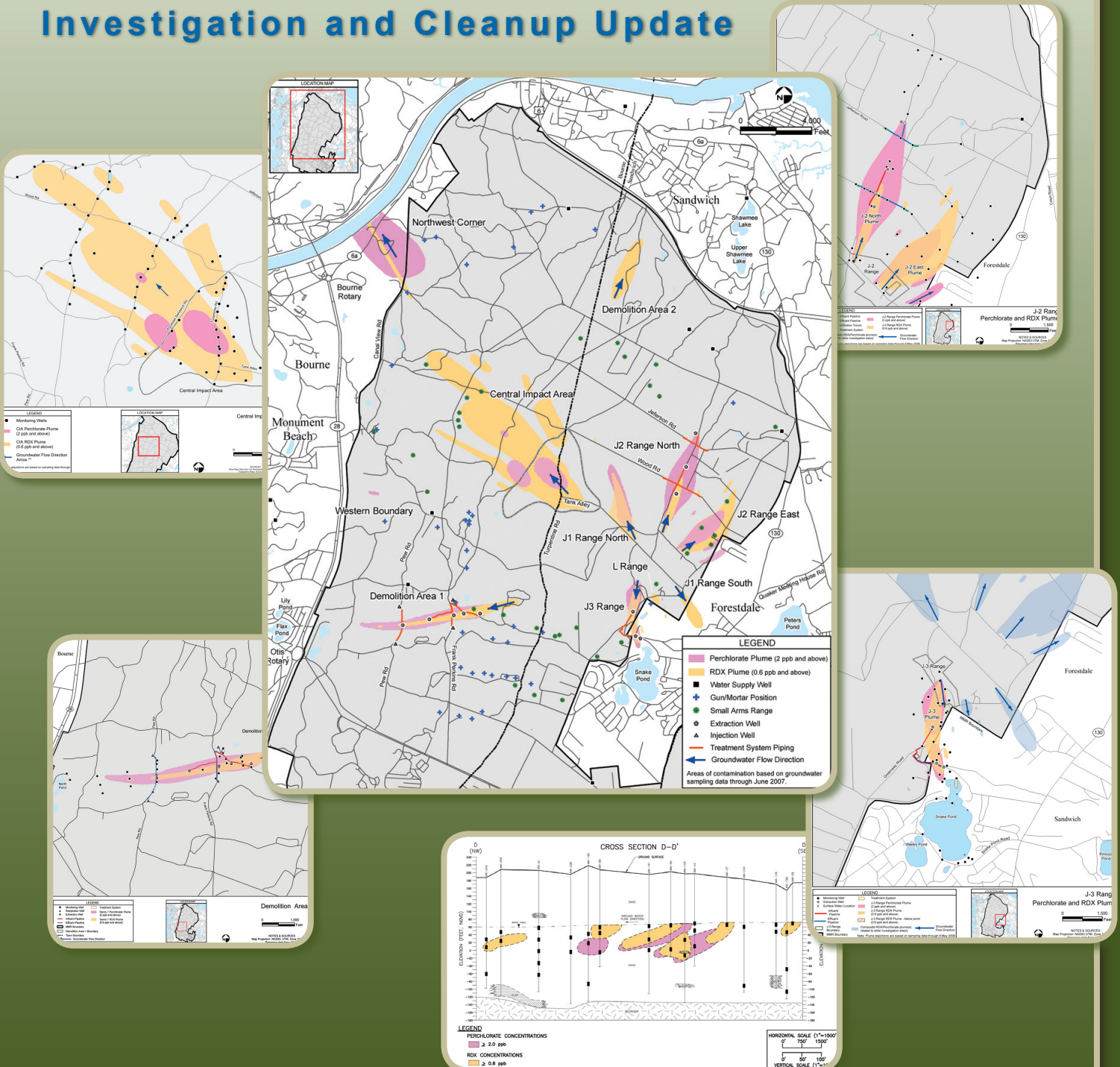


Summer 2007



# IMPACT AREA GROUNDWATER STUDY PROGRAM Investigation and Cleanup Update



Camp Edwards at the Massachusetts Military Reservation



## ABOUT THE IMPACT AREA GROUNDWATER STUDY PROGRAM

The U.S. Army Environmental Command'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 (MassDEP), the IAGWSP is committed to investigating and cleaning up groundwater contamination and its sources, on or emanating from Camp Edwards, in a manner that is protective of human health.

## PROGRAM BACKGROUND

Investigations into possible contamination at Camp Edwards began in response to community concerns about potential impacts from historic activities on the groundwater underlying the installation. The 15,000 acres that comprise Camp Edwards lie above the Sagamore Lens, and are an important recharge area for this aquifer that is the principal source of drinking water for the four Upper Cape communities. Beginning in 1997, the EPA issued Administrative Orders under the Safe Drinking Water Act that halted the use of explosives, propellants, flares and lead bullets at MMR, and required the investigation and cleanup of contamination from past activities.

IAGWSP investigations have looked at the impacts from military and defense contractor activities conducted on Camp Edwards since the early 1900s. These activities included firing of artillery, mortars, small arms and other projectiles; demolition training; and the detonation of munitions and explosives. Additionally, burning and burial of munitions and explosives occurred on some of the defense contractor ranges. Initial investigations included the review of historic records and photographs, and interviews with former soldiers and workers. To date, the IAGWSP has installed and sampled almost 1,000 groundwater monitoring well screens in 480 locations. More than 20,000 groundwater and 60,000 soil samples have been collected and analyzed.

## SOURCE AREA FINDINGS

**Source Areas** are areas of soil containing contaminants that are or could be leaching to the aquifer at high enough levels to create groundwater contamination. Ongoing investigations into potential sources of contamination have looked at training areas and other sites where historic activities were reported to have occurred. As a result, the following sites are being investigated as potential sources of groundwater contamination:

- **Demolition Area 1** – Previously used for demolition and disposal of munitions and other items. Source area removal was completed in 2005.
- **J-1 Range, J-2 Range and J-3 Range** – Ranges initially used for military training and then leased to defense contractors for testing. Several source areas have been removed from these ranges. Completion of investigations and cleanup is expected in 2008.
- **L Range** – Used for weapons and grenade training. No soil contamination detected. Unexploded munitions are being evaluated.

There are several sites including the J Ranges, the L Range, the Central Impact Area, Former A Range and Former K Range that contain unexploded or partially exploded munitions. Studies are ongoing to determine what, if any, impact they may have on groundwater quality.

- **Central Impact Area** – Former target for mortar and artillery firing practice. Two of the site's multiple source areas were removed in 2004. Cleanup alternatives are expected in 2009.
- **Demolition Area 2** – A former demolition training site. Source area removal was completed in 2004.

No groundwater contamination has been identified in connection with the following sites. Investigation reports on each of these areas are expected in 2008.

- **Gun & Mortar Firing Positions** – 37 areas used until 1997 as firing points for mortars and artillery. Contaminated soil was removed at two positions.
- **Small Arms Ranges** – 24 training areas used for small arms firing practice
- **Former A and Former K Ranges** – A former anti-tank range and a former rocket range
- **BA-4 Disposal Site** – Cleared area and roadways at the corner of a training range where soil contamination was found. A soil removal was completed in 2007.

The primary contaminants of concern discovered in soil are explosives, including RDX, TNT and its breakdown products; perchlorate; the propellants 2,4- and 2,6-DNT; nitroglycerin, and metals. Not all of these contaminants have been found in groundwater.

## GROUNDWATER FINDINGS

**Groundwater** plumes are areas of contamination above federal and state health-based levels defined by detections in multiple monitoring wells. The explosive compound RDX and perchlorate, which is used as an oxidizer, are the primary contaminants of concern in groundwater at Camp Edwards. The explosives HMX and TNT and its breakdown products also have been found in groundwater. Plumes identified to date and their status include:

None of these areas of groundwater contamination are impacting public or private drinking water supplies. The contamination is being addressed to ensure drinking water supplies are not impacted.

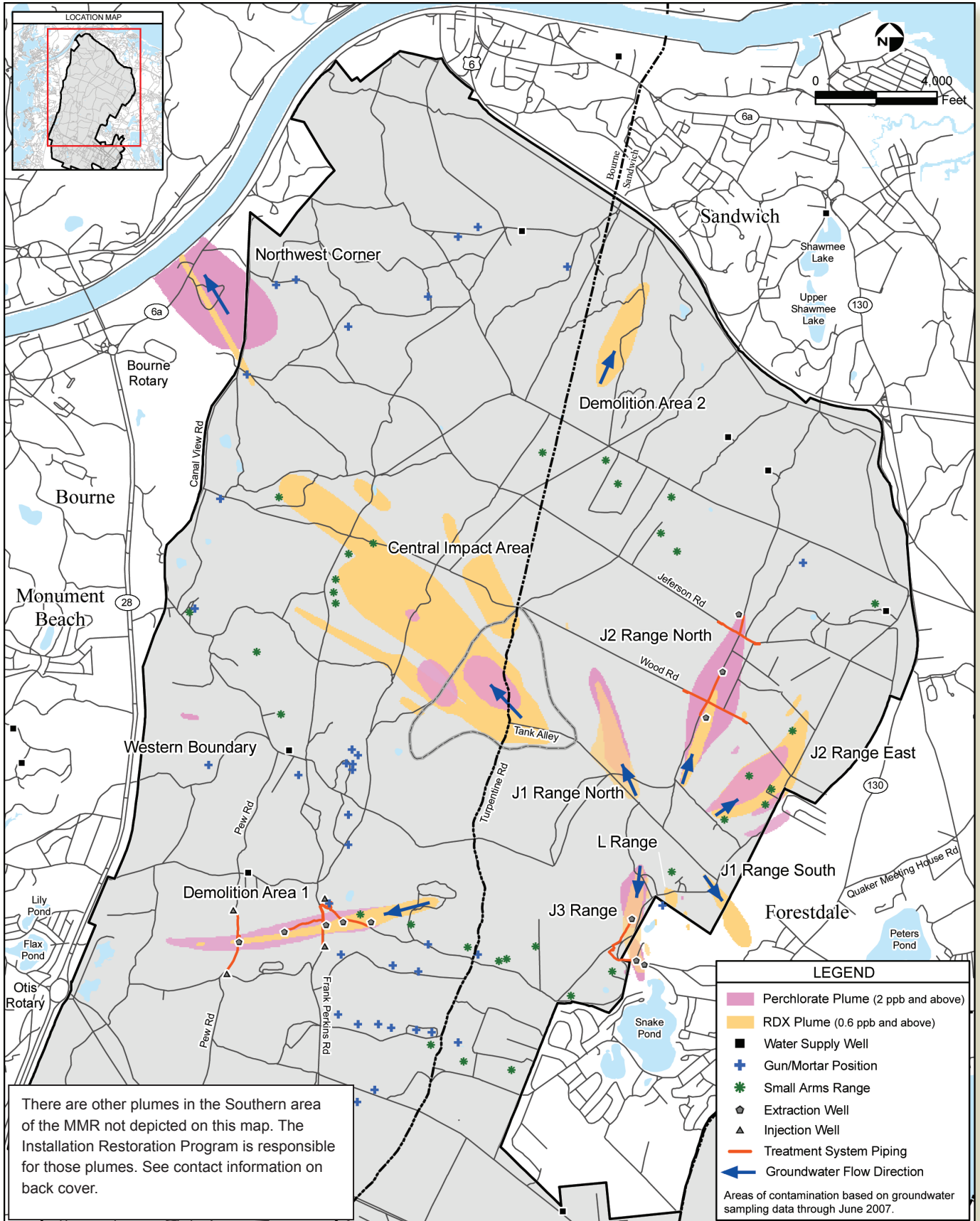
- **Demolition Area 1** – An expanded treatment system for this RDX and perchlorate plume is now operational and is expected to return the groundwater to risk-based levels in approximately 11 years. An interim system cleaned 792 million gallons of groundwater between September 2004 and June 2007.
- **J-1 Range North** – A feasibility study presenting alternatives to address this RDX and perchlorate plume is expected in 2008.
- **J-1 Range Southeast** – Installation of an interim treatment system to begin addressing this RDX plume is expected in fall 2007.
- **J-2 Range North/J-2 Range East** – An interim system began treating the J-2 North plume in 2006. Selection of a remedy to address both of these RDX and perchlorate plumes is expected in 2007.
- **J-3 Range** – An interim system began treating this RDX and perchlorate plume in 2006. Final remedy selection is expected in 2007.
- **L Range** – Alternatives to address RDX and perchlorate contamination will be presented in 2008.
- **Central Impact Area** – Presentation of alternatives to address finger-like plumes of RDX and perchlorate emanating from multiple source areas is expected in 2009.
- **Northwest Corner** – Alternatives for addressing perchlorate and RDX plumes will be presented in 2008.
- **Western Boundary** – Monitoring is ongoing in this area where several perchlorate detections near the state standard have been found in monitoring wells on the installation upgradient of four Bourne drinking-water supply wells.
- **Demolition Area 2** – Presentation of alternatives for addressing an area of RDX contamination is expected in late-2008.

