprised of response activities at the Central Impact Area through informational meetings, fact sheets, press releases and public meetings. Below is a brief chronology of public outreach efforts.

The Impact Area Review Team (IART) was a citizen advisory committee established in 1997 by the EPA under AO1. The IART served as a technical advisory resource, allowing the EPA, the Army, the NGB, and MassDEP to be responsive to public concerns related to the ongoing investigation and cleanup effort at Camp Edwards. In 2007, this team was merged with the Plume Containment Team, the citizens' advisory team for the Air Force Center for Engineering & Environment's MMR Installation Restoration Program, and renamed the MMR Cleanup Team. The combined team meets regularly throughout the year to hear updates and provide public input on the MMR investigations and cleanup.

The IAGWSP also briefs the Senior Management Board (SMB), which advises MMR organizations on environmental programs and policies. Members of the SMB include selectmen or their designated representative from the towns of Bourne, Falmouth, Mashpee, and Sandwich and representatives from the EPA, MassDEP, Massachusetts Department of Public Health, Massachusetts National Guard, U.S. Coast Guard, and a representative from the Mashpee Wampanoag Tribe.

All IART, MMR Cleanup Team, and Senior Management Board meetings related to the investigation and response activities were advertised in the *Cape Cod Times* and the local edition of *The Enterprise* newspapers.

In October 2001, the IAGWSP, EPA and MassDEP released a Public Involvement Plan outlining activities to address community concerns and to keep citizens informed about and involved in response activities.

From the time the initial investigations at the Site began, through the present, the IAGWSP regularly presented updates on the investigation and response activities at the Site. With

respect to this Decision Document, the most important updates were:

- On May 11, 2011, an informational meeting was held at Otis ANGB, MA, to present the findings of the source investigation and remediation work to the MMR Cleanup Team and the public. A display ad regarding the meeting was placed in the May 6, 2011 editions of the *Cape Cod Times* and *The Enterprise* newspapers and a news release regarding the meeting was sent to the local media.

- On July 13, 2011, an informational meeting was held on Camp Edwards to describe the Groundwater Alternatives in the Feasibility Study and announce the availability of the Remedy Selection Plan for the Central Impact Area. At the meeting, the IAGWSP presented the alternatives and the proposed additional UXO removal efforts. EPA presented the proposed response and answered questions from the MMR Cleanup Team and Senior Management Board. The IAGWSP notified the public of the meeting and announced the public comment period in a display ad placed in the July 8, 2011 editions of the *Cape Cod Times* and *The Enterprise* newspapers and a news release regarding the meeting was sent to the local media.

- From July 25, 2011 through August 25, 2011, a Public Comment Period was held on the Remedy Selection Plan for the Central Impact Area. The IAGWSP placed copies of the Remedy Selection Plan in the IAGWSP's information repositories at the Bourne, Falmouth, and Sandwich, MA, public libraries. The repository contains documents on the Central Impact Area investigations and findings supporting selection of the response action including the FS and Source Investigation reports, along with other relevant documents. The Remedy Selection Plan was also made available on the IAGWSP Web site. The web site contains the supporting documents and which offered a means of submitting public comments on the Remedy Selection Plan. In addition, the IAGWSP provided copies of the Remedy Selection Plan to MMR Cleanup Team members and distributed it to individuals in attendance at the public meeting and public hearing.

- On July 27, 2011, a Public Information Session and Public Hearing were held on the Remedy Selection Plan for the Central Impact Area on Camp Edwards, MA. The public information session, along with a presentation on the Remedy Selection Plan and EPA's proposed response, was held prior to the opening of the public hearing. Local residents and officials, news media representatives, and members of the public interested in site activities and cleanup decisions were invited to attend both meetings. Representatives from EPA, MassDEP and IAGWSP were available to answer questions. The IAGWSP notified the public of the July 27, 2011 information session and public hearing, and reminded them about the public comment period in a display ad placed in the July 22, 2011 editions of the *Cape Cod Times* and *The Enterprise* newspapers. Comments received during the Public Comment Period for the Remedy Selection Plan were compiled and answered in the Responsiveness Summary included in Part III of this document.

All draft and final reports related to the investigation and response activities were made available through the Information Repository at the public libraries in Bourne, Falmouth, and Sandwich, MA. These documents also were made available to the public through the IAGWSP Web site: mmr-iagwsp.org and the Administrative Record at 1803 West Outer Road, Camp Edwards, MA.

Media releases related to presentations and Public Comment Period for the Central Impact Area were distributed to the Cape *Cod Times* and other area media including newspapers, radio and television media.

General fact sheets pertaining to the IAGWSP investigations and findings and on related issues, such as the COCs, were also published and distributed.

The IAGWSP, EPA, and MassDEP also participated in general information sessions, that included open houses, information sessions, community meetings and annual updates to the local Town Managers, Boards of Selectmen, and Boards of Health on MMR investigation and response activities.

D. SCOPE AND ROLE OF OPERABLE UNITS

The Site consists of source areas contributing to groundwater contamination (i.e., contaminated soil and the areas known or suspected to contain UXO, DMM or MC) and groundwater operable units. The current source areas contributing to groundwater contamination were addressed through the removal of geophysical anomalies and the excavation and removal of contaminated soils. It is estimated that there are approximately 4,000 to 9,000 munitions items containing high explosives remaining in the Central Impact Area. These remaining munitions pose a potential long term threat to the groundwater. In addition, these remaining munitions, and the soil beneath, may also pose public safety risks, ecological risks, dermal contact risks, and/or soil ingestion risks. However, these potential UXO/MEC-related risks are not addressed by this Decision Document, which was issued pursuant to Administrative Order No. SDWA-1-2000-0014 and Section 1431(a) of the SDWA, and which focuses on potential endangerment to the health of persons deriving from contaminants present in or likely to enter the underground source of drinking water.

E. SITE CHARACTERISTICS

Site Geology

The Central Impact Area is situated within the Mashpee Pitted Plain, a thick wedge-shaped deposit of unconsolidated Late Pleistocene outwash sands and gravels. The Mashpee Pitted Plain is bounded to the west and north by the Buzzards Bay and Sandwich moraines, respectively. The Mashpee Pitted Plain is an outwash plain formed by streams that drained the Buzzards Bay and Cape Cod Bay lobes of retreating glaciers. Depositional environments of the Mashpee Pitted Plain range from glaciofluvial for the coarser deposits to glaciolacustrine for the finer deposits. In the Mashpee Pitted Plain, the glaciolacustrine deposits are discontinuous and commonly overlie basal till or bedrock. Coarse textured basal till, consisting of poorly sorted sands and gravels, occurs sporadically across the top of the bedrock surface. Coarser grained sands and gravels, deposited in glaciofluvial environments, usually overlie the glaciolacustrine deposits and are more continuous across the plain. Overlying these glaciofluvial deposits is a thin veneer of eolian silt. A general description of the geology of Cape Cod and the geology of

the Central Impact Area is provided in the Draft UXO/Source Investigation Report for the Central Impact Area (AMEC 2008).

Soils encountered during installation of the numerous borings and monitoring wells within the Central Impact Area are consistent with the descriptions of the Mashpee Pitted Plain stratigraphy, and depths to the bedrock surface. The top 260 feet consists predominantly of poorly graded medium to coarse sands with intervals of fine gravelly sediments and is classified using the Unified Soil Classification System as SP. Between 260 and 330 feet, soils are principally classified as finer sands and silts. These deposits are representative of a sandy basal till. Crystalline bedrock was encountered at a depth of approximately 320 to 380 feet below grade.

Site Hydrogeology

Surface water is not significantly retained due to the excessively drained sandy soils of Camp Edwards. No large lakes, rivers, or streams exist on the property; only small, marshy wetlands and ponds exist. Most of the wetlands and surface waters in the Sandwich and Buzzards Bay Moraines on Camp Edwards are considered to be perched (MAARNG 2001).

The aquifer system is unconfined (i.e., it is in equilibrium with atmospheric pressure and is recharged by infiltration from precipitation). The sole source of natural fresh water recharge to this groundwater system is rainfall and snow meltwater that averages approximately 48 inches per year. Except on extreme slopes, surface water runoff at Camp Edwards is virtually nonexistent due to the highly permeable nature of the sand and gravel underlying the area.

The top of the groundwater mound within the western Cape Cod groundwater system is located beneath the ranges on the southeast side of MMR. Groundwater flows radially outward: north to either the Cape Cod Canal or the Cape Cod Bay, east to the Bass River, south and southeast to Nantucket Sound, and west and southwest to Buzzards Bay (ANG 2001). The height of the water table in and around the MMR can fluctuate up to 7 feet annually due to seasonal

variations in groundwater recharge and pumping demand (USGS 1996). Groundwater levels are highest in the spring when recharge rates are high and pumping demand is low; levels are lowest in the late summer/early autumn when rainfall is minimal and pumping demand is at its maximum. The total thickness of the aquifer varies from approximately 80 feet in the south to approximately 350 feet in the north. The variation in thickness is due to the episodes of glacial advance and retreat, the underlying bedrock geology, and the presence of fine-grained materials in the deeper sediments beneath the southern portion of the aquifer (ANG 2001).The groundwater flow direction from the Central Impact Area is predominantly to the northwest (and the hydraulic gradient steepens with increasing distance from the top of the regional potentiometric groundwater mound. Within the Central Impact Area, groundwater elevations typically range between 65 and 70 feet National Geodetic Vertical Datum, and depth to groundwater ranges from approximately 100 to 140 feet below ground surface (bgs). Based on the observed response of the water table relative to recharge events, the hydraulic travel time through the vadose zone is expected to be three to six months. The thickness of the saturated zone varies between 180 and 280 feet.

A hydraulic conductivity value of 155 feet per day for the saturated zone was calculated from the results of an aquifer test performed within the Central Impact Area on well P-1 (AMEC 2003a). This value is consistent with the estimated range of 125 to 350 feet per day based on grain size (Masterson et al. 1996) and is approximately double those calculated in the moraine material. The hydraulic conductivity of the 5- to 20-foot thick basal till on top of bedrock is estimated at one foot per day (Masterson et al. 1996). Bedrock occurs at a depth of approximately 320 to 380 feet bgs beneath the Central Impact Area and can be considered impermeable. Therefore, the bulk of regional groundwater flow is transmitted through the upper outwash units. The effective porosity of the saturated zone, which was determined from several past MMR studies (AMEC 2003b; AFCEE 2003; LeBlanc et al. 1991; Barber et al. 1988; Morrison and Johnson 1967), is assumed to be 0.39.

Groundwater flow calculations for different Central Impact Area well pairs using measured gradients and assuming relatively constant hydraulic conductivity and effective porosity values

yield mean and median velocities of 0.32 and 0.29 feet per day, respectively and compare well to the aquifer test derived groundwater flow velocity of 0.48 feet per day (AMEC 2003a).

Movement of Contaminants in Groundwater

RDX leaches from soil to the groundwater. Movement of RDX is slightly retarded in the soil and the aquifer due to limited sorption to soil particles. Therefore, RDX will generally move at a velocity slightly less than that of normal advective flow. Longitudinal dispersion is a significant transport process for RDX and a factor in natural attenuation.

Estimate of the Contaminant Volume and Mass

The estimated volume of RDX-contaminated water emanating from the CIA is 2.57 billion gallons. The estimated mass of RDX within this volume is 22.5 kg (49.6 lbs). The estimated volume of perchlorate-contaminated water emanating from the CIA is 153 million gallons. The estimated mass of perchlorate within this volume is 2.9 Kg (6.4 lbs).

Current Exposure Pathways

There are currently two known private residential water supply wells located downgradient of the Central Impact Area on Route 6 (see Figure 6). The closest of these is located approximately three miles from the Central Impact Area boundary. In addition, an evaluation will be conducted as part of the Land Use Control Program to identify any additional private residential wells downgradient of the Central Impact Area. There are no private or public water supply wells located within the Central Impact Area study area. There are no known municipal water supply wells located between the Central Impact Area and the Cape Cod Canal, the discharge point for Central Impact Area plume.

Potential Exposure Pathways

The development of new water supply wells and consumption of groundwater resources in areas contaminated or predicted to be contaminated by the Central Impact Area plumes are potential future exposure pathways. As noted above, the Cape Cod Aquifer is the sole or principal source of drinking water for Cape Cod. Portions of Camp Edwards, including the on-base portions of the Site, have been set aside as a drinking water supply reserve by the Massachusetts legislature.

F. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

The Central Impact Area is located on the MMR and is designated as an active military training area. It is anticipated that these areas will remain under the control and direction of government agencies and will continue to be used for military training and support purposes until 2051 (and perhaps longer). The Central Impact Area also is located within the Upper Cape Water Supply Reserve established pursuant to Chapter 47 of the Massachusetts Acts of 2002 and designated as conservation land under the care and control of the Massachusetts Division of Fisheries and Wildlife. Areas that lie between the installation boundary and the Cape Cod Canal are used for residential, commercial and industrial purposes The Central Impact Area overlays portions of a sole source aquifer that is a valued water supply for the upper portion of Cape Cod. The Land Use Controls (described in Section K) will prevent the installation of new water supply wells, or use of existing water supply wells (if any), that could provide a pathway for ingestion of drinking water that contains COCs in concentrations that exceed applicable drinking water standards, health advisories, and/or risk-based levels and maintain the integrity of any current or future groundwater monitoring wells and treatment systems.

G. SUMMARY OF SITE RISKS

A risk screening evaluation was conducted for the Central Impact Area. The objective of the risk screening was to identify any chemical constituents in the groundwater or soil that warranted further evaluation.

Groundwater and soil samples collected at the Central Impact Area from 1997 through 2010 were analyzed for a comprehensive suite of analytes. Over the course of investigating the Central Impact Area, a greater understanding of potential contaminant release mechanisms was achieved through the evaluation of the sampling results and a review of available historic records. These studies indicate that contaminants at the Central Impact Area are primarily constituents of artillery and mortar shells, which include explosives and projectile-related metals. For each analyte detected within either groundwater or soil associated with the Central Impact Area, the risk screening considered the maximum detected concentration, the location of the maximum detected concentration, the frequency of detection, and the results of a comparison of the maximum detected concentration to applicable screening criteria.

Groundwater monitoring data were available for explosives, perchlorate, metals and inorganics, pesticides and herbicides, SVOCs, VOCs, and PCBs. Of the 65 analytes detected in groundwater, 20 exceeded at least one screening criteria, and seven were detected at a maximum concentration that exceeded their respective MCL and/or MCP GW-1 Standard. These seven analytes are RDX, perchlorate, antimony, lead, thallium, pentachlorophenol, and bis(2-ethylhexyl)phthalate. Of these seven analytes, only RDX and perchlorate were selected for further evaluation. The other five analytes were inconsistently and sporadically detected at various wells and/or the exceedances were not repeated in subsequent groundwater monitoring events.

Soil data were available for explosives, perchlorate, metals and inorganics, pesticides and herbicides, SVOCs, VOCs, PCBs, PCNs, dioxins and furans. Of the 169 detected soil analytes presented in Table 6-3, 97 exceeded at least one screening criterion. Of these, seven were detected in groundwater at concentrations that exceeded an MCL or MCP Method 1 GW-1 Standard. These seven were RDX, perchlorate, antimony, lead, thallium, pentachlorophenol, and bis(2-ethylhexyl)phthalate. Antimony, lead, and thallium were only sporadically detected in groundwater and these detections were not repeated in subsequent monitoring events. Thus the soil and groundwater detections do not appear to be related. Based on the available data and the low environmental mobility of these metals they are unlikely to pose a threat to groundwater.

Pentachlorophenol was only detected in two soil samples and five groundwater samples. The groundwater exceedances were not repeated in subsequent monitoring events. In the case of bis(2-ethylhexyl)phthalate, the maximum soil detection only exceeded the EPA Risk-Based SSL but was below the MMR SSL and MCP Method 1 GW-1 Standard. For groundwater, each exceedance was observed in a different well and was only observed on one occasion. All subsequent sample results for each of these wells were below all screening criteria. Based on their low environmental mobility and the lack of significant groundwater detections, neither bis(2-ethylhexyl)phthalate or pentachlorophenol are considered to be a threat to groundwater and neither of these SVOCs was selected for further evaluation. While RDX and perchlorate have been detected in groundwater, most of these detections and the highest concentrations were detected below the surface of the water table, suggesting that peak mass loading had occurred sometime in the past and the current known source is now reduced. RDX has been detected at low levels in water table wells along Turpentine Road and Tank Alley suggesting that there was a possible continuing source in this area. A removal action is being conducted to eliminate or reduce this potential current known source of RDX contamination.

H. RESPONSE ACTION OBJECTIVES

Based on preliminary information relating to types of contaminants, environmental media of concern, and potential exposure pathways, response action objectives were developed to aid in the development and screening of alternatives. The response action objectives for the selected Central Impact Area alternative are: to restore the useable groundwater to its beneficial use, wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site; to provide a level of protection in the aquifer that takes into account that the Cape Cod Aquifer, including the Sagamore Lens, is a sole source aquifer that is susceptible to contamination; and to prevent ingestion and inhalation of groundwater containing the COCs RDX and perchlorate in excess of federal maximum contaminant levels, Health Advisories, drinking water equivalent levels (DWELs), applicable State standards and/or an unacceptable excess lifetime cancer risk or non-cancer Hazard Index.

I. DEVELOPMENT AND SCREENING OF ALTERNATIVES

Pursuant to the AO3 SOW, the following range of remedial alternatives was developed that consider the following objectives: provide an appropriate level of protection to the aquifer underlying the training ranges and impact area, evaluate and address the short-term and long-term potential for human exposure; and consider the potential threat to human health if the remedial alternative proposed were to fail:

- A no-action alternative to serve as a baseline for alternative comparisons.
- An alternative that, throughout the entire groundwater plume, reduces the contaminant concentrations to background conditions.
- An alternative that, throughout the entire groundwater plume, reduces the contaminant concentrations to levels that meet or exceed the MCLs, health advisories, DWELS, other relevant standards, and a cumulative 10^{-6} excess cancer risk. It shall achieve the objective as rapidly as possible and must be completed in less than 10 years and shall require no long-term maintenance.
- A limited number of remedial alternatives that attain site-specific remediation levels within different restoration time periods utilizing one or more different technologies if they offer the potential for comparable or superior performance or implementability; fewer or lesser adverse impacts than other available approaches; or lower costs for similar levels of performance than demonstrated treatment technologies.

A range of alternatives from no action to focused extraction were developed in consideration of the response action objectives described in Part II.H above. Other alternatives utilizing one or more different technologies were not included because, for the circumstances of this Site, they would not provide superior performance or implementability, fewer or less adverse impacts, or lower costs for similar levels of performance, than the alternatives evaluated.

Seven alternatives were developed to address the response action objectives and to meet the requirements set forth in the AO3. Each of the alternatives reduces the contaminant concentrations to background conditions. In addition, the alternative with the greatest number of extraction wells (Alternative 6) also reduces the contaminant concentrations to levels that meet

or exceed all regulatory and risk-based standards in 10 years or less. All of the alternatives, except Alternative 1 – No Further Action, include a Long Term Source Area Response Plan to address the UXO that remain in the CIA. Due to a number of uncertainties, the details and costs of this source remedy are difficult to determine but an approximate cost to address UXO is $600,000/acre. This component is intended to optimize the groundwater treatment alternatives while achieving source reduction for long term protectiveness.

- Alternative 1 – No Action
- Alternative 2 – Monitored Natural Attenuation (MNA) and Land Use Controls (LUCs)
- Alternative 3 – Focused Extraction with one well (with MNA and LUCs)
- Alternative 4 – Focused Extraction with two wells (with MNA and LUCs)
- Alternative 4 (Modified) – Focused Extraction with three wells (with MNA and LUCs)
- Alternative 5 – Focused Extraction with three wells (with MNA and LUCs)
- Alternative 6 – Focused Extraction with thirty-one wells (with MNA and LUCs)

All alternatives, except Alternative 1, include both long-term groundwater monitoring (to confirm model predictions and achievement of cleanup goals) and monitoring of LUCs (to ensure their effective implementation until the aquifer achieves risk-based levels and is restored to allow for unrestricted use and exposure). Groundwater monitoring will be performed in accordance with an approved, long-term monitoring plan with periodic and annual summaries of available groundwater monitoring data. Monitoring of LUCs will be conducted annually by the Army and results will be included in a separate report or a section of another report, if appropriate, and submitted annually to the regulatory agencies. The annual monitoring report will evaluate the status of the LUCs and how any LUC deficiencies or inconsistent uses have been addressed. These reports will be used in preparation of the five-year review to evaluate the effectiveness of the remedy in protecting human health and the sole source aquifer.

