MONTHLY PROGRESS REPORT #129
FOR DECEMBER 2007

EPA REGION I ADMINISTRATIVE ORDERS SDWA 1-97-1019 and 1-2000-0014

MASSACHUSETTS MILITARY RESERVATION
TRAINING RANGE AND IMPACT AREA

The following summary of progress is for the period from 1 December to 28 December 2007.

1. SUMMARY OF REMEDIATION ACTIONS

The following is a description of Remediation Actions (RA) underway at Camp Edwards as of December 31, 2007. Remediation actions may include Rapid Response Actions (RRA). An RRA is an interim action that may be conducted prior to risk assessments or remedial investigations to address a known, ongoing threat of contamination to groundwater and/or soil.

Demo Area 1 Comprehensive Groundwater RA

The Demo Area 1 Comprehensive Groundwater RA consists of the removal and treatment of contaminated groundwater to control further migration of explosives and perchlorate. Extraction, treatment, and recharge (ETR) systems at Frank Perkins Road and Pew Road include extraction wells, ex-situ treatment processes to remove explosives and perchlorate from the groundwater, and injection wells to return treated water to the aquifer.

The Pew Road ETR continues operation at a flow rate of 103 gallons per minute (gpm). As of 28 December 2007, over 26 million gallons of water have been treated and re-injected at the Pew Road ETR System. Note that the flow total reported for Pew Road ETR has been changed to reflect the start of Demo 1 RA.

The Frank Perkins Road ETR is operating at a flow rate of 808 gpm. As of 28 December 2007, approximately 386 million gallons of water had been treated and re-injected at the Frank Perkins Road ETR System. The RA system has treated 132 million gallons of the 386 million gallon total.

J-1 Range South Groundwater RRA

The J-1 Range South Groundwater RRA consists of removal and treatment of contaminated groundwater to control further migration of explosives. The ETR system includes a single extraction well, ex-situ treatment process to remove explosives from the groundwater, and an infiltration gallery to return treated water to the aquifer.

The ETR unit continues operation at a flow rate of 75 gpm. As of 28 December 2007, approximately 8 million gallons of water have been treated and re-injected at the ETR System.

J-2 Range North Groundwater RRA

The J-2 Range Groundwater RRA consists of removal and treatment of contaminated groundwater to control further migration of explosives and perchlorate. ETR systems include single extraction wells, ex-situ treatment processes to remove explosives and perchlorate from the groundwater, and infiltration basins to return treated water to the aquifer.

The mobile ETR units continue operation at a flow rate of 250 gpm and the building ETR continues operation at a flow rate of 125 gpm. As of 28 December 2007, approximately 166

million gallons of water have been treated and re-injected at the mobile ETR System and 83 million gallons of water have been treated and re-injected at the building ETR System.

J-3 Range Groundwater RRA

The J-3 Range Groundwater RRA consists of removal and treatment of contaminated groundwater to control further migration of explosives and perchlorate. ETR systems include single extraction wells, ex-situ treatment processes to remove explosives and perchlorate from the groundwater and use of the existing Fuel Spill-12 (FS-12) infiltration gallery to return treated water to the aquifer.

The ETR continues operation at a flow rate of 195 gpm. As of 28 December 2007, approximately 118 million gallons of water have been treated and re-injected at the ETR System.

2. SUMMARY OF ACTIONS TAKEN

Drilling progress for the month of December is summarized in Table 1.

Table 1
Drilling progress as of 28 December 2007

Boring Number	Purpose of Boring/Well	Total Depth (ft bgs)	Depth to Water Table (ft bgs)	Completed Well Screens (ft bgs)
No wells were installed during the month of December.				
ft bgs = ft below ground surface				

Samples collected during the reporting period are summarized in Table 2.

Long Term Groundwater Monitoring (LTGM) samples were collected from wells at Central Impact Area (CIA), J-1 Range, J-3 Range, and the Bourne water district wells in the Western Boundary. Groundwater samples were collected from five locations at the Small Arms Ranges Tango, Bravo, Charlie and Oscar.

Performance monitoring groundwater samples were collected from the Demo 1 GW RA.

Post excavation soil samples were collected at J-1 Range Target H40 Area 2 and at J-2 Range L19. Discrete supplemental soil samples were collected at four locations in accordance with the BIP Management program. Multipoint composite soil samples were collected at various locations in J-2 Range North as part of the EDD Pilot Study post-survey investigation. Multipoint composite soil samples were also collected at the Juliet Range.

There were no BIP activities during the month of December. There is no grid summary information for this reporting cycle.