## CURRENT STATUS

In 2003, the IAGWSP began transitioning from investigation to cleanup. This effort has resulted in:

- Excavation and treatment of close to 50,000 tons of soil from Demolition Area 1, the J-2 and J-3 Ranges, two Central Impact Area targets, Demolition Area 2, and two Gun Positions
- Start-up of groundwater treatment systems to address the three plumes with the highest contaminant levels





Impact Area Groundwater Study Program — Site-wide Map — June 2007



- Treatment of close to 850 million gallons of groundwater since 2004, with 2.1 million gallons now being treated each day

The IAGWSP is continuing to move forward by completing investigations, presenting cleanup alternatives and proposing accelerated cleanup actions, as appropriate, to protect public health.

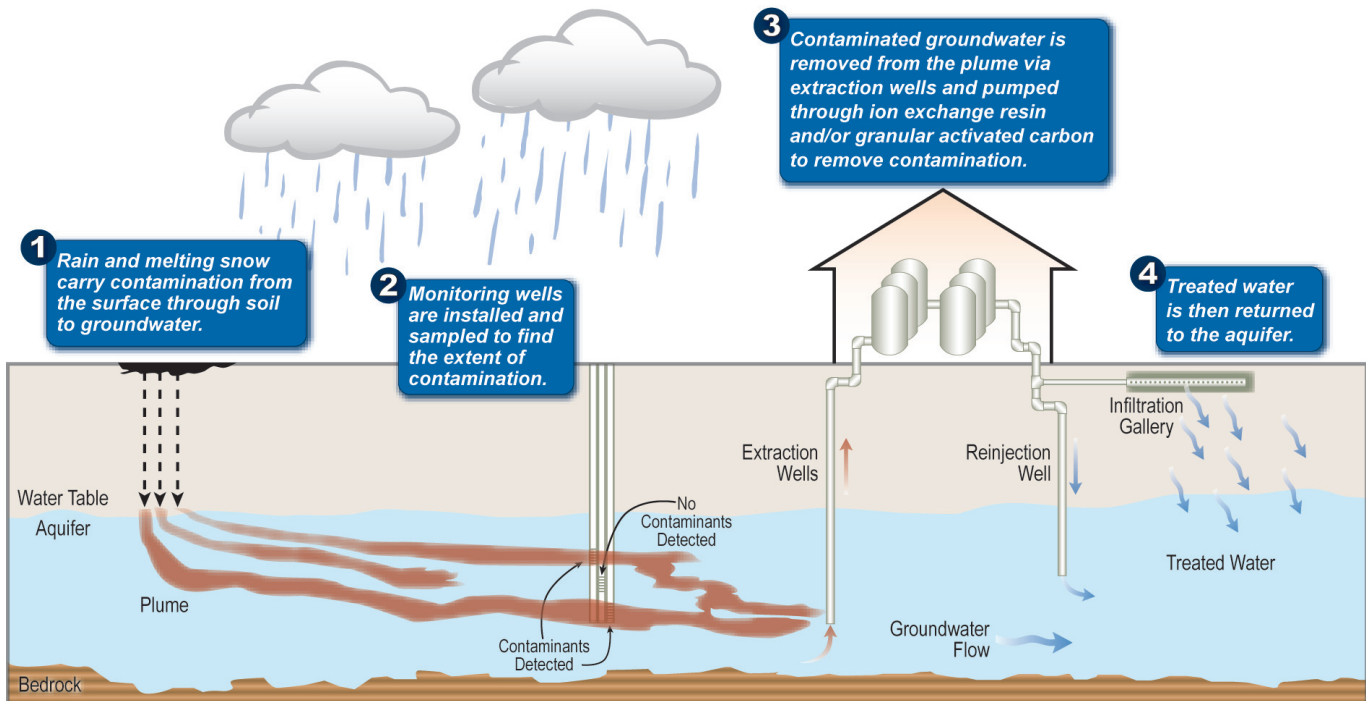
## GROUNDWATER CLEANUP

Several systems already are in place to address the groundwater contamination from the three plumes with the highest levels of contamination – the Demolition Area 1 plume, the J-2 Range North plume and the J-3 Range plume. With the expansion of the Demolition Area 1 system, these systems are reducing contamination and limiting plume migration by treating more than 765 million gallons of groundwater per year.

The  $10^{-6}$  risk-based level for RDX in groundwater is 0.6 parts per billion (ppb). This is the concentration resulting in an increased lifetime cancer risk of one in a million. The Federal Lifetime Health Advisory is 2 ppb. The Massachusetts Maximum Contaminant Level for perchlorate in drinking water is 2 ppb.

With groundwater investigations now complete for several other plumes, a range of cleanup alternatives to address the contamination at each site will be proposed. These alternatives will be presented for public review and comment in the Remedy Selection Plan. Alternatives for addressing contamination are expected to be selected and in place for all identified plumes by 2011, and it is expected that most response actions will return groundwater to health-based levels in 10 to 20 years.

### How Pump and Treat Systems Clean Up Groundwater Contamination



## SOURCE AREA CLEANUP

Several different methods have been used to address areas of soil that are continuing sources of groundwater contamination.

- Dry screening and soil washing were used to remove 50 tons of lead from 28,000 tons of soil and rocks excavated during the 1998 berm maintenance program.

- A thermal desorption unit, which used heat to separate and destroy contaminants, treated more than 50,000 tons of soil from known source areas at Demolition Area 1, Demolition Area 2, the Central Impact Area, Gun Position 6, and the J-2 and J-3 Ranges.
- Off-site disposal is used for soil from small removal actions or when the soil is not suitable for treatment due to the contaminant types or concentrations. More than 300 tons of soil have been disposed of off site.

More than 100,000 metal objects, including munitions, ammunition, munitions-related items and scrap, have been investigated and removed. Metal items, including inert munitions, are recycled as scrap. Munitions that potentially contain explosives are destroyed by open or contained detonation as determined by munitions experts.

Soil investigations are ongoing in a number of areas including the Gun & Mortar Positions and the Small Arms Ranges. Rapid Response Actions or feasibility studies, including treatment or disposal plans, will be presented for locations where removals are appropriate. Rapid Response Action and Remedy Selection plans will be submitted to the public for review and comment.

## CLEANUP PROCESS

The following process is followed in conducting the IAGWSP investigation and cleanup:

### INVESTIGATION:

**Site Identification** – Sites are identified through historical accounts and records, site inspections, interviews, and air and ground-based magnetic surveys.

**Investigation** – Soil and groundwater sampling determines the presence, types, levels, and extent of any contamination.

**Rapid Response Actions** – Interim actions may be proposed to begin cleanup while investigations and the formal process of presenting and selecting long-term alternatives to address contamination is completed. These actions are presented for public comment.

### RESPONSE DEVELOPMENT AND SELECTION:

**Feasibility studies/analysis** – Once areas of contamination are sufficiently defined, findings are presented along with alternatives for addressing contamination, if necessary.

**Remedy Selection Plan** – The information from the feasibility studies/analysis is used to develop a Remedy Selection Plan that details the recommended alternative for addressing contamination. Remedy Selection Plans are presented for public comment.

**Decision Document** – After considering comments, a decision document is prepared describing the selected alternative and how it will be implemented.

### RESPONSE IMPLEMENTATION:

**Response Action** – The Response Action is the implementation of the selected alternative for addressing contamination, including any required construction, operation and maintenance, and monitoring.

**Operation and Maintenance** – The required activities, such as periodic sampling of monitoring wells, and, if a treatment system is part of the Response Action, sampling of the system, the change-out of treatment media, and other maintenance required to ensure the effectiveness of the response action.

| SITE                   | INVESTIGATION                        | RESPONSE DEVELOPMENT AND SELECTION (IF REQUIRED) | RESPONSE IMPLEMENTATION (IF REQUIRED) | ANTICIPATED REMEDY IN PLACE/RESPONSE COMPLETE* |
|------------------------|--------------------------------------|--------------------------------------------------|---------------------------------------|------------------------------------------------|
| DEMOLITION AREA 1      | <b>Source Area/Groundwater RRA</b> → |                                                  |                                       | SPRING 2007                                    |
| J-3 RANGE              | <b>Source Area/Groundwater RRA</b> → |                                                  |                                       | SPRING 2008                                    |
| WESTERN BOUNDARY       | →                                    |                                                  |                                       | SPRING 2008                                    |
| BA-4 DISPOSAL SITE     | <b>Source Area RRA</b> →             |                                                  |                                       | SPRING 2008                                    |
| J-2 RANGE              | <b>Source Area/Groundwater RRA</b> → |                                                  |                                       | SUMMER 2008                                    |
| FORMER K RANGE         | →                                    |                                                  |                                       | SUMMER 2008                                    |
| SMALL ARMS RANGES      | →                                    |                                                  |                                       | FALL 2008                                      |
| NORTHWEST CORNER       | →                                    |                                                  |                                       | FALL 2008                                      |
| DEMOLITION AREA 2      | <b>Source Area RRA</b> →             |                                                  |                                       | WINTER 2008                                    |
| GUN & MORTAR POSITIONS | →                                    |                                                  |                                       | SPRING 2009                                    |
| FORMER A RANGE         | →                                    |                                                  |                                       | SPRING 2009                                    |
| J-1 RANGE              | <b>Groundwater RRA</b> →             |                                                  |                                       | FALL 2009                                      |
| L RANGE                | →                                    |                                                  |                                       | FALL 2009                                      |
| CENTRAL IMPACT AREA    | →                                    |                                                  |                                       | SPRING 2011                                    |

\*Remedy in Place/Response Complete - When remedial action, if required, has been completed or a groundwater system is in place.

The time required to complete each phase of the process will vary depending on the site and the types/level of contamination. Some, like the BA-4 Disposal Site, where little soil and no groundwater contamination has been found, may move from Investigation to Remedy in Place in less than a year. For a larger site, like the Central Impact Area, with soil and groundwater contamination spread over a wide area, it may take several years just to complete the Response Development and Selection phase.

The length of time it will take to return the groundwater to beneficial use can not be determined until the response action, if necessary, is selected. It is estimated that most areas of groundwater contamination will be returned to risk-based levels within 10 to 20 years of the Response in Place date.



# DEMOLITION AREA 1

## BACKGROUND

Demolition Area 1 is a naturally formed, 7.4-acre, 45-foot deep topographical depression located on the installation two miles northeast of the Otis Rotary in Bourne. The former demolition site was used from the mid-1970s to 1997 for training and disposal of items, including munitions, fireworks, small arms ammunition and explosives.

## FINDINGS

Soil sampling results from Demolition Area 1 found RDX and other explosives, propellants, and perchlorate in soil at depths of up to 12 feet. In addition, subsurface areas that could be disposal pits were identified. These pits, where burial and burning of items may have occurred, are considered likely groundwater contamination sources.

Results from samples collected at more than 100 groundwater monitoring wells in locations extending west from Demolition Area 1 identified a 9,000- x 1,000-foot area of groundwater contamination with RDX above 0.6 parts per billion (ppb) or perchlorate above 2 ppb. Maximum RDX and perchlorate detections within the plume were 370 ppb and 500 ppb, respectively. The current upper limits are 140 ppb for RDX and 102 ppb for perchlorate. The contamination is not threatening public or private water supply wells.