A detailed analysis was performed on the alternatives using nine evaluation criteria in order to select the appropriate remedy for each site. These criteria are divided into threshold, balancing, and modifying criteria and are given different weights accordingly. Although this decision is being made under the SDWA, these criteria provide a useful framework for evaluating response alternatives. The threshold criteria include the protection of human health and the environment and compliance with regulations. These criteria must be met by the remedy. The balancing criteria include the long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, short-term effectiveness, implementability, and cost. Modifying criteria include state and community acceptance of the selected remedy. These criteria were modeled on those used under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the National Contingency Plan (NCP).

In this decision under Section 1431(a) of the SDWA, the agency is using these criteria, not strictly in accordance with CERCLA and the NCP, but as a way to evaluate and balance a number of relevant factors. The remedy selected through this process is determined to be necessary to protect the health of persons from contaminants present in or likely to enter an underground source of drinking water and that it is otherwise in accordance with existing law or laws. It also reflects the EPA's determination of the appropriate balance of other environmental concerns as reflected by the other criteria. The following are the nine evaluation criteria:

- Overall protection of human health and the environment; this shall include prevention of the movement of contaminants into the aquifer and its preservation as a public drinking water supply.
- Compliance with state and federal regulations
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability

- Cost
- State acceptance
- Community acceptance

J. DESCRIPTION OF ALTERNATIVES, SUMMARY OF COMPARATIVE ANALYSIS AND THE SELECTED RESPONSE ACTION

Description of Alternatives

Alternative 1 - No Action: Alternative 1 provides for no further action to address groundwater contamination associated with the Central Impact Area plume. Under this alternative:

- No active groundwater treatment would occur.
- Model predictions could not be confirmed due to discontinued groundwater sampling/analysis and abandonment of existing monitoring wells.
- Land-use controls would not be implemented and so would not ensure against exposure until cleanup is achieved.
- Site close-out documentation would be completed.
- RDX concentrations are expected to decrease below the 10^{-5} risk based level of 6 ppb by 2030, the HA of 2 ppb by 2053, the 10^{-6} risk-based level after 2090.
- The total cost of Alternative 1 is estimated to be $325,000.

Alternative 2 - Monitored Natural Attenuation and Land Use Controls: Alternative 2 would provide optimized monitoring of the Central Impact Area groundwater until concentrations of contaminants within the plume reach risk-based levels. Under this alternative:

- Long-term groundwater monitoring would be implemented and optimized as required as the plume attenuates.

Land-use controls would be implemented to prevent use of contaminated portions of the aquifer for drinking water, maintain the integrity of any current or future groundwater monitoring wells and treatment systems and prevent actions that would interfere with the remedy.

- Monitoring, reporting and site close-out documentation would be completed.
- RDX concentrations are expected to decrease below the 10^{-5} risk based level of 6 ppb by 2030, the HA of 2 ppb by 2053, the 10^{-6} risk-based level after 2090.
- Groundwater modeling results also predict that natural attenuation processes would limit RDX plume concentrations exceeding the 2 ppb RDX Health Advisory to areas within the MMR boundary.
- The total cost for Alternative 2 is estimated at $7,860,000.

Alternative 3 - Focused Extraction with One Well, MNA and LUCs: Alternative 3 would provide for extraction and treatment of the groundwater. Under this alternative:

- A 300-gallon-per-minute (gpm) pump and treat system would be installed that would include: One extraction well pumping at 300 gpm; two mobile treatment units; and infiltration of the treated water via an infiltration trench.
- A long-term groundwater monitoring plan would be implemented and optimized as required.
- Land-use controls would be implemented to prevent use of contaminated portions of the aquifer for drinking water, maintain the integrity of any current or future groundwater monitoring wells and treatment systems and prevent actions that would interfere with the remedy.
- Monitoring, reporting and site-closeout documentation would be completed.
- RDX concentrations are expected to decrease below the 10^{-5} risk based level of 6 ppb by 2027, the HA of 2 ppb by 2056, the 10^{-6} risk-based level by 2084 and background by 2110.
- The total cost for Alternative 3 is estimated at $22,900,000.

Alternative 4 – Focused Extraction with Two Wells, MNA and LUCs: Alternative 4 would provide for extraction and treatment of the groundwater. Under this alternative:

- Two extraction wells with a cumulative pumping rate of 550 gpm would be installed along Burgoyne Road
- Contaminated water would be piped to the Demolition Area 1 treatment facility:
- A long-term groundwater monitoring plan would be implemented and optimized as required.
- Land-use controls would be implemented to prevent use of contaminated portions of the aquifer for drinking water, maintain the integrity of any current or future groundwater monitoring wells and treatment systems and prevent actions that would interfere with the remedy.
- Monitoring, reporting and site-closeout documentation would be completed.
- RDX concentrations are expected to decrease below the 10^{-5} risk-based level of 6 ppb by 2027, the HA of 2 ppb by 2049, the 10^{-6} risk-based level by 2077 and background by 2110.
- The total cost for Alternative 4 is estimated at $17,200,000.

Alternative 4 (Modified) – Focused Extraction with Three Wells, MNA and LUCs: Alternative 4 (Modified) would provide for extraction and treatment of the groundwater (Figure 7). Under this alternative:

- Two extraction wells with a cumulative pumping rate of 550 gpm would be installed along Burgoyne Road.
- The southern well would be turned off (estimated) in 2035, at which time a third, northern well, would begin operation.
- Contaminated water would be piped to the Demolition Area 1 treatment facility.
- A long-term groundwater monitoring plan would be implemented and optimized as required.
- Land-use controls would be implemented to prevent use of contaminated portions of the aquifer for drinking water, maintain the integrity of any current or future groundwater

monitoring wells and treatment systems and prevent actions that would interfere with the remedy.

- Monitoring, reporting and site-closeout documentation would be completed.
- RDX concentrations are expected to decrease below the 10^{-5} risk-based level of 6 ppb by 2027, the HA of 2 ppb by 2047 the 10^{-6} risk-based level by 2055 and background by 2110.
- The total cost of Alternative 4 (Modified) is estimated at $18,200,000.

Alternative 5 – Focused Extraction with Three Wells, MNA and LUCs: Alternative 5 would provide for extraction and treatment of the groundwater. Under this alternative:

- Two extraction wells would be installed along Burgoyne Road; one extraction well would be installed along Spruce Swamp Road. The cumulative pumping rate of the three extraction wells would be 700 gpm.
- Contaminated water from Burgoyne Road wells would be piped to the Demolition Area 1 treatment facility. Water from the Spruce Swamp Road well would be treated at two mobile treatment units.
- A long-term groundwater monitoring plan would be implemented and optimized as required.
- Land-use controls would be implemented to prevent use of contaminated portions of the aquifer for drinking water, maintain the integrity of any current or future groundwater monitoring wells and treatment systems and prevent actions that would interfere with the remedy.
- Monitoring, reporting and site-closeout documentation would be completed.
- RDX concentrations are expected to decrease below the 10^{-5} risk-based level of 6 ppb by 2027, the HA of 2 ppb by 2049 the 10^{-6} risk-based level by 2055 and background by 2110.
- The total cost of Alternative 5 is estimated at $36,000,000.

Alternative 6 – Focused Extraction with Thirty One Wells, MNA and LUCs: Alternative 6 would provide for extraction and treatment to achieve the 10-6 risk level for RDX (0.6 ppb) throughout the groundwater plume within 10 years. Under this alternative:

- A pump and treat system would be installed that would include: Thirty-one extraction wells with a combined pumping rate of 6,500 gpm; Treatment with granular activated carbon at three treatment facilities and one mobile treatment unit; and infiltration of the treated water via infiltration trenches.
- A long-term groundwater monitoring plan would be implemented and optimized as required.
- Land-use controls would be implemented to prevent use of contaminated portions of the aquifer for drinking water, maintain the integrity of any current or future groundwater monitoring wells and treatment systems and prevent actions that would interfere with the remedy.
- Monitoring, reporting and site-closeout documentation would be completed.
- RDX concentrations are expected to decrease below the 10^{-5} risk-based level of 6 ppb by 2015, the HA of 2 ppb by 2019, the 10^{-6} risk-based level by 2020 and background by 2036.
- The total cost of Alternative 6 is estimated at $108,900,000.

Summary of the Comparative Analysis of Alternatives (Table 1)

The following discussion summarizes the strengths and weaknesses of each response action alternative identified for the Central Impact Area with respect to the nine criteria: Overall Protection of Human Health and the Environment: Alternatives 2 through 6 would be protective of human health and the environment. Alternative 1, however, offers no monitoring or confirmation of existing land-use controls to ensure that future exposures do not occur. Alternative 2 adds provisions for plume monitoring and land-use controls to help prevent future

exposure to contaminated groundwater. Alternatives 3 through 6 add extraction and treatment components and achieve risk-based concentrations earlier than Alternatives 1 and 2.

Compliance with Regulations: All alternatives are eventually expected to result in compliance with applicable regulations. Alternatives 1 and 2 allow for continued migration of the plume. Because these alternatives involve no active remediation, chemical-specific regulations would be met only when contaminant concentrations decrease below the cleanup standards by natural attenuation. Alternative 2 includes monitoring to confirm this occurs; Alternative 1 does not. Alternatives 3, 4, 4 (Modified), 5, and 6 include active treatment to ensure that applicable standards are met.

Long-Term Effectiveness and Permanence: A significant portion of the source area has been removed so residual soil contamination is unlikely to compromise the permanence of the remedial alternatives once completed. All of the alternatives would permanently achieve the cleanup goals; however, time to cleanup would vary. Moreover, Alternatives 3, 4, 4 (Modified), 5, and 6, which include active treatment of the plume, may result in fewer uncertainties over the long term regarding the fate and transport of the plume.

Reduction of Toxicity, Mobility, or Volume through Treatment: Alternatives 3, 4, 4 (Modified), 5, and 6 reduce the toxicity, mobility, and volume of contaminated groundwater through treatment. Alternative 3 through 6 would extract various amounts of RDX mass (relative to Alternative 2).

- Alternative 3 – 5.5 Kg of RDX
- Alternative 4 – 7.0 Kg of RDX
- Alternative 4 (Modified) – 7.1 Kg of RDX
- Alternative 5 – 8.5 Kg of RDX
- Alternative 6 – 16 Kg of RDX

Short-Term Effectiveness: Alternative 1 would have the least impact on workers because construction is minimal. Alternative 6 would have the greatest impact because of the large amount of construction and additional source removal involved. Alternatives 3 through 6 would have the additional risks to workers associated with construction in an Impact Area containing

unexploded ordnance. Alternative 6 would cause the greatest environmental impact to natural resources and includes expanded source removal, the installation of 31 extraction wells, piping, three treatment facilities, an MTU, and infiltration trenches. Alternatives 3, 4, 4 (Modified), and 5 would also have some environmental impacts due to construction. Alternative 2 through 6 would have environmental impacts from monitoring well installation, monitoring, and well abandonment. The only environmental impact of Alternative 1 would be from abandonment of the current monitoring-well system.

Implementability: Alternatives 1 to 5 are not limited by administrative feasibility. Alternative 1 is the most easily implemented alternative since it requires no further action other than abandoning groundwater monitoring wells and preparing close out documentation. Alternative 2 is the next most easily implemented alternative with groundwater monitoring and land-use controls implemented. Alternatives 3, 4, 4 (Modified), and 5 are somewhat more difficult alternatives to implement, since they include the installation of extraction well(s), MTU(s), new piping/power lines, and/or infiltration trench(es). Operation of treatment systems for Alternatives 3 and 5 would be in an environment with the potential for munitions and maintenance of systems down range from small arms firing ranges. Alternative 6 has significant administrative and technical implementability issues due to the extensive source removal, the large multi-facility treatment plant construction, and extensive land clearance required (up to 30 acres). Alternative 6 would be the most difficult alternative to implement technically to obtain the cleanup in ten years.

Cost: Alternative 1 and Alternative 2 would be the least costly, with most of the Alternative 2 cost associated with long-term monitoring. Costs for Alternative 3, Alternative 4, and Alternative 4 (Modified) are similar with differences primarily reflecting the fact that for Alternative 4 and 4 (Modified), all water would be piped to the Demolition Area 1 facility. Alternative 5 would be significantly more costly than either Alternative 3 or Alternative 4. Alternative 6 is by far the most costly alternative. The primary driver of the costs for Alternative 6 is the capital cost for the very large scale extraction, treatment and discharge facilities required for this alternative, and the cost for additional soil source removal.

- Alternative 1 – total estimated cost of $ 325,000

- Alternative 2 – total estimated cost of $7,860,000
- Alternative 3 – total estimated cost of $22,900,000
- Alternative 4 – total estimated cost of $17,200,000
- Alternative 4 Modified – total estimated cost of $ 18,200,000
- Alternative 5 – total estimated cost of $ 36,000,000
- Alternative 6 – total estimated cost of $ 108,900,000

These cost estimates are exclusive of the costs of the long term plan to address UXO which would be a component of each alternative except Alternative 1. Due to a number of uncertainties, the details and costs of this source area remedy are somewhat difficult to determine but an approximate cost to address UXO is $600,000/acre.

State Acceptance: This criterion is continually evaluated as MassDEP participates in all aspects of the evaluation and selection of a remedy. MassDEP's official concurrence with the selected remedy is set forth in Appendix A.

Community Acceptance: Comments were received from 5 members of the public as part of the public comment period on the Remedy Selection Plan for the Central Impact Area. See "Part III Responsiveness Summary" for more details.

The Selected Response Action

For the reasons set forth herein, EPA has identified Alternative 4 (Modified) - Focused Extraction with Three Wells, Monitored Natural Attenuation, Source Controls and Land Use Controls as the appropriate response action for the Central Impact Area site. This alternative, provides the best balance of the criteria used to evaluate the cleanup alternatives. The proposed remedy consists of in-plume extraction along Burgoyne Road for the purposes of containing the plume along this road. The extraction system will prevent the migration of water containing RDX greater than 2 ppb from passing Burgoyne Road. The contaminated water will be piped to the Demolition Area 1 treatment facility. Based on current modeling and assumptions, three wells pumping a total of 550 gpm can contain the groundwater plume at this point, and this will be verified during design. The southern and central wells will operate until

2035, at which time the southernmost well would be shutdown and the northern well would commence operation. Active treatment of the plume would remove RDX and perchlorate from the extracted groundwater and return the treated water to the aquifer. This system will also serve to prevent migration of future contamination until the source control work is completed. Downgradient of Burgoyne Road, the plume is expected to naturally attenuate to acceptable levels prior to reaching the base boundary. This alternative includes an enhancement of the existing monitoring well network and the option to modify the extraction and treatment system if necessary to optimize the system performance and/or maintain containment. The pipeline to the Demo 1 treatment plant will be constructed with extra capacity to address future contamination, if detected. The groundwater remedy for the larger plume lobe is expected to achieve an RDX level of 0.6 ppb by 2055 and 2 ppb by 2047. The smaller plume lobe emanating from the J1 range is expected to achieve an RDX level of 0.6 by 2024 and 2 ppb by 2019. The estimated cost of the proposed groundwater remedy is approximately $18,200,000.

The response actions taken to date have addressed known areas of soil contamination and varying degrees of UXO removal over a 56 acre area. However, there is an estimated 4,000 to 9,000 UXO items remaining within Central Impact Area. A Long Term Source Area Response Plan will be developed by the EPA, the Army, the NGB, and MassDEP and will be implemented by the Army and NGB in a phased approach to address these items and any soil contamination that may be discovered in these areas (Figure 8).

The first phase will consist of UXO clearance of an additional 30 acres of the CIA over a 3 year period followed by a second phase consisting of UXO clearance of an additional 20 acres of the CIA. The development and implementation of additional phases, if necessary, will be based on the results of these first two phases. A Work Plan for the first phase shall be developed by the Army/NGB within sixty (60) days of the issuance of this Decision Document and submitted to the EPA and MassDEP for review. The work plan shall be approved by EPA in consultation with MassDEP. A Work Plan for the second phase shall be developed by the Army/NGB within sixty (60) days of the completion of the first phase. The work plan for the second phase will take into account information gathered from the first phase and will be submitted to the EPA and MassDEP for review. The work plan shall be approved by EPA in consultation with MassDEP.

The plans for the first two phases will employ techniques to minimize habitat destruction while maximizing the reduction of UXO with a goal to remove 75% to 95% of the UXO within the fifty acres covered by the first two phases.

Human health is protected through the use of groundwater monitoring to ensure that groundwater modeling predictions regarding the reduction and migration of contamination are correct and that any remaining contamination remains below risk-based levels. Groundwater monitoring will also provide information on potential impacts from the remaining UXO and whether additional actions are needed to minimize those impacts.

Human health will be further protected through the implementation and verification of land-use controls. These controls will further prevent use of contaminated portions of the aquifer for drinking water, maintain the integrity of any current or future groundwater monitoring wells and treatment systems and prevent actions that would interfere with the remedy until contamination is reduced to below risk-based levels.

This remedy will be evaluated every five years to determine if the groundwater treatment system is still protective and achieving the goals established. The long term plan for UXO removal will also be evaluated at this time to determine if additional actions and/or more expedited actions are needed to protect groundwater or if improved technologies are available.

The estimated cost of the proposed remedy including the first two phases of source control work is approximately $48,000,000. Additional phases, if necessary, of source control work will add to this cost.

This alternative is proposed because it achieves permanent cleanup of RDX in groundwater in the Central Impact Area most economically and in a reasonable timeframe without excessive environmental and worker impacts. The proposed remedy ensures protection of human health and the environment through continued monitoring and enforcement of land-use controls that will prevent exposure to contaminated groundwater. In this proposed plan, EPA is making no

determination regarding any remaining public safety risk, ecological risk, dermal contact risk, and/or soil ingestion risk posed by any remaining contamination at the site.

K. RESPONSE ACTION IMPLEMENTATION

Plume Monitoring

The cleanup goals at the Central Impact Area will be achieved through a combination of focused extraction and natural processes. The success of these processes to achieve regulatory standards will be confirmed through the development and implementation of an approved, long-term groundwater monitoring plan. The long-term groundwater monitoring will also verify that any remaining UXO will not pose a threat to groundwater. Optimization of the program will lead to changes that will be documented in the periodic monitoring reports.

If EPA determines, based on groundwater monitoring data, revised modeling, or other relevant information that plume migration is substantially different from the model predictions discussed in the Central Impact Area Feasibility Study, the Army will conduct a detailed analysis to determine, as accurately as possible, the extent of the deviation(s), including whether the plume in question might migrate off-base at concentrations exceeding cleanup standards. If EPA, in consultation with MassDEP, determines based on the results of the detailed analysis, that significant changes to the response actions described in this Decision Document are warranted, such changes will be addressed in accordance with the "Modifications" section below.

Cleanup Levels

The groundwater cleanup level for RDX is the 10^{-6} risk-based level that results in an increased lifetime cancer risk of one in a million, currently 0.6 µg/L. The groundwater cleanup level for perchlorate is the 2 ug/l MMCL. Soil cleanup levels will be established during the development of the work plan and will be based on levels necessary to protect the aquifer, at a minimum.

Land Use Controls

Contaminated groundwater at the CIA currently poses an unacceptable risk to human health if used for drinking water purposes. Administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use, known as "Land Use Controls" (LUCs), must be established to avoid the risk of exposure to contaminated groundwater above regulatory standards, health advisories, and/or risk-based levels, maintain the integrity of any current or future groundwater monitoring wells and treatment systems and prevent actions that would interfere with the remedy. The LUCs are needed until the groundwater contamination no longer poses an unacceptable risk.

The performance objectives of the LUCs are to:

- Prevent access to or use of the groundwater from the Central Impact Area plumes until the groundwater no longer poses an unacceptable risk, and
- Maintain the integrity of any current or future groundwater monitoring wells and treatment systems.

The LUCs will be implemented in the areas encompassing the Central Impact Area contaminated groundwater and surrounding areas to prevent risks from exposure to contaminated groundwater. The on-base areas of concern are controlled and operated by the Massachusetts National Guard in conjunction with the US Army (Army) which leases the land from the Commonwealth of Massachusetts. It is expected that these entities will operate and lease, respectively, the Site and the surrounding areas for the duration of the remedy specified in this Decision Document. As a result, the Army will coordinate with the Commonwealth of Massachusetts as it fulfills its responsibility to establish, monitor, maintain and report on the LUCs for the Sites. Although homes located in the off base area have been connected to town water, an additional land use control will be necessary within the Town of Bourne for the downgradient portion of the Central Impact Area site.