The following are notes from the 06 December 2007 Technical Team Meeting of the Impact Area Groundwater Study Program office at Camp Edwards:

Revised Combined Schedule (RCS) Review

EPA stated their highest priority for FY 2008 is the UXO issue and paid particular attention to the deliverables dealing with UXO in their review of the draft RCS. Specifically, the draft L Range UXO/Source Assessment Work Plan; the CIA UXO Source Investigation Report; Former

A and Former K; and theJ-3, J-1, J-2 Ranges are OUs that have significant UXO components. EPA envisions fieldwork would likely be required and are not certain how the work can be accomplished in the period of time allotted.

Following discussions on the L Range document, EPA suggested that work plans should be developed using scoping sessions. EPA envisions scoping meetings be included in the schedule before the documents are developed and asked how the work plans can be incorporated into the RI/FS reports in the relatively short time-frame indicated on the RCS.

Ben Gregson (IAGWSP) replied that in developing these schedules, IAGWSP envisioned using existing UXO information to the extent possible. Regarding scoping sessions, it is IAGWSP's expectation that after working through the draft L Range Work Plan and the draft CIA UXO Source Assessment (which are both nearly complete) most of the major scope details can be established for future work plans. A lot of fieldwork has been completed at these sites, specifically on the J Ranges, and much information has been accumulated on UXO density from clearance work and sampling work

EPA noted that each operable unit is unique with respect to UXO; for example Former A has little similarity to the J Ranges.

IAGWSP agrees the approach is different on L Range and Former K Range; CIA was more focused on establishing density; whereas safety issues need to be considered on L Range and K Range. If information on the number of UXO that could cause a problem can be established based on a back calculation (which is how cleanup standards are established on other compounds), it would be advantageous to do that at sites with a significant UXO safety risk.

EPA has concerns with the back-calculation approach. EPA clarified that their understanding of a back calculation is to start with a contaminant concentration that represents an appropriate groundwater standard and then calculate the number of UXO that would be necessary to exceed the standard at that particular range. EPA's understanding of a forward calculation is estimating the UXO density and making a determination on whether or not that density of UXO are going to cause a problem with groundwater.

Mr. Gregson noted that all of the OUs rely on the information collected to date for the UXO investigations. There is some level of UXO information on all of the OUs, so the question is whether more work needs to be performed up front to establish density, or will the data available provide an adequate assessment of the UXO density and risks.

Lynne Jennings (EPA) stated the EPA has significant issues with approach at L Range and the comments on the Quantitative Risk Assessment (Risk to Groundwater from UXO at L Range dated 2007) will be submitted in a week. EPA suggests holding back the L Range Work Plan that is due in December until IAGWSP has reviewed and considered EPA's comments.

IAGWSP and the regulatory agencies discussed their vision of what should be included in a work plan. Mr. Gregson will work with EPA on how to scope the work plans. EPA requested being involved in the meeting with contractors on how to approach the process.

EPA will establish enforceable milestones for the work plans. EPA will submit comments on the L Range Work Plan, the next work plan to evaluate will be CIA, and then the J Ranges.

CIA UXO Source Work Summary – Bill Gallagher

Bill Gallagher (IAGWSP) introduced the topic of work done for the Central Impact Area MEC Assessment. IAGWSP has completed work on nine test plots to validate the UXO density estimation model and are preparing the UXO/Source Report. The methodology used to estimate UXO density in the CIA has previously been presented to the agencies. Today's presentation will address how the estimation model was updated with the results of the nine test plots. The second part of the presentation will discuss corrosion processes at MMR and the last part will present a method that can be used to estimate future potential future impacts to groundwater from UXO perforated by corrosion. Mr. Gallagher stressed that this presentation only addresses potential future releases from currently intact UXO. Mr. Gallagher introduced Chris Abate of AMEC.

Mr. Abate presented the "Central Impact Area MEC Assessment".