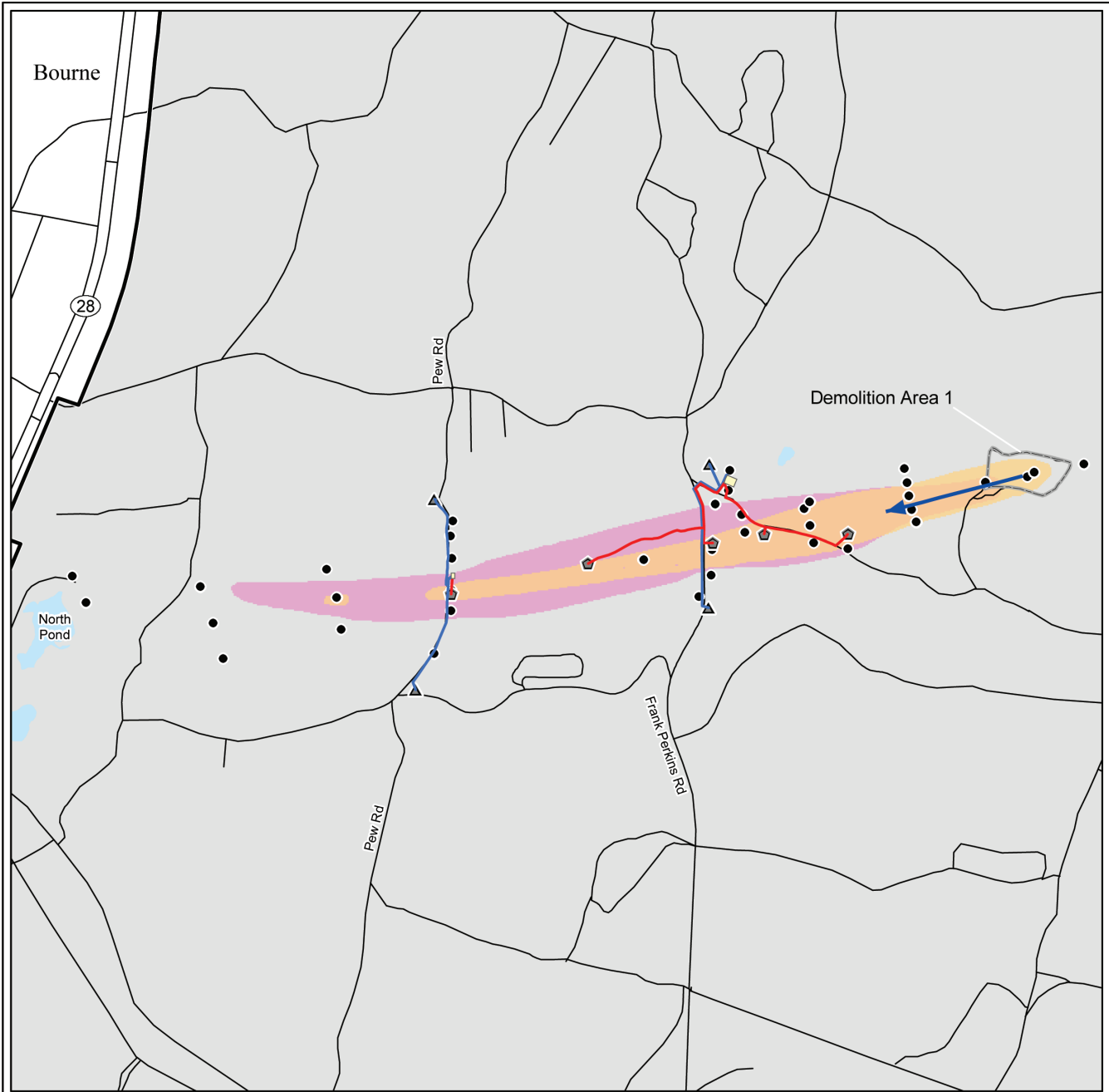
## CLEANUP PLANS AND ACTIONS

**Source Area:** A soil Rapid Response Action conducted from 2003 to 2004 excavated 28,000 tons of soil that were the source of groundwater contamination migrating from the Demolition Area 1 site. Thermal desorption was used to treat the soil on site. After treatment, the soil was returned to Demolition Area 1 for restoration. In addition, approximately 70,000 metallic items including munitions and related items, 14 disposal pits and 200 tons of scrap were removed. This action is expected to be the final response for soil cleanup at this source area.

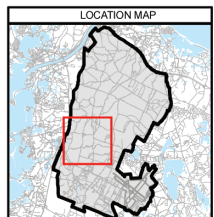
**Groundwater:** In 2004, groundwater cleanup began under a Rapid Response Action treating approximately 460,000 gallons a day. The action consisted of treatment systems in two locations along the central area of the plume. Two extraction wells pumped 430 gallons of groundwater per minute through four modular treatment units where granular activated carbon and ion exchange resin removed explosives and perchlorate from the water. Three reinjection wells returned cleaned water to the aquifer.

The comprehensive Demolition Area 1 remediation system became operational in mid-2007. The expanded system treats 1.3 million gallons a day using a total of five extraction wells and four reinjection wells. A permanent facility was constructed near Demolition Area 1 to replace three of the modular units. The system is expected to achieve cleanup levels in 11 years. The response action includes a contingency that would be activated if modeling indicates contamination above health-based levels would migrate west of monitoring wells at North Pond.

The annual System Performance & Monitoring Plan verifies system effectiveness and tracks plume reduction. Contamination is not expected to migrate off post with the current system in place.



| LEGEND |                                            |
|--------|--------------------------------------------|
| ●      | Monitoring Well                            |
| ▲      | Reinjection Well                           |
| ●      | Extraction Well                            |
| —      | Influent Pipeline                          |
| —      | Effluent Pipeline                          |
| —      | MMR Boundary                               |
| —      | Demolition Area 1 Boundary                 |
| —      | Town Boundary                              |
| →      | Groundwater Flow Direction                 |
| □      | Treatment System                           |
| ■      | Demo 1 Perchlorate Plume (2 ppb and above) |
| ■      | Demo 1 RDX Plume (0.6 ppb and above)       |



### Demolition Area 1



NOTES & SOURCES  
 Map Projection: NAD83, UTM, Zone 19N, meters  
 Basemap data from ARNG

Demolition Area 1 plume depictions are based on sampling data through April 2006.

# J-1 RANGE

## BACKGROUND

The 600- x 6,000-foot J-1 Range is one of four ranges commonly referred to as the Southeast Ranges. Located on the installation, west of the boundary with Sandwich, the range was used beginning in the 1940s as an anti-tank range and for small arms firing. From 1957 until the mid-1980s the range was leased to a variety of Department of Defense contractors who conducted munitions testing.

## FINDINGS

Soil sampling on the J-1 Range found the explosives RDX and TNT, the propellant 2,4-DNT and perchlorate in areas related to previous defense contractor munitions testing and disposal activities. Buried items also were found in these areas.

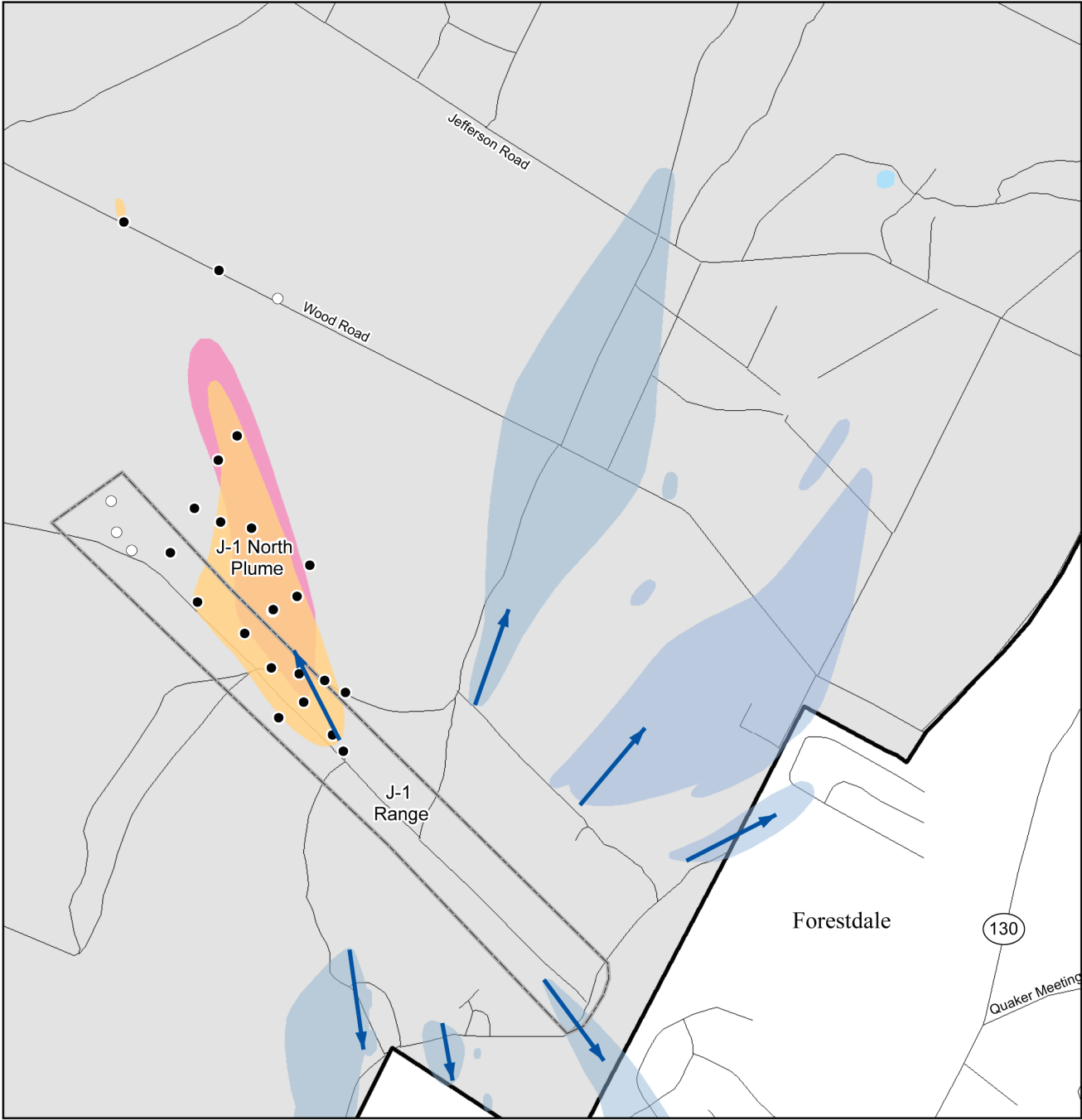
Results from samples collected from more than 100 groundwater monitoring wells have helped define two areas of groundwater contamination migrating from the J-1 Range. The J-1 North plume is a 6,000- x 1,100-foot plume with RDX above 0.6 ppb and perchlorate above 2 ppb. The plume contains RDX concentrations up to 27 ppb and perchlorate at levels up to 30 ppb. It is migrating northwest into the Impact Area and is not impacting any existing private or public drinking water wells. Investigation of the J-1 South plume began when a 120 ppb detection of RDX was confirmed at the installation boundary with Sandwich. Detections of 13 ppb in recently installed off-post wells indicated the plume has migrated approximately 1,500 feet beyond the installation boundary. Since all homes in the immediate area are on town water, no drinking water wells are affected.

## CLEANUP PLANS AND ACTIONS

**Source Area:** Investigation and removal of subsurface areas that could be disposal pits has been ongoing on the J-1 Range since 2004. These pits, where burial and burning of munitions and other items occurred, are considered likely sources of groundwater contamination. To date, more than 40 100- x 100-foot grids, along with an equal number of individual areas where magnetic signals indicated possible pits, have been excavated. Any contaminated soil from these excavations is removed and disposed of off site. Additional subsurface investigations are under way and expected to be completed in 2007. Alternatives for addressing J-1 Range North and J-1 Range South source areas will be presented in 2008.

**Groundwater:** Based on recent investigations, the J-1 Range North plume is believed to be sufficiently defined to begin evaluating and selecting alternatives to address groundwater contamination. These alternatives will be presented in conjunction with those for addressing J-1 Range North soil. Since the J-1 Range South plume has migrated off the installation, a Rapid Response Action is being implemented in 2007 to begin treating groundwater contamination while evaluation and selection of alternatives to address both J-1 Range South groundwater contamination and any related source area is completed. The interim action scheduled for startup in late-2007 will consist of a system that extracts water from the plume, treats it and returns it into the aquifer. Both plumes are continuing to be tracked under groundwater monitoring plans. The J-1 Range North and J-1 Range South feasibility studies are scheduled for mid-2008.