Each land use control will be maintained until either (1) the concentrations of RDX and perchlorate in the groundwater are at levels that allow for unrestricted use and unlimited

exposure, or (2) the Army, with the prior approval of the EPA, in consultation with MassDEP, modifies or terminates the land use control in question.

Specific Land Use Controls

The Army is responsible for ensuring that the following land use controls are established, monitored, maintained, reported on, and enforced as part of this final remedy to ensure protection of human health in accordance with SDWA § 1431(a) for the duration of the final remedies selected in this Decision Document. The Town of Bourne has enforcement authority regarding the first land use control, which is applicable to the off-base portion of the Central Impact Area site. The Commonwealth of Massachusetts has enforcement authority regarding the second land use control, which applies to all sites. The Massachusetts Air National Guard and Massachusetts Army National Guard have enforcement authority regarding the third and fourth land use controls, which are applicable to the on-base portions of the Site. The Air Force has enforcement authority regarding the fifth land use control, which is applicable to the on-base portions of the Site.

1. The Bourne Board of Health requires a permit for the installation and use of all wells, including drinking water wells, irrigation wells, and monitoring wells. No well will be allowed to be constructed for human consumption or irrigation if its placement is known to be over a known plume of contamination or in the direct path of an advancing plume of contamination. The minimum lateral distance from potential contamination sources is 400 feet. If a permit to install a drinking water well is approved, the Bourne Board of Health will not approve the use of that well until its water has been tested and the Board of Health has determined that the water is potable. The Bourne Board of Health Well Regulations do not apply to use of existing drinking water wells and irrigation wells.

   To assist the Town of Bourne in the implementation of this land use control, the Army will meet with the Bourne Board of Health on an annual basis, or more frequently if needed, to provide and discuss plume maps that document the current and projected location of the Central Impact Area plumes within the town

of Bourne. While Figure 9 shows the current area of land use controls in the town, the Bourne Board of Health may modify the areas where the Board of Health may require additional well testing, and this land use control will apply to such areas even if they differ from the area shown.

2. In addition to the Town of Bourne Board of Health regulations, which generally apply to small water supply wells, existing land use controls also prevent the possible creation of a large potable water supply well. MassDEP administers a permitting process for any new drinking water supply wells in Massachusetts that propose to service more than 25 customers or exceed a withdrawal rate of 100,000 gallons per day. This permitting process, which serves to regulate the use of the Central Impact Area contaminated groundwater for any new withdrawals of groundwater for drinking water purposes, constitutes an additional land use control for these final remedies. This land-use control applies to both on-post and off-post areas. (Existing public water supply wells will remain subject to permits currently in place.)

3. For on-post areas, a prohibition on new drinking water wells serving 25 or fewer customers has been established and placed on file with the planning and facilities offices for the Massachusetts Air and Army National Guard (major tenants at the MMR). The prohibition will be applied to future land-use planning per Massachusetts Air National Guard Instruction (ANGI) 32-1003, Facilities Board and Massachusetts Army National Guard Regulation 210-20, Real Property Development Planning for the Army National Guard.

4. For the on-post areas, the Massachusetts Air National Guard has administrative processes and procedures that require approval for all projects involving construction or digging/subsurface soil disturbance, currently set forth in Massachusetts Air National Guard Instruction 32-1001, Operations Management. This procedure is a requirement of the Massachusetts Army National Guard, by the Massachusetts Air National Guard, through Installation Support Agreements.

The Massachusetts Air National Guard requires a completed AF Form 103, Base Civil Engineer Work Clearance Request (also known as the base digging permit), prior to allowing any construction, digging, or subsurface soil disturbance activity. All such permits are forwarded to the Army for concurrence before issuance. An AF Form 103 will not be processed without a Dig Safe permit number (see next paragraph).

5. The Dig Safe program implemented in Massachusetts provides an added layer of protection to prevent the installation of water supply wells in the Central Impact Area groundwater area and to protect monitoring wells. This program requires, by law, anyone conducting digging activities (e.g., well drilling) to request clearance through the Dig Safe network. The Air Force at the MMR is a member utility of Dig Safe. The Camp Edwards Training Range and Impact Area, fall within the geographical area identified by the Air Force as a notification region within the Dig Safe program. Through the Dig Safe process, the Air Force will be electronically notified at least 72 hours prior to any digging within this area. The notification will include the name of the party contemplating, and the nature of, the digging activity. Upon receiving Dig Safe notification of any proposed digging activity on Camp Edwards (which includes the Impact Area), the Air Force will promptly transmit the Dig Safe notification information to the Army with a copy to the Massachusetts National Guard MMR Environmental & Readiness Center (E&RC). The Army (or its designee) will promptly review each notification and if the digging activity is intended to provide a previously unknown water supply well, the Army (or its designee) will immediately notify the project sponsor (of the well drilling), the EPA, and the MassDEP in order to curtail the digging activity. If the Dig Safe notification indicates proposed work near monitoring wells, the Army (or its designee) will mark its components to prevent damage due to excavation. The extent of the Army's enforcement of this land use control does not address off-base parties failing to file a Dig Safe request or the improper processing of a notification; but if incidents do occur, the Army is responsible for ensuring remedy

integrity and, if necessary, repairing damage caused by third parties to the monitoring wells or treatment systems.

In the event that the Town of Bourne fails to promptly enforce the first land use control, the Commonwealth of Massachusetts fails to promptly enforce the second land use control, the Massachusetts Air and Army National Guards fail to promptly enforce the third or fourth land use control, or the Air Force fails to promptly enforce the fifth land use control, the Army will act in accordance with the third to last paragraph in this section, headed "*Activities Inconsistent With Land Use Controls.*" Specifically, if the Army discovers that the party responsible for enforcing the identified land use control has failed to promptly enforce that land use control, then, as soon as practicable, but no later than 10 days after the Army becomes aware of this failure to promptly enforce the land use control, the Army will notify the EPA and MassDEP and initiate actions to address such failure. The Army will notify the EPA and MassDEP regarding how the Army has addressed or will address the breach within 10 days of sending the EPA and MassDEP notification of the breach. For purposes of this paragraph, "promptly enforce" means if the violation or potential violation is imminent or on-going, enforce to prevent or terminate the violation within 10 days from the enforcing agency's (i.e., the Town's, Commonwealth's, Massachusetts Air and Army National Guards', or Air Force's) discovery of the violation or potential violation; otherwise, enforce as soon as possible.*Private Wells*

The LUCs are intended to prevent exposure to groundwater impacted by the plumes. However, to ensure that the LUCs achieve the LUC performance objectives, the Army will take the following additional action with respect to the Central Impact Area plume.

Within three years of the signing of this Decision Document, the Army shall:

a. Document all private wells (i.e., non-decommissioned wells, including wells not currently in use) located on or off the MMR that are above or within the projected path of the plume.

b. Demonstrate and document that the private well is not capable of drawing contaminated groundwater originating from the Central Impact Area plumes, or test the private well for contamination and demonstrate the private well to be safe for human use. The Army will continue such testing, on an appropriate frequency as determined in coordination with the EPA and MassDEP, until the plume no longer presents a threat to that well as determined in coordination with EPA and MassDEP.

c. If the Army identifies a well containing COCs, the Army shall assess the risk that current and potential future non-drinking uses of such a well pose to human health. The Army shall submit a draft version of any such risk assessment to EPA and MassDEP for review and EPA approval.

d. If neither b nor c is able to confirm that the identified well is safe for human use, the Army will offer the owner decommissioning of the well. If accepted, the Army will document such action with the Bourne Board of Health. If the decommissioning is not accepted, the Army will take other steps to ensure protectiveness to include, but not be limited to, requesting assistance from the Bourne Board of Health to issue health warnings to the property owner and any other person with access to the well (such as a lessee or licensee), offering bottled water (if well is used for drinking), or installing treatment systems on affected wells. In each instance, the Army shall submit a schedule subject to EPA concurrence, outlining and including time limitations for the completion of steps sufficient to prevent exposure to concentrations of contaminated groundwater from the Central Impact Area plume having COCs in excess of cleanup levels.

Monitoring

Monitoring of the land use restrictions and controls will be conducted annually by the Army. The monitoring results will be provided annually in a separate report or as a section of another monitoring report, if appropriate, and provided to the EPA and MassDEP. The reports will be used in preparation of the Five-Year Review to evaluate the effectiveness of the final remedy.

The annual monitoring report, submitted to the regulatory agencies by the Army, will evaluate the status of the LUCs and how any LUC deficiencies or inconsistent uses have been addressed. The annual evaluation will address (1) whether the use restrictions and controls referenced above were put in place and effectively communicated, (2) whether the operator, owner, and state and local agencies were notified of the use restrictions and controls affecting the property, and (3) whether use of the property has conformed with such restrictions and controls and, in the event of any violations, summarize what actions have been taken to address the violations. In addition, the Annual Monitoring Report will include a discussion of the efforts undertaken during the past year to complete the tasks outlined in "*Private Wells*" above.

Operational Responsibilities and Liability

Upon approval by EPA, after consultation with MassDEP, the Army may transfer various operational responsibilities for LUCs (i.e., monitoring) to other parties, through agreements. However, the Army acknowledges its ultimate liability under the SDWA § 1431(a) for remedy integrity.

Activities Inconsistent With Land Use Controls

For any proposed land use change(s) that would be inconsistent with the land use control objectives or the final remedy, the Army shall seek EPA review and concurrence at least 45 days prior to any proposed land-use change(s). In addition, if the Army discovers a proposed or ongoing activity that would be or is inconsistent with the land-use control objectives or use restrictions, or any other action (or failure to act) that may interfere with the effectiveness of the land use controls, it will address this activity or action as soon as practicable, but in no case will the process be initiated later than 10 days after the Army becomes aware of this breach. The Army will notify the EPA and MassDEP as soon as practicable, but no later than 10 days after the discovery of any activity that is inconsistent with the LUC objectives or use restrictions, or any other action that may interfere with the effectiveness of the LUCs. The Army will notify the EPA and MassDEP regarding how the Army has addressed or will address the breach within 10 days of sending the EPA and MassDEP notification of the breach.

Ensuring Continued Maintenance of LUCs

The Army will provide notice to the EPA and MassDEP at least six months prior to relinquishing the lease to the Central Impact Area site so the EPA and MassDEP can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective LUCs. If it is not possible for the Army to notify the EPA and MassDEP at least six months prior to any transfer or sale of property located within the Central Impact Area site, then the Army will notify the EPA and MassDEP as soon as possible, but no later than 60 days prior to the transfer or sale of any property, subject to LUCs.

The Army shall not modify or terminate LUCs or implementation actions, or modify land use without approval by the EPA, in consultation with MassDEP. The Army, in coordination with other agencies using or controlling the Central Impact Area, shall obtain prior approval before taking any anticipated action that may disrupt the effectiveness of the LUCs or any action that may alter or negate the need for LUCs. The Army will provide EPA and MassDEP 30 days' notice of any changes to the internal procedures for maintaining land-use controls which may affect the Central Impact Area.

Expected Outcomes of the Selected Responses

The response action objectives for groundwater associated with the Central Impact Area are to restore the useable groundwater to its beneficial use, wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site; to provide a level of protection in the aquifer that takes into account that the Cape Cod Aquifer, including the Sagamore Lens, is a sole source aquifer that is susceptible to contamination; and to prevent ingestion and inhalation of groundwater containing RDX in excess of federal Maximum Contaminant Levels, Health Advisories, DWELs, applicable State standards or an unacceptable excess lifetime cancer risk or non-cancer Hazard Index.

The proposed remedy is expected to achieve permanent cleanup of RDX in groundwater at the site. RDX concentrations in groundwater are expected to drop below the 2 ppb Health Advisory by 2047, the 0.6 ppb 10^{-6} risk-based level by 2055, and the 0.25 ug/L background level by 2110.

Five-Year Reviews

In addition to annual reports on groundwater monitoring and verification of land use controls at the Site, groundwater responses for the site will be reviewed every five years. The purpose of the review is to revisit the appropriateness of the response in providing adequate protection of human health. The scope of the review will include, but is not limited to the following questions: is the response operating as designed; have any of the cleanup standards changed since finalization of this Decision Document; and is there any new information that would warrant updating the remedy? If appropriate, additional actions (including, if necessary, reopening this decision) may be required as a result of these reviews.

Modifications

Any significant changes to the response action described in this Decision Document will be documented in a technical memorandum in the Administrative Record. If the EPA, in consultation with MassDEP, believes that fundamental changes to the response action are necessary, the EPA will issue a proposed revised Decision Document and accept public comment on it before issuing a final, revised Decision Document.

Response Completion for the Groundwater Remedy

The Massachusetts Military Reservation (MMR) groundwater plumes, including the Central Impact Area plumes, are located within the Cape Cod sole-source aquifer. Subject to EPA approval, in consultation with MassDEP, the following three-step process will be implemented by the Army to achieve site closure:

(1) The plumes will be monitored in accordance with an EPA-approved monitoring plan.

(2) In accordance with applicable EPA guidance, a cumulative, residual risk assessment(s) for all contaminants will be performed to determine if additional measures are necessary to achieve acceptable risk levels.

(3) Once acceptable levels have been achieved, the technical feasibility of additional remediation to approach or achieve background concentrations will be evaluated. In the event that a dispute arises regarding any of the determinations reached under the process outlined above, such dispute shall be resolved under the dispute resolution procedure of AO3.

L. DETERMINATIONS

The response actions selected for implementation at the Central Impact Area are consistent with the SDWA Section 1431(a), 42 USC § 300i(a), as amended, and with AO3.

The selected response actions are protective of human health, and will comply with applicable federal and state requirements, standards, MCLs, health advisories, and DWELS. The response actions will adequately protect human health and the sole source aquifer which constitutes a current and potential drinking water supply by eliminating, reducing, or controlling exposures to potential human receptors at the site through groundwater monitoring and institutional controls. In addition, the selected response actions include a periodic review at a frequency not to exceed five years so that relevant data can be provided to EPA for purposes of determining whether additional measures are necessary for the protection of human health.

As required by AO3, the selected alternative for the Site (Focused Extraction, Monitored Natural Attenuation, Source Controls, and Land Use Controls and Long Term Source Area Response Plan) provides a level of protection to the aquifer underlying and downgradient of the Site commensurate with the aquifer's designation as a Sole Source Aquifer and a Potentially Productive Aquifer and is protective of human health. EPA's determination is related to unacceptable threats to the groundwater aquifer from the Site; however, by this Decision Document EPA is making no determination regarding any remaining public safety risk, ecological risk, dermal contact risk, and/or soil ingestion risk posed by any remaining contamination at the Site.

M. DOCUMENTATION OF NO SIGNIFICANT CHANGES

EPA presented a Remedy Selection Plan for the selected alternatives set forth in Part II for the Central Impact Area on July 27, 2011. EPA reviewed all written and verbal comments submitted during the public comment period. EPA determined that no significant changes to the response action, as originally identified in the Remedy Selection Plan, were necessary.

N. STATE ROLE

The MassDEP has reviewed the various alternatives and has concurred with the selected response actions. See Appendix A.

PART III: THE RESPONSIVENESS SUMMARY

On July 13, 2011, EPA published the remedy selection plan for the Central Impact Area, which included the proposed remedy and announced the public comment period on the proposed remedy. EPA proposed an alternative that includes Focused Extraction with three wells, UXO removal under a long term phased approach, Monitored Natural Attenuation and Land Use Controls as the remedy.

At the July 13, 2011 public meeting of the MMRCT and the SMB, held on Camp Edwards, MA, the Army gave a presentation on the remedial investigation and feasibility study and the EPA presented its proposed remedy and answered questions from the oversight teams and the public. Representatives from MassDEP were present.

In addition, the Army and EPA held a public hearing on the remedy selection plan on July 27, 2011 on Camp Edwards, MA. A public information session, along with a presentation on EPA's proposed remedy was held prior to the opening of the public hearing. Local residents, officials, and news media representatives interested in site activities and cleanup decisions were invited to attend both meetings. Representatives from EPA, MassDEP, and Army were present.

The Army notified the public of the July 27, 2011 public meeting and announced the public comment period in a display ad placed in the July 22, 2011 editions of the *Cape Cod Times* and *Enterprise* newspapers.

The Army placed copies of the remedy selection plan for the Central Impact Area in the Army's information repositories at the Bourne, Falmouth, and Sandwich, MA public libraries. The repository contains documents on the investigations and findings supporting selection of the response action including the feasibility study and other relevant documents upon which EPA relied in selecting the proposed remedies. The remedy selection plan and key supporting documents were also made available on both the EPA and Army Web sites.

The following table provides a summary of issues and concerns that were raised during the public comment period held on the remedy selection plan for the Central Impact Area from July 25, 2011 through August 25, 2011.

Comments:	Responses:
Comments from Ron Reif, P.E., MMRCT (1) "Investigations and Findings, page 4: This section describes a narrow RDX plume that originated in the CIA and has migrated off the installation and makes the statement, 'There is currently no exposure to this plume.' Please describe the rationale/basis for this statement." (2) "Investigations and Findings, page 4: This section states that, 'because of inconsistencies of soil detections, potential source areas were identified through water table detections.' Please describe 'water table detections' and how they are used to identify potential source areas." (3) "Response Actions, page 5: This section states, 'this surface clearance resulted in approximately 25% munitions removal from these acres.' Please clarify the depth of this surface clearance, i.e., 0-6", 0-12", etc. " (4) "Development of Alternatives, page 5: This section discusses 'a long term plan to address the UXO that remain in the CIA' and 'due to a number of uncertainties that are difficult to quantify, the details and costs of this source area remedy are not included in the costs noted below'. Next this section states that 'this component is intended to optimize the groundwater treatment alternatives while achieving source reduction for the long term protectiveness'. These statements may be confusing, misleading, and unsupported. If your data is uncertain regarding the remaining 4,000-9,000 UXO items and future groundwater contamination, then it may not be appropriate to use this 'component' to optimize the treatment alternatives. Uncertainty will propagate through the assumptions, models, optimization process, and ultimately the decisions. Also, it is not clear to me	General note: The editorial comments are appreciated and many will be considered when future publications are prepared. Because the Central Impact Area Remedy Selection Plan was issued in final form, the editorial comments cannot be integrated into that document. However, we can offer clarification in response to some of the inquiries that were made. (1) There are no private or public water supply wells located within the Central Impact Area study area. There are no known municipal water supply wells located between the Central Impact Area and the Cape Cod Canal, which is the discharge point for the plume. There are two private residential water supply wells located to the northeast and downgradient of the Central Impact Area on Route 6A. The closest of these is located approximately three miles from the Central Impact Area boundary. (2) Precipitation that doesn't run off into rivers or is not absorbed into the ground or used by humans ends up in an aquifer. Just as above-ground water has a definite surface, so do subterranean aquifers. This surface is called a water table. Detections at this level are "water table detections." Contamination leaching from the surface would first be detected in groundwater samples collected at the water table located below the contaminated source areas.. (3) The surface clearance referenced in this paragraph was done on UXO items visible on the ground surface. Items were not excavated and there was no specified depth clearance. (4) While there are uncertainties regarding the numbers and condition of UXO that remain in the

how you would use this 'component' as part of the optimization process. Please revisit this section and consider removing the statements that could be confusing and misleading or provide clarification." (5) "Long-Term Effectiveness and Permanence, p. 9: The section states, 'a significant portion of the source area has been removed so residual soil contamination is unlikely to compromise performance.' With 4,000 to 9,000 UXO items estimated to be present in the CIA, I find this statement to be misleading. Additionally, at the most recent MMRCT meeting I recall that several presenters expressed significant uncertainty regarding the remaining UXO items as a future source of groundwater contamination. This section should be revisited." (6) "Glossary of Terms, p. 12: The following terms were discussed in the plan and should be included here: TNT and ion exchange resin. It should be clarified in this section that the GAC removes RDX and the ion exchange resin removes perchlorate."	Central Impact Area, it is believed that these items represent a potential future source of groundwater contamination. Removing UXO will reduce the mass of explosives in the environment, which should reduce the overall time that treatment systems would have to be operated. However, quantifying the future benefit from UXO removal is difficult. The language in the Decision Document will be written to clarify the uncertainties associated with future sources of groundwater contamination. (5) Soil removal actions have been conducted at several locations and approximately 20,845 tons of contaminated soil has been excavated to address an ongoing source of groundwater contamination. The source of the existing groundwater contamination is explosives residue from the past firing of artillery and mortars. The UXO represent a potential future source of groundwater contamination. The estimated 4,000-9,000 items that remain vary in terms of age, corrosion and depth. Their potential future impact on groundwater is uncertain but the source area and groundwater remedies will be designed to minimize any such risk. Additional removal actions will be conducted to remove more of the UXO items and further refine the estimates. (6) This editorial comment has been noted for future publications.
Comments from David Dow on behalf of the Cape Cod & the Islands Sierra Club (1) "The CC&I Group doesn't support the fate and effect conceptual approach used by the military and approved by the regulators on how the cocs get from the soil surface down to the groundwater. We feel that there is no evidence that perchlorate will be actively reduced as its travels through our soil/groundwater ecosystem and that for the organic cocs there will be little active chemical/biological degradation (since we lack the conditions for coupled aerobic/ anaerobic microbial breakdown of these cocs, which only exist down gradient of Landfill Plume source areas on the southern portion of the MMR)."	(1) The conceptual site model for the fate and transport of perchlorate and explosives at MMR begins with the deposition of solid particles on the surface. These particles are dissolved by rainwater and leach in to the underlying groundwater. Once exposed to the environment, the concentrations of perchlorate and explosives are reduced by natural attenuation processes. At MMR the physical processes of dilution, dispersion and sorption are thought to be more significant than chemical or biological degradation, given the aerobic conditions typical of the groundwater. The proposed remedy uses both natural attenuation processes and active treatment to achieve the remediation goals.