The first slide was the problem statement which asked; "Do currently intact MEC pose a future threat to groundwater?" The next two slides presented an overview of the CIA MEC Assessment Process and the UXO Density Estimation Model. The next slide showed the results of intrusive UXO investigations in the CIA. All items and types discovered and quantities were presented. The five most common types discovered made up 90% of the items (155 mm projectiles, 105 mm projectiles, 81 mm mortars, 60 mm mortars, and 4.2 inch mortars). The next slide showed the three UXO density indicators: proximity to known target locations, aeromagnetic signal intensity, and cleared areas. The next slide, Target Proximity Ranking Map, showed the ranking of quarter acre grids within the CIA relative to their proximity to known targets. The next slide, Aeromagnetic Ranking Map, showed the ranking of grid cells within the CIA relative to their median airmag signal strength. The next slide, Cleared Areas from Air Photos, showed detailed bubble maps representing cleared areas from 1943, 1947, 1956, 1966, 1977, 1986, and 1991. The next slide, Cleared Areas Ranking Map, showed the ranking of grid cells within the CIA relative to the amount of area cleared of vegetation and the duration in which these areas were cleared of vegetation. The next slide, Compositing Three Ranking Indices, shows how the three indices were combined to provide a relative ranking of each grid cell with respect to UXO density. The next slide, Final HE UXO Density Correlation, provides a plot of UXO densities versus the sum of inverse rankings of the three indices. The next slide, Estimated HE UXO Density, shows a prediction of HE UXO density in the CIA. The next slide, UXO Density Model Validation, is a plot of predicted UXO density versus observed UXO density. Based on these results it appears that the model provides a reasonable good prediction of UXO density in the CIA. The next slide, Corrosion Observations and Measured Rates, presents some corrosion observations at MMR and provides an overview of the UXO Corrosion Report for MMR (2005). The next slide, Theoretical Corrosion Rates, shows the five most common round types and times to perforation for these items estimated by various methods. The next slide, 2007 Metallurgical Study, provides some observation from the Thielsh Engineering Report on corrosion which was based on a detailed examination of 51 items from the first six PSI test plots. The next slide, MEC Release Concept, presents some basic assumptions used by the IAGWSP when estimating potential future release from UXO. The next slide, MEC Release Models, provided references for two methods; "Praxis" and "Chambre" that can be used to estimate future release from UXO. The next slide, RDX Release Rate Input Parameters, showed both chemical and site specific input parameters used by the IAGWSP to estimate future releases of RDX from UXO. The next slide, RDX Release Rate Calculations, provides a composite RDX release rate. The next slide, Potential Groundwater Impacts, states that the CIA numerical model was used to estimate potential future impacts to groundwater from releases from corroded UXO. This slide also provides the base case release rate (0.014 g/yr-

item). A sensitivity analysis was conducted by evaluating the affects of increasing the composite release rate by factors of 2 and 10. The next slide, Base Case Plume Projections, 100 years from release start. The next two slides showed Sensitivity Analysis Plume Projections, for 2X Base Case and 10X Base Case. The next slide, Summary of Potential Future RDX Plume Modeling Results; for base case (no plume >0.6 ppb), 2X base case (no plume >0.6 ppb), and 10X Base Case (0.6 ppb plume extends of MMR). The final slide showed five conclusions: the UXO Density Estimation Model (DEM) is a good estimator of relative density; MEC corrosion processes are relatively slow and require centuries to produce perforation by localized pitting; release rates through perforation can be estimated and combined with the DEM to estimate chemical loadings; potential future aquifer impacts can be predicted using conventional deterministic groundwater fate-and-transport modeling techniques; and estimates of future impacts are subject to uncertainties, especially regarding corrosion and release rates.
A copy of the presentation was provided at the meeting.

IAGWSP suggested the regulatory agencies review this report when it is submitted and start breaking it down in major areas for review and discussion such as how explosive "chunks" are assessed; how UXO density was determined; the condition of UXO as observed in the field; and other pertinent questions.

Overview of Results from GP-10 and GP-11 Drive Point Work – Bill Gallagher
Drive points were installed in April and data were provided to the regulatory agencies in June 2007. On18 July IAGWSP agreed to install well locations at each position; and to collect total organic carbon (TOC) samples per EPA request. The wells were installed (MW-495 GP-100 installed on 25 October and sampled on 08 November; and MW-496 GP-11 installed on 26 October and sampled on 09 November) and samples were analyzed for SVOC's, metals, explosives, and perchlorate. TetraTech received data from the lab yesterday. It appears that no explosives or DNT were detected. ***The chemists requested time for review and will provide the summary table of the unvalidated data next week.***

Update on CRREL Lab Work – Ben Gregson
Samples were collected for the study. The soils were air dried, sieved to determine grain size, and the portion of each soil sample was prepped and analyzed for propellants. The samples collected for this study had a variety of levels of nitroglycerine. It is IAGWSP's assumption the study cannot be done with soil containing nitroglycerine. New samples may need to be collected. **After conferring with CRREL, Mr. Gregson will follow up with the regulatory agencies next week.**

EPA requested this be a standing item on each tech meeting agenda.

Carol Keating (EPA) requested CRREL provide information on where the samples were collected at each range and the concentrations. Paul Nixon will provide.

Update on EDD Field Investigations – Darrin Smith
Since the last update, 10 locations at J-2 Extension were completed. Crews are currently at the 11th and 12th locations. Darrin Smith (USACE) provided pictures showing excavation in progress at location 18; 7.62 mm bullets with tracers found at location 17; propellant grains found at location 21; an expended 105 mm projectile and expended M557 fuses found at location 37; and 7.62 mm bullets (non-MEC) found at location 47.