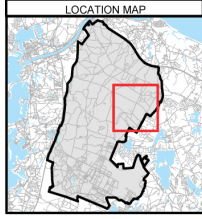




**LEGEND**

|                              |                                                                           |
|------------------------------|---------------------------------------------------------------------------|
| ● Monitoring Well            | J-1 Range North Perchlorate Plume (2 ppb and above)                       |
| ○ Proposed Monitoring Well   | J-1 Range North RDX Plume (0.6 ppb and above)                             |
| ▭ J-1 Range Boundary         | Composite RDX/Perchlorate plume(s) related to other investigation site(s) |
| ▭ MMR Boundary               |                                                                           |
| ← Groundwater Flow Direction |                                                                           |

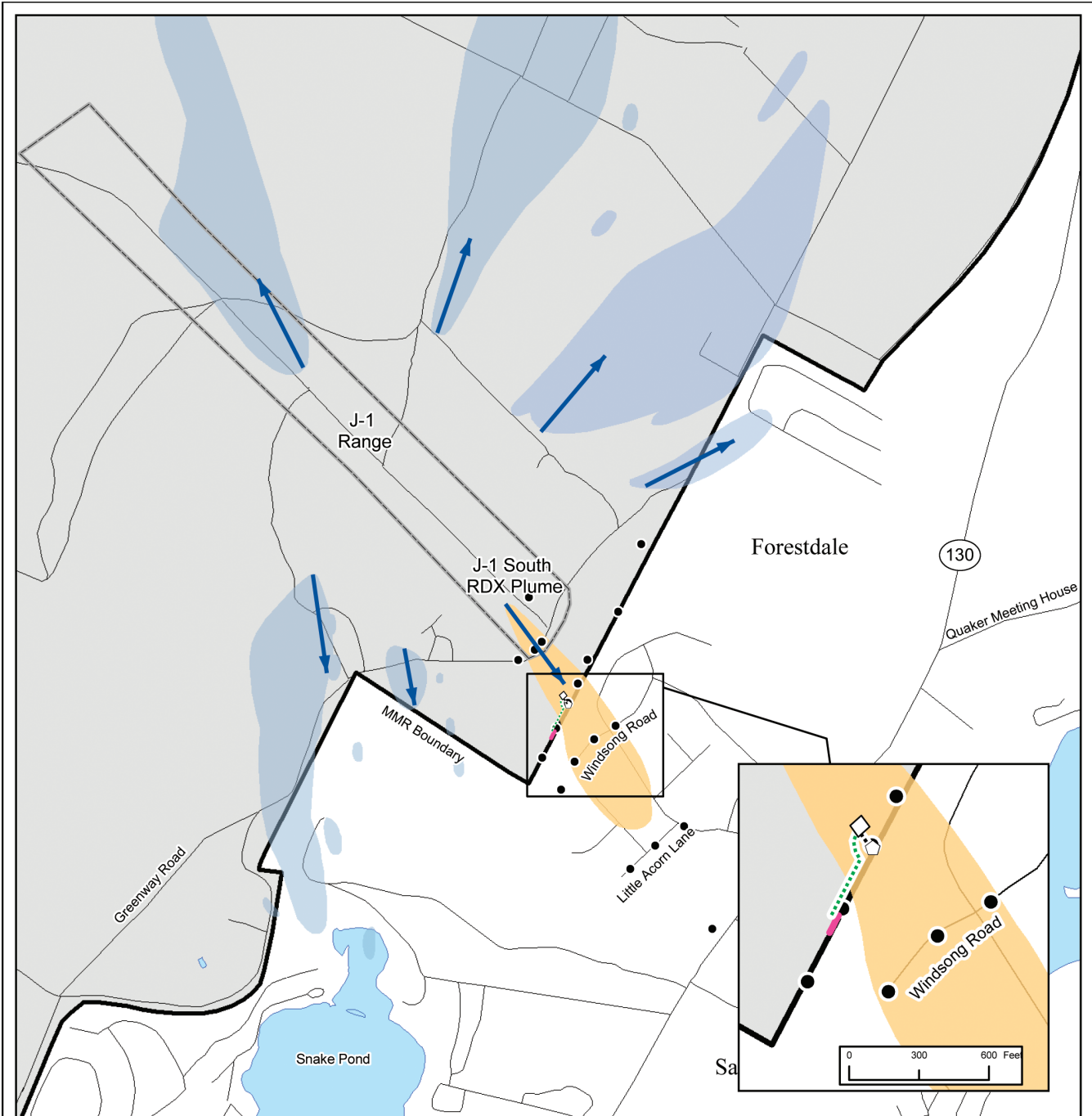
Note: Plume depictions are based on sampling data through 8 May 2006.



**J-1 Range North**



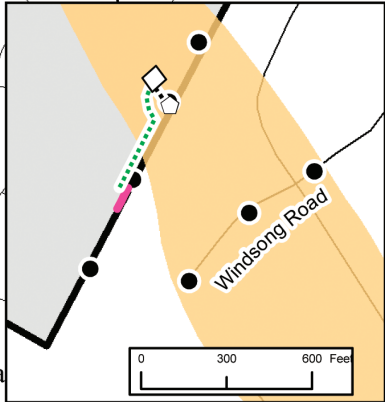
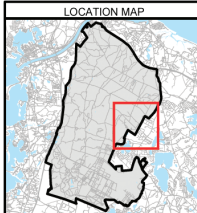
NOTES & SOURCES  
 Map Projection: NAD83 UTM, Zone 19N, meters  
 Basemap data from ARNG



**LEGEND**

|                      |                                                                           |                                |
|----------------------|---------------------------------------------------------------------------|--------------------------------|
| ● Monitoring Well    | J-1 Range South RDX Plume (0.6 ppb and above)                             | ○ Proposed Extraction Well     |
| ▭ J-1 Range Boundary | Composite RDX/Perchlorate plume(s) related to other investigation site(s) | ▭ Proposed Treatment System    |
| ▭ MMR Boundary       | ← Groundwater Flow Direction                                              | - - - Proposed Influent Piping |
|                      |                                                                           | - - - Proposed Effluent Piping |
|                      |                                                                           | — Proposed Infiltration Trench |

Note: Plume depictions are based on sampling data through 15 March 2007.



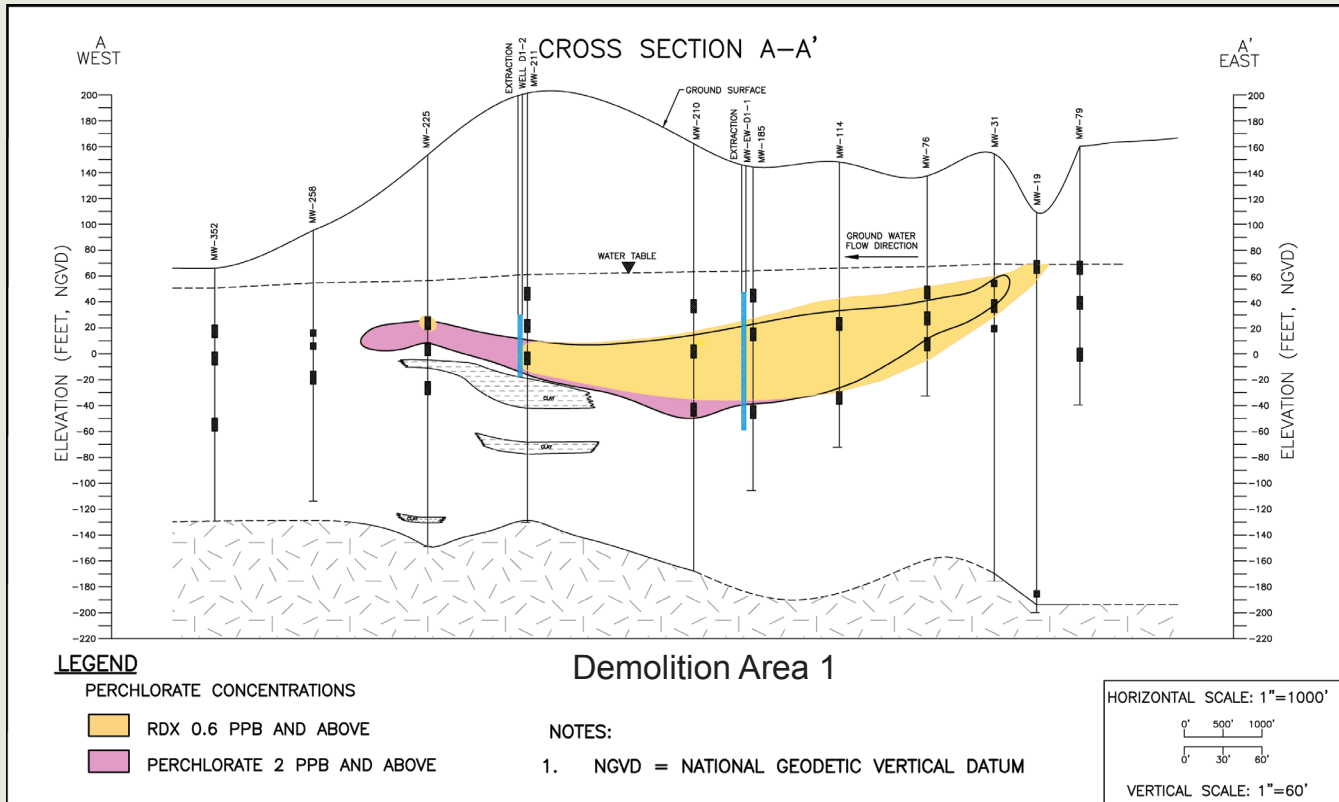
### J-1 South Plume



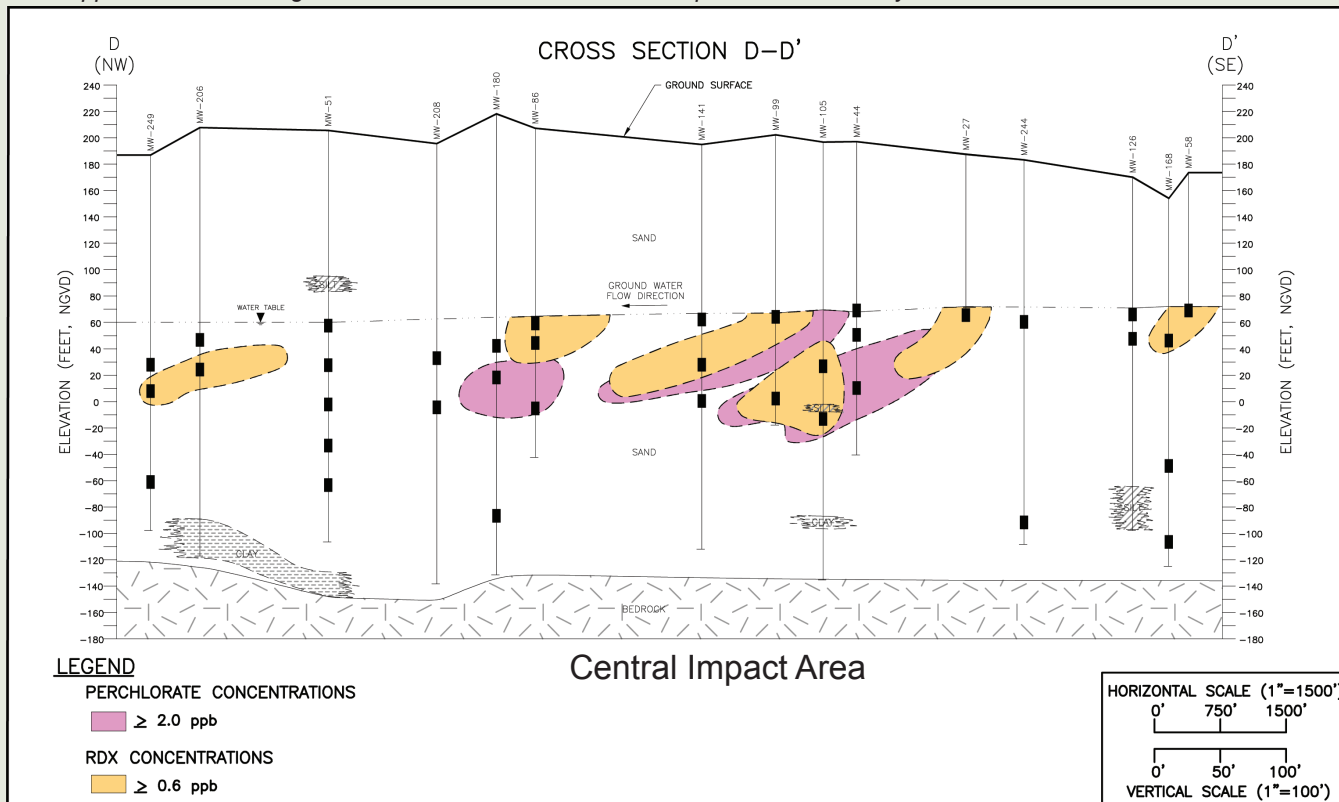
NOTES & SOURCES  
 Map Projection: NAD83 UTM, Zone 19N, meters  
 Basemap data from ARNG

# EXAMPLES OF GROUNDWATER CONTAMINATION BENEATH THE SURFACE

This cross section of groundwater contamination from Demolition Area 1 shows an example of a plume originating from a single source area.



This cross section of the Central Impact Area plume is an example of groundwater contamination from multiple source areas. What appears as one contiguous area of contamination from the plan view is actually a number of unconnected lobes.





## J-2 RANGE

### BACKGROUND

The 600- x 3,500-foot J-2 Range is one of four ranges commonly referred to as the Southeast Ranges. Located on the installation, west of the boundary with Sandwich, the range was used for small arms firing in the 1940s. From 1953 until the late-1980s, it was leased by various Department of Defense contractors for munitions testing.

### FINDINGS

Soil sampling results on the J-2 Range identified RDX and other explosives, along with perchlorate, in areas related to previous defense contractor munitions testing and disposal activities. Buried materials also were found in these areas.