(2) "It is encouraging that three ETR systems will be installed in a portion of the CIA plume, but having to wait until 2055 to reach "safe levels" is unacceptable. Since the maximum contaminant levels (mcls) for the cocs in drinking water have slowly decreased over time, the target date of 2055 is probably optimistic. Since biomonitoring studies of human blood and urine by the Center for Disease Control (CDC) have detected perchlorate in 90% of the U.S. population, this contaminant must have more exposure routes than are commonly assumed by the military and EPA. This raises the issue of addressing cumulative effects in the health risk assessments that guide the CIA cleanup and the supporting modeling studies that support the preferred mitigation option. We don't view this process as a cleanup program that will make Cape Cod whole from toxic contamination created by past military training operations."

(3) "The preferred option is better than relying completely on MNA w/LUCs to address the CIA source areas and groundwater plume contamination of our sole source aquifer for drinking water. Our hope is that EPA and Ma. DEP will make changes in the preferred plan during the 5 year evaluation period (i.e. adaptive management), so that real progress can be made in cleaning up the CIA plumelets before they move off base or contaminate potential future drinking water sources on the northern portion of the MMR. Even though Tank Alley was the target of most of the mortar and howitzer shells fired into the CIA, the complex sources areas/plumelet distribution suggest that there are other human sources of contamination in the CIA. Since the Sierra Club is an environmental advocacy organization with limited scientific/technical capacity, we don't know what these other sources of contamination are."

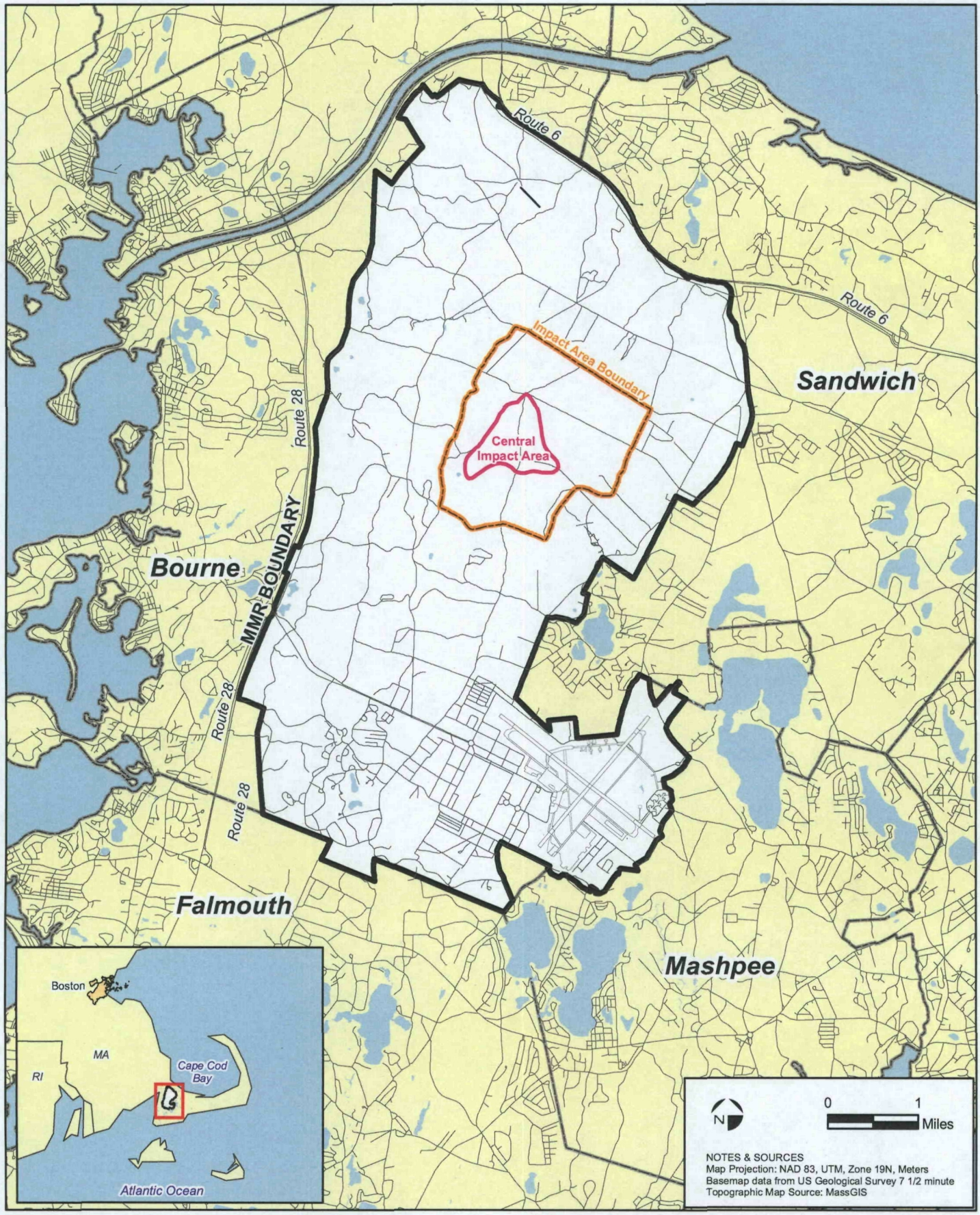
(2) The groundwater contamination at the Central Impact Area consists of multiple source areas, which resulted in multiple plumelets over a relatively large area. The proposed extraction, treatment and reinjection system provides a balance between cleanup cost and restoration time, while minimizing impacts to sensitive wildlife habitat. While we cannot predict future changes (increases or decreases) to maximum contaminant levels, there are mechanisms in place to change the remedy in the future, should it be necessary to meet new cleanup goals. In addition, the remedy requires the implementation of a residual risk assessment for all contaminants prior to the completion of the response. If unacceptable residual risks remain, additional response actions will be required. In addition, it is important to note that the projected time frame for operation of the proposed remedy assumes steady-state groundwater withdrawal conditions in the extraction wells. The extraction well screens and pumping rates will be optimized as necessary to focus extraction on the areas of highest groundwater contamination. Optimization should result in an increase in the rate of contaminant removal and a reduction in time frame estimated to achieve cleanup. Currently, there are no exposures to contaminated groundwater and the selected remedy has land use control measures in place to prevent future exposures. Based on the information presented in the Feasibility Study, the proposed remedy achieves the cleanup goals in a reasonable time frame.

(3) As stated previously, the contamination at the Central Impact Area is complex. These complexities were taken into account when selecting the proposed remedy and they will be considered when designing the monitoring program for that remedy. EPA and MassDEP will continue to monitor the progress of the cleanup of the Central Impact Area until the remediation goals are achieved. EPA will reevaluate the selected remedy if monitoring results or other information indicates that the behavior of any plume differs sufficiently from modeling predictions, or if the land use controls are failing to achieve their objectives. If EPA determines that the selected remedy is failing to meet the cleanup objectives, EPA will reevaluate this decision and decide whether to require additional actions.

Comments from Laura Olah – Citizens for Safe Water Around Badger (1) "We strongly encourage EPA to require environmental monitoring for all six isomers of dinitrotoluene (DNT) in all media in order to assure full and accurate characterization of potential risks to human health and the environment. In addition to appropriate testing for all forms of DNT, it is also critical that testing and consideration of all potential degradation and biotransformation products of DNT be integrated in site characterization, remedy selection, risk assessments, and other decisions that may affect human health and the environment."	(1) The EPA, Mass DEP and the Army Impact Area Groundwater Study Program (IAGWSP) have been considering information on the six isomers of dinitrotoluene (DNT) in response to groundwater results reported at Badger Army Ammunition Plant. At the MMR, DNT was used in the past as a component of propellants for artillery, mortar and small arms weapons. Artillery and mortars were propelled from Gun and Mortar positions located outside the Central Impact Area at targets within the CIA. Small arms ranges are located outside the perimeter of the CIA. The IAGWSP has routinely analyzed soil and groundwater samples at MMR for the most common isomers, 2,4-DNT and 2,6-DNT. The isomer 2,4-DNT has been detected in soil, primarily at gun positions and small arms ranges. Detections of 2,4-DNT and 2,6-DNT in groundwater at MMR are rare. Since the other isomers, 2,3-DNT, 2,5-DNT, 3,4-DNT and 3,5-DNT constitute only a small portion of the total DNT, they were not considered likely to be contaminants of concern at MMR. In order to confirm this, groundwater sampling was conducted in 2008 at six wells to obtain data on the concentrations of the minor DNT isomers at locations where 2,4-DNT or 2,6-DNT has been detected in groundwater or the overlying soil. The samples were analyzed at the SpecPro Laboratory at Badger Army Ammunition Plant. 2,4-DNT was detected in one well, but none of the other DNT isomers were detected. Based on these results, coupled with nature of activities that took place in the Central Impact Area, DNTs were not determined to be contaminants of concern.
Comments from Thomas Chapman - US Department of Interior Fish and Wildlife Service New England Field Office (1) "Given the stated criteria for evaluating the	(1) The concurrence with the remedy is noted. The remedy will be designed and implemented in a phased approach so as to minimize ecological impacts. The Environmental Management Commission and the Environmental & Readiness Center are located at the MMR in part to ensure

alternatives to address groundwater contamination associated with the Central Impact Area plume, we conditionally concur that Alternative 4 Modified (Focused Extraction with Monitored Natural Attenuation) is the most appropriate remedy to address the groundwater contamination, provided that measures to conserve and protect the New England cottontail (Sylvilagus transitionalis) habitat are implemented."	that activities are performed in such a manner as to be protective of the sensitive ecological system located in the impact area at the MMR.
Comments Mary Griffin, Commissioner – MA Department of Fish and Game (DFG) (1) "As a general comment, the DFG supports the need for and the objectives of the Remedy Selection Plan. The removal of unexploded ordnance (UXO) from the Reserve is necessary for the long-term protection of the public's health and safety and is an obligation of the Department of the Army under its lease with the Commonwealth." (2) "Given that the impact area is a globally significant pine-barrens supporting many state-listed species, and given that the impact area is part of a larger Reserve under the care and control of DFW, it is of the utmost importance that EPA, MassDEP, and the Army consult with DFG in order to identify remediation strategies that minimize rare species habitat impacts to the greatest extent practical. Specifically, DFG request that its staff, the NHESP in particular, participate in the ongoing evaluation of the effectiveness of the selected habitat protection techniques employed during the phased implementation of the Plan. Consistent with the evaluation criteria on page 3 of the Remedy Selection Plan, the selected remedy should be designed so as to comply with state regulations to the greatest extent practical, including but not limited to MESA, and to ensure "State Acceptance." To the extent that certain impacts to state-listed species habitat may be unavoidable, a detailed habitat restoration plan should be designed and implemented, in consultation with the NHESP. In addition, mitigation of unavoidable habitat impacts should be carried out consistent with MESA standards."	(1) The commenter's support for the remedy is noted. (2) EPA, MassDEP and the IAGWSP understand the importance of the pine-barrens habitat and its role in supporting state-listed species. Throughout the course of the work at MMR, techniques have been employed to reduce the impacts to critical habitats. We will coordinate closely with the Department of Fish and Game's Division of Fisheries and Wildlife (DFW) and its Natural Heritage and Endangered Species Program (NHESP) on the development of the scope of work and the ongoing evaluation of the effectiveness of the habitat protection techniques to be employed during the implementation of the work, including the detailed habitat restoration and mitigation plans that will be developed and implemented whenever impacts to MESA-regulated and other habitats are unavoidable.

FIGURES



AMEC Earth & Environmental, Inc.
Westford, Massachusetts

MMR Location and General Site Use

FIGURE
1

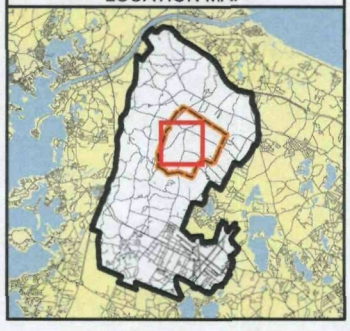
File: P:\GIS\MMR\CIA\GIS\Spatial\MXD\20120109_FigureEdits\Figure_1.mxd
Drawn by: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

Impact Area Groundwater Study Program

LEGEND

- Targets
- CS-19 Perimeter Road
- Sub Caliber Aircraft Rocket (SCAR) Sites
- Eastern Test Site
- Tank Alley
- Central Impact Area Boundary
- Impact Area Boundary

LOCATION MAP



N

0 1,000 Feet

NOTES & SOURCES
Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
1966 Aerial Photo

AMEC Earth & Environmental, Inc.
Westford, Massachusetts

Central Impact Area Location & Site History

FIGURE
2

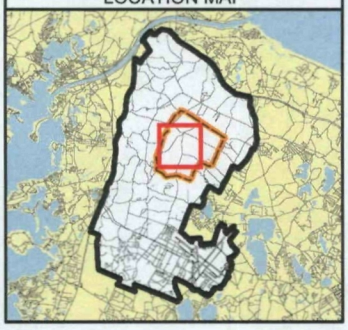
File: P:\GIS\MMR\CIA\GIS\Spatial\MXD\20120109_FigureEdits\Figure_2.mxd
Drawn by: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

Impact Area
Groundwater Study Program

LEGEND

- Targets
- CS-19 Perimeter Road
- Locations of Investigations
- Central Impact Area Boundary
- Impact Area Boundary

LOCATION MAP



N

0 1,000 Feet

NOTES & SOURCES
Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
1966 Aerial Photo

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Westford, Massachusetts

Locations of Investigations

FIGURE
3

File: P:\GIS\MMR\CIA\GIS\Spatial\MXD\20120109_FigureEdits\Figure_3.mxd
Drawn by: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

Impact Area Groundwater Study Program

Impact Area Groundwater Study Program

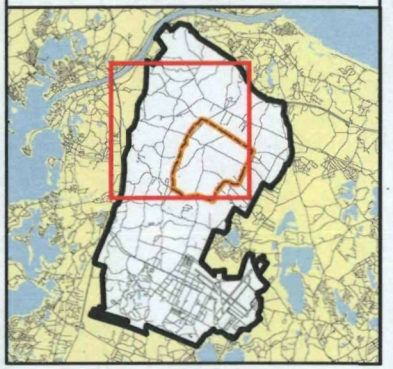
LEGEND

- Central Impact Area Boundary
- Impact Area Boundary
- MMR Boundary

RDX in Groundwater

- 0.6 - 2 ppb
- 2 - 6 ppb
- > 6 ppb

LOCATION MAP



NOTES & SOURCES

Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Aerial Imagery Source: ESRI Streaming Imagery

TITLE

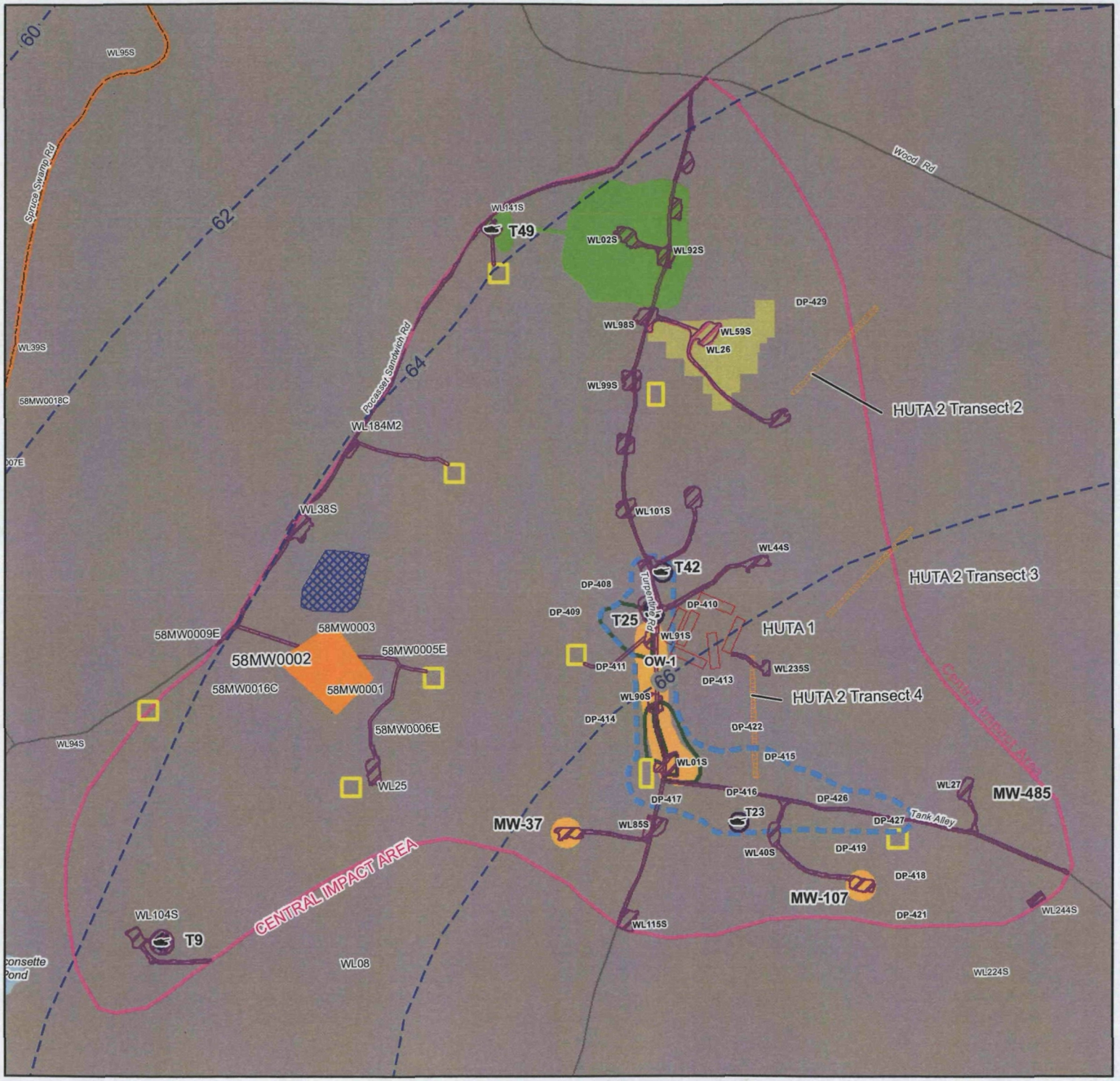
Extent of RDX in Groundwater (2010)

0 1,800 3,600 Feet

N

File: P:\GIS\MMR\CIA\GIS\Spatial\MXD\20120109_FigureEdits\Figure_4.mxd
Drawn by: william.scales
Coordinate System: NAD 1983 UTM Zone 19N