Dave Hill (IAGWSP) noted that the dogs did not detect anything at some significant size magnetic anomalies and suggests expanding the investigation to determine if some of these anomalies contain MEC. A proposal will be provide in a project note.

South East Ranges Update – Dave Hill

- **Pit Discrimination Analysis: Dave Hill will consult with team and suggest next steps to Jane Dolan.**
- **Regarding the J-2 East Systems, EPA asked if there will be an EM-61 survey along access roads. Dave Hill will check on this and inform EPA.**
- **EPA asked if there is a construction start date. The ROA needs to be approved. Natural Heritage asked if a MW location could be moved out of a depression but the well location is critical. IAGWSP revised ROA language to better describe how the impacted areas will be restored. Karen Wilson is working the issue with Natural Heritage. Dave Hill will follow up with EPA. Deadline for completion is September 2008.**
- Ms. Dolan noted that the L Range Neighborhood Notice regarding clearing vegetation has not gone yet. Tentatively, the work will begin the second week of January 2008.
- **Regarding the issue of the false positive in MW-330, Ms. Dolan noted it still shows as 0.35ug/L (J) in the database. IAGWSP to correct database if needed.**
- **Regarding groundwater samples collected under the Long Term Monitoring Plan, Ms. Dolan noted that semi-annual and annual reports for L Range, J-1 North, and J-2 East are required. Ben Gregson will follow up.**
- **EPA will provide comments on the Six Month Reports for J-2 and J-3 in mid-January.**
- **Dave Hill will provide data with figure on J-2 Area 2 drill cuttings.**
- **CRM on J-3 Groundwater scheduled for Wednesday, 19 December. MassDEP requested Elliott Jacobs be included. Dave Hill will follow up with an email.**

IART Meeting for December 2007

There was a meeting of the Impact Area Groundwater Review Team (IART) on 4 December 2007.

3. SUMMARY OF DATA RECEIVED

Table 4 (sorted by analyte) summarizes the detections, since 1997, that equaled or exceeded an EPA Maximum Contaminant Level (MCL), MassDEP MCL (MMCL) or Health Advisory (HA) for drinking water. Table 4 is updated on a monthly basis; discussions in the text are updated on the same schedule as Figures 1 through 8, which are discussed later in this section.

Table 5 summarizes the validated detections of explosives and perchlorate for all groundwater results received from 1 December through 28 December 2007. These results are compared to the MCL/HA values for respective analytes. First-time validated detections of VOCs, SVOCs, herbicides and pesticides are included and discussed quarterly in the March, June, September, and December Monthly Progress Reports. Metals, chloroform, and bis (2-ethylhexyl) phthalate (BEHP) are excluded from Table 5 for the following reasons: metals are a natural component of groundwater, particularly at levels below MCLs or HAs; detections of chloroform are pervasive throughout Cape Cod and are not likely the result of military training activities; and BEHP is believed to be largely an artifact of the investigation methods and introduced to the samples during collection or analysis.

Figures 1 through 8 depict the cumulative results of groundwater analyses for the period from the start of the Impact Area Groundwater Study (July 1997) to December 2007. There are no new groundwater data to report in this report. Since this is the December report; a full set of the most recent figures are included. Each figure depicts results for a different analyte class:

- Figure 1 shows the results of explosive analyses by EPA Method 8330. This figure is updated and included each month.
- Figure 2 shows the results of inorganic analyses (collectively referred to as "metals", though some analytes are not true metals) by methods E200.8, 300.0, 350.2M, 353M, 365.2, CYAN, IM40MB, IM40MBM, and IM40HG. This figure is updated and included quarterly in the March, June, September, and December Monthly Progress Reports.
- Figure 3 shows the results of Volatile Organic Compound (VOC) analyses by methods OC21V, OC21VM, 504, 8021W, and SW8260 exclusive of chloroform detections. This figure is updated and included quarterly in the March, June, September, and December Monthly Progress Reports.
- Figure 4 shows the chloroform results using the Volatile Organic Compound (VOC) analyses by method OC21V and OC21VM. This figure is updated and included semi-annually in the June and December Monthly Progress Reports.
- Figure 5 shows the results of Semi-Volatile Organic Compound (SVOC) analyses by methods OC21B and SW8270, exclusive of detections of BEHP. This figure is updated and included quarterly in the March, June, September, and December Monthly Progress Reports.
- Figure 6 shows the BEHP results using the Semi-Volatile Organic Compound (SVOC) analyses by methods OC21B and SW8270. This figure is updated and included semi-annually in the June and December Monthly Progress Reports.
- Figure 7 shows the results of Pesticide (method OL21P) and Herbicide (method 8151) analyses. This figure is updated and included quarterly in the March, June, September, and December Monthly Progress Reports.
- Figure 8 shows the results of Perchlorate analysis by method E314.0. This figure is updated and included each month.