Results of samples collected at more than 200 groundwater monitoring wells have identified two plumes with RDX above 0.6 ppb and perchlorate above 2 ppb migrating from the J-2 Range. The 5,800- x 1,500-foot J-2 Range North plume with RDX at levels up to 3.1 ppb and perchlorate up to 149 ppb extends north from the northwestern end of the range toward an on-post public water supply well. The 4,600- x 2,200-foot J-2 Range East plume, with RDX up to 12 ppb and perchlorate up to 55.6 ppb, is migrating north from the southeastern end of the range. Contamination has not been found off the installation. A public drinking water well is located in an area downgradient from these plumes. As a result, the J-2 plumes were given high priority for treatment.

### CLEANUP PLANS AND ACTIONS

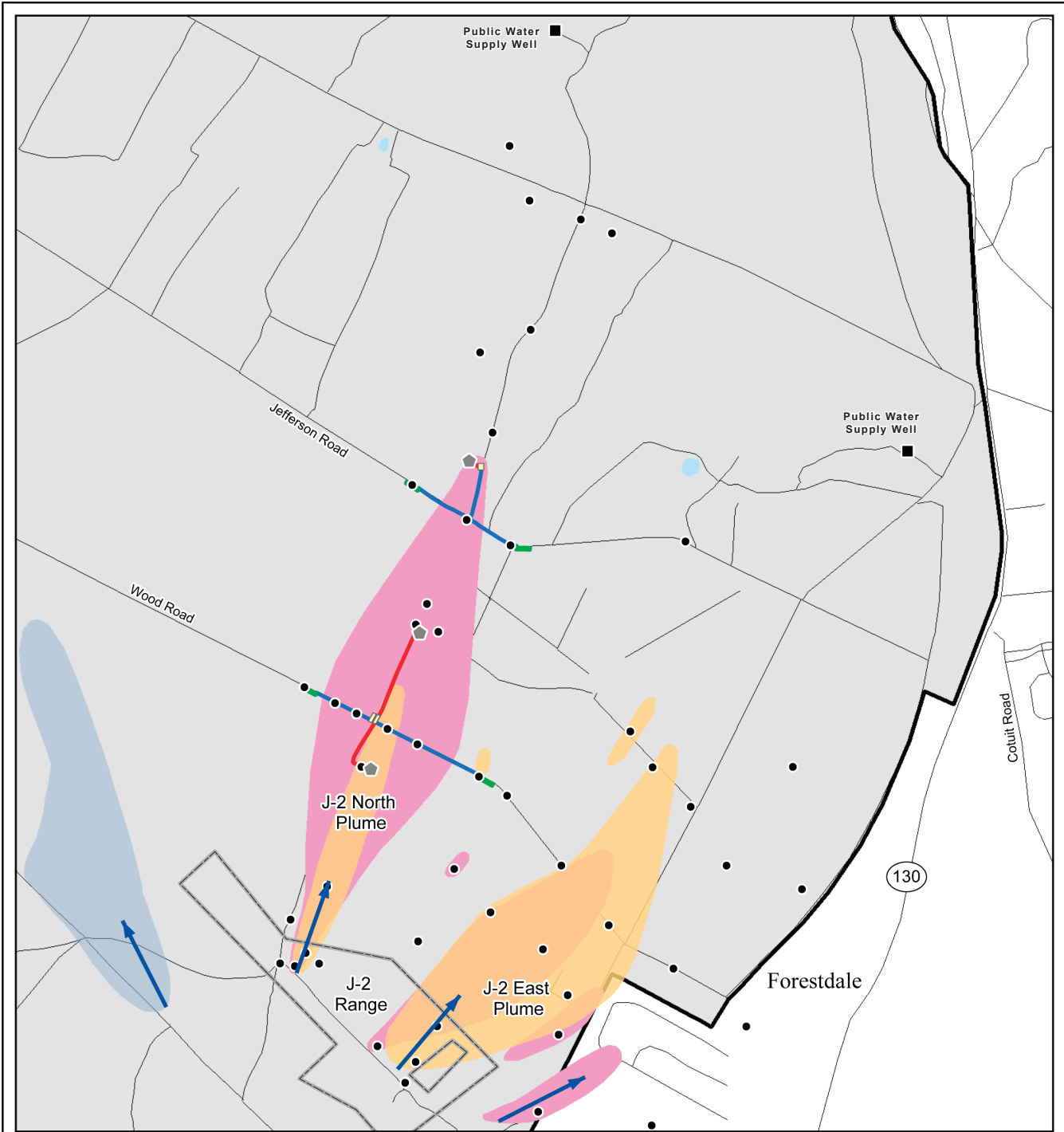
**Source Area:** A Rapid Response Action conducted in 2004 removed 8,400 tons of contaminated soil from areas on the J-2 Range believed to be groundwater contamination sources. This included the source area for the J-2 Range North plume. The soil was treated on site by thermal desorption, which uses heat to remove contaminants. More than 50,000 metallic objects were investigated and removed as part of this action. Investigations in 2005 and 2006 removed additional soil and metallic items from possible disposal pits that are considered likely groundwater contamination sources. Additional subsurface investigations are under way and expected to be completed in 2007. Any contaminated soil from these excavations will be removed and disposed of off site.

**Groundwater:** Treatment of the J-2 Range North plume began in 2006 under a Rapid Response Action that is treating approximately 540,000 gallons of groundwater a day. The system is designed to limit plume migration so it does not impact the water supply well and to reduce plume concentrations. This system:

- Uses three extraction wells to remove 375 gallons of groundwater from the aquifer per minute
- Pumps groundwater through a 900-square-foot treatment building and two modular treatment units that use granular activated carbon and ion exchange resin to remove RDX and perchlorate
- Returns the cleaned water to the aquifer using four infiltration trenches

The annual System Performance & Monitoring Plan monitors for system effectiveness and tracks plume reduction.

The Remedy Selection Plan, which will present cleanup alternatives for both the J-2 plumes, will be completed and provided for public review and comment in 2007.



**LEGEND**

|                            |                       |                                                                             |
|----------------------------|-----------------------|-----------------------------------------------------------------------------|
| ● Monitoring Well          | — Influent Pipeline   | J-2 Range Perchlorate Plume (2 ppb and above)                               |
| ◆ Extraction Well          | — Effluent Pipeline   | J-2 Range RDX Plume (0.6 ppb and above)                                     |
| ■ Public Water Supply Well | — Infiltration Trench | ← Composite RDX/Perchlorate plume(s) related to other investigation site(s) |
| □ J-2 Range Boundary       | ■ Treatment System    | → Groundwater Flow Direction                                                |
| ▭ MMR Boundary             |                       |                                                                             |

Note: Plume depictions are based on sampling data through 8 May 2006.



**J-2 Range**

0 1,500 Feet

NOTES & SOURCES  
Map Projection: NAD83 UTM, Zone 19N, meters  
Basemap data from ARNG

# J-3 RANGE

## BACKGROUND

The 300- x 3,000-foot J-3 Range is one of four ranges commonly referred to as the Southeast Ranges. Located on the installation, northwest of Snake Pond in Sandwich, the site was used as a mortar firing position and rocket impact area in the 1940s. From 1968 to 1997 the range was leased by a Department of Defense contractor for munitions testing.

## FINDINGS

Soil sampling on the J-3 Range detected RDX and other explosives, along with perchlorate, in areas related to previous defense contractor munitions testing and disposal activities. Buried materials also were found in these areas.

Results from samples collected at more than 170 groundwater monitoring wells identified a 3,750- x 1,100-foot plume with RDX above 0.6 ppb and perchlorate above 2 ppb migrating southeast into Sandwich and under the northwest portion of Snake Pond. Maximum RDX and perchlorate detections within the J-3 Range plume were 35 ppb and 770 ppb, respectively. The current upper limits are 24 ppb for RDX and 431 ppb for perchlorate. These contaminants have not been detected in pond surface water samples. Results from wells drilled south of the pond indicate the plume does not underflow the pond. Area residences are on town water.

## CLEANUP PLANS AND ACTIONS

**Source Area:** A 2004 Rapid Response Action removed 3,500 tons of soil believed to be groundwater contamination source areas. This included the suspected source of the J-3 Range plume. Soil was treated on site using thermal desorption, which uses heat to remove contaminants. Limited ongoing investigations to identify any other potential source areas are expected to be completed by 2007. Any contaminated soil from these excavations will be removed and disposed of off site.

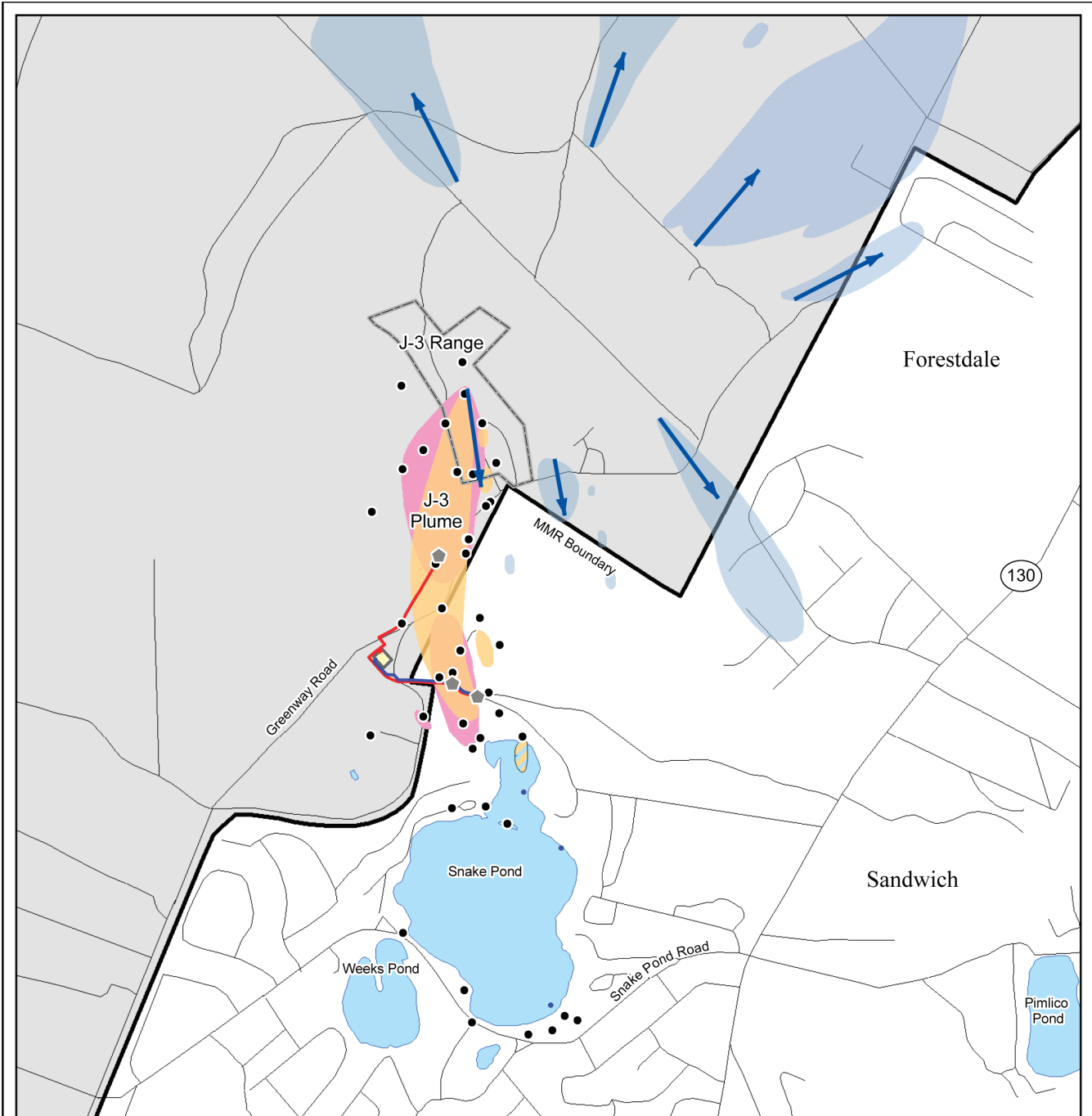
**Groundwater:** Treatment of the J-3 Range plume began in 2006 under a Rapid Response Action. This system is reducing contamination using portions of the Air Force Center for Engineering and the Environment's Fuel Spill 12 (FS-12) treatment facility. The system cleans approximately 92 million gallons of groundwater a year and:

- Uses three extraction wells to remove 175 gallons of groundwater per minute from the aquifer
- Removes RDX and perchlorate using containers of granular activated carbon and ion exchange resin housed in the FS-12 building
- Returns the cleaned water to the aquifer using existing FS-12 reinjection wells

Plume migration and results of ongoing treatment are monitored through an annual System Performance & Monitoring Plan.