FIGURE 4



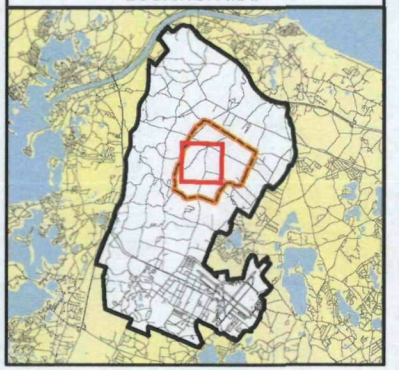
Impact Area
Groundwater Study Program

LEGEND

- 2010 Estimated RDX Source Area
- Water Table Contour (Feet NVGD) AMEC, August 2004
- Target Excavations
- Robotic Excavation
- Robotics Investigation/Clearance
- CIA Test Plot Investigation/Clearance
- HUTA 1 Transect Investigation/Clearance
- HUTA 2 Transect Investigation/Clearance
- Well Pads and Access Roads Clearance
- CS-19 Investigation/Clearance
- CS-19 Bunker Area Investigation/Clearance
- SCAR Site Investigation/Clearance
- Eastern Test Site Investigation

*RDX results as of 03/07

LOCATION MAP



NOTES & SOURCES

Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS

TITLE

Source Investigation and Excavation Areas

0 550 1,100 Feet

N

File: P:\GIS\MMR\CIA\GIS\Spatial\MXD\20120109_FigureEdits\Figure_5.mxd
Drawn by: william.scales
Coordinate System: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001

FIGURE 5

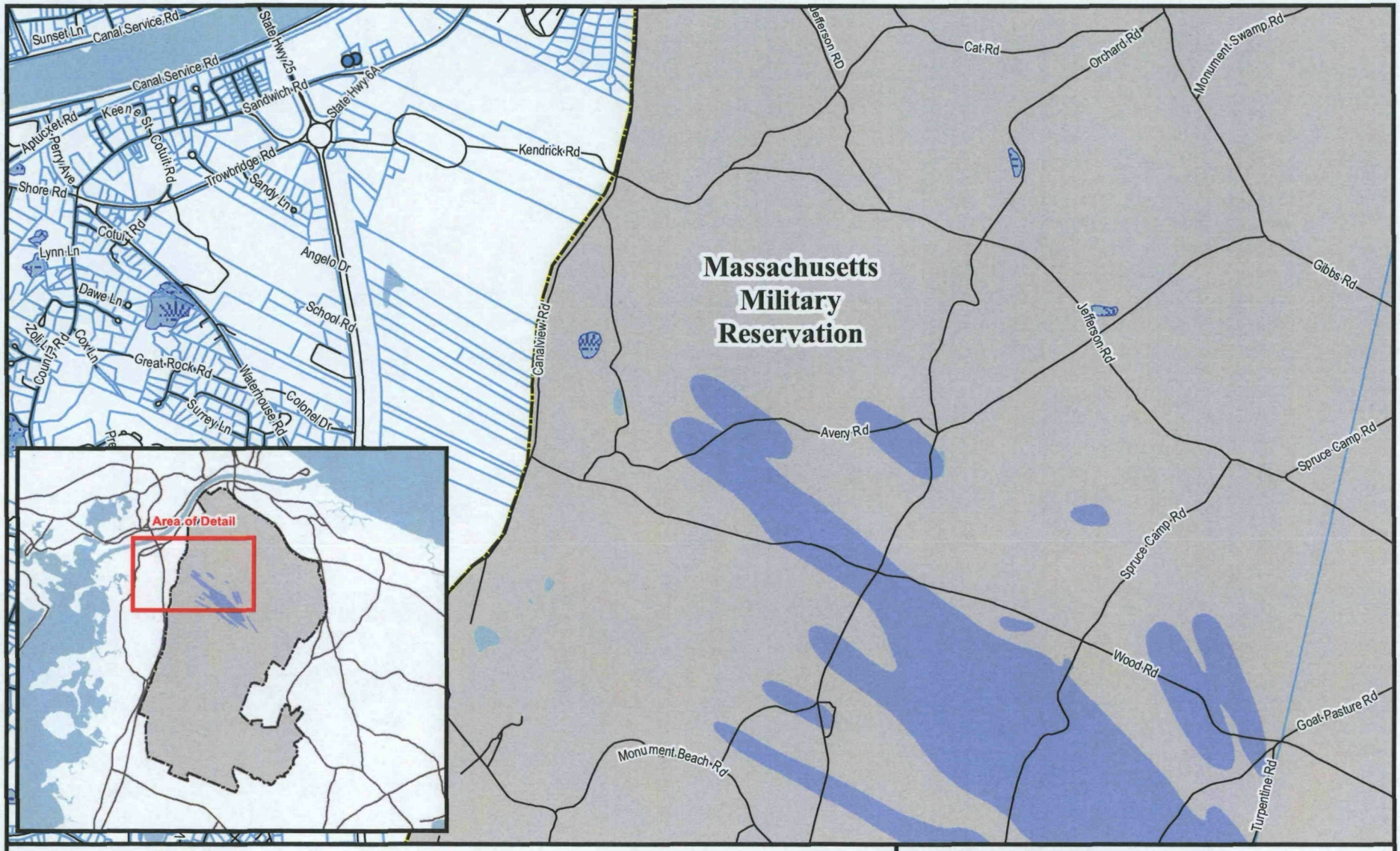
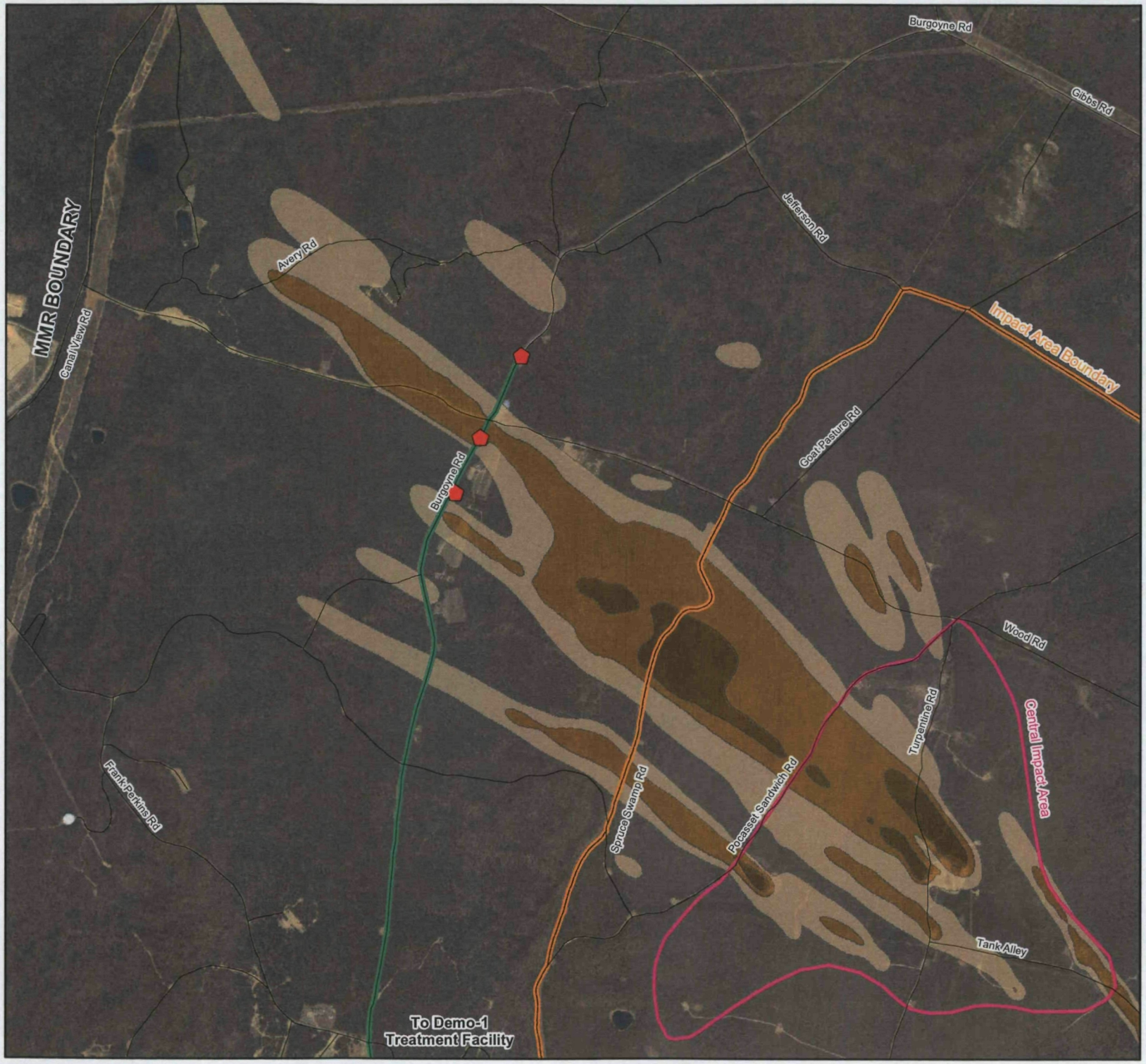


FIGURE 6
PRIVATE WELLS DOWNGRADIENT OF CENTRAL IMPACT AREA PLUME

IAGWSP - Massachusetts Military Reservation

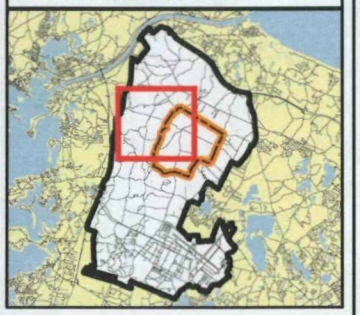


Impact Area Groundwater Study Program

LEGEND

- Extraction Well
- Underground Piping
- 2010 RDX Plume Outline
  - 0.6 - 2 ppb
  - 2 - 6 ppb
  - > 6 ppb
- Central Impact Area
- Impact Area Boundary
- Road

LOCATION MAP



NOTES & SOURCES

Map Coordinates: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS
Orthos: MassGIS April, 2005

TITLE

Configuration of Alternative 4 (Modified) Treatment at Burgoyne Road

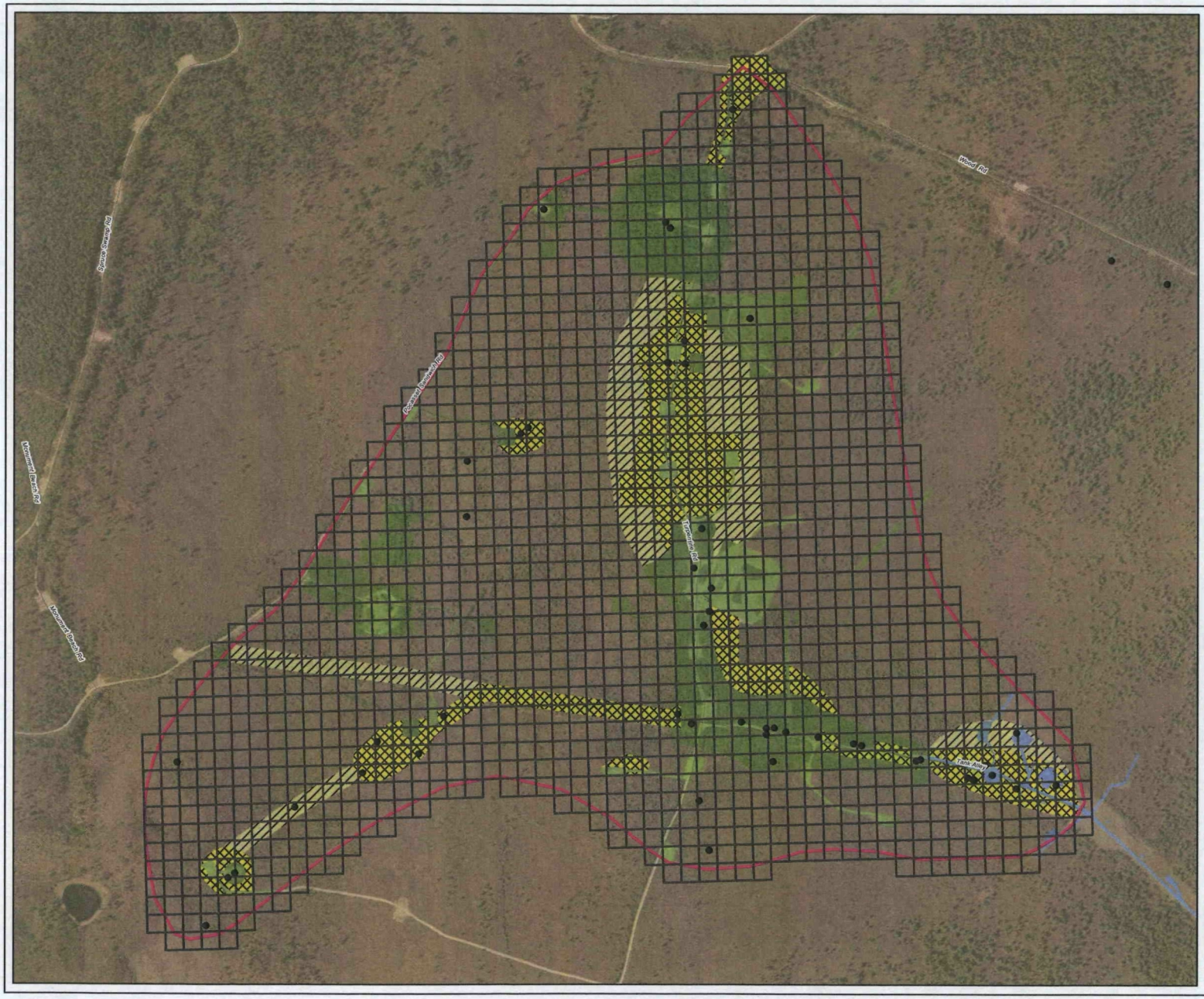
0 2,000 Feet

N

AMEC Earth & Environmental, Inc.
Westford, Massachusetts

FIGURE 7

File: P:\GIS\MMR\CIA\GIS\Spatial\MXD\20120109_FigureEdits\Figure_7.mxd
Drawn by: william.scales
Coordinate System: NAD 1983 UTM Zone 19N



Impact Area Groundwater Study Program

LEGEND

Legend

- Target
- Proposed Source Area Removal (30 Acres)
- Additional Source Area Removal (20 Acres)
- UXO Removed to Date
- J1 Range UXO Cleared Area
- Quarter-Acre Grid
- Central Impact Area

LOCATION MAP

NOTES & SOURCES

Map Projection: NAD 83, UTM, Zone 19N, Meters
Basemap data from US Geological Survey 7 1/2 minute
Topographic Map Source: MassGIS

TITLE

Conceptual UXO Source Removal Plan

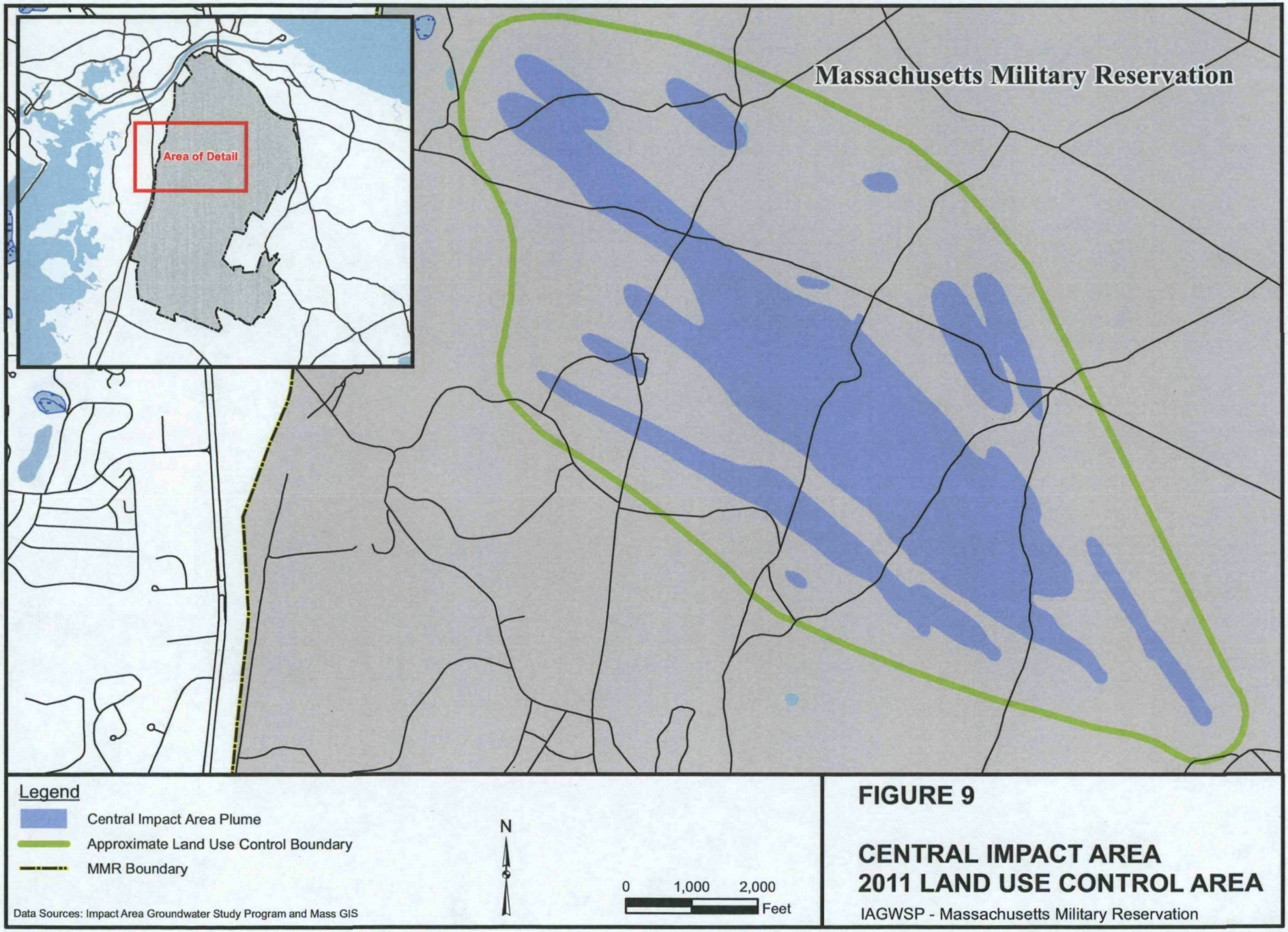
0 500 1,000 Feet

N

Tetra Tech EC, Inc.
160 Federal St.
Boston, MA 02110

File: P:\GIS\MMR\CIA\GIS\Spatial\MXD\2012\2012019_FigureEdits\Figure_8.mxd
Drawn by: william.scales
Coordinate System: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001

FIGURE 8


Massachusetts Military Reservation
Area of Detail
Legend
Central Impact Area Plume
Approximate Land Use Control Boundary
MMR Boundary
Data Sources: Impact Area Groundwater Study Program and Mass GIS
N
0
1,000
2,000
Feet
FIGURE 9
CENTRAL IMPACT AREA
2011 LAND USE CONTROL AREA
IAGWSP - Massachusetts Military Reservation

TABLES

Table 1
Summary of Alternatives

Scenario	Description	Cumulative Pumping Rate (gpm)	# of Extraction Wells	Years to <6 ppb RDX	Years to <2 ppb RDX	Years to <0.6 ppb RDX	Years to ND RDX	Estimated RDX Mass Captured (Kg)	Cost ($) [4]	Comment
Alternative 1	No Further Action	-	-	20	43	80	>100	-	325,000	
Alternative 2	Monitored Natural Attenuation with Land-Use Controls	-	-	20	43	80	>100	-	7,860,000	
Alternative 3	Focused Extraction with 1 Well (Spruce Swamp Road)	300	1	17	46	74	>100	5.5	22,900,000	EW could be shut down after 2035
Alternative 4 (Original)	Focused Extraction with 2 Wells (Burgoyne Road)	550	2	17	39	67	>100	7.0	17,200,000	South EW could be shut down after 2040, North EW after 2050
Alternative 4 (Modified)	Focused Extraction with 3 Wells (Burgoyne Road)[2]	550	3	17	37	45[1]	>100	7.1	18,200,000	EW could be shut down after 2055
Alternative 5	Focused Extraction with 3 Wells (2 Burgoyne Road and 1 Spruce Swamp)	700	3	17	39	45[1]	99	8.5	36,000,000	EW could be shut down after 2055
Alternative 6	Focused Extraction with 31 Wells[3]	6504	31	5	9	10	26	16	132,900,000	Select EWs could be shut down prior to 2020

Notes:

1) Values reflect "main body" of the plume and exclude isolated plumelet originating in the southeastern part of the CIA. This plumelet attenuates in approximately 65 years.

2) Southern extraction well will be replaced by the northern extraction well in 2035.

3) This alternative reduces contaminant concentration to levels that meet or exceed regulatory and risk-based standards in less than 10 years.