The concentrations from these analyses are depicted in Figures 1 through 7 compared to Maximum Contaminant Levels (MCLs) or Health Advisories (HAs) published by EPA for drinking water. The color coded legends are defined on each figure.

There are multiple labels listed for some wells in Figures 1 through 8, which indicate multiple well screens at different depths throughout the aquifer. The aquifer is approximately 200 to 300 feet thick in the study area. Well screens are positioned throughout this thickness based on various factors, including the results of groundwater profile samples, the geology, and projected locations of contaminants estimated by groundwater modeling. The screen labels are colored to indicate which of the depths had the chemical detected above drinking water standards. Generally, groundwater entering the top of the aquifer will move deeper into the aquifer as it moves radially outward from the top of the water table mound. Light blue dashed lines in Figures 1 through 8 depict water table contours. Groundwater generally moves perpendicular to these contours, starting at the center of the 70-foot contour (the top of the mound) and moving radially outward. The rate of vertical groundwater flow deeper into the aquifer slows as groundwater moves away from the mound.

The results presented in Figures 1 through 8 are cumulative, which provides a historical perspective on the data rather than a depiction of current conditions. Any detection at a well that equals or exceeds the MCL/DWEL/HA results in the well having a red symbol, regardless of

later detections at lower concentrations, or later non-detects. The difference between historical and current conditions varies according to the type of analytes. There are little or no differences between historical and current exceedances of drinking water criteria for Explosives, Perchlorate, VOCs, Pesticides, and Herbicides; the minor differences are mentioned in the following paragraphs. There are significant differences between historical and current exceedances of drinking water criteria for Metals and SVOCs, as described further below.

Figure 1: Explosives in Groundwater Compared to MCLs/HAs

For data validated in December 2007, no wells had first-time validated detections of explosives above the MCL/HAs. Two wells, had first time validated detections below the MCL/HA. MW-178M1 had a detection of RDX at 1.4 µg/L; previous detections were greater than the MCL/HA. MW-207M1 had a first time detection of HMX below the MCL/HA of 400 ppb; previous results were non-detect for HMX.

Exceedances of drinking water criteria for explosive compounds are indicated in seven general areas:

- Demo Area 1 (wells 19, 31, 34, 73, 76, 77, 114, 129, 139, 165, 210, and 211);
- Demo Area 2 (wells 16, 160, 259, 262, and 404);
- Former A Range (well 206);
- The Impact Area and CS-19 (wells 58MW0001, 58MW0002, 58MW0009E, 58MW0011D, 58MW0016B, 58MW0016C, 58MW0018B; and wells 1, 2, 23, 25, 37, 38, 40, 43, 85, 86, 87, 88, 89, 90, 91, 93, 95, 98, 99, 100, 101, 102, 105, 107, 111, 112, 113, 176, 178, 184, 201, 203, 204, 207, 209, 212, 223, 235, OW-1, OW-2, and OW-6);
- J Ranges and southeast of the J Ranges (wells 45, 58, 130, 132, 147, 153, 163, 164, 166, 171, 191, 193, 196, 198, 215, 218, 227, 232, 234, 247, 265, 289, 303, 306, 324, 326, 343, 360, 368, 369, 398, 477, 481, 485, 486, 487, and wells 90MW0022, 90MW0041, 90MW0054 and 90WT0013);
- Landfill Area 1 (wells 27MW0018A, 27MW0020A, and 27MW0020B); and
- Northwest Corner of Base Boundary (well 323).

Exceedances of drinking water criteria were measured for TNT at Demo Area 1 (wells 19S, 31S, 31M, and 31D) and Southeast of the Ranges (196S). Exceedances of the HA for RDX were noted at all of the locations listed above except at MW-45 and the LF-1 wells. Exceedances of drinking water criteria were measured for 2,6-dinitrotoluene (2,6-DNT) at MW-45S. Exceedances of drinking water criteria were measured for 1,3-dinitrobenzene at LF-1 wells 27MW0018A, 27MW0020A and 27MW0020B.

Demo Area 1 has a single well-defined source area and extent of contamination. The estimated extent of RDX exceeding the HA at Demo Area 1 based on the most recent groundwater measurements is indicated by a magenta concentration contour line on Figure 1 and Inset A.

Demo Area 2 has five groundwater exceedances of the RDX HA at MW-16S, MW-160S, MW-259, MW-262M1, and MW-404M2. The extent of the contamination is currently under investigation.

The Former A Range has exceedances of the RDX HA at MW-206M1. The S screen in this location is non-detect for all explosives.