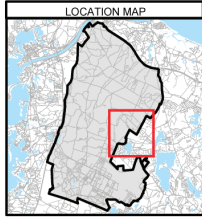
The Remedy Selection Plan, which will present cleanup alternatives for the J-3 Plume, will be completed and provided for public review and comment in 2007.





| LEGEND                   |                                                                             |
|--------------------------|-----------------------------------------------------------------------------|
| ● Monitoring Well        | ■ Treatment System                                                          |
| ● Extraction Well        | ■ J-3 Range Perchlorate Plume (2 ppb and above)                             |
| ● Surface Water Location | ■ J-3 Range RDX Plume (0.6 ppb and above)                                   |
| — Influent Pipeline      | ■ J-3 Range RDX Plume - below pond (0.6 ppb and above)                      |
| — Effluent Pipeline      | ← Composite RDX/Perchlorate plume(s) related to other investigation site(s) |
| □ J-3 Range Boundary     | ← Groundwater Flow Direction                                                |
| □ MMR Boundary           |                                                                             |

Note: Plume depictions are based on sampling data through 8 May 2006.



### J-3 Range



NOTES & SOURCES  
 Map Projection: NAD83 UTM, Zone 19N, meters  
 Basemap data from ARNG

# L RANGE

## BACKGROUND

The 600- x 1,500-foot L Range is one of four ranges commonly referred to as the Southeast Ranges. Located on the installation, near the boundary with Sandwich, the range was used from the 1940s until the mid-1990s for the firing of various weapons, including grenades. In addition, detonation of explosives to simulate battlefield conditions for training was reported.

## FINDINGS

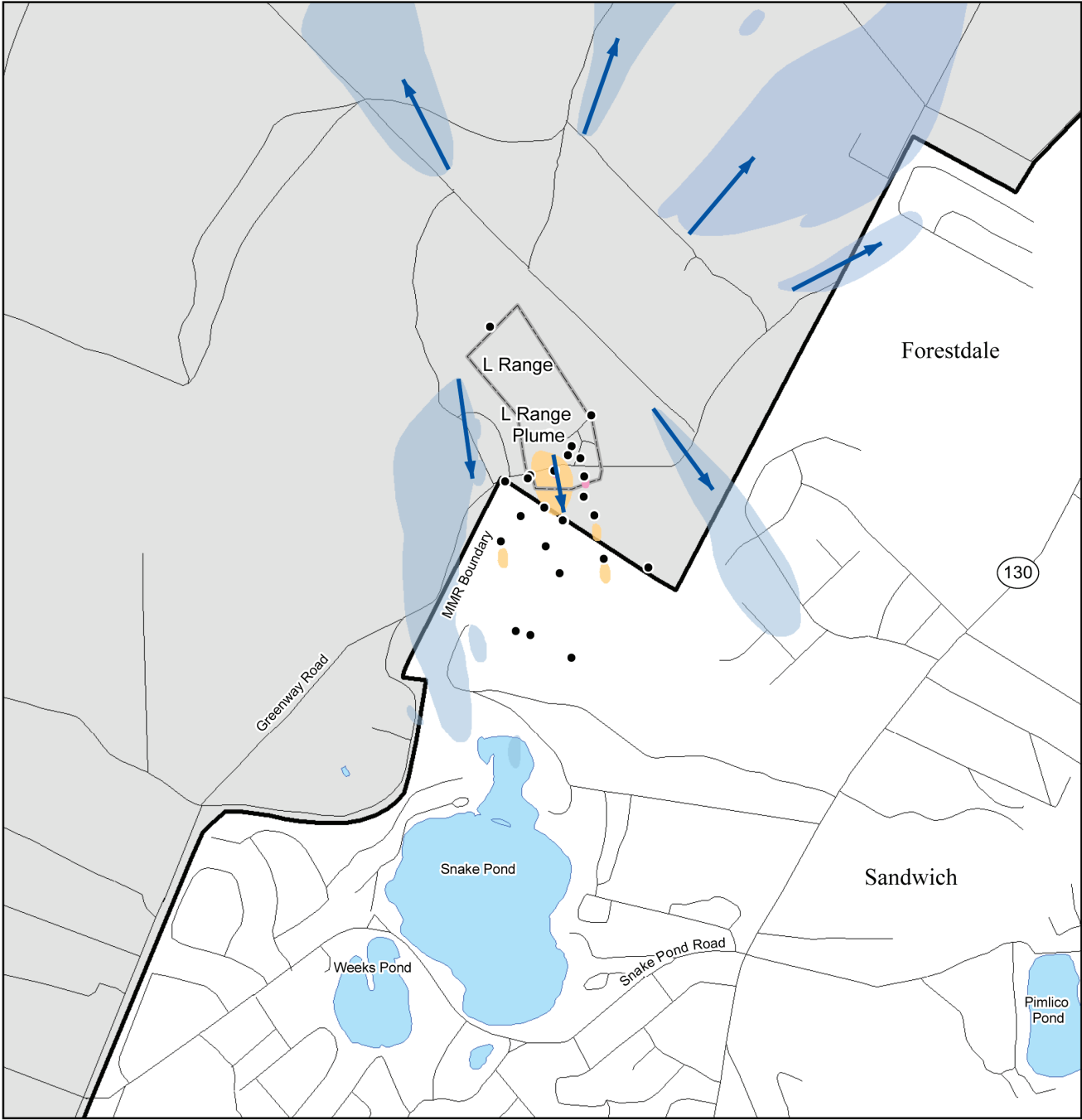
The L Range soil investigation included collection of 473 samples from 60 locations. There were no detections of explosives, propellants or perchlorate in L Range soil. Munitions have been found on the surface around various targets on the range. The area is fenced to prevent access.

Sampling results from 55 monitoring wells identified several small lobes of groundwater contamination in a 1,000- x 800-foot area extending from east of the L Range to just southeast of the installation boundary. The contamination is not threatening any public or private water supplies. Two lobes contain RDX, with past concentrations up to 9.2 ppb. Four lobes containing perchlorate had past detections up to 3 ppb. Currently the highest detection levels are less than 3 ppb for RDX and less than 1 ppb for perchlorate. This indicates the lobes are detached from their sources and that concentrations are decreasing below detectable levels through natural attenuation.

## CLEANUP PLANS AND ACTIONS

**Source Area:** Based on the lack of contamination described above, no further action is necessary for soil. This is one of several sites that contain unexploded or partially exploded munitions. Studies are ongoing to determine what, if any, impact they may have on groundwater quality.

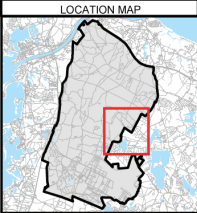
**Groundwater:** The findings of the soil and groundwater investigation and response alternatives will be presented in a combined report in Spring 2008.



**LEGEND**

|                              |                                                                           |
|------------------------------|---------------------------------------------------------------------------|
| ● Monitoring Well            | L Range Perchlorate Plume (2 ppb and above)                               |
| ▭ L Range Boundary           | L Range RDX Plume (0.6 ppb and above)                                     |
| ▭ MMR Boundary               | Composite RDX/Perchlorate plume(s) related to other investigation site(s) |
| ← Groundwater Flow Direction |                                                                           |

Note: Plume depictions are based on sampling data through 8 May 2006.



**L Range**

NOTES & SOURCES  
 Map Projection: NAD83 UTM, Zone 19N, meters  
 Basemap data from ARNG

# CENTRAL IMPACT AREA

## BACKGROUND

The 330-acre Central Impact Area is located within Camp Edwards' 2,200-acre Impact Area. From the early-1900s, this site in the center of the installation's northern 15,000 acres, served as the primary target area for artillery, mortar and other firing activities.

## FINDINGS

Soil investigations in the Central Impact Area, which consisted of more than 2,000 samples from 300 locations, have focused on the areas previously used as targets for artillery and mortar firing. Forty-nine potential targets have been identified. Detections of RDX, other explosives, propellants and perchlorate have been found at various targets. The soil around these targets and unexploded or partially exploded munitions are considered to be potential sources of groundwater contamination.

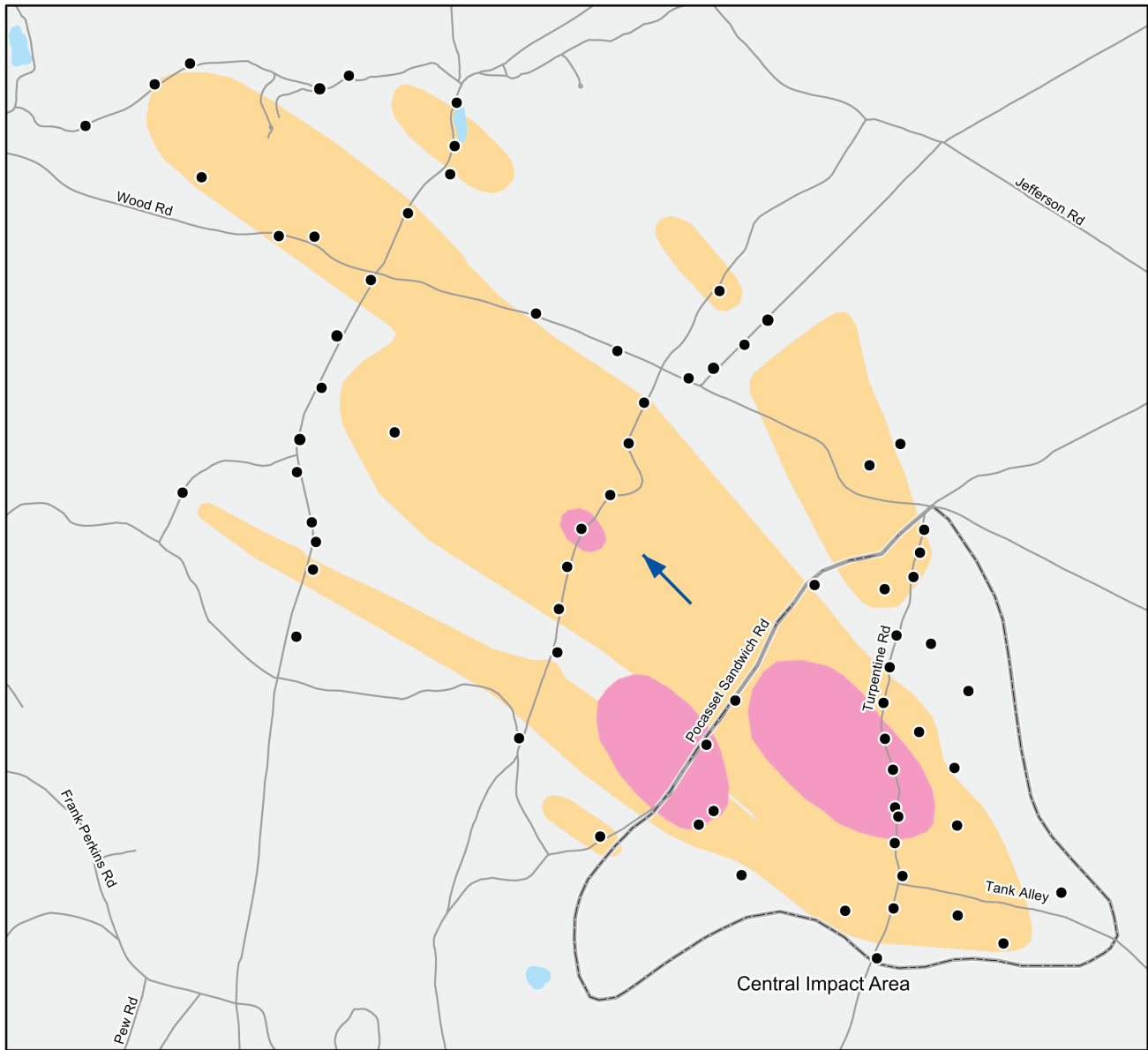
Sampling results from more than 270 monitoring wells have identified a series of finger-like plumes of RDX and, to a lesser extent, perchlorate extending over an 11,900- x 5,000-foot area. These plumes, with RDX up to 40 ppb and perchlorate up to 4 ppb, are migrating northwest toward the installation's boundary and the Cape Cod Canal. No public water supply wells are located in this area and no private water supplies are threatened by these plumes.

## CLEANUP PLANS AND ACTIONS

**Source Area:** Two high-use-target-area investigations were conducted to help determine the extent and distribution of explosives compounds and unexploded munitions around the Central Impact Area targets. A Rapid Response Action removed soil to a depth of two feet in a 50-foot circumference around two targets with high levels of contamination to help determine the effectiveness of such removals in reducing contaminant migration to groundwater and to remove two potential source areas. Thermal desorption, which uses heat to remove contaminants, was used for on-site treatment of the soil from both of these actions. Information from these investigations and removal actions is being used to compile a joint soil and groundwater Central Impact Area feasibility study, which will outline cleanup alternatives.

**Groundwater:** A joint soil and groundwater feasibility study is planned for the Central Impact Area and should be completed by mid-2009.



