

ENVIRONMENTAL IMPLICATIONS OF PYROTECHNIC TRAINING IN AN IMPACT AREA – PERCHLORATE CONTAMINATION



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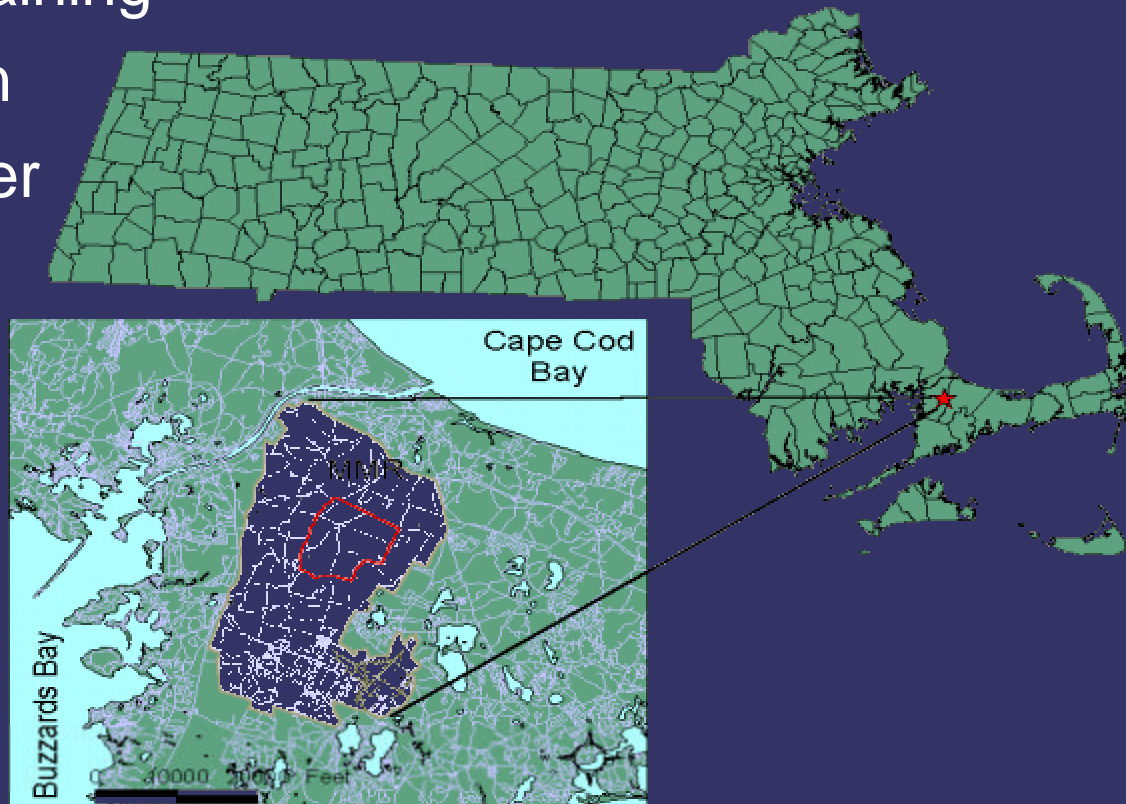
Introduction

- Military training ranges under scrutiny
 - Potential impacts to ecology and environment
 - Complex issues and problems
- Major ranges receiving attention
 - **Massachusetts Military Reservation (MMR) – ARNG**
 - Vieques, Puerto Rico - U.S. Navy
 - Fort Ord, CA – Army
 - Fort Lewis, WA - Army

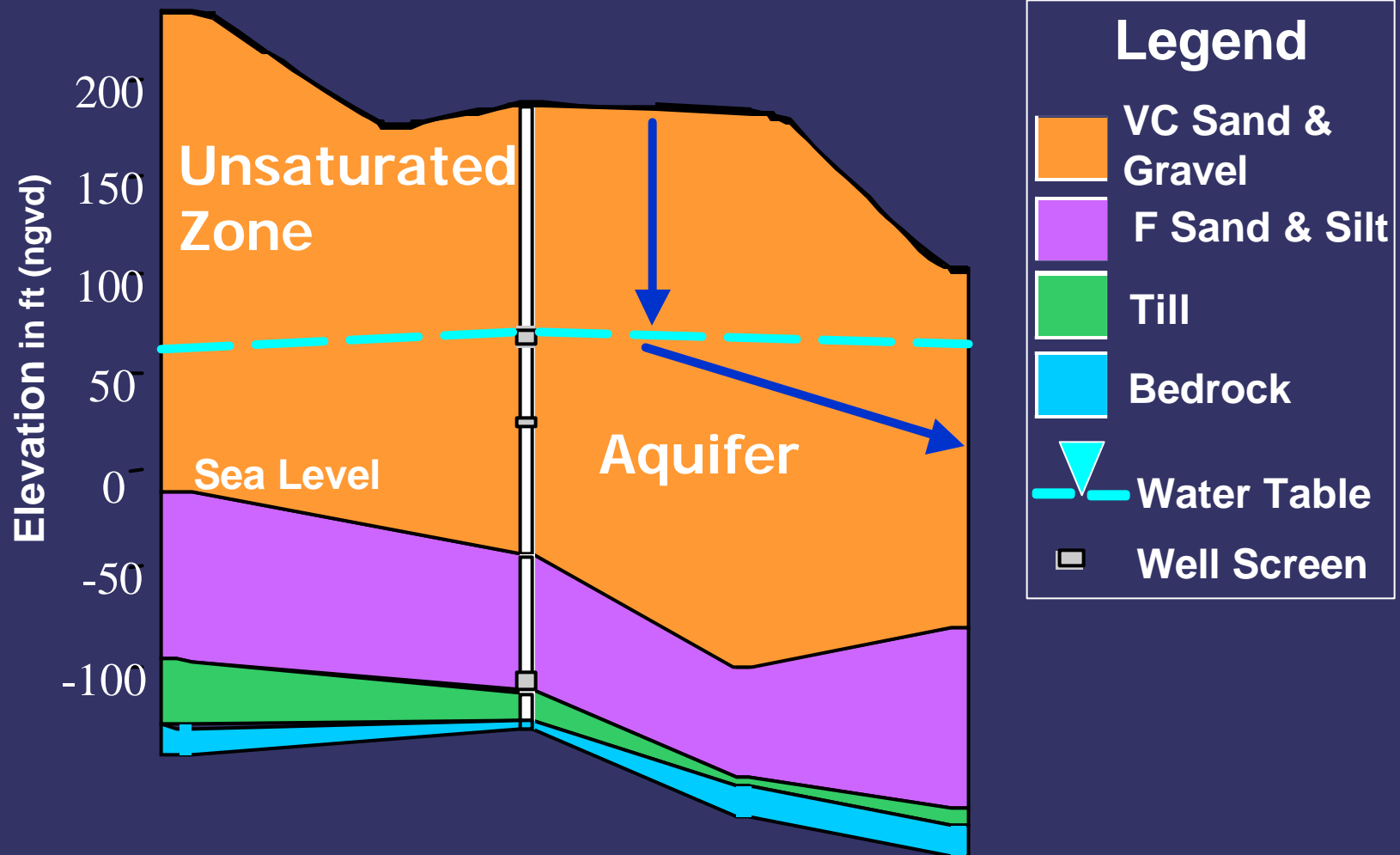


Site History

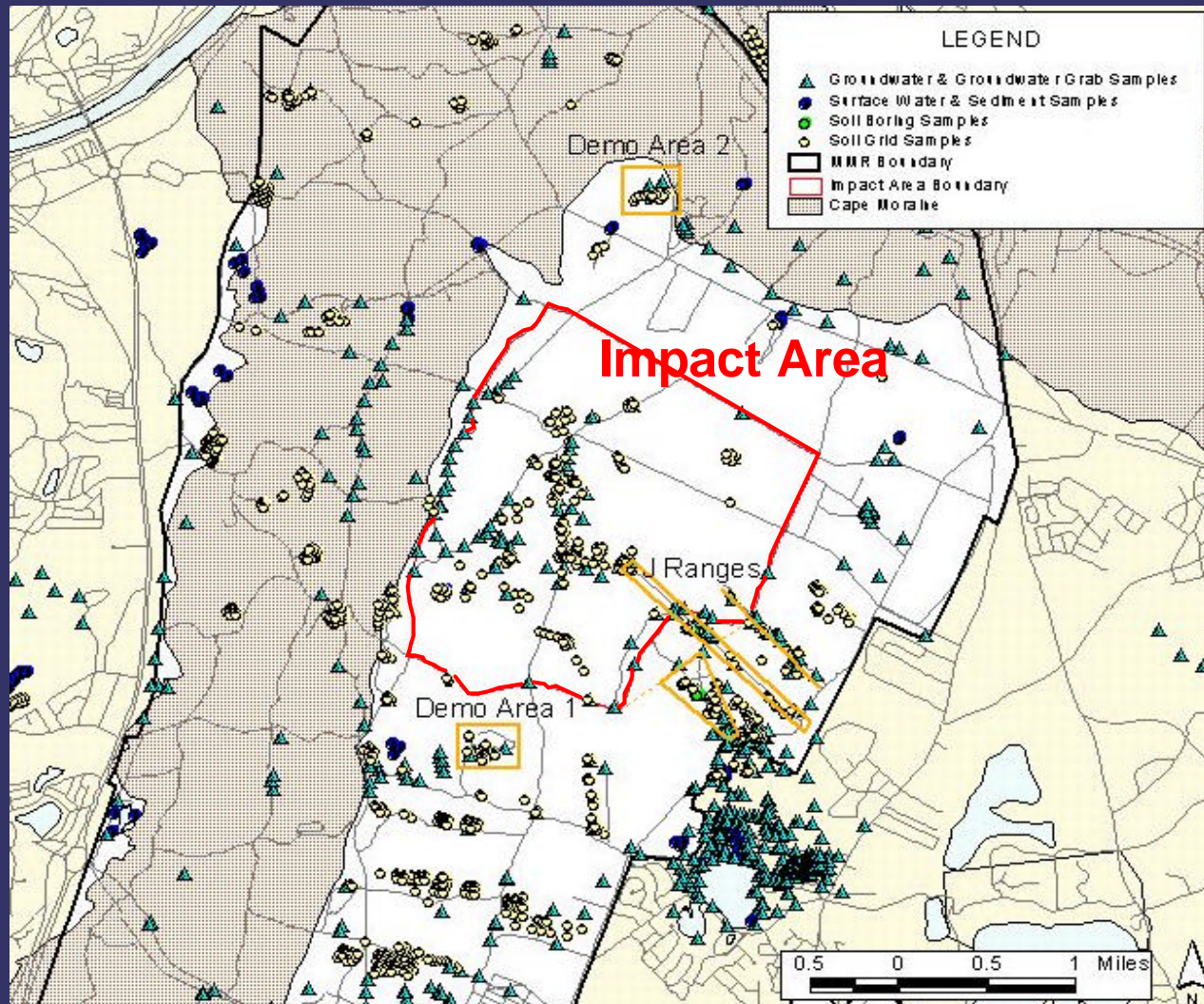
- Training and Impact Areas used since 1911
- Designed to house 30,000 troops during WWII
- USEPA banned training in 1997 through an administrative order



Site Lithology

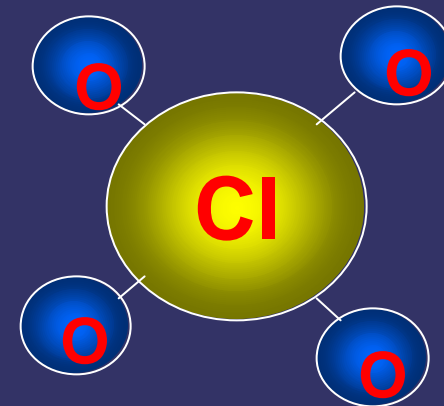


Areas of Investigation



What is Perchlorate ?

- Anion: ClO_4^-
- Ammonium perchlorate is in solid propellant for rockets and missiles
- Potassium perchlorate is in pyrotechnics such as illumination and tracer rounds as well as spotting charges, fuzes, and grenades
- Perchlorate is also present in fertilizers, herbicides, and fireworks
- Current MDL of 0.35 ug/L



Health/Ecological Concerns

- Soluble - Mobile – Persistent – Clean-up Challenge
- Human Health
 - If exposed - disrupts normal thyroid function and uptake of iodine
- Ecological Risks
 - Little information available on ecological effects



Regulatory Guidelines

- No national or state drinking water standards
- MMR was using 4 to 18 ug/L (USEPA Provisional Action Level)
- July 27, 2001 USEPA Letter – MMR should use 1.5 ug/L
- October 4, 2001 MMR/DOD Letter – Concerns...use 4 to 18 ug/L until national standard set
- April 16, 2002 MADEP recommends 1 ug/L guideline

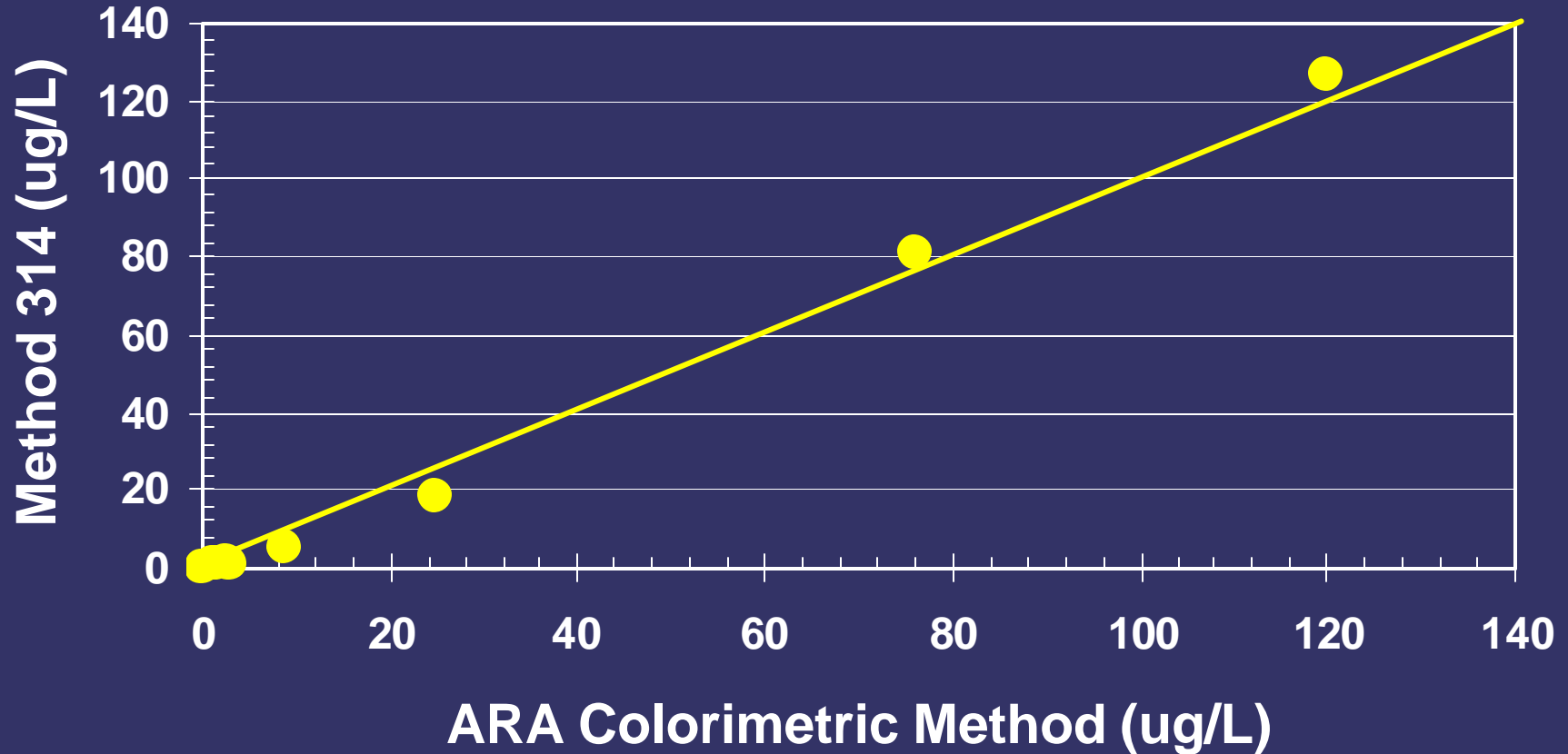
Detection Limits

- Standard USEPA Method 314.0 – 4 to 5 ug/L
 - August 2000 – 1.5 ug/L
 - October 2001 – 0.85 ug/L
 - November 2001 – 0.35 ug/L
- ARA Colorimetric Method - ~ 1 to 2 ug/L
- LC-MS/MS – 0.015 to 0.020 ug/L
- Thermospray/MS - .27 to 0.30 ug/L
- Paired Ion C18 Method - ???

Alternative Analytical Methods Explored

- USEPA Method 314.0 – Standard methodology
- ARA Colorimetric Method
 - Well Samples – Good Results
 - Grab Samples – Interference Issues
 - GAC Column Effluent Samples – False Positives, High Bias
- ARA Paired Ion Chromatography Pre-Concentration
 - Colorimetric Method – Good Results
 - Method 314.0 – Incompatible

Perchlorate Method Comparison