The Impact Area has a plume defined by RDX concentrations above the HA of 2 ppb. The plume originates primarily along Turpentine Road and extends downgradient to the west-northwest. Another source of RDX in the Impact Area is CS-19. Portions of CS-19 are currently under investigation by the Air Force Center for Environmental Excellence (AFCEE) under the Superfund program. The extent of RDX has largely been defined in the Impact Area and the investigation phase of the project is nearing completion.

The J Ranges and downgradient areas have five groundwater plumes defined by concentrations of RDX above the HA of 2 ppb. The five plumes originate at the J-1 Range Interberm Area (northern plume in the vicinity of MW-58 and MW-265), the J-2 Range North plume (northern plume extending from MW-130), the J-2 Range East plume (eastern plume including MW-215), the J-3 Range Demolition Area (southern plume extending from MW-163 south to Snake Pond) and the L Range (in an area defined by MW-147 and MW-153 at Greenway Road). In addition, RDX detections at MW-398M2 suggest a possible plume at the south end of the J-1 Range. All the J ranges and the L Range are currently under investigation and the plumes will be updated and refined as new validated data is received.

The Northwest Corner of the base boundary has one validated detection of RDX in groundwater above the HA of 2 ppb at MW-323M2. The M1 screen in this location has a validated detection of RDX in groundwater below 2 ppb.

Figure 2: Metals in Groundwater Compared to MCLs/HAs

Exceedances of drinking water criteria for metals are scattered throughout the study area. Where two or more rounds of sampling data are available, the exceedances generally have not been replicated in consecutive sampling rounds. The exceedances have been measured for antimony, arsenic, cadmium, chromium, lead, molybdenum, sodium, thallium and zinc. Exceedances of the arsenic drinking water criteria were repeated at three (wells 58MW0010A, MW-7M1 and MW-45S) of the six locations with arsenic exceedances. At the remaining three locations (wells MW-3D, MW-52M2 and MW-152M1), arsenic exceedances were not repeated in subsequent results. Cadmium (well MW-52M3) and chromium (well MW-7M1) were each detected above drinking water criteria in a single sampling round in August-September 1999. Exceedances of the drinking water criteria for lead were repeated at two of four locations (wells ASP and MW-45S). At the remaining two locations (wells MW-2S and MW-7M1) lead exceedances were not repeated in subsequent results. Exceedances of the drinking water criteria for molybdenum were repeated at two of eight locations (wells MW-53M1 and MW-54S) with molybdenum exceedances. All of the molybdenum exceedances were observed in year 1998 and 1999 results. Exceedances of the drinking water criteria for sodium were repeated at 12 of the 21 locations with sodium exceedances (wells MW-2S, MW-21S, MW-46S, MW-57M3, MW-57M2, MW-57M1, MW-144S, MW-145S, MW-148S, MW-187D, ASP and SDW261160). Seven wells (MW-21S, MW-57M1, MW-57M3, MW-187D, BHW215083B, BHW215083D and ASP) had sodium exceedances in year 2004, 2005, and/or 2006 results. Zinc exceeded the HA in seven wells, all of which are constructed of galvanized (zinc-coated) steel.

There have been few exceedances of drinking water limits for antimony and thallium since the introduction of the ICP/GFAA and ICP/MS methods, discussed in the next paragraph. Antimony levels exceeding drinking water criteria were detected in samples from 13 locations; these levels were not detected in subsequent sampling rounds. Only two antimony exceedances (wells MW-38M2 and MW-73S) were measured since January 2003. Twelve of the 71 locations with thallium exceedances had repeated exceedances in subsequent sampling rounds (wells MW-7M1, MW-7M2, MW-19S, MW-45S, MW-47M2, MW-47M3, MW-52S, MW-52D, MW-54S, MW-

54M1, MW-58S and MW-94M2). There have been no exceedances of thallium since January 2003.

Groundwater samples sent for metals analysis are analyzed for most metals by Inductively Coupled Plasma (ICP) in accordance with U.S. EPA Contract Laboratory Program Statement of Work ILM04.0. In May of 2001, the IAGWSP began analyzing for antimony and thallium using the GFAA (graphite furnace atomic adsorption) method in accordance with EPA Drinking Water Methods 204.2 (antimony) and 279.2 (thallium) in order to achieve lower detection limits for these metals. Both the ILM04.0 and GFAA methods are subject to false positive results at trace levels due to interferences. As a result, the IAGWSP changed to a new method to achieve lower detection limits for antimony and thallium in January of 2003. Groundwater samples are now analyzed for antimony and thallium by Inductively Coupled Plasma/Mass Spectroscopy (ICP/MS) in accordance with the EPA Method 6020. The ICP/MS Method 6020 has greater sensitivity and the added feature of selectivity for antimony and thallium. These additional methods achieve lower detection limits for these two metals and reduce the number of false positive results.