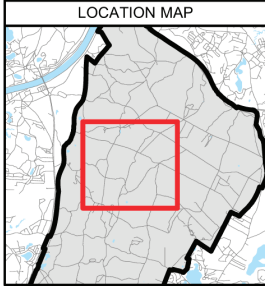


**LEGEND**

- Monitoring Wells
- CIA Perchlorate Plume (2 ppb and above)
- CIA RDX Plume (0.6 ppb and above)
- ← Groundwater Flow Direction Arrow \*\*

\*\* Plume depictions are based on sampling data through April 2006

**LOCATION MAP**



**Central Impact Area**



SOURCES  
Base Map Data from US Geological Survey 7 1/2 minute Topographic Maps. Source: MassGIS

# NORTHWEST CORNER

## BACKGROUND

The Northwest Corner investigation area is located on the corner of Camp Edwards that runs along Canal View Road in Bourne. The site, which extends from 2,700 feet inside the installation boundary west to the Cape Cod Canal, is defined by a groundwater plume of perchlorate. The section of the investigation area located on the installation encompasses portions of two training areas where pyrotechnics were used, four gun positions formerly used for artillery training, and a small arms training area. The site includes a portion of the town of Bourne that was used for annual fireworks displays from 1996 until 2003.

## FINDINGS

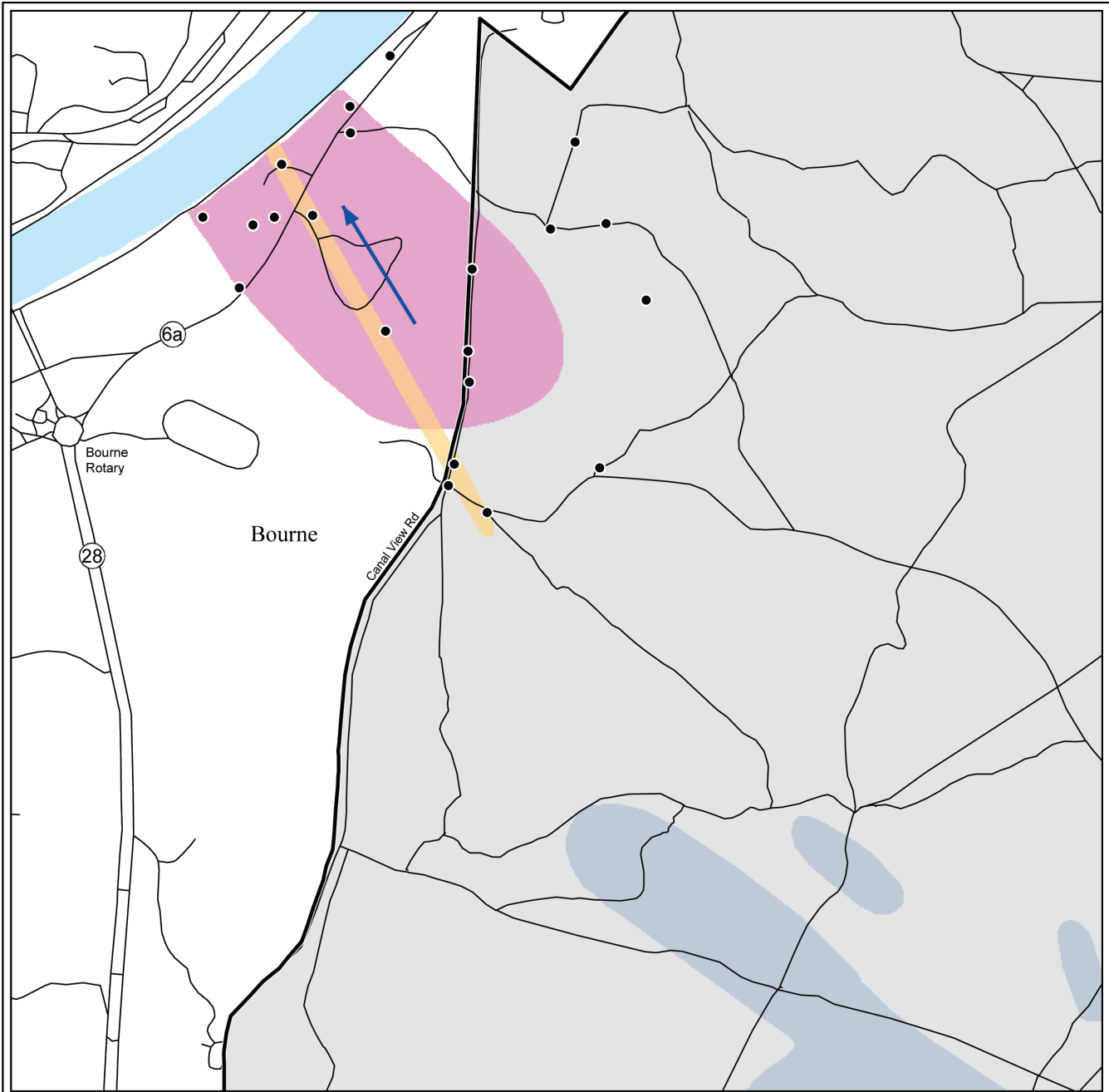
Soil investigations in the Northwest Corner have included the collection of more than 250 samples. Results from samples taken before and after a fireworks event indicated that fireworks were a significant contributing source of perchlorate contamination in this area. Other perchlorate detections, at much lower levels, were found in the soil near the gun positions. RDX and other explosives have not been found in the Northwest Corner soil sampling.

Groundwater sampling results from close to 80 wells identified plumes with perchlorate and RDX. A 4,700- x 3,750-foot plume of perchlorate with detections up to 15.9 ppb extends from inside the installation boundary west to the canal. A narrow 3,000- x 150-ft plume of the RDX, with concentrations up to 3.6 ppb, generally underflows the perchlorate plume and extends back toward the Central Impact Area indicating its source is located farther back on the installation. No public water supply wells are located in this area and no private water supplies are threatened by these plumes. Area residences are on town water.

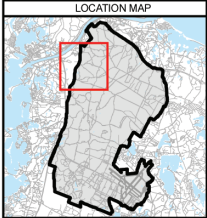
## CLEANUP PLANS AND ACTIONS

**Source Area:** The concentrations of perchlorate detected in the soil in 2003 rapidly decreased following the discontinuation of fireworks displays; therefore no soil remediation is anticipated. Any required soil cleanup actions for the gun positions located in the Northwest Corner area would be included in the Gun & Mortar Firing Positions investigation and cleanup.

**Groundwater:** The findings of the soil and groundwater investigations and response alternatives will be presented in a combined report in Spring 2008.



| LEGEND         |                                                                           |
|----------------|---------------------------------------------------------------------------|
| ●              | Monitoring Well                                                           |
| ▬              | MMR Boundary                                                              |
| ■ (Pink)       | Northwest Corner Perchlorate Plume (2 ppb and above)                      |
| ■ (Orange)     | Northwest Corner/Central Impact Area RDX Plume (0.6 ppb and above)        |
| ■ (Light Blue) | Composite RDX/Perchlorate plume(s) related to other investigation site(s) |
| ← (Blue Arrow) | Groundwater Flow Direction                                                |



### Northwest Corner



NOTES & SOURCES  
 Map Projection: NAD83, UTM, Zone 19N, meters  
 Basemap data from ARNG

Northwest Corner plume depictions are based on sampling data through November 2008.

## DEMOLITION AREA 2

### BACKGROUND

The 2,300- x 300-foot Demolition Area 2 site located in the north-central portion of the installation was used from the late-1970s to the late-1980s for demolition training involving explosive charges of less than 10 pounds. Demolition-training activities took place in a shallow, cleared depression flanked by moderately elevated terrain to the north and east.

### FINDINGS

Soil sampling results from approximately 40 locations in and around the depression at Demolition Area 2 found explosives, including RDX, and propellants. These were in two main areas – a “U”-shaped, man-made berm on the western edge of the Demolition Area 2 clearing and a 30-square-foot area located at the center of the depression.

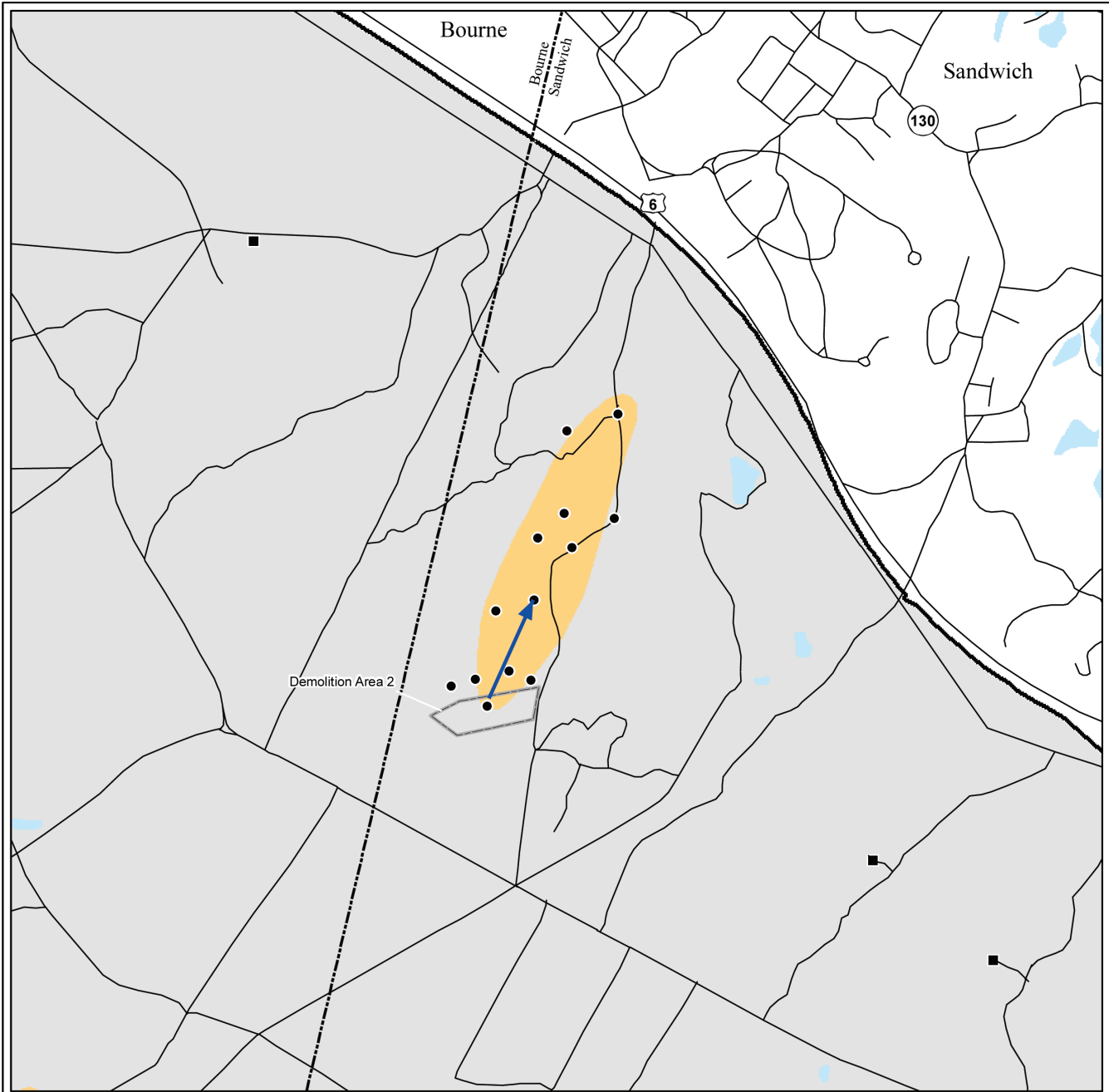
Samples from more than 20 groundwater monitoring wells identified a 1,000- x 300-foot plume with concentrations of RDX above 0.6 ppb, migrating north toward the installation boundary. The current maximum concentration of RDX in the plume is 6.7 ppb and decreasing concentrations immediately downgradient of Demolition Area 2 indicate that the plume’s source was eliminated by a 2004 soil removal action. No private or public water supplies are threatened by the plume.

### CLEANUP PLANS AND ACTIONS

**Source Area:** A 2004 soil Rapid Response Action excavated 1,200 tons of soil from the man-made berm and the 30-square-foot area at the center of the site, which were believed to be the sources of groundwater contamination at Demolition Area 2. Thermal desorption, which uses heat to remove contaminants, was used to treat the soil on site. With the soil contamination removed to below detectable levels, this is expected to be the final action for soil cleanup at the site.

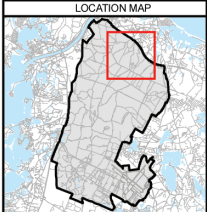
**Groundwater:** The findings of the soil and groundwater investigation and response alternatives will be presented in a combined report in Spring 2008.