4) Costs do not include the long term UXO costs of approximately $600,000 per acre ($30,000,000 for 50 acres)

Table 2
Central Impact Area Feasibility Study
Summary of Regulatory Considerations

AUTHORITY/TYPE	PROVISION	SYNOPSIS
Federal/Chemical Specific	SDWA MCLs, 40 CFR 141.61 – 141.63	The EPA has promulgated SDWA MCLs (40 CFR 141-143) that are enforceable standards for public drinking water supplies. The standards protect drinking water quality by limiting the levels of specific contaminants that can adversely affect public health.
State/Chemical Specific	MA Drinking Water Regulations, 310 CMR 22.00	These standards establish Massachusetts MCLs (MMCLs) for public drinking water systems (310 CMR 22.00 et seq.).
Federal/Action Specific	SDWA 47 FR 30282 Sole Source Aquifer	Pursuant to Section 1424(e) of the Safe Drinking Water Act, the EPA has determined that the Cape Cod aquifer is the sole or principal source of drinking water for Cape Cod, Massachusetts, and that the Cape Cod aquifer, if contaminated, would create a significant hazard to public health.
Federal/Chemical Specific	Drinking Water Health Advisories, published at http://www.epa.gov/ waterscience/criteria/drinking/	These are exposure concentrations protective of adverse non-cancer effects for a given exposure period. The 1-day and 10-day HA are designed to protect a child; the lifetime HA is designed to protect an adult.
Federal/Chemical Specific	Drinking Water Equivalent Levels (DWELs), published at http://www.epa.gov/ waterscience/criteria/drinking/	DWELs set forth lifetime exposure concentration values protective of adverse, non-cancer health effects, assuming that all of the exposure to a contaminant is from drinking water.
Federal/Chemical Specific	Human Health Reference Doses (RfDs), Reference Concentrations (RfCs), Cancer Slope Factors (CSFs), and 10^{-6} excess lifetime cancer risk level	These risk-based concentrations are considered together with site-specific exposure information to develop concentrations of residual contamination that will not endanger human health.

Table 2
Central Impact Area Feasibility Study
Summary of Regulatory Considerations

State/Chemical Specific	Massachusetts Contingency Plan, Method 1, GW-1 Groundwater Standards, 310 CMR 40.0974(2) Table 1	These cleanup standards were developed by MassDEP considering a defined set of exposures considered to be a conservative estimate of the potential exposures at most sites. Groundwater at MMR is classified as GW-1.
State/Chemical Specific	Massachusetts Drinking Water Guidelines, in Standards and Guidelines for Chemicals in Massachusetts Drinking Waters (Spring 2009), available at http://www.mass.gov/dep/water/dwstand.pdf.	This document lists both promulgated Massachusetts MCLs and also MassDEP Office of Research and Standards guidelines for chemicals that do not have Massachusetts MCLs. Standards promulgated by EPA but not yet effective may be included on the Guidelines list. These values are derived based on a review and evaluation of all available data for the chemical of interest.
State/Action Specific	Massachusetts Surface Water Quality Standards, 314 CMR 4.00	These MassDEP standards prescribe the minimum water quality criteria required to sustain the designated uses of Massachusetts waters. The levels are designed to prevent all adverse health effects from ingestion, inhalation or dermal contact.
Federal/Action Specific	Subtitle C Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, 40 CFR Part 264	These requirements establish minimum national standards that define the acceptable management of hazardous waste.
State/Action Specific	MA Hazardous Waste Management Regulations (310 CMR 30.0000)	These requirements specify how a generator of solid waste must determine whether that waste is hazardous. If waste is determined to be hazardous, it must be managed in accordance with these requirements.

Table 2
Central Impact Area Feasibility Study
Summary of Regulatory Considerations

Federal/Action Specific	EPA Guidance on "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites" (9200.4-17P) (Apr. 21, 1999)	This guidance describes EPA's policy regarding the use of monitored natural attenuation (MNA) for the cleanup of contaminated soil and groundwater. It provides guidance regarding necessary site-specific characterization data and analysis, a methodology for determining a reasonable timeframe for remediation, a preference for remediation of sources, appropriate performance monitoring and evaluation, and a preference for contingency remedies.
Federal/Action Specific	Resource Conservation and Recovery Act (RCRA) [40 CFR 261 - 262]	These regulations govern the identification and listing of hazardous waste under RCRA, and the requirements on generators of hazardous waste.
Federal/Action Specific	RCRA Land Disposal Restrictions [40 CFR 268]	These regulations restrict the disposal of any treatment wastes classified as hazardous waste.
State/Action Specific	Solid Waste Management Regulations (RCRA Subtitle D), 310 CMR 19.000 et seq.	If a waste is determined to be a solid waste, it must be managed in accordance with the state regulations at 310 CMR 19.000 et seq.
Federal/Action Specific	Hazardous Waste Operations and Emergency Response, 29 CFR 1910.120	These regulations describe training, monitoring, planning, and other activities to protect the health of workers performing hazardous waste operations.

Table 2
Central Impact Area Feasibility Study
Summary of Regulatory Considerations

Federal/Action Specific	Underground Injection Control Program [40 CFR 114, 144, 146, 147, 148, 1000]	Underground Injection Control Program regulations outline minimum program and performance standards for underground injection wells and prohibit any injection that may cause a violation of any primary drinking water regulation in the aquifer. Infiltration galleries and wells fall within the broad definition of Class V wells. These regulations are administered by the State.
State/Action Specific	MassDEP Stormwater Management Program Policy (Nov. 18, 1996)	Provides policies and guidance on complying with the state's stormwater discharge requirements.
Federal/Action Specific	National Environmental Policy Act, 42 U.S.C. 4321-4370f	"EPA believes that NGB is not required to follow NEPA procedures, as long as the NGB's actions are conducted in accordance with the administrative order, because of the provision in the CEQ regulations exempting enforcement actions from NEPA." (USEPA, 1 March 01)
Federal/Action Specific	CWA NDPES Stormwater Discharge Requirements, 40 CFR 122.26	Establishes requirements for stormwater discharges associated with construction activities that result in a land disturbance of equal to or greater than one acre of land. The requirements include good construction management techniques; phasing of construction projects; minimal clearing; and sediment, erosion, structural, and vegetative controls to mitigate stormwater run-on and runoff.
State/Action Specific	Stormwater Discharge Requirements, 314 CMR 3.04 and 314 CMR 3.19	Requires that stormwater discharges associated with construction activities be managed in accordance with the general permit conditions of 314 CMR 3.19 so as not to cause a violation of Massachusetts surface water quality standards in the receiving surface water body (including wetlands).

Table 2
Central Impact Area Feasibility Study
Summary of Regulatory Considerations

State/Chemical Specific	Massachusetts Air Pollution Control Regulations [310 CMR 6.00 – 7.00]	Construction activities could trigger Massachusetts Air Pollution Control Regulations (310 CMR 6.00 – 7.00). These regulations set emission limits necessary to attain ambient air quality standards for fugitive emissions, dust and particulates.
State/Action Specific, Chemical Specific	310 CMR 40.0040 Construction and operation of a groundwater treatment plant	Regulations establish management procedures for remedial wastewater as well as the construction, installation, change, operation and maintenance of treatment works for Remedial Wastewater. Treatment works shall be inspected and the inspections documented. Treatment works shall be protected from vandalism and measures shall be taken to prevent system failure, contaminant pass through, interference, by-pass, upset, and other events likely to result in a discharge of oil and/or hazardous material to the environment.
State/Action Specific, Chemical Specific	Discharge of Groundwater 310 CMR 40.0045	Regulations restrict remedial wastewater discharge to the ground surface or subsurface and/or groundwater. Such a discharge should not erode or impair the functioning of the surficial and subsurface soils, infiltrate underground utilities, building interiors or subsurface structures, result in groundwater mounding within two feet of the ground surface, or result in flooding or breakout to the ground surface. The concentrations of all pollutants discharged must be below the Massachusetts Groundwater Quality Standards established by 314 CMR 6.0. The concentrations must also be below the applicable Reportable Concentrations established by 310 CMR 40.0300 and 40.1600.

Table 2
Central Impact Area Feasibility Study
Summary of Regulatory Considerations

State/Action Specific	Discharge of Groundwater 310 CMR 40.0300 and 310 CMR 40.1600	The MCP contains special provisions for the discharge of groundwater containing very low levels of oil or hazardous material. Groundwater containing oil and/or hazardous material in concentrations less than the applicable release notification threshold established by 310 CMR 40.0300 and 40.1600, can be discharged to the ground subsurface and/or groundwater only when following appropriate guidelines.
State/Action Specific	Groundwater Discharge Regulations [314 CMR 5.00]	Recharge of effluent from some treatment works requires a permit under Groundwater Discharge Regulations at 314 CMR 5.00 unless the exemption allowing for actions taken in compliance with MGL C. 21E and regulations at 40 CMR 40.00 applies. The effluent discharged must not exceed any Massachusetts Groundwater Quality Standards and effluent limitations in 314 CMR 5.10(3). For previous projects on MMR, the MassDEP has determined that effluent from any constructed treatment system is "conditionally exempt" from obtaining the permit provided that the applicable or relevant provisions of the MCP 310 CMR 40.0000 are complied with.
State/Action Specific	MassDEP Drinking Water Program, Private Well Guidelines (2008), available at http://www.mass.gov/dep/water/laws/prwellgd.pdf	These are guidelines concerning private well location, design, construction, development, water quality testing, operation, maintenance, and decommissioning.
State/Action Specific	Underground Injection Control [310 CMR 27.00]	These regulations prohibit injection of fluid containing any pollutant into underground sources of drinking water where such pollutant will, or is likely to, cause a violation of any state drinking water standard or adversely affect the health of persons.

Table 2
Central Impact Area Feasibility Study
Summary of Regulatory Considerations

State/Action Specific	STATE - MA Erosion and Sediment Control Guidelines for Urban and Suburban Areas (May 2003), available at http://www.mass.gov/dep/water/essec1.pdf	Provides guidance and best management practices regarding erosion and sediment control.
Federal/Action Specific	Archaeological Resources Protection Act, 16 U.S.C. §§ 470aa-ll, 43 CFR Part 7; Native American Graves Protection and Repatriation Act, 25 U.S.C. §§ 3001-3013, 43 CFR Part 10, National Historic Preservation Act, 16 U.S.C. §§ 470 et seq., 36 CFR Part 800; Massachusetts Historic Preservation Act, MGL ch. 9 §§ 26-27C; MGL ch. 7, § 38A; MGL ch. 38, §§ 6B-6C; 950 CMR 70-71.	These statutes and regulations provide for the protection of historical, archaeological, and Native American burial sites, artifacts, and objects that might be lost as a result of a federal construction project.
State/Action Specific	Massachusetts Endangered Species Act.	The Massachusetts Endangered Species Act provides that impacts to state-listed endangered or threatened species, or species of special concern or their habitats from actions are to be avoided, minimized, and/or mitigated.

*Regulations that EPA will either consider or require, as appropriate, in selecting and defining the remedial action as specified in the final decision document.

APPENDIX A
MassDEP Letter of Concurrence

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

One Winter Street Boston, MA 02108 • 617-292-5500

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

RICHARD K. SULLIVAN JR.
Secretary

KENNETH L. KIMMELL
Commissioner

March 2, 2012

Mr. James T. Owens III, Director
Office of Site Remediation and Restoration
U.S. Environmental Protection Agency, Region I
5 Post Office Square Suite 100
Boston, MA 02109-3912

RE: **BOURNE**
Release Tracking Number: 4-0015031
Massachusetts Military Reservation (MMR)
Central Impact Area Soil and Groundwater Operable Units, Decision Document,
Concurrence

Dear Mr. Owens:

The Massachusetts Department of Environmental Protection (MassDEP) has reviewed the document entitled **"Decision Document Central Impact Area, Soil and Groundwater Operable Units"** (Decision Document), dated February 2012. The Decision Document presents the selected remedy for the groundwater contamination and the source areas contributing to groundwater contamination at and emanating from the Central Impact Area (CIA) Soil and Groundwater Operable Units (Site), located on Camp Edwards at the Massachusetts Military Reservation (MMR). The CIA is a 330-acre portion of MMR, located within the Towns of Bourne and Sandwich, where artillery and mortar targets were concentrated. The remedy was selected by the United States Environmental Protection Agency (EPA) in accordance with Section 1431(a) of the Safe Drinking Water Act (SDWA), 42 USC §300i(a), as amended and Administrative Order No. SDWA-1-2000-0014 (AO3), which includes consideration of the substantive cleanup standards set forth under M.G.L. c. 21E and 310 CMR 40.0000, the Massachusetts Contingency Plan (MCP). The U.S. Army (Army) and the National Guard Bureau (NGB) are Respondents under EPA AO3.

Groundwater

The EPA, in consultation with MassDEP, has selected a response action for the Central Impact Area Groundwater Operable Unit under which the EPA-designated Sole Source Aquifer and the MassDEP-designated Potentially Productive Aquifer will be restored. Portions of Camp Edwards, including the CIA, have been set aside as a drinking water supply reserve by the Massachusetts legislature. Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) and perchlorate have been identified as the Contaminants of Concern (COCs) for the CIA Groundwater Operable Unit. These COCs were used to develop and evaluate a range of potential response actions for groundwater. Groundwater modeling was used to determine the feasibility of the alternatives; because the perchlorate and RDX plumes are co-located and remediation of RDX will also remediate perchlorate, the selected response action was based on the remediation of

the RDX plume. The cleanup objectives for the CIA Groundwater Operable Unit include: (1) restoration of the useable groundwater to its beneficial use, wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site; (2) the provision of a level of protection in the aquifer that takes into account that the Cape Cod Aquifer, including the Sagamore Lens, is a sole source aquifer that is susceptible to contamination; and (3) the prevention of ingestion and inhalation of groundwater containing the COCs, in excess of federal Maximum Contaminant Levels (MCLs), Health Advisories (HA), Drinking Water Equivalent Levels (DWELs), applicable State standards or unacceptable excess lifetime cancer risk (ELCR) or non-cancer Hazard Index (HI).

EPA has identified *Alternative 4-(Modified) Focused Extraction with Three Wells, Monitored Natural Attenuation and Land-use Controls* as the selected remedy for the CIA Groundwater Operable Unit. The selected remedy will be comprised of two focused extraction wells pumping at a cumulative rate of 550 gallons per minute (gpm). Contaminated water will be conveyed to the Demolition Area 1 groundwater treatment facility on Camp Edwards for treatment by granular activated carbon (GAC) prior to reinjection to the aquifer. The exact location of the extraction wells will be determined based on the most recent groundwater sampling data and will be optimized to achieve the best balance between efficiency, cleanup time, cost, implementability and environmental and worker impacts. The groundwater cleanup level for RDX is the EPA risk-based level that results in an ELCR of one in a million (10^{-6}), currently 0.6 µg/L. The groundwater cleanup level for perchlorate is the 2 µg/l Massachusetts Maximum Contaminant Level (MMCL).

Soil/Source Areas

EPA, in consultation with MassDEP, has chosen a phased plan for removal of unexploded ordnance (UXO) and contaminated soil for the CIA Soil Operable Unit. The response actions taken to date as a component of the investigation of the nature and extent of contamination at the source areas within the CIA have addressed known areas of soil contamination and have removed approximately 820 items of UXO over a 56 acre area. However, it is estimated that 4,000 to 9,000 UXO items remain within the CIA. A Long Term Source Area Response Plan will be developed and implemented in a phased approach to address these items and any soil contamination that may be discovered in these areas. The first phase will consist of removal of UXO and contaminated soil throughout an additional 30 acres of the CIA over a 3 year period, followed by a second phase of UXO and soil removal on an additional 20 acres. The development and implementation of additional phases of UXO and soil removal, if necessary, will be based on the results of these first two phases. A Work Plan for the first phase of the Long Term Source Area Response Plan will be developed by the Army/NGB within sixty (60) days of the issuance of the Decision Document and submitted to the EPA and MassDEP for review. The Work Plan will be approved by EPA, in consultation with MassDEP. A Work Plan for the second phase of the Long Term Source Area Response Plan will be developed by the Army/NGB within sixty (60) days of the completion of the first phase. The Work Plan for the second phase will take into account information gathered from the first phase and will be submitted to the EPA and MassDEP for review. The Work Plan for the second phase will be approved by EPA, in consultation with MassDEP.

The Work Plans for the first two phases of the Long Term Source Area Response Plan will employ techniques to minimize habitat destruction while maximizing the reduction of UXO with a goal to remove 75% to 95% of the UXO within the fifty acres covered by the first two phases. It is MassDEP's expectation that the Army/NGB and the EPA will coordinate closely with the Department of Fish and Game (DFG), Division of Fisheries and Wildlife (DFW) and the Natural Heritage and Endangered Species Program (NHESP) during the development and implementation of the Work Plans.

Determination

MassDEP concurs with the selected remedy in the *Decision Document Central Impact Area, Soil and Groundwater Operable Units*, dated February 2012. The selected remedy consists of Focused Extraction with Monitored Natural Attenuation and Land Use Controls (LUCs) for groundwater and a phased approach for UXO removal at the CIA Source Area. This remedy is designed to ensure a sufficient level of control for the CIA Groundwater Operable Unit such that none of the contamination associated with the CIA groundwater will present a significant risk of harm to health, safety, public welfare or the environment during any foreseeable period of time, and has also been designed to reduce the level of contaminants to background, consistent with the MCP. LUCs will minimize the potential for exposure to the CIA groundwater. The aquifer is anticipated to be completely restored to its beneficial uses within a reasonable period of time.

In addition to preparing annual reports on groundwater monitoring and verification of LUCs, the Army will evaluate the selected response actions every five years. EPA, in consultation with MassDEP, will review this evaluation and any other relevant information (such as new regulatory requirements or changes in environmental conditions) to determine if additional investigative and/or remedial measures are necessary. The Long Term Source Area Response Plan for UXO removal will be evaluated periodically to determine if additional actions and/or more expedited actions are needed to protect groundwater or if new/improved technologies are available.

Areas exist within the CIA where UXO and the soil beneath may pose public safety risks, ecological risks, dermal contact risks, and/or soil ingestion risks. These potential UXO-related public safety, ecological, dermal contact and/or soil ingestion risks may not be fully addressed by this Decision Document because this Decision Document addresses directly only the risks from groundwater exposure. MassDEP will continue to work with the Massachusetts Army National Guard (MANG), the Army/NGB, the Environmental Management Commission (EMC) and the DFG to mitigate the risk posed by soil contamination and UXO by establishing and implementing LUCs and other measures at the CIA.

MassDEP's concurrence with the remedy selected by the USEPA set forth in the Decision Document is based upon representations made to MassDEP by the Army/NGB and assumes that all information provided is substantially complete and accurate. MassDEP reserves its authority under M.G.L. c. 21E, CERCLA, the MCP, the NCP and any other applicable law or regulation to require further response actions at the Central Impact Area Soil and Groundwater Operable Units including, without limitation, additional investigation, remedial measures, the implementation of LUCs and actions to address potential UXO-related public safety, ecological, dermal contact and/or soil ingestion risks. MassDEP will review relevant information as it becomes available to determine if additional investigative and/or remedial measures are necessary for the protection of public health, safety, welfare or the environment at the Central Impact Area Soil and Groundwater Operable Units. This includes information acquired after the implementation of the groundwater remedy including, without limitation, new regulatory requirements or changes in the environmental conditions at the Site.

Please incorporate this letter into the Administrative Record for the Central Impact Area Soil and Groundwater Operable Units. If you have any questions regarding this matter, please contact Leonard J. Pinaud, Chief, State & Federal Sites Management Section in MassDEP's Southeast Region, at (508) 946-

2871 or Millie Garcia-Serrano, Deputy Regional Director of the Bureau of Waste Site Cleanup, at (508) 946-2727.

Sincerely,

Benjamin J. Ericson
Assistant Commissioner
Bureau of Waste Site Cleanup
Massachusetts Department of Environmental Protection

E/lp/

File : 4-0015031 Central Impact Area DD Letter 03-02-2012

Ec: Gary Moran, Deputy Commissioner
David Johnston, Regional Director
Millie Garcia-Serrano, Deputy Regional Director
Leonard J. Pinaud, Chief, State & Federal Site Management Section
Rebecca Tobin, Regional Counsel
Mark Begley, Environmental Management Commission
Richard Lehan, Department of Fish and Game
Colonel Richard Crivello, Post Commander, HQ Camp Edwards
MassDEP Southeast Region
MMR Senior Management Board
MMR Plume Cleanup Team
Upper Cape Boards of Selectmen
Upper Cape Boards of Health

APPENDIX B
GLOSSARY OF TERMS AND ACRONYMS

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GLOSSARY OF TERMS AND ACRONYMS

2A-DNT	2-amino-4,6-dinitrotoluene, a breakdown product of the explosive TNT
4A-DNT	4-amino-2,6-dinitrotoluene, a breakdown product of the explosive TNT
AFCEE	U.S. Air Force Center for Environmental Excellence
AO	Administrative Order
Background	A background level is the concentration of a hazardous substance that represents the level of the substance in an undisturbed environmental setting at or near the site.
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
COC	Contaminant of Concern
DMM	Discarded Military Munitions
DWEL	Drinking Water Equivalent Level
EPA	United States Environmental Protection Agency
FS	Feasibility Study
ft	feet
GMP	Gun and Mortar Position
HA	Health Advisory; EPA guidelines that represent the concentration of a chemical in drinking water that, given a lifetime of exposure, is not expected to cause adverse, non-cancerous, effects.
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine, an explosives compound
IAGWSP	Impact Area Groundwater Study Program
IART	Impact Area Review Team
kettle hole	a depression that in the ground surface that was formed during the last ice age from the melting of a remnant glacial ice block
LUC	Land Use Control
MassDEP	Massachusetts Department of Environmental Protection
MC	Munitions Constituents
MCL	Maximum Contaminant Level (Federally-promulgated)
MEC	Munitions and Explosives of Concern
mg/Kg	Milligrams per Kilogram
MMCL	Massachusetts Maximum Contaminant Level (State-promulgated)
MMR	Massachusetts Military Reservation
O&M	Operation and Maintenance
OU	Operable Unit

oxidizer	A substance that gives up oxygen easily to stimulate combustion of organic material
perchlorate	A water-soluble salt used as an oxidizer
ppb	parts per billion, a measure of concentration in liquid, e.g. one part of contaminant in one billion parts of water is 1 ppb, or 1 microgram per liter
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine / Royal Demolition Explosive, an explosives compound
RI/FS	Remedial Investigation/Feasibility Study
RRA	Rapid Response Action (an interim cleanup action taken to reduce contamination while the investigation and selection, design and implementation of a comprehensive cleanup plan is completed)
RSP	Remedy Selection Plan, the plan outlining the cleanup alternatives and the proposed plan
SDWA	Safe Drinking Water Act
SVOC	semi-volatile organic compound
TNT	Trinitrotoluene, an explosives compound
ug/Kg	Micrograms per Kilogram
ug/L	Micrograms per Liter
UXO	Unexploded Ordnance
VOC	volatile organic compound

APPENDIX C
INDEX OF KEY SUPPORTING DOCUMENTS

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Completion of Work Report, Rapid Response Action – May 2002

Final Central Impact Area Post-Screening Investigation Aquifer Test Summary Report - April 2003

Draft Saturated Zone Flow and Transport Modeling Summary Report – June 2003

Final Chemical Spill-19 Remedial Investigation Report (AFCEE) – October 2003

Central Impact Area Focused Investigation Report – November 2004

Final Completion of Work Report, Rapid Response Action at Targets 23 and 42 – August 2005

Final Central Impact Area Post-Screening Investigation Source Characterization Workplan – June 2006

Final Chemical Spill-19 Source Removal Action Report (AFCEE) – September 2009

Central Impact Area Groundwater Monitoring Report – June 2010

Final Central Impact Area Feasibility Study – July 2011

Final Central Impact Area Source Investigation Summary – July 2011

Final Central Impact Area Remedy Selection Plan – July 2011

APPENDIX D
SOIL AND GROUNDWATER SCREENING

Table 6-2
Central Impact Area
Groundwater Screening

Detected Analyte	Maximum Concentration (ug/L)	Location of Maximum Concentration (Date of Collection)	Detection Frequency	Maximum Contaminant Level (MCL) [a] (ug/L)	EPA Chronic (Lifetime) Health Advisory (HA) for Drinking Water [b] (ug/L)	EPA Regional Screening Level (RSL) for Tapwater [c] (ug/L)	Massachusetts Contingency Plan (MCP) GW-1 Standard [d] (ug/L)
2,4,6-TRINITROTOLUENE	1.6 J	MW-40S (10/09/03)	18 / 2651	-	1	2.2	-
2,6-DINITROTOLUENE (BY 8330)	0.59 J	MW-141S (08/24/01)	1 / 2651	-	0.05	37	-
2-AMINO-4,6-DINITROTOLUENE	0.82	MW-91S (06/08/10); MW-40S (04/26/05)	31 / 2651	-	-	73	-
4-AMINO-2,6-DINITROTOLUENE	1.2	MW-40S (04/26/05; 06/02/01)	67 / 2651	-	-	73	-
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE (RDX)	45	MW-235M1 (05/01/06)	1531 / 2651	-	2	0.61	1
HEXAHYDRO-1-MONONITROSO-3,5-DINITRO-1,3,5-TRIAZINE (MNX) [e]	0.85	MW-235M1 (09/29/05)	8 / 329	-	2	0.61	1
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRAZOCINE (HMX)	4.7	MW-91S (04/19/06)	556 / 2651	-	400	1800	200
PERCHLORATE [f]	9.9	MW-89M2 (06/02/09)	562 / 1591	-	15	26	2
ALUMINUM	11600	MW-02S (02/23/98)	49 / 272	-	-	37000	-
ANTIMONY	12.4 J	MW-38M2 (10/14/05)	12 / 278	*6*	*6*	*15*	*6*
ARSENIC	6.6 J	MW-01D (09/07/99)	16 / 272	10	0.02	0.045	10
BARIUM	154	MW-02S (02/23/98)	79 / 272	2000	7000	7300	2000
BERYLLIUM	1.3	MW-02S (02/23/98)	9 / 272	4	70	73	4
BORON	24.8	MW-02S (02/23/98)	142 / 256	-	1000	7300	-
CADMIUM	3.1	MW-26 (03/17/99)	9 / 272	5	5	18	5
CALCIUM	13900	MW-02S (12/01/01)	267 / 273	-	-	-	-
CHROMIUM, TOTAL	59.9	MW-02S (02/23/98)	29 / 272	100	100	-	100
COBALT	3.8	MW-25 (10/16/97)	16 / 272	-	-	11	-
COPPER	41.7	MW-40M1 (04/14/00)	44 / 272	1300	-	1500	-
IRON	29900	MW-02S (02/23/98)	79 / 274	-	-	26000	-
LEAD	20.1	MW-02S (02/23/98)	6 / 272	15	-	-	15
MAGNESIUM	3350	MW-02D (11/19/97)	267 / 273	-	-	-	-
MANGANESE	643	MW-02S (02/23/98)	206 / 273	-	300	880	-
MERCURY	0.16 J	MW-38D (05/17/00)	4 / 272	2	2	0.57	2
MOLYBDENUM	72.1	MW-02S (02/23/98)	43 / 256	-	40	180	-
NICKEL	16	MW-02S (02/23/98)	38 / 272	-	100	730	100
NITROGEN, AMMONIA (AS N)	120	MW-59M1 (11/16/99)	38 / 141	-	30000	-	-
NITROGEN, NITRATE-NITRITE [g]	1000	MW-38M3 (11/10/99)	106 / 143	1000	1000	3700	-
POTASSIUM	4500	MW-41M1 (08/19/99)	200 / 272	-	-	-	-
SELENIUM	3.3 J	MW-38S (08/18/99)	4 / 272	50	50	180	50
SILVER	2.9	MW-38M2 (05/11/99)	7 / 272	-	100	180	100
SODIUM	27200	MW-02S (02/23/98)	272 / 272	-	-	-	-
THALLIUM	5.3 J	MW-25 (09/14/99)	14 / 273	2	0.5	-	2
VANADIUM	12.5	MW-02D (11/19/97)	14 / 272	-	-	180	30
ZINC	40 J	MW-26 (03/17/99)	95 / 272	-	2000	11000	5000
GAMMA-CHLORDANE	0.009 NJ	MW-50D (04/27/99)	2 / 156	2	0.1	0.19	2
4-(2,4-DICHLOROPHENOXY)BUTYRIC ACID (2,4 DB)	2.4 NJ	MW-23M1 (09/13/99)	1 252	-	-	290	-
TRICHLOROPHENOXYACETIC ACID (2,4,5-T)	1.4 NJ	MW-44M2 (04/03/00)	11 / 252	-	70	370	-
BENTAZON	3.8 NJ	MW-23M1 (09/13/99)	1 / 172	-	200	1100	-
CHLORAMBEN	1 NJ	MW-38D (11/11/99)	12 / 194	-	100	550	-
DCPA (DACTHAL)	0.21	MW-02D (02/02/99)	2 / 225	-	70	370	-
DICAMBA	0.17 J	MW-23M1 (06/10/02)	3 / 252	-	4000	1100	-
MCPP [h]	110 NJ	MW-50M2 (11/13/00)	1 / 250	-	30	37	-
PENTACHLOROPHENOL	1.8 J	MW-41M1 (5/18/00)	5 / 203	1	0.3	0.56	1
PICLORAM	0.13 NJ	MW-44M2 (04/03/00)	2 / 166	500	700	2600	-

Table 6-2
Central Impact Area
Groundwater Screening

Detected Analyte	Maximum Concentration (ug/L)	Location of Maximum Concentration (Date of Collection)	Detection Frequency	Maximum Contaminant Level (MCL) [a] (ug/L)	EPA Chronic (Lifetime) Health Advisory (HA) for Drinking Water [b] (ug/L)	EPA Regional Screening Level (RSL) for Tapwater [c] (ug/L)	Massachusetts Contingency Plan (MCP) GW-1 Standard [d] (ug/L)
2,6-DINITROTOLUENE (BY 8270)	5 J	MW-41M1 (08/19/99)	1 / 201	-	0.05	37	-
2-METHYLPHENOL (o-CRESOL)	21	MW-477M1 (05/10/07)	2 / 201	-	-	1800	-
4-METHYLPHENOL (p-CRESOL)	28	MW-477M1 (05/10/07)	3 / 201	-	-	180	-
BENZYL ALCOHOL	7.3	MW-477M1 (05/10/07)	1 / 188	-	-	3700	-
bis(2-ETHYLHEXYL) PHTHALATE	24	MW-02M2 (01/20/98)	34 / 201	6	3	4.8	6
DIETHYL PHTHALATE	2 J	MW-37M2 (09/29/99); MW-40M1 (09/21/99)	2 / 201	-	30000	29000	2000
DI-n-BUTYL PHTHALATE	0.33 J	MW-477M1 (05/10/07)	1 / 201	-	4000	3700	-
DI-n-OCTYLPHTHALATE	0.41 J	MW-38M2 (08/14/01)	1 / 201	-	-	-	-
PHENOL	5.3	MW-477M1 (05/10/07)	1 / 201	-	2000	11000	1000
ACETONE	15 J	MW-02S (02/23/98)	8 / 244	-	-	22000	6300
BENZENE	0.4 J	MW-02M2 (01/20/98)	1 / 281	5	1	0.41	5
BROMODICHLOROMETHANE	0.4 J	MW-02M1 (01/21/98)	1 / 281	80	1	0.12	3
BROMOMETHANE	0.52 J	MW-477M2 (05/10/07)	1 / 281	-	10	8.7	10
CARBON DISULFIDE	3	MW-02D (02/02/99)	2 / 281	-	-	1000	-
CHLOROFORM [i]	5	MW-97M3 (12/16/01)	59 / 281	80	70	0.19	70
CHLOROMETHANE	0.5 J	MW-02M1 (11/20/03)	7 / 281	-	30	190	-
DIBROMOCHLOROMETHANE	0.9 J	MW-02M1 (01/21/98)	2 / 281	80	0.8	0.15	2
tert-BUTYL METHYL ETHER	2 J	MW-01D (10/01/97)	3 / 177	-	-	12	70
TETRACHLOROETHYLENE (PCE)	0.36 J	MW-477M1 (01/08/07)	1 / 281	5	10	0.11	5
TOLUENE	18	MW-02S (02/23/98)	22 / 281	1000	3000	2300	1000

NOTES:

Data set consists of all sampling events for the 140 monitoring wells presented within Table 6-1.

Laboratory data validation qualifier codes used for the "Maximum Concentration" are as follows:

J = Estimated Concentration

NJ = Presumptively Identified Compound, Estimated Concentration

Yellow highlighting indicates those groundwater criteria that have been exceeded by the maximum detected concentration.

- = No listed value.

(a) Federal Maximum Contaminant Level (MCL)

(b) HA is the Federal EPA Lifetime Health Advisory value (June, 2006) (http://www.epa.gov/waterscience/criteria/drinking/dwstandards.pdf) with the exception of perchlorate. The USEPA Interim Drinking Water Health Advisory is used for both RDX (the chronic lifetime value) and perchlorate (USEPA, 2007). (http://www.epa.gov/ogwdw000/contaminants/unregulated/pdfs/healthadvisory_perchlorate_interim.pdf). The HA shown is the lowest of either the Lifetime listing or the $1x10^{-6}$ Cancer Risk level. If neither of these values was available, the Drinking Water Equivalent Level (DWEL) is shown. If no DWEL was available, then the 1--Day acute concentration is shown.

(c) The USEPA Regional Screening Level (RSL) for Tapwater, May, 2010. (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)

(d) MCP Method 1 GW-1 Standards, May 2009 (http://www.mass.gov/dep/service/compliance/riskasmt.htm)

(e) RDX used as a surrogate for the HA, RSL, and MCP GW-1 Standard for hexahydro-1-mononitroso-3,5-dinitro-1,3,5-triazine.

(f) The MCP GW-1 Standard for perchlorate is also the Massachusetts MCL.

(g) The MCL for nitrate is 10,000 ug/L and the RSL is 58,000 ug/L. Values shown are for nitrite which was conservatively chosen for screening purposes. The HA shown is the 10-day HA for nitrate + nitrite.

(h) MCPA used as a surrogate for the HA value for MCPP.

(i) The MCL for Total Trihalomethanes is used for chloroform.

Table 6-3
Central Impact Area
Soil Screening

Detected Analyte	Maximum Concentration (mg/Kg)	Location of Maximum Concentration (depth ft)	Detection Frequency	MCP S-1/GW-1 Standard[a] (mg/Kg)	MMR SSL[b] (mg/Kg)	EPA RSL Risk-Based SSL[c] (mg/Kg)	MassDEP Leaching-Based Soil Concentration[a] (mg/Kg)	MMR Outwash Background Concentration (0 - 2 ft bgs)[d] (mg/Kg)
1,3,5-TRINITROBENZENE	9 J	SS176A (0-0.3)	15 / 3801	-	-	3.9	-	-
1,3-DINITROBENZENE	1.9 J	SS00121-A (0-0.8)	6 / 3802	-	-	0.0033	-	-
2,4,6-TRINITROTOLUENE by 8330	21000 D	SS00121-A (0-0.8)	152 / 3797	-	0.00021	0.013	-	-
2,4-DIAMINO-6-NITROTOLUENE	0.1 J	SS08915-A (0-1)	1 / 3731	-	-	-	-	-
2,4-DINITROTOLUENE by 8330	44 J	SS00121-A (0-0.8)	24 / 3800	0.7	0.020	0.00029	0.057	-
2,6-DINITROTOLUENE by 8330	0.168	SS04871-A (2.8-3)	8 / 3798	-	0.0088	0.05	-	-
2-AMINO-4,6-DINITROTOLUENE by 8330	16	SS00224-A (0-0.3), SS00263-A (0-0.3)	176 / 3797	-	0.00038	0.056	-	-
2-NITROTOLUENE (o-NITROTOLUENE)	0.253	SS00110-A (1-1.3)	17 / 3801	-	0.0022	0.00029	-	-
3-NITROTOLUENE (m-NITROTOLUENE)	0.14	SSCS19BK6D (0-0.3)	7 / 3797	-	-	0.0034	-	-
4-AMINO-2,6-DINITROTOLUENE	22 J	SS00224-A (0-0.3)	149 / 3797	-	0.00038	0.056	-	-
4-NITROTOLUENE (p-NITROTOLUENE)	0.98	SS00121-A (0-0.8)	11 / 3798	-	0.026	0.0039	-	-
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE (RDX)	77	SSCIATP040 (0-0.25)	188 / 3786	1	0.00011	0.00023	0.0017	-
NITROBENZENE	2.61 J	SS00278-A (1-1.5)	3 / 3804	-	-	0.000079	-	-
NITROGLYCERIN	242	SS04892-A (0.3-0.5)	4 / 3759	-	0.001	0.0016	-	-
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRAZOCINE (HMX)	24	SS111A (0-0.25)	96 / 3786	2	0.32	2.3	0.34	-
PENTAERYTHRITOL TETRANITRATE	7 NJ	CP02L (0-0.5)	2 / 3800	-	-	-	-	-
PICRIC ACID	0.36 J	CP02H (0-0.5)	7 / 3697	-	0.03	-	-	-
TETRYL	5.5	SS00064-A (0-0.8)	22 / 3800	-	0.064	1.4	-	-
PERCHLORATE	41	SS04891-A (1-1.2)	129 / 671	0.1	0.0031	-	-	-
PHOSPHORUS, TOTAL ORTHOPHOSPHATE (AS PO4)	780 J	CP11D (1.5-2)	447 / 447	-	-	-	-	291
ALUMINUM	57200	SS120B (0-0.3)	1499 / 1499	-	54006	55000	-	16000
ANTIMONY	9.8 J	SS00236-A (0-0.3)	268 / 1496	20	0.27	0.66	-	1.9
ARSENIC	40.2 J	SS00236-A (0-0.3)	1246 / 1567	20	0.009	0.0013	-	5.5
BARIUM	1310	SSCIATP093 (0-0.3)	1503 / 1568	1000	120	300	-	24
BERYLLIUM	1.4	SS04J (0.5-1)	1219 / 1502	100	2.6	58	-	0.38
BORON	29	SS08802-A (0-0.3)	599 / 1423	-	9.5	23	-	9.6
CADMIUM	410	SS00236-A (0-0.3)	861 / 1593	2	0.4	1.4	-	0.94
CALCIUM	1800 J	SSCIATP091 (0-0.3)	1299 / 1499	-	-	-	-	-
CHROMIUM, TOTAL	71.8	SS00236-A (0-0.3)	1470 / 1567	30	7	-	-	19
COBALT	12.2	SS00236-A (0-0.3)	1393 / 1499	-	132	0.49	-	4
COPPER	6990	SSCIATP091 (0-0.3)	1485 / 1524	-	46	51	-	11
CYANIDE	6.8	SSCIATP075 (0-0.3)	45 / 577	100	0.0011	7.4	-	-
IRON	248000	SS00236-A (0-0.3)	1499 / 1499	-	2422	640	-	17800
LEAD	1320	SSCIATP091 (0-0.3)	1567 / 1571	300	4.1	-	-	19
MAGNESIUM	3360	CP03E (1.5-2)	1498 / 1499	-	-	-	-	2010
MANGANESE	2120 J	SS00236-A (0-0.3)	1499 / 1499	-	44	-	-	134
MERCURY	16.6	AM081301-01 (0-0.3)	341 / 1570	20	0.02	0.03	-	0.12
MOLYBDENUM	14.2	SS00236-A (0-0.3)	745 / 1426	-	0.18	3.7	-	1.2
NICKEL	379	SS08889-A (0-0.3)	1407 / 1499	20	292	48	-	10
NITROGEN, AMMONIA (AS N)	88.9	SS141C (0-0.3)	415 / 447	-	-	-	-	38
NITROGEN, NITRATE-NITRITE	3.6 J	SS141D (0-0.3)	324 / 442	-	-	-	-	-
POTASSIUM	1750	SS04J (0.5-1)	1432 / 1499	-	-	-	-	766
SELENIUM	15.1	OG042800-02 (0-0.3)	411 / 1547	400	2.8	0.95	-	1.7
SILVER	23.8	AM062001-01 (0-0.2)	252 / 1539	100	16	1.6	-	0.74
SODIUM	1150 J	SS08850-A (3-6)	269 / 1496	-	-	-	-	-
THALLIUM[e]	16.3	SS00236-A (0-0.3)	167 / 1494	8	3	-	-	1.6
TITANIUM	300	SS122B (0.5-1)	2 / 2	-	-	-	-	-
VANADIUM	51.8	SS05053-A (0-0.2)	1493 / 1499	-	260	180	-	28.8
ZINC	1360	SSCIATP087 (0-0.3)	1482 / 1499	2500	2202	680	-	25.6

Table 6-3
Central Impact Area
Soil Screening

Detected Analyte	Maximum Concentration (mg/Kg)	Location of Maximum Concentration (depth ft)	Detection Frequency	MCP S-1/GW-1 Standard[a] (mg/Kg)	MMR SSL[b] (mg/Kg)	EPA RSL Risk-Based SSL[c] (mg/Kg)	MassDEP Leaching-Based Soil Concentration[a] (mg/Kg)	MMR Outwash Background Concentration (0 - 2 ft bgs)[d] (mg/Kg)
ALDRIN	0.0023 J	SS179B (0.5-1)	3 / 846	0.04	0.0098	0.00065	-	-
ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	0.0055	CP03N (0-0.5)	20 / 846	-	0.000062	0.000062	-	-
ALPHA ENDOSULFAN	0.0031 J	CP03F (0-0.5)	6 / 846	-	1.3	-	-	-
ALPHA-CHLORDANE[f]	0.0058 J	SS116B (0.3-0.5)	34 / 846	0.7	0.00038	0.013	-	-
BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	0.015 NJ	SS181B (0.3-0.5)	15 / 846	-	0.0002	0.00022	-	-
DDD (1,1-bis(CHLOROPHENYL)-2,2-DICHLOROETHANE)	0.00329 J	SS09021-A (9-12)	4 / 178	4	0.28	0.066	-	-
DDE (1,1-bis(CHLOROPHENYL)-2,2-DICHLOROETHENE)	0.0104 J	SS08914-A (3-6)	2 / 178	3	0.88	0.047	-	-
DDT (1,1-bis(CHLOROPHENYL)-2,2,2-TRICHLOROETHANE)	0.00122 J	SS08924-A (3-6)	4 / 178	3	0.53	0.067	-	-
DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	0.0015 J	SS89B (0-0.3)	11 / 846	-	-	-	-	-
DIELDRIN	0.019 NJ	SS183B (0-0.3)	9 / 846	0.05	0.0008	0.00017	-	0.03
ENDOSULFAN SULFATE[g]	0.0069 NJ	SS116B (0-0.3)	4 / 846	-	2.2	-	-	-
ENDRIN	0.0043	SS184A (0-0.3)	5 / 846	8	0.19	0.44	-	-
ENDRIN ALDEHYDE[h]	0.0132	SS08873-A (9-12)	70 / 859	-	0.19	-	-	-
ENDRIN KETONE[h]	0.0056 NJ	SS86B (0-0.3)	5 / 846	-	0.19	-	-	-
GAMMA BHC (LINDANE)	0.0024 J	SS141D (0-0.3)	4 / 846	0.003	0.00073	0.00036	0.0028	-
GAMMA-CHLORDANE[f]	0.00979 J	SS08914-A (3-6)	3 / 846	0.7	0.00038	0.013	-	-
HEPTACHLOR	0.0015 NJ	SS116B (0.3-0.5)	8 / 846	0.2	0.021	0.0012	-	-
HEPTACHLOR EPOXIDE	0.0039	SS141D (0-0.3)	20 / 846	0.09	0.0061	0.00015	-	-
METHOXYCHLOR	0.18 J	SS144C (0-0.3)	15 / 846	200	4	9.9	-	-
p,p'-DDD	0.0054	SS08814-A (0-0.3)	6 / 668	4	0.28	0.066	-	-
p,p'-DDE	0.032	SS183A (0-0.3)	93 / 668	3	0.88	0.047	-	-
p,p'-DDT	0.044	SS183A (0-0.3)	188 / 668	3	0.53	0.067	-	-
2,4,5-T (TRICHLOROPHENOXYACETIC ACID)	0.024	CP04B (0-0.5)	10 / 421	-	0.49	0.15	-	-
3,5-DICHLOROBENZOIC ACID	0.14 J	CP04B (0-0.5)	2 / 421	-	-	-	-	-
4-NITROPHENOL	0.49 J	SS113B (0-0.3)	2 / 363	-	-	-	-	-
ACIFLUORFEN	0.064 J	SS110B (0-0.3)	13 / 309	-	-	3.8	-	-
BENTAZON	0.36 NJ	CP03A (0-0.5)	4 / 355	-	0.037	0.24	-	-
CHLORAMBEN	0.066 NJ	CP03M (0-0.5)	5 / 336	-	0.12	0.13	-	-
DALAPON	0.19 J	SS110B (0-0.3)	4 / 421	-	-	0.23	-	-
DCPA (DACTHAL)	0.0074 J	SS85A (0.3-0.5)	1 / 358	-	4.9	0.45	-	-
DICAMBA	0.011 NJ	CP03G (0-0.5)	2 / 421	-	0.26	0.28	-	-
MCPA	35 NJ	SS112B (0.5-1)	34 / 421	-	0.0014	0.0047	-	-
MCPP	35 NJ	SS04H (0-0.3)	6 / 420	-	0.05	0.011	-	-
PENTACHLOROPHENOL	0.037 J	SS141D (0.5-1)	2 / 386	3	0.00043	0.0057	0.008	-
PICLORAM	0.02 J	SS110B (0-0.3)	31 / 322	-	0.088	0.71	-	-
1,4-DICHLOROBENZENE	0.02 J	SSCS19BK5AA (0-0.3)	4 / 1372	0.7	-	0.00041	0.095	-
2,4,6-TRINITROTOLUENE by 8270	35 NJ	SSCIATP077 (0-0.3)	14 / 16	-	0.00021	0.013	-	-
2,4-DICHLOROPHENOL	0.034 J	AFC032609BA01 (0-0.3)	1 / 1372	0.7		0.13	0.027	-
2,4-DIMETHYLPHENOL	0.028 J	SSCS19BK2D (0-0.3)	2 / 1357	0.7	0.3	0.86	0.18	-
2,4-DINITROTOLUENE by 8270	2.4 J	SS00064-A (0-0.8)	11 / 1372	0.7	0.02	0.00029	0.057	-
2,6-DINITROTOLUENE by 8270	0.10 J	SS00121-A (0-0.75)	4 / 1372	-	0.0088	0.05	-	-
2-AMINO-4,6-DINITROTOLUENE by 8270	0.43 NJ	SSCIATP077 (0-0.3)	3 / 3	-	0.00038	0.056	-	-
2-CHLOROBENZOIC ACID	1.8 J	SS08876-A (0-0.3)	22 / 594	-	-	-	-	-
2-METHYLNAPHTHALENE	0.04 J	SS105MM_MW40 (0-0.3)	7 / 1372	0.7	0.072	0.75	0.36	-
2-METHYLPHENOL (o-CRESOL)	0.047 J	SS00121-A (0-0.8)	3 / 1373	-	0.47	1.5	-	-
2-NITRODIPHENYLAMINE	0.051 J	AFC033109BA01 (0-2)	7 / 941	-	-	-	-	-
3,5-DINITROANILINE	0.13 J	SS00121-A (0-0.8)	3 / 927	-	-	-	-	-
4-CHLOROANILINE	0.197 J	SS05197-A (1.5-1.7)	1 / 1324	1	-	0.00014	0.04	-
4-METHYLPHENOL (p-CRESOL)	0.34 J	SS89B (0-0.3)	12 / 1373	-	0.039	0.15	-	-

Table 6-3
Central Impact Area
Soil Screening

Detected Analyte	Maximum Concentration (mg/Kg)	Location of Maximum Concentration (depth ft)	Detection Frequency	MCP S-1/GW-1 Standard[a] (mg/Kg)	MMR SSL[b] (mg/Kg)	EPA RSL Risk-Based SSL[c] (mg/Kg)	MassDEP Leaching-Based Soil Concentration[a] (mg/Kg)	MMR Outwash Background Concentration (0 - 2 ft bgs)[d] (mg/Kg)
ACENAPHTHYLENE	0.13 J	SSCIATP091 (0-0.3)	14 / 1373	1	0.068	-	1.2	-
ANTHRACENE	1.5	SSCIAT23001 (0-0.2)	15 / 1372	1000	54	360	-	-
BENZO(a)ANTHRACENE	2.4	SSCIAT23001 (0-0.2)	53 / 1372	7	0.037	0.01	-	0.46
BENZO(a)PYRENE	2.2	SSCIAT23001 (0-0.2)	53 / 1372	2	0.2	0.0035	-	0.46
BENZO(b)FLUORANTHENE	5.3	SSCIAT23001 (0-0.2)	66 / 1372	7	0.11	0.035	-	0.46
BENZO(g,h,i)PERYLENE	1.1	SSCIAT23001 (0-0.2)	44 / 1372	1000	554	-	-	0.46
BENZO(k)FLUORANTHENE	3.5	SSCIAT23001 (0-0.2)	62 / 1370	70	0.11	0.35	-	0.46
BENZOIC ACID	1.3	SSCIATP091 (0-0.3)	169 / 1223	-	-	34	-	-
BENZYL ALCOHOL	0.49	SSCS19BK5A (0-0.3)	68 / 1232	-	-	0.89	-	-
BENZYL BUTYL PHTHALATE	0.046 J	SS83A (0-0.3)	33 / 1372	-	491	0.51	-	-
bis(2-ETHYLHEXYL) PHTHALATE	63 J	SS144A (0.5-1)	348 / 1375	200	72	1.1	-	-
CARBAZOLE	0.038 J	SS126A (0.3-0.5)	4 / 1372	-	0.012	-	-	-
CHRYSENE	4.1	SSCIAT23001 (0-0.2)	70 / 1370	70	3.4	1.1	-	0.46
DIBENZ(a,h)ANTHRACENE	0.58	SSCIAT23001 (0-0.2)	28 / 1371	0.7	0.038	0.011	-	-
DIETHYL PHTHALATE	0.3 J	AFC033109BA01 (0-2)	22 / 1371	10	13	12	9.98	-
DIMETHYL PHTHALATE	0.08 J	OG042800-06 (0-0.3)	2 / 1371	30	-	-	33	-
DI-n-BUTYL PHTHALATE	0.87	SSCS19BK1D (0-0.3)	91 / 1372	-	151	9.2	-	-
DI-n-OCTYLPHTHALATE	0.21 J	SS144A (0.5-1)	4 / 1372	-	0.48	-	-	-
FLUORANTHENE	4.8	SSCIAT23001 (0-0.2)	110 / 1372	1000	108	160	-	0.46
FLUORENE	0.04 J	SS00052-A (0-0.3)	5 / 1371	1000	14	27	-	-
HEXACHLOROBENZENE	1 J	SS104A (0-0.3)	6 / 1372	0.7	0.007	0.00053	-	-
HEXACHLOROETHANE	0.071 J	OG042500-02 (0-0.3)	1 / 1373	0.7	-	0.0029	0.2	-
INDENO(1,2,3-c,d)PYRENE	1.2	SSCIAT23001 (0-0.2)	41 / 1371	7	0.32	0.12	-	0.46
N,N'-DIETHYLCARBANILIDE	0.1 J	SSCIATP087 (0-0.3)	2 / 911	-	-	-	-	-
NAPHTHALENE	0.22 J	SSCIATP091 (0-0.3)	31 / 1372	4	0.014	0.00047	4.5	-
N-NITROSODIPHENYLAMINE	0.04 J	SS08887-A (0-0.3)	1 / 1371	-	0.0078	0.075	-	-
PHENANTHRENE	0.3 J	SS106B (0-0.3)	53 / 1373	10	48	-	11	0.46
PHENOL	0.27 J	SSCIATP091 (0-0.3)	39 / 1373	1	0.77	6.3	0.95	-
PYRENE	6.5	SSCIAT23001 (0-0.2)	98 / 1372	1000	19	120	-	0.46
1,1,2,2-TETRACHLOROETHANE	0.000921 J	SS08998-A (3-6)	2 / 1051	0.005	-	0.000026	0.004	-
1,1,2-TRICHLOROETHANE	0.0064 J	SS02315-A (1-1.3)	1 / 1055	-	-	0.000078	-	-
1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.19 J	CP02J (0-0.5)	1 / 803	0.1	-	0.0000018	0.00004	-
2-HEXANONE	0.12 J	SS11G (0-0.3)	6 / 1049	-	-	0.011	-	-
ACETONE	2 J	SS08607-A (0-3), SS08819-A (0-0.3)	780 / 1055	6	0.11	4.5	6.3	-
BENZENE	0.045	SS05235-A (1.8-1.9)	60 / 1054	2	0.0001	0.00021	1.5	-
BROMODICHLOROMETHANE	0.002 J	SS117A (0.3-0.5)	2 / 1054	0.1	-	0.000032	0.005	-
BROMOFORM	0.0158	SS06882-A (0-0.3)	84 / 1055	0.1	0.0022	0.0023	0.007	-
BROMOMETHANE	0.34 J	SS04891-A (1-1.2)	102 / 1054	0.5	0.0018	0.0022	0.05	-
CARBON DISULFIDE	0.013	SS120A (0.3-0.5), SS00057-A (0-0.5)	43 / 1054	-	0.41	0.31	-	-
CHLOROBENZENE	0.004 J	SS09041-A (0-0.3)	2 / 1047	1	-	0.062	1.2	-
CHLOROETHANE	0.002 J	AM081301-01 (0-0.3)	2 / 1054	-	-	5.9	-	-
CHLOROFORM	0.012	SS117A (0.3-0.5)	65 / 1055	0.4	0.000036	0.000053	0.35	-
CHLOROMETHANE	0.1	SS04891-A (1-1.2)	52 / 1055	-	0.0004	0.049	-	-
DIBROMOCHLOROMETHANE	0.000897 J	SS08998-A (3-6)	1 / 1054	0.005	0.000032	0.000039	0.004	-
ETHYLBENZENE	0.002 J	SS05235-A (1.8-1.9), SS120A (0-0.3), SS124B (0-0.3)	5 / 1049	40	1.9	0.0017	45	-
METHYL ETHYL KETONE (2-BUTANONE)	0.1 J	SS08819-A (0-0.3)	604 / 1055	4	0.34	1.5	4	-
METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	0.00341 J	SS08867-A (9-12)	2 / 1049	0.4	-	0.45	0.35	-
METHYLENE CHLORIDE	0.005	SS85B (0.25-0.5)	7 / 1055	0.1	-	0.0012	0.01	-
STYRENE	0.0031 J	SS05235-A (1.8-1.9)	15 / 1049	3	2.3	1.8	2.9	-

Table 6-3
Central Impact Area
Soil Screening

Detected Analyte	Maximum Concentration (mg/Kg)	Location of Maximum Concentration (depth ft)	Detection Frequency	MCP S-1/GW-1 Standard[a] (mg/Kg)	MMR SSL[b] (mg/Kg)	EPA RSL Risk-Based SSL[c] (mg/Kg)	MassDEP Leaching-Based Soil Concentration[a] (mg/Kg)	MMR Outwash Background Concentration (0 - 2 ft bgs)[d] (mg/Kg)
tert-BUTYL METHYL ETHER	0.19	CP02J (0-0.5)	10 / 814	0.1	-	0.0028	0.14	-
TETRACHLOROETHYLENE(PCE)	0.073	OG042500-02 (0-0.3)	21 / 1049	1	0.00044	0.000049	1.2	-
TOLUENE	0.022 J	SS110A (0.3-0.5)	308 / 1053	30	0.27	1.6	32	-
TRICHLOROETHYLENE (TCE)	0.004 J	CP02I (0-0.5), CP03O (0-0.5)	7 / 1055	0.3	0.0005	0.00072	0.28	-
XYLENES, TOTAL	0.007 J	SS00051-A (0-0.3)	9 / 1049	400	0.81	0.2	360	-
PCB-1260 (AROCHLOR 1260)	0.51	SS184A (0-0.3)	16 / 846	2	0.01	0.024	-	-
PENTACHLORONAPHTHALENE[i]	0.0181	SS05235-A (1.8-1.9)	1 / 30	0.2	-	-	-	-
TOTAL DICHLORINATED NAPHTHALENES	0.046	SSCIATP007 (0-0.2)	1 / 50	-	-	-	-	-
TOTAL PENTACHLORINATED NAPHTHALENES[i]	0.11	SSCIATP007 (0-0.2)	2 / 49	0.2	-	-	-	-
TOTAL TETRACHLORINATED NAPHTHALENES	0.53	SSCIATP007 (0-0.2)	2 / 49	-	-	-	-	-
TOTAL TRICHLORINATED NAPHTHALENES	0.54	SSCIATP007 (0-0.2)	2 / 50	-	-	-	-	-
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	0.000015 J	SSCS19BK6B (4-4.3)	1 / 1	0.002	5.00E-11	2.60E-05	0.003	-
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	0.0000077 J	SSCS19BK6B (4-4.3)	1 / 1	0.002	5.00E-11	2.60E-05	0.003	-
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	0.0000045 J	SSCS19BK6B (4-4.3)	1 / 1	0.0002	5.00E-12	2.60E-06	0.0003	-
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	0.0000014 J	SSCS19BK6B (4-4.3)	1 / 1	0.0002	5.00E-12	2.60E-06	0.0003	-
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	0.0000025 J	SSCS19BK6B (4-4.3)	1 / 1	0.0002	5.00E-12	2.60E-06	0.0003	-
2,3,4,7,8-PENTACHLORODIBENZOFURAN	0.00000092 J	SSCS19BK6B (4-4.3)	1 / 1	6.67E-05	1.67E-12	8.67E-07	0.0001	-
HEPTACHLORINATED DIBENZOFURANS, (TOTAL)	0.00002 J	SSCS19BK6B (4-4.3)	1 / 1	-	-	-	-	-
HEPTACHLORINATED DIBENZO-P-DIOXINS, (TOTAL)	0.000014 J	SSCS19BK6B (4-4.3)	1 / 1	-	-	-	-	-
HEXACHLORINATED DIBENZOFURANS, (TOTAL)	0.000015 J	SSCS19BK6B (4-4.3)	1 / 1	-	-	-	-	-
HEXACHLORINATED DIBENZO-P-DIOXINS, (TOTAL)	0.0000042 J	SSCS19BK6B (4-4.3)	1 / 1	-	-	9.00E-06	-	-
OCTACHLORODIBENZOFURAN	0.0000082 J	SSCS19BK6B (4-4.3)	1 / 1	6.67E-02	1.67E-09	8.67E-04	0.1	-
OCTACHLORODIBENZO-P-DIOXIN	0.00026 J	SSCS19BK6B (4-4.3)	1 / 1	6.67E-02	1.67E-09	8.67E-04	0.1	-
PENTACHLORINATED DIBENZOFURANS, (TOTAL)	0.000009 J	SSCS19BK6B (4-4.3)	1 / 1	-	-	-	-	-
PENTACHLORINATED DIBENZO-P-DIOXINS, (TOTAL)	0.0000003 J	SSCS19BK6B (4-4.3)	1 / 1	-	-	-	-	-

Notes:
Laboratory data validation qualifier codes used for the "Maximum Concentration" are as follows:
J = Estimated Concentration
D = Analyte identified in an analysis at a secondary dilution factor.
NJ = Presumptively Identified Compound, Estimated Concentration
Yellow highlighting indicates those soil criteria that have been exceeded.
"-" = No listed value.

(a) MCP Method 1 S-1/GW-1 Standards and MassDEP Leaching-Based Soil Concentration, May 2009 (http://www.mass.gov/dep/service/compliance/riskasmt.htm). MassDEP Leaching-Based Soil Concentrations (GW-1) are not used as screening criteria, but for comparison purposes only. MCP Numerical Standards Development Spreadsheets, May 2009 (http://www.mass.gov/dep/service/compliance/riskasmt.htm)
(b) MMR SSL values from the site-specific tabulated standards listed in "vvlSSLstd.xls".
(c) The USEPA Regional Screening Level (RSL) for Residential Soil and Risk-Based SSL, May, 2010. (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)
(d) The Outwash Background values reflect the maximum of the 0-2 ft depth interval and are not used as screening criteria, but for comparison purposes only.
(e) EPA Risk-Based SSL for Thallium, Soluable Salts used as a surrogate for Thallium.
(f) MCP standards and USEPA screening levels for Chlordane used as a surrogate for alpha-Chlordane and gamma-Chlordane.
(g) MCP standards and USEPA screening levels for Endosulfan used as a surrogate for Endosulfan sulfate.
(h) MCP standards and USEPA screening levels for Endrin used as a surrogate for Endrin Aldehyde and Endrin Ketone.
(i) MCP S-1/GW-1 Standard Value for pentachlorinated naphthalenes is based on the Standard for 2,3,7,8-TCDD equivalents (2.0 E-05) divided by the Relative Experimental Potency value.