The distribution and lack of repeatability of the metals exceedances is not consistent with a contaminant source, nor do the detections appear to be correlated with the presence of explosives or other organic compounds. The IAGWSP evaluated inorganic background concentrations using the groundwater quality database of 1999, and submitted a draft report describing background groundwater quality in December 1999.

Figure 3: VOCs in Groundwater Compared to MCLs/HAs

Exceedances of drinking water criteria for VOCs are indicated in six general areas: Northeast Corner (well LRMW003), Impact Area boundary (MW-28S), CS-10 (wells 03MW0007A, 03MW0014A, and 03MW0020), LF-1 (well 27MW0017B), FS-12 (wells MW-45S, 90MW0003, and ECMWSNP02D), and in the J-1 Range (well MW-187D). CS-10, LF-1, and FS-12 are sites located near the southern extent of the Training Ranges that are currently under investigation by AFCEE under the Superfund program. Exceedances of drinking water criteria were measured for tetrachloroethylene (PCE) at CS-10, for vinyl chloride at LF-1, and for methylene chloride, toluene, 1,2-dichloroethane, and ethylene dibromide (EDB) at FS-12. These compounds are believed to be associated with the sites under investigation by AFCEE. Detections of benzene, tert-butyl methyl ether, and chloromethane at J-1 Range well MW-187D, chloromethane at Northeast Corner well LRMW003, and 1,2-dibromo-3-chloropropane at Impact Area boundary well MW-28S are currently under investigation.

Figure 4: Chloroform in Groundwater Compared to MCLs

Chloroform has been widely detected in groundwater across the Upper Cape as stated in a joint press release from USEPA, MassDEP, IRP, and the Joint Programs Office. The Cape Cod Commission (2001) in their review of public water supply wells for 1999 found greater than 75% contained chloroform with an average concentration of 4.7 ug/L. The IRP has concluded chloroform is not the result of Air Force activities. A detailed discussion of the presence of chloroform is provided in the Final Central Impact Area Groundwater Report (06/01).

Figure 5: SVOCs in Groundwater Compared to MCLs/HAs

Exceedances of drinking water criteria for SVOCs are scattered throughout the study area. All exceedances of drinking water criteria for SVOCs were measured for bis (2-ethylhexyl)

phthalate (BEHP), with the exception of two wells. MW-264M1 (J-3 Range) had a detection of benzo(a)pyrene at concentrations of more than twice the HA and MW-241M1 (L Range) had detections of naphthalene above the HA of 100 ppb. Detections of BEHP are presented separately in Figure 6 and discussed in the next paragraph.

Figure 6: BEHP in Groundwater Compared to MCLs

Exceedances of drinking water criteria for bis (2-ethylhexyl) phthalate (BEHP) are scattered throughout the study area. BEHP is believed to be largely an artifact of the investigation methods, introduced to the samples during collection or analysis. However, the potential that some of the detections of BEHP are the result of activities conducted at MMR has not been ruled out.

A detailed discussion of the presence of BEHP is provided in the Draft Completion of Work Report (7/98) and subsequent responses to comments. The theory that BEHP mostly occurs as an artifact, and is not really present in the aquifer, is supported by the results of subsequent sampling rounds that show much lower levels of the chemical after additional precautions were taken to prevent cross-contamination during sample collection and analysis. Only four locations (out of 93) showed BEHP exceedances in consecutive sampling rounds: 28MW0106 (located near SD-5, a site under investigation by AFCEE), 58MW0006E (located at CS-19), 90WT0013 (located at FS-12), and MW-146M1 (located at L Range). Subsequent sampling rounds at all these locations have had results below the MCL. Eleven wells (27MW0705, 27MW2061, C2-B, C6-C, C7-B, MW-47M2, MW-164M1, MW-168M1, MW-188M1, MW-196M1, and MW-198M1) had BEHP exceedances in the year 2002 and 2003 results. There have been no exceedances of BEHP in 2004, one exceedance of BEHP, at MW-356M1 (J-3 Range), in 2005, and one exceedance of BEHP, at MW-477M2 (J-1 Range), in 2007.

Figure 7: Herbicides and Pesticides in Groundwater Compared to MCLs/HAs

There has been one exceedance of drinking water criteria for pesticides, at well PPAWSMW-1. A contractor to the United States Air Force installed this monitoring well at the PAVE PAWS radar station in accordance with the Massachusetts Contingency Plan (MCP), in order to evaluate contamination from a fuel spill. The exceedance was for the pesticide dieldrin in a sample collected in June 1999. This well was sampled again in November 1999. The results of the November sample indicate no detectable pesticides although hydrocarbon interference was noted. It appears from the November sample that pesticides identified in the June sample were false positives. However, the June sample results cannot be changed when following the EPA functional guidelines for data validation. The text of the validation report for the June sample has been revised to include an explanation of the hydrocarbon interference and the potential for false positives.