**LEGEND**

- Monitoring Well
- Water Supply Well
- ▭ MMR Boundary
- ▭ Demolition Area 2 Boundary
- Town Boundary
- ← Groundwater Flow Direction
- Demo 2 RDX Plume (0.6 ppb and above)



**Demolition Area 2**



**NOTES & SOURCES**  
 Map Projection: NAD83, UTM, Zone 19N, meters  
 Basemap data from ARNG

Demolition Area 2 plume depictions are based on sampling data through March 2006.

# WESTERN BOUNDARY

## BACKGROUND

The Western Boundary investigation encompasses a 12,000- x 6,000-foot area extending from Frank Perkins Road on the installation, west into the Monument Beach section of Bourne. The portion of this area located on the installation includes four maneuver areas but no firing ranges. The site includes an area in the town of Bourne containing four public water supply wells. The investigation was initiated to look into perchlorate detections upgradient of the Bourne Water District's Monument Beach well field.

## FINDINGS

Soil investigations in the Western Boundary area included the collection of more than 150 samples. Neither perchlorate nor explosives were detected in any of the soil samples.

Results from groundwater samples collected from more than 90 monitoring wells located on and off the installation found perchlorate detections up to 2.87 ppb on the installation and up to 0.97 ppb in the Monument Beach area. Detections in monitoring wells on the installation have become less frequent and only one monitoring well on base has perchlorate concentrations near the state's 2 ppb cleanup standard. Detections in the Monument Beach area have generally declined below the detection level with a maximum level of 0.52 ppb in three monitoring wells that still have detections.

## CLEANUP PLANS AND ACTIONS

**Source Area:** Investigations in the Western Boundary area have been completed and the investigation report, which details findings from investigations conducted in this area, was submitted in 2006. No source area has been identified for the perchlorate detections related to the Western Boundary investigation.

**Groundwater:** The investigation report for the Western Boundary, which details the findings from both the soil and groundwater investigations in this area, was submitted in 2006. The report recommends continued long-term monitoring to verify the investigation's findings that the contamination is naturally attenuating below action levels. A Remedy Selection Plan will be prepared in late-2007 detailing the response alternative for the area. It will be presented for public review and comment.

# GUN & MORTAR FIRING POSITIONS

## BACKGROUND

The Gun & Mortar Firing Positions consist of 37 firing sites used for training with practice and explosive artillery and mortar rounds from the early-1930s until firing ceased in 1997. The positions range in size from about a half acre to several acres. The firing sites are located to the south, west and north of the Impact Area. Propellants from firing and the reported burning of unused propellant bags were the primary concerns at these sites.

## FINDINGS

To date, the soil investigations for the Gun & Mortar Firing Positions have included the collection and analysis of close to 700 soil samples. The propellants, 2,4-DNT and 2,6-DNT, and semi-volatile organic compounds (SVOCs) were found in the soil at some of the firing positions.

Sampling results from four monitoring wells located at former gun positions and 16 other wells located in areas downgradient of the positions have not had detections of propellants, explosives or perchlorate that track back to the firing positions.

## CLEANUP PLANS AND ACTIONS

**Source Area:** Removal actions in 2000 and 2004 excavated approximately 2,000 tons of contaminated soil from two gun positions. Soil was disposed of off site in 2000. In 2004, soil was treated using thermal desorption, which uses heat to remove contaminants. Investigations to define the extent of contamination are ongoing at the other firing positions. This work is expected to be completed and findings submitted in late-2008.

**Groundwater:** Installation of groundwater monitoring wells is ongoing at two positions where the highest concentrations of propellants were identified in the soil. Results from these wells will help determine future actions at other Gun & Mortar Firing Positions. Completion of the investigation is planned for late-2008.

# SMALL ARMS RANGES

## BACKGROUND

The Small Arms Ranges include 24 current and former ranges used since the 1940s for various types of small arms firing. The main concerns at these locations was lead from the berms and firing lines potentially leaching into the soil and groundwater, as well as contamination from propellant residue at the firing points.

The ranges are located around the outside of the impact area boundary with the firing lines facing into the center of the installation. The ranges vary in size from 200- x 200-feet to approximately 3,000- x 2,000-feet. Ranges include firing points and targets, many with earthen berms used to capture fired rounds. Eighteen of the ranges are still active for training; however, firing of lead ammunition was suspended in 1997. The Massachusetts National Guard is currently petitioning to resume firing lead on selected ranges.

## FINDINGS

The soil investigation for the Small Arms Ranges site included collection of close to 350 soil samples. Metals, explosives, and propellants were found in the berms or at the firing line at 17 ranges.

Seventeen wells, on or downgradient of the small arms ranges have been sampled to determine if contaminants related to the firing of lead ammunition have reached groundwater. No detections of lead, propellants or explosives have been found in these wells, with the exception of a single detection of lead in one well at less than 2 ppb. (The drinking water action level for lead is 15 ppb.)

## CLEANUP PLANS AND ACTIONS

**Source Area:** Approximately 28,000 tons of soil were excavated from existing berms on 16 ranges in 1998. This action removed 50 tons of lead bullets and fragments and treated the excavated soil with a stabilizing compound called MAECTITE to prevent the lead from leaching to groundwater. Another 8,000 tons of soil were treated in place on unbermed ranges. Additional investigations are ongoing to characterize the ranges where the Massachusetts National Guard is in the process of upgrading training facilities. Results from investigations at two of these ranges were presented in early 2007 and work at additional ranges is ongoing. Soil investigations of the other small arms ranges also are under way. This work is expected to be completed in mid-2008, along with the investigation report that will present investigation findings. A Rapid Response Action may be proposed to remove contaminated soil, if necessary.

**Groundwater:** Sampling of the monitoring wells installed on the ranges is continuing as part of the investigation. Findings will be submitted with the investigation report scheduled for mid-2008.

## FORMER A RANGE

### BACKGROUND

The 2,600- x 1,500-foot Former A Range is located east of the installation's boundary with Bourne. Both practice and explosive munitions were used on the range from 1941 until the mid-1970s. It was used as an anti-tank artillery and rocket range, and for machine-gun training.

### FINDINGS

Soil sampling results from approximately 540 locations around the firing points and target areas detected propellants and SVOCs in soil at the firing points. Explosives detections in soil, along with munitions found on or near the surface, indicated a possible source of groundwater contamination in the upper target area.

Results from three groundwater monitoring wells sampled as part of this investigation found explosives detections of less than 1 ppb.

### CLEANUP PLANS AND ACTIONS

**Source Area:** In 2005, a soil investigation that included the removal of 360 tons of soil was conducted to analyze deep soil for explosives. The soil was disposed of off site. An investigation report that will present the findings of the investigation and outline any cleanup proposal is scheduled for early 2008.

**Groundwater:** Monitoring of wells associated with the investigation is ongoing. An investigation report is scheduled for early 2008. Due to the absence of significant groundwater contamination no groundwater response is anticipated.

## FORMER K RANGE

### BACKGROUND

The 800- x 1,200-foot Former K Range is located west of Greenway Road near the installation's southeastern boundary with Sandwich. The range was used as a rocket range in the 1960s and a grenade launcher range from 1968 until the 1970s. A portion of the Former K Range was used as a pistol range until the late-1980s.

### FINDINGS

Soil sampling results from more than 50 locations found random detections of the explosives RDX and TNT at the firing line, as well as two detections of lead.

No detectable levels of explosives, lead or other contaminants related to the investigation were found in sampling results from eight groundwater monitoring wells at and downgradient of the targets.



## CLEANUP PLANS AND ACTIONS

**Source Area:** An investigation report that details the findings of the investigation will be submitted in early 2008.

**Groundwater:** Monitoring of wells associated with the investigation is ongoing. An investigation report will be submitted in early 2008. Due to the absence of significant groundwater contamination, no groundwater response is anticipated.

## BA-4 DISPOSAL SITE

### BACKGROUND

The 1,300- x 850-ft. BA-4 Disposal site includes roadways and cleared areas in the vicinity of the BA-4 Training Range. Soil contamination was found during initial investigations of all sites where historical activities were reported to have taken place.

### FINDINGS

Soil sampling for explosives and other contaminants was completed at 24 locations. A small area with lead detections was identified. Surveys with metal-detecting devices were conducted in five areas suspected of containing burial sites. Results from these surveys indicate the presence of a number of medium to large subsurface metallic objects that warranted further investigation.

Sampling results from five groundwater monitoring wells have not found any contamination related to activities at the site. Additional groundwater sampling continues.

### CLEANUP PLANS AND ACTIONS

**Source Area:** A Rapid Response Action to remove subsurface items and any contaminated soil was completed in early 2007. Related soil and scrap were disposed of off site. An investigation report is scheduled to be completed in late-2007. No further soil response is anticipated at the site.

**Groundwater:** Monitoring of wells associated with the investigation is ongoing. An investigation report that details the findings of the investigation is scheduled for late-2007. Due to the absence of significant groundwater contamination, no groundwater response is anticipated.

## TO LEARN MORE ABOUT THE PROGRAM

The IAGWSP welcomes input from the local community. Ways that the public can learn more about or become involved in the IAGWSP's activities include:

**Impact Area Review Team (IART) Meetings** – The IART is comprised of citizen members from the communities surrounding the MMR, as well as representatives from EPA, MassDEP, and the IAGWSP. The team serves as a technical advisory resource to EPA, MassDEP, and the IAGWSP. Meetings, which are open to the public, are generally on the fourth Tuesday of the month. Visit the [groundwaterprogram.army.mil](http://groundwaterprogram.army.mil) Web site for meeting dates, locations and agendas.

**Senior Management Board (SMB) Meetings** – This citizens' advisory team includes elected officials from the towns surrounding the MMR and local tribal representatives. Public meetings are generally held the fourth Wednesday of every other month. Visit [www.eandrc.org](http://www.eandrc.org) for meeting dates, locations and agendas.

**Neighborhood Meetings** – The IAGWSP periodically holds neighborhood meetings, open houses, and information sessions to update local communities about investigations of interest to a particular community.

**Public Comment Periods** – Rapid Response Action or Remedy Selection plans are presented for public review and comment. To find out more about upcoming opportunities for public comment and proposed actions, visit the IAGWSP Web site.

**Town Updates** – The IAGWSP updates the Boards of Selectmen and Health in each of the four towns surrounding Camp Edwards each year. Presentations to the selectmen are televised on public access TV.

**Mailing List** – Mailing and e-mail lists are used to send out meeting announcements, updates, fact sheets and newsletters. To be added to the list, please contact Kristina Curley at 508-968-5626.

**Local Media** – The IAGWSP routinely updates the local media on program events, advertises meetings and other events in the local newspapers, and responds to requests for information on all aspects of the program.

VISIT THE IAGWSP WEB SITE AT: [GROUNDWATERPROGRAM.ARMY.MIL](http://GROUNDWATERPROGRAM.ARMY.MIL)

### DOCUMENTS AND UPDATES:

Documents related to the IAGWSP investigation and cleanup are available on the IAGWSP Web site and at the following public libraries:

Falmouth Public Library  
123 Katherine Lee Bates Road  
Falmouth, MA 02540

Jonathan Bourne Library\*  
19 Sandwich Road  
Bourne, MA 02532

Mashpee Public Library  
Steeple Street, Mashpee Commons  
Mashpee, MA 02649

Sandwich Public Library  
142 Main Street  
Sandwich, MA 02563

*\*The most complete record of documents pertaining to the IAGWSP cleanup is available at the Bourne library.*

## CONTACTS

### FOR ADDITIONAL INFORMATION, PLEASE CONTACT:

#### **Impact Area Groundwater Study Program**

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#### **U.S. Environmental Protection Agency, New England Region**

Jim Murphy  
Phone: 617.918.1028  
E-mail: murphy.jim@epa.gov

#### **Massachusetts Department of Environmental Protection**

Ellie Grillo  
Phone: 508.946.2866  
E-mail: ellie.grillo@state.ma.us

### FOR INFORMATION ON THE INSTALLATION RESTORATION PROGRAM, PLEASE CONTACT:

#### **Air Force Center for Engineering And the Environment**

Doug Karson  
Phone: 508.968.4678, ext. 2  
E-mail: doug.karson@brooks.af.mil

### FOR INFORMATION ON CAMP EDWARDS, TRAINING AND SMALL ARMS RANGES ACTIVITIES, PLEASE CONTACT:

#### **Massachusetts National Guard Environmental & Readiness Center**

Lynda Wadsworth  
Phone: 508.968.5152  
E-mail: lynda.e.wadsworth@us.army.mil

Impact Area Groundwater Study Program  
1803 West Outer Road  
Camp Edwards, MA 02542

**This fact sheet was developed in coordination  
with the EPA and the MassDEP.**