Massachusetts Military Reservation
Impact Area Groundwater Study Program

REMEDY SELECTION PLAN FOR THE DEMOLITION AREA 1 GROUNDWATER PLUME

August 2005

The US Army Environmental Center's Impact Area Groundwater Study Program (IAGWSP) is conducting an investigation into groundwater contamination at Camp Edwards on the Massachusetts Military Reservation (MMR), working in cooperation with the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (MADEP). The IAGWSP is issuing this Remedy Selection Plan (RSP) for the Demolition Area 1 (Demo 1) Groundwater Plume for public comment. This Remedy Selection Plan provides a summary of all cleanup alternatives considered for the Demo 1 groundwater plume and a rationale for the selection of the proposed remedy. More detailed information regarding Demo 1 can be found in the Groundwater Report, Groundwater Report Addendum, and the Feasibility Study. These documents are available at the information repository locations listed on page 12.

The EPA will select a final remedy after reviewing and considering all information submitted during the 30-day public comment period (August 22 through September 19, 2005). The proposed remedy may be modified based on new information or public comments. The public is encouraged to review and comment on all the alternatives in this RSP.

Following the public comment period, a Decision Document (DD) will be issued. The DD will present the final selected remedy and will include a section called the Responsiveness Summary that provides official responses to all public comments received during the public comment period.

HOW TO PARTICIPATE

This RSP for the Demo 1 Groundwater Plume has been issued for a 30-day public comment period that runs from August 22 through September 19, 2005. The public is invited to provide written comments on the plan (see below for directions on providing written comment), and to attend a public informational meeting on September 13 at 6:00 PM to learn more about this groundwater plume and the proposed remedy for cleanup. Representatives from the EPA, the MADEP, and the IAGWSP will be available to respond to your questions and comments. Immediately following the informational meeting, a public hearing will be conducted at which the public can provide oral comments for the Administrative Record.

Public Comment Period
August 22 through September 19, 2005

To provide formal comments, you may offer oral comments at the Public Hearing or you may submit written comments by U.S. mail or email no later than September 19, 2005.

Public Information Meeting/Public Hearing for the Remedy Selection Plan:
September 13, 2005 at 6:00 pm

This event will be held at the:
Bourne Best Western Hotel
100 Trowbridge Road
Bourne, MA

Written comments should be mailed to:
Kris Curley
Impact Area Groundwater Study Program
1803 West Outer Road
Camp Edwards, MA 02542-5003

Or sent by:
Fax: (508) 968-5286
Email: kristina.curley@ma.ngb.army.mil

A comment form is available on the IAGWSP Website:
http://groundwaterprogram.army.mil

For more information, please contact Kris Curley, IAGWSP
Tel: (508) 968-5626

SITE BACKGROUND

Demo 1 is a 7.4-acre site located on Camp Edwards approximately two miles northeast of the Otis Rotary in Bourne. Demo 1 is located in a natural topographic depression, or kettle hole, that covers approximately one acre at its base, which is 45 feet (ft) below the surrounding grade. The site was used from the mid 1970s to late 1980s primarily for disposal and destruction of munitions, and training of explosive ordnance disposal technicians. Measurements indicate that groundwater is located from 45 to 48 ft below the base of the depression.

Site investigations at and downgradient (west) of Demo 1 included the collection of approximately 650 soil samples and the installation of monitoring wells in 33 locations. Results indicate that the primary contaminants at Demo 1 are the explosives hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) and trinitrotoluene (TNT) and its breakdown products, along with the water-soluble salt perchlorate, and the propellant 2,4-nitrotoluene (2,4-DNT).

The presence of explosive and propellant compounds in groundwater is consistent with the following observations:

- RDX, followed by TNT are the predominant explosive compounds used in demolition munitions;
- HMX is an impurity in RDX and can be present at up to ten percent of the total RDX mass;
- 2-amino-4,6-dinitrotoluene (2A-DNT) and 4-amino-2,6-dinitrotoluene (4A-DNT) are byproducts of TNT's breakdown in the environment;
- 2,4-DNT is a propellant that was disposed of at Demo 1;
- Perchlorate, a water-soluble salt used as an oxidizer, is a component of munitions, fireworks, rocket propellants and pyrotechnics that were likely disposed of at Demo 1; and
- Each of these compounds was detected in soil at Demo 1.

Interim soil and groundwater cleanup actions called Rapid Response Actions (RRAs) were conducted in 2003 and 2004, respectively, to remove soil contamination and begin groundwater remediation. The soil removal and treatment is substantially complete and two interim groundwater cleanup systems known as the Frank Perkins Road Treatment Unit and the Pew Road Treatment Unit are continuing to remove contamination from the groundwater.

WHY CLEANUP IS NEEDED AT DEMOLITION AREA 1

IAGWSP investigations have identified and delineated a plume of groundwater contamination emanating from the Demo 1 site that extends approximately 10,300 ft west. It is approximately 1,400 ft wide and 100 ft thick. Specific contaminants of concern (COCs) for groundwater at Demo 1 include the explosives chemicals RDX and TNT, and perchlorate.

Demo 1 Kettle Hole

Detections of RDX in the Demo 1 plume range from the detection limit of 0.25 parts per billion (ppb) to 370 ppb. Perchlorate detections range from the detection limit of 0.35 ppb to 500 ppb.

The lifetime federal health advisory for RDX in drinking water is 2 ppb. There currently is no federal or state drinking water standard for perchlorate. However, MADEP is in the process of proposing a cleanup standard for RDX and cleanup and drinking water standards for perchlorate. The EPA has established an official reference dose for perchlorate of 0.0007 milligram per kilogram per day (mg/kg/day). This translates to a Drinking Water Equivalent Level (DWEL) of 24.5 ppb, assuming all of the contaminant comes from drinking water. With a contaminant like perchlorate, individuals may be exposed through other sources, such as food or breast milk. EPA previously issued interim guidance suggesting 4-18 ppb perchlorate as a provisional cleanup level (1999 and 2003). The MADEP perchlorate advisory level for ingestion of water by sensitive populations (children, pregnant women and individuals with hypothyroidism) is 1 ppb.

The Demo 1 Plume will be remediated to restore the aquifer which has been designated a Sole Source Aquifer by the EPA and a Potentially Productive Aquifer by the MADEP.

THE DEMO 1 PLUME

It is estimated that the Demo 1 plume contains a total RDX mass, or amount of contaminant that would remain if all water was removed, of 46 pounds (lbs). The total mass of perchlorate in the plume is 93 lbs. The area upgradient of the Frank Perkins Road Treatment Unit contains 97 percent (45 lbs) of the RDX in the plume and 75 percent (70 lbs) of the perchlorate in the plume. The remainder of the RDX and 23 percent (21 lbs) of the remaining perchlorate is contained in the portion of the plume located between the Frank Perkins Road and the Pew Road treatment units. The portion of the plume in the area west of the Pew Road Treatment Unit contains about 2 percent (1.7 lbs) of the perchlorate contamination.

SITE HISTORY

1970-89 Munition destruction and disposal activities and training at Demo 1 area

1997 Administrative Order 1 issued by EPA requiring investigation of potential impacts of military training on groundwater

2000 Administrative Order 3 issued by EPA requiring investigation and remediation of several areas at Camp Edwards including Demo 1

2001 RDX, HMX, 2,4-DNT, 2A-DNT, 4A-DNT, and TNT identified as COCs for Demo 1

2001 Perchlorate added to list of COCs

2002 The northern portion of Camp Edwards, including the Demo 1 area, designated by the MA Legislature as the Upper Cape Water Supply Reserve

2003 Draft RRA Plan completed for Demo 1 Groundwater

2003 Final Groundwater Report Addendum completed detailing the nature and extent of the Demo 1 groundwater plume

2003 Delineation of the Demo 1 groundwater plume completed for the purposes of conducting a Feasibility Study; Feasibility Study began

2003 The RRA for Demo 1 soil undertaken to remove the source area of the groundwater plume; approximately 27,000 tons of soil excavated and treated or disposed

2004 Revised Draft Feasibility Study for Demo 1 Groundwater completed

2004 The RRA pump and treat systems for Demo 1 groundwater start in September at 320 gallons per minute (gpm); these systems have treated 126 million gallons of groundwater through June 2005

RAPID RESPONSE ACTIONS

Soil and groundwater RRAs were conducted at Demo 1 beginning in 2003 and 2004, respectively. These actions were conducted to expedite cleanup of the aquifer and eliminate the source of groundwater contamination through the removal of contaminated soil, munitions items and other material from the Demo 1 area.

The Demo 1 Soil RRA is substantially complete. This RRA included removal and treatment of contaminants found in the soil. A thermal treatment unit (TTU) was used to heat up the contaminated soil and separate the contaminants from the soil. A portion of the contaminated soil was excavated and removed from the site and disposed off-site in a licensed facility. To date, approximately 27,000 tons have been excavated and treated or transported off-site for disposal. It is expected that the RRA has remediated the source area such that no further action will be necessary to prevent further impact to the groundwater. A completion of work report will be prepared to summarize the work completed and the conditions of the former source area, as well as to provide recommendations for the site.

Two Demo 1 Groundwater RRA extraction, treatment and reinjection systems that started in September 2004 are continuing cleanup operations pumping a total of 320 gpm. At the Frank Perkins Road facility, which is located in the central area of the plume, groundwater is treated for RDX and perchlorate as it flows through a combination of granular activated carbon (GAC) and ion exchange resin (IX) containers at a rate of 220 gpm. Treated groundwater is returned to the aquifer via two reinjection wells placed outside the plume. At Pew Road, which is nearer the leading edge of the plume, groundwater is treated at a rate of 100 gpm using containers of GAC to remove lower levels of RDX and perchlorate. Treated groundwater is returned to the aquifer through one reinjection well. The groundwater RRA was designed to reduce the mass of contamination within the plume and to prevent further migration of the plume until the comprehensive groundwater remedy is selected. The RRA will operate until a comprehensive remedy is proposed, selected, designed, and implemented.

GROUNDWATER FEASIBILITY STUDY

The Feasibility Study is the document used to summarize and evaluate a range of comprehensive groundwater remedies for the removal of contamination from the site.

The Demo 1 Feasibility Study contains three remedial action objectives. They are to restore the useable groundwater to its beneficial use within a reasonable timeframe; 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 potential ingestion and inhalation of groundwater containing COCs (RDX, HMX, 2,4-DNT, 2A-DNT, 4A-DNT, TNT, and perchlorate) 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 Feasibility Study evaluated six alternatives for achieving these objectives. These alternatives were also evaluated to determine the feasibility of approaching or achieving background conditions. Background conditions are generally the conditions which would exist in the absence of the groundwater contamination. In this case, the laboratory methods used to detect explosives and perchlorate defines the background conditions. The six alternatives are described and evaluated in this Plan.

After the completion of the Draft Feasibility Study, a Supplemental Evaluation was performed with updated plume conditions to assess the performance of Alternatives 5 and 6 using new data. The results confirmed the results of the Feasibility Study and the relative performance of the alternatives remained approximately the same. The Supplemental Evaluation was appended to the Final Feasibility Study.

All remedial timeframes and costs presented in this RSP for Alternatives 1 through 6 are taken from the Feasibility Study. In addition, remedial timeframes and costs determined by the Supplemental Evaluation for Alternatives 5 and 6 are also included in this RSP and supersede the original costs and timeframes.

The alternative preferred by EPA and supported by the Army and MADEP is proposed in this RSP. Public review and comment is sought prior to selecting the alternative or combination of alternatives that will be selected as the comprehensive remedy. The proposed remedy may be modified based on new information or public comments.

SUMMARY OF REMEDIAL ALTERNATIVES

Background concentrations are defined as 0.25 ppb for RDX and TNT and 0.35 ppb for perchlorate, based on the analytical methods. Risk-based concentrations used in the Demo 1 Feasibility Study are 0.6 ppb for RDX, 2 ppb for TNT, and 1 ppb for perchlorate.

All six alternatives include long-term monitoring and implementation of land use controls which prevent groundwater use downgradient of Demo 1 for any water supply purpose until the aquifer is restored. The active treatment systems will all use GAC and IX, as appropriate, to remove contaminants. Alternatives 2 - 6 also include a new permanent structure at Frank Perkins Road to house the treatment system. Table 1 at the end of this document summarizes the alternatives, the costs, flow rates, and other pertinent information to facilitate comparison of the alternatives. The alternatives include:

Alternative 1 - Minimal Action

Capital Cost	$ 1,550,000
Operation and Maintenance (O&M)	$ 1,300,000
Total Present Worth	$ 2,850,000

Alternative 1 is a minimal action alternative with no active remediation. This alternative calls for:

- Shut-down of the two RRA extraction, treatment, and reinjection systems located at Frank Perkins Road and Pew Road;
- Installation of six additional monitoring wells for long-term monitoring of the groundwater plume;
- Long-term monitoring at 12 monitoring wells; and
- Costs are estimated for 50 years.

Alternative 2 - Baseline

Capital Cost	$ 3,640,000
O&M	$ 11,400,000
Total Present Worth	$ 15,000,000

Alternative 2 provides a baseline alternative that makes use of the RRA systems currently in place as a final cleanup solution. Groundwater modeling predicts that this alternative would restore groundwater to risk-based concentrations for contaminants of concern within 36 years and achieve background concentrations within 50 years. This alternative includes:

- Continued operation of the two RRA extraction, treatment and reinjection systems;
- Extraction of groundwater at the total pumping rate of 320 gpm; and
- Recharge of the treated groundwater into the aquifer using three injection wells.

Alternative 3 - Background

Capital Cost	$ 6,350,000
O&M	$ 14,700,000
Total Present Worth	$ 21,100,000

Groundwater modeling predicts that Alternative 3 provides an alternative that would restore groundwater to risk-based concentrations for COCs in less than 23 years and to background concentrations in less than 27 years. Alternative 3 would include:

- Continued operation of the two RRA extraction, treatment and reinjection systems;
- Installation of two additional extraction wells;
- Extraction of groundwater from the four wells at a total pumping rate of 472 gpm; and
- Recharge of treated groundwater into the aquifer using a total of four injection wells (three from RRA systems plus one new well).

Alternative 4 - 10 Year

Capital Cost	$ 10,200,000
O&M	$ 15,500,000
Total Present Worth	$ 25,700,000

Alternative 4 is designed to achieve risk-based concentration for COCs within 11 years and background concentrations within 15 years. This alternative calls for:

- Continued operation of the two RRA extraction, treatment and reinjection systems;
- Installation of three additional extraction wells;
- Extraction of groundwater from the five wells at a total pumping rate of 1,417 gpm; and
- Recharge of the treated groundwater into the aquifer using a total of four injection wells (three RRA wells plus one new well).

Alternative 5 - Additional Alternative A (5-well system)

Capital Cost	$ 8,340,000
(revised to $8,300,000 by the Supplemental Evaluation)	
O&M	$ 12,700,000
(revised to $10,600,000 by the Supplemental Evaluation)	
Total Present Worth	$ 21,000,000
(revised to $18,900,000 by the Supplemental Evaluation)	

Alternative 5 provides a design that groundwater modeling predicts would achieve risk-based concentrations for the COCs within approximately 11 years and background concentrations within 19 years. This alternative calls for:

- Continued operation of the two RRA extraction, treatment and reinjection systems;
- Installation of three additional extraction wells;
- Extraction of groundwater from five extraction wells at a total pumping rate of 906 gpm; and
- Recharge of the treated groundwater into the aquifer using a total of four injection wells (three RRA wells, plus one new well).

Alternative 6 - Additional Alternative B (6-well system)

Capital Cost	$ 9,870,000
(revised to $9,900,000 by the Supplemental Evaluation)	
O&M	$ 16,700,000
(revised to $14,000,000 by the Supplemental Evaluation)	
Total Present Worth	$ 26,600,000
(revised to $23,900,000 by the Supplemental Evaluation)	

Alternative 6 provides a design that groundwater modeling predicts will restore groundwater to risk-based concentrations for the COCs within 11 years and background concentrations in approximately 17 years. This alternative includes:

- Continued operation of the two RRA extraction, treatment and reinjection systems;
- Installation of four additional extraction wells;
- Extraction of groundwater at a total pumping rate of 1,006 gpm;
- Recharge of the treated groundwater into the aquifer using a total of four (five) injection wells (three RRA wells plus one [two] new well[s]); and
- A new portable treatment unit near Frederickson Road to house treatment equipment including GAC and potentially IX filters.

CRITERIA FOR EVALUATING A CLEANUP REMEDY

A detailed analysis was performed on the alternatives using EPA's nine evaluation criteria in order to select a site response action. The following is a summary of the comparison of each alternative's strengths and weaknesses with respect to the nine evaluation criteria.

Under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and the National Contingency Plan (NCP), these criteria are divided into threshold, balancing, and modifying criteria and are given different weights accordingly. The threshold criteria include the protection of public health 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 selection of the remedy.

In this decision under Section 1431 of the Safe Drinking Water Act (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 one determined to be necessary to protect the health of persons from contaminants that are present in or likely to enter an underground source of drinking water and that is otherwise in accordance with law, as reflected in the first two criteria. It also reflects the EPA's determination of the appropriate balance of other environmental concerns as reflected by the other criteria. These nine criteria are summarized as follows:

1. Overall protection of human health and aquifer: Will the remedy protect the human health? Will it restore the aquifer?

2. Compliance with Regulations: Does the remedy meet all applicable federal and state standards including prevention of movement of contaminants into the aquifer and its preservation as a potential drinking water supply?

3. Long-term effectiveness and permanence: What is the size of the residual risk after the remedy is completed? How reliable are controls for minimizing future risk and restoring aquifer as drinking water supply?

4. Reduction of toxicity, mobility or volume through treatment: What is the amount of hazardous materials that are destroyed or treated? Is treatment irreversible? What residuals remain after treatment?

5. Short-term effectiveness: Is the community protected during remedial actions? Are workers protected during cleanup? How long will it take to achieve cleanup goals?

6. Implementability: Is it feasible to construct the technology? How reliable is the technology? Can the remedy effectiveness be monitored?

7. Cost: What are the capital costs of the remedy? What are the O&M costs? What are these costs in present worth terms?

8. State acceptance: Does the state accept this approach?

9. Community acceptance: Does the community accept this approach?

EVALUATION OF ALTERNATIVES

Below is a summary of how the alternatives presented in the Feasibility Study including the supplemental evaluation meet the nine criteria. In the Feasibility Study, each alternative evaluated performance to achieve both risk-based levels and background levels.

OVERALL PROTECTION OF HUMAN HEALTH AND AQUIFER

Alternative 1 provides the least protection of human health and the aquifer because the plume is not prevented from further migration by extraction and treatment, and concentrations of explosives and perchlorate will persist in the aquifer for the longest time period. Alternatives 2 through 5 differ in their degrees of protectiveness in that some achieve cleanup levels more quickly. Alternative 6 is the most

protective in that it achieves background levels sooner and actively remediates contamination downgradient of Pew Road, halting further migration of the plume. Alternatives 2 through 6 all protect human health by limiting the further migration of the plume and reducing contaminant concentrations. Alternatives 4, 5 and 6 provide protection in similar timeframes that are substantially faster than Alternatives 2 and 3. Alternative 5 achieves similar results through active remediation of the upgradient portions of the plume, and natural attenuation of the leading edge of the plume.

COMPLIANCE WITH FEDERAL AND STATE STANDARDS

If no remedy is implemented, groundwater contamination will attenuate over a lengthy period of time to health based standards but this is not protective of the aquifer. Alternative 1 is such a remedy. Alternatives 2 through 6 achieve federal and state health-based standards and background in differing periods of time. Alternatives 4, 5 and 6 achieve background and health-based levels in a reasonable period of time.

LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 1 is the least effective alternative in that time to achieve background is longer and results in the most significant degradation of the aquifer. Alternatives 4, 5, and 6 all provide for effective and permanent remediation for the portion of the plume that is captured by extraction wells. Alternatives 4 and 5 include natural attenuation of the downgradient portion of the plume while Alternative 6 would actively restore the aquifer downgradient of Pew Road limiting further migration of the plume.

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Alternative 1 does not reduce the toxicity, mobility, or volume of contaminated groundwater through treatment because it relies on natural processes of dilution. Alternatives 2 through 6 vary in their rate of reduction of the total mass and volume of contamination due to differences in the number of extraction wells, their placement and pumping rates. Alternative 6 reduces toxicity, mobility and volume of the plume the quickest because it includes an extraction well near the leading edge of the plume. Based on modeling, it is estimated that the leading edge would migrate approximately 250 ft further in Alternative 5 than in Alternative 6.

SHORT-TERM EFFECTIVENESS

Alternative 4 would reach risk-based cleanup goals or background concentrations most quickly. Alternatives 5 and 6 also reach the objectives quickly and in similar timeframes but have significantly lower flow rates, less cost and less stress on the aquifer than Alternative 4.

Alternatives 4, 5 and 6 would reach the cleanup goals most quickly, providing the greatest short-term effectiveness. Alternatives 2 and 3 would achieve background levels in greater than 50 and 27 year timeframes, respectively, providing the least short-term effectiveness. Alternative 1 would not achieve background conditions within the aquifer in the time period used in the analysis.

Alternative 6 would have the most construction activities since additional pipelines are required for the leading edge extraction well. Alternatives 4 and 5 with each having five extraction wells and associated piping would have the next greatest impact on natural resources but these impacts are minimized by construction on existing road and power line corridors.

None of the alternatives are expected to have significant short-term impacts on the community since the construction activities, if any, would be restricted to Camp Edwards. Alternative 1 would have the least short-term impact on the community since it involves no further action, except for the long-term groundwater monitoring and institutional controls.

EVALUATION OF ALTERNATIVES (CONTINUED)

IMPLEMENTABILITY

All alternatives can be implemented and rely upon proven technologies. Alternatives 1 and 2 are the most easily implemented alternatives because Alternative 2 relies on the existing treatment systems which were installed as part of the RRA, and Alternative 1 relies on existing monitoring wells. Alternatives 3 through 6 can be implemented, and can be effectively operated and monitored. The treatment technologies of groundwater extraction and treatment with GAC and IX in Alternatives 2 through 6 are reliable technologies.

STATE ACCEPTANCE

This criterion is continually evaluated as the MADEP participates in all aspects of the evaluation and selection of a remedy. The MADEP's official acceptance will be provided with concurrence on the selected remedy in the DD which will be issued after the public comment period. The MADEP generally determines whether the State concurs with the proposed remedy after the public comment period has closed and all public comments have been received and reviewed.

COMMUNITY ACCEPTANCE

This criterion will be evaluated based on all public comments received on this RSP during the public comment period.

PROPOSED COMPREHENSIVE REMEDY FOR DEMO 1 GROUNDWATER PLUME

Alternative 5 as presented in the Feasibility Study provides for a groundwater extraction system with five wells with treatment to risk-based levels. This alternative provides the best balance of the criteria used to evaluate cleanup alternatives. It achieves cleanup goals in a reasonable timeframe. However, to strengthen this alternative, EPA has recommended an Enhanced Alternative 5. This Enhanced Alternative 5 includes the groundwater extraction design provided in Alternative 5 and adds a significant feature - a contingency to add additional extraction wells if the plume is found to migrate further than expected.

This feature of Enhanced Alternative 5 relates to the capture of the plume downgradient of Pew Road. The IAGWSP has presented information in its Supplemental Evaluation that under Alternative 5 a small section of the plume would migrate an additional 250 ft west and thereafter disperse to background levels. Because this assessment is based on projected conditions from modeling results, it contains uncertainties. So as to be protective of human health and the aquifer, EPA's Enhanced Alternative 5 would create a contingency for additional action.

If it is determined, based on monitoring data or revised modeling, that plume migration is substantially different than predicted by the modeling conducted in the Feasibility Study, the IAGWSP will conduct a detailed analysis to determine, as accurately as possible, the current and projected future plume location. If groundwater modeling suggests that contamination above federal or state regulatory or risk-based levels for COCs will likely migrate past the well transect that will include wells D1P-30, D1P-31, and D1P-32, (which are to be installed as close as possible to the western edge of North Pond), an additional active groundwater treatment system will be designed and built within 12 months prior to the plume arrival date, and operated to prevent migration beyond the vicinity of the well transect.

The additional active treatment system will likely consist of an extraction well pumping at 30 to 50 gpm and a portable treatment container, similar to the unit located at Pew Road, which will use GAC and/or ion exchange filters to clean the groundwater.

In the Enhanced Alternative 5, the IAGWSP, as part of its annual monitoring reporting, will conduct a detailed annual assessment of plume migration west of Fredrikson Road.

EPA believes that this Enhanced Alternative 5 is reasonable when compared to Alternative 6 because it provides similar benefits at significantly less cost.

Thus, the proposed remedy for the Demo 1 Groundwater Plume is Enhanced Alternative 5, which includes:

- Groundwater extraction at a total flow rate of 906 gpm from five extraction wells, three of which will be new construction;
- Treatment of water at two treatment facilities with construction of a permanent treatment building at Frank Perkins Road;
- Recharge of treated water via four injection wells;
- Monitoring for the entire plume including the leading edge downgradient of Pew Road; and
- Contingency for additional active treatment in the area downgradient of Pew Road.

CLEANUP GOALS

The primary cleanup goals for groundwater at Demo 1 are to restore the useable groundwater to its beneficial use within a reasonable timeframe; 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 potential ingestion and inhalation of groundwater containing COCs (RDX, HMX, 2,4-DNT, 2A-DNT, 4A-DNT, TNT, and perchlorate) 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.

In addition, the Enhanced Alternative 5 will also prevent any migration of contaminants above regulatory or risk-based levels beyond the vicinity of the well transect that will include monitoring wells D1P-30, D1P-31, and D1P-32, which are to be installed as close as possible to the western edge of North Pond. The trigger for additional action will be activated if actual or modeled data at the above well transect exceeds federal or state regulatory or risk-based levels for COCs.

The proposed remedy is expected to achieve a risk-based level of 0.6 ppb for RDX in 11 years and reduce perchlorate concentrations to 1 ppb within the same time frame.

MAJOR COMPONENTS OF ENHANCED ALTERNATIVE 5

Frank Perkins Road

Groundwater extracted from eastern extraction wells (EW-D1-1, EW-D1-501, EW-D1-502, EW-D1-503) would be pumped to a treatment facility at the Frank Perkins Road location. Based on the modeling results, a total of 808 gpm would be conveyed to this treatment facility. Groundwater would be treated by a combination of IX and GAC. Groundwater treated at the Frank Perkins Road system would be recharged to the aquifer via the existing injection wells IW-D1-1 and IW-D1-2. The flow would typically be split equally between the two injection wells, or 404 gpm each.

PROPOSED COMPREHENSIVE REMEDY FOR DEMO 1 GROUNDWATER PLUME (CONTINUED)

Pew Road

Groundwater extracted from the extraction well at Pew Road (EW-D1-2) would be conveyed to a treatment facility located on Pew Road. Based on the modeling results a total of 98 gpm of groundwater would be pumped to this location. A treatment container system, like those being used for the RRA, would be used at Pew Road. The treatment system would consist of GAC with the addition of ion exchange media if necessary. Groundwater treated via the Pew Road system would be recharged to the aquifer via the existing injection well IW-D1-3 and one new injection well IW-D1-4. The flow would typically be split equally between the two injection wells, or 49 gpm each.

Contingency Locations

The design and implementation of the contingency will be completed within 12 months prior to the arrival of the plume at the well transect that will include monitoring wells D1P-30, D1P-31, and D1P-32.

Operation and Maintenance

O&M of the extraction, treatment and recharge systems will be routinely conducted to ensure effective operation of the remedy.

Monitoring and Contingency for Additional Active Remediation

A detailed groundwater monitoring and evaluation program will be developed and implemented to confirm that the remedy is performing as predicted. The program will include routine monitoring of existing and newly installed wells, and periodic evaluation of groundwater data to confirm that the plume is behaving as predicted by the groundwater model.

Modifications or additions to the system will be made if modeled data at the well transect that includes monitoring wells D1P-30, D1P-31, and D1P-32, which are to be installed as close as possible to the western edge of North Pond, exceeds federal or state regulatory or risk-based levels for COCs.

Land Use Controls

Land use controls would be implemented where appropriate to minimize potential risk of exposure to contaminated groundwater from the Demo 1 plume. Land use controls protect the health of persons living, working, or visiting the area and can be considered in three categories - (i) those that relate to property that is under the control of the Army through the existing lease between the Commonwealth of Massachusetts and the US Army (i.e. on-post administrative controls), (ii) those that relate to property that is not under the control of the Army (i.e. off-post institutional controls), and (iii) those that would relate to the currently on-post property after the cessation of the lease between the Army and the Commonwealth. On-post land use controls will be established by the Army, Massachusetts National Guard, and any other entity in control of the on-post areas in a Memorandum of Understanding (MOU) with the EPA (and MADEP, as necessary) within six months following the DD. The MOU shall also provide for a program to monitor the effectiveness of the institutional controls and a process under which EPA can enforce the implementation, monitoring, maintenance, and modification of the institutional controls, if necessary.

Site Closeout

Following completion of the proposed activities, measures would be taken to properly abandon and remove the extraction, treatment and recharge system components associated with the remedy and restore the property.

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
2,4-DNT	2,4-nitrotoluene, a propellant
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. It can be used to evaluate whether or not a release from the site has occurred.
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Contaminant of Concern
DD	Decision Document; summarizes the selected comprehensive remedy
Demo 1	Demolition Area 1
DWEL	Drinking Water Equivalent Level
EPA	United States Environmental Protection Agency
EW-DX-X	Extraction Well at Demo 1
ft	feet
GAC	Granular Activated Carbon; used in the treatment of contaminated water
gpm	gallons per minute; unit of measure for liquid flow per unit time
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine, an explosives compound
IAGWSP	Impact Area Groundwater Study Program
IW-DX-X	Injection Well at Demo 1
IX	Ion exchange resin; used in the treatment of contaminated water
kettle hole	a depression that is now covered with soil that was formed during the last ice age from the melting of a remnant glacial ice block
kg	kilogram; unit of measure for mass
Lifetime Health Advisory	Guideline established by EPA that represents the concentration of a chemical in drinking water that, given a lifetime of exposure, is not expected to cause adverse, non-cancerous effects
lb	pound; unit of measure for weight
MADEP	Massachusetts Department of Environmental Protection
mg	milligram; unit of measure for mass
mg/kg/day	milligram of substance per kilogram of bodyweight per day of consumption
MMR	Massachusetts Military Reservation
MOU	Memorandum of Understanding
NCP	National Contingency Plan
O&M	Operation and Maintenance
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 explosive compound
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
TNT	Trinitrotoluene, an explosives compound
TTU	Thermal Treatment Unit; a system that uses heat to treat contaminated soil

NEXT STEPS/UPCOMING ACTIVITIES

The next steps toward selection and implementation of an alternative for addressing groundwater contamination at Demo 1 include: Presentation of the RSP, conducting a 30-day public comment period on the RSP, and completing the DD outlining final remedy selection including a Responsiveness Summary of comments received. It is expected that system startup of the final remedy will occur in early 2007.

FOR MORE INFORMATION

Contact the following individuals for more information:

Kris Curley - Impact Area Groundwater Study Program
(508) 968-5626

Ellie Grillo - Massachusetts Department of Environmental Protection
(508) 946-2866

Jim Murphy - U.S. Environmental Protection Agency
(617) 918-1028

Or visit the Groundwater Study Program Web site at:
http://groundwaterprogram.army.mil

Information repositories have been established at the public libraries in Bourne, Sandwich, Mashpee and Falmouth to make information on the program available to the public. The repositories are updated to ensure that all necessary documents including copies of work plans, sampling results, site reports, fact sheets, meeting minutes and other materials are available. Key documents related to the Demo 1 plume and the selected remedy include:

- Final IAGWSP Demo 1 Groundwater Report, April 2001
- Final Demo 1 Groundwater Report Addendum, April 2004
- Final Feasibility Study, Demo 1 Groundwater Operable Unit, August 2005

OPPORTUNITIES FOR PUBLIC COMMENT

The 30-day public comment period for the RSP will be August 22 through September 19, 2005.

During public comment periods, comments can be submitted as follows:

On the Groundwater Study Program Web site:
http://groundwaterprogram.army.mil

By fax to (508) 968-5286

By mail to:
IAGWSP
1803 West Outer Road
Camp Edwards, MA 02542-5003

By e-mail to: kristina.curley@ma.ngb.army.mil

Alt#	Design Details			RDX Remediation			Perchlorate Remediation			Capital Cost	O&M	Total Present Worth***
	Number of Extraction Wells	Total Extraction Rate (gpm)	Number of Injection Wells	Years to Achieve Risk-Based Concentration (0.6 ppb)	Years to Achieve Background (0.25 ppb)	% Mass Removed After 10 years	Years to Achieve Risk-Based Concentration (1.0 ppb)	Years to Achieve Background (0.35 ppb)	% Mass Removed after 10 years			
1	0	0	0		>50	0		>50	0	1,550,000	1,300,000	2,850,000
2	2	320	3	36	50	67.5	36	35/>50*	80.2	3,640,000	11,400,000	15,000,000
3	4	472	4	23	27	92.1	23	23/21*	92.7	6,350,000	14,700,000	21,100,000
4	5	1417	4	11	15	99.7	10	15/15*	98.3	10,200,000	15,500,000	25,700,000
5**	5	906	4	14 (11)	16 (13)	98.8	13 (11/9)*	15/20* (12/19)*	98.3	8,340,000 (8,300,000)	12,700,000 (10,600,000)	21,000,000 (18,900,000)
6**	6	981 (1006)	4 (5)	14 (11)	16 (13)	99.0	14 (11/9)*	15/17* (12/17)*	97.9	9,870,000 (9,900,000)	16,700,000 (14,000,000)	26,600,000 (23,900,000)

NOTES:

Although the Contaminants of Concern list includes other explosive compounds, this table presents only RDX and perchlorate because those two plume shells contain the other contaminants.

* upgradient/downgradient of Pew Road

All percentages reflect cumulative mass removed including interim actions taken prior to startup of selected cleanup alternative.

gpm = gallons per minute

** Alternatives 5 and 6 were reevaluated in early 2005 to account for revised RDX and perchlorate plume shells. The results of the supplemental evaluation are presented within the parentheses below the results from the Feasibility Study. These results show that Alternatives 5 and 6 perform relatively similar in time to restore the aquifer.

*** In the supplemental evaluation, the estimated time to reach a 1 ppb cleanup for perchlorate is 11 years for both Alternatives 5 and 6 with total present worth cost to achieve 1 ppb for perchlorate of $18.9 million and $22.1 million for Alternative 5 and Alternative 6 respectively. To achieve background for perchlorate, the total present worth costs are $20.3 million and $23.9 million for Alternatives 5 and 6, respectively.

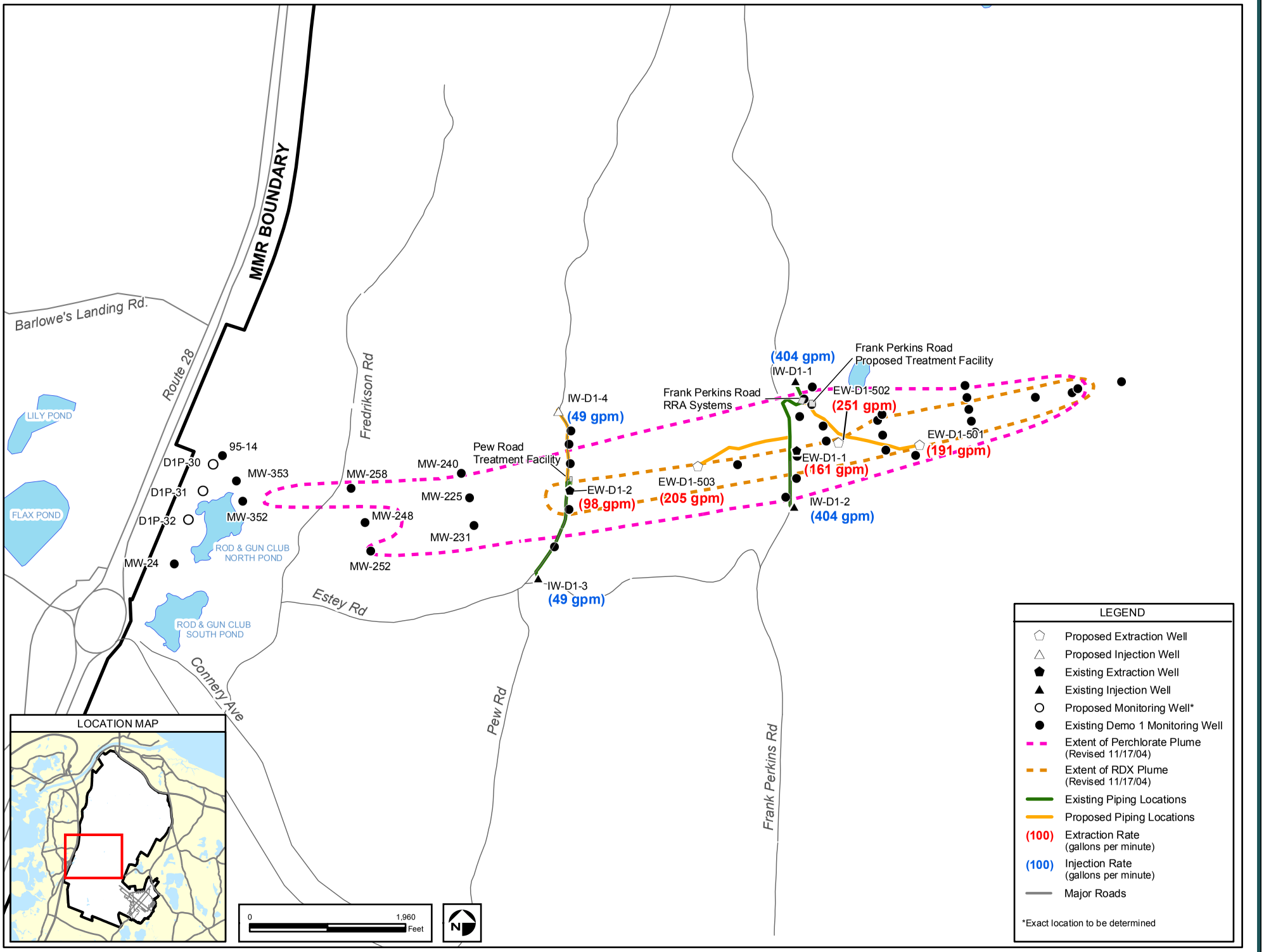

Figure 1 - Conceptual Design of the Proposed Remedy