There has been one exceedance of drinking water criteria for herbicides, at well MW-41M1 (Impact Area). This response well was installed downgradient of the Impact Area. The exceedance was for the herbicide pentachlorophenol in a sample collected in May 2000. There were no detections above the MCL of this compound in the three previous sampling rounds in 1999, nor in the subsequent sampling rounds in 2000, 2001, 2002, and 2003.

Figure 8: Perchlorate in Groundwater Compared to a 2 ppb Concentration

There were no validated detections of perchlorate for any groundwater data that was validated in December 2007.

Sampling and analysis of groundwater for perchlorate was initiated at the end of the year 2000 as part of the IAGWSP. Cumulative exceedances of the 2 ppb concentration of perchlorate are indicated in seven general areas:

- Demo Area 1 (wells 19, 31, 32, 33, 34, 35, 36, 73, 75, 76, 77, 78, 114, 129, 139, 162, 165, 172, 210, 211, 225, 255, 258 and 341);
- Impact Area and CS-19 (wells 58MW0009C, 58MW0015; and wells 38, 89, 91, 93, 101, and OW-1);
- J Ranges and southeast of the J Ranges (wells 93, 125, 127, 128, 130, 132, 142, 143, 158, 163, 166, 193, 197, 198, 215, 232, 234, 237, 243, 247, 250, 263, 265, 286, 289, 293, 295, 300, 302, 303, 305, 307, 310, 313, 319, 321, 324, 326, 329, 335, 339, 343, 346, 348, 366, 368, 370, 393, and wells 90PZ0211, 90MW0022 and 90MW0054, 90WT0013, J2EW3-MW-2-B, and RS003P);
- Landfill Area 1 (27MW0031B);
- CS-18 (well 16MW0001);
- Northwest Corner of Base Boundary (wells 4036009DC, 66, 270, 277, 278, 279, 283, 284, 287, 297, 301, 309, 323, and RSN0W3); and
- Western Boundary (wells 80, 233, and 267).

Demo Area 1 has a single well-defined source area and extent of contamination. The downgradient extent of the perchlorate plume has been determined with the installation of monitoring wells along the power line right-of-way east of Fredrickson Road.

The Impact Area has eight locations with exceedances of the 2 ppb concentration of perchlorate. The perchlorate plume extends from near the center of the Impact Area to the northwest, in the vicinity of Burgoyne Road.

Plumes have been identified in four areas in the J Ranges. The J-1 Interberm perchlorate plume has several perchlorate detections in downgradient locations MW-265, MW-286, MW-303, MW-326, MW-346, and MW-370. The J-3 Range Demolition perchlorate plume has detections in several wells immediately downgradient of the source area, which is centered at MW-198, and further downgradient centered near location 90MW0054. The J-2 Range North perchlorate plume has detections at source area locations MW-130 and MW-263, and downgradient locations MW-289, MW-293, MW-300, MW-302, MW-305, and MW-313. The J-2 East perchlorate plumes are in the process of delineation and include detections at MW-307, MW-310 and MW-368. There is a single perchlorate detection (well 90WT0013) at the L Range which exceeds the 2 ppb concentration.

The Northwest Corner has a perchlorate plume extending from Canal View Road at the base boundary to the Cape Cod Canal. This area is under investigation and the plume will be updated and refined as new data is received.

The LF-1 and CS-18 areas are under investigation by AFCEE in the Superfund Program.

The Western Boundary has three locations (wells 80, 233, and 267), which exceed the 2 ppb perchlorate MMCL.

4. DELIVERABLES SUBMITTED

Deliverables submitted during the reporting period include the following:

Monthly Progress Report No. 129 for December 2007	12/10/2007

5. SCHEDULED ACTIONS

Figure 9 provides a Gantt chart updated as of 31 October 2007, to reflect progress and proposed work. The October 2007 Revised Combined Schedule (RCS), included in this monthly report, is currently under review by the IAGWSP, EPA, and MassDEP. A revised and "up-to-date" RCS will be provided as it is available. There are no documents currently scheduled for submittal in January 2008.

The following documents are being prepared or revised during January:

- J-2 Range Groundwater Interim Final Remedial Investigation/Feasibility Study Report
- J-3 Range Groundwater Interim Final Remedial Investigation/Feasibility Study Report
- L Range South Soil/Groundwater Draft Remedial Investigation/Feasibility Study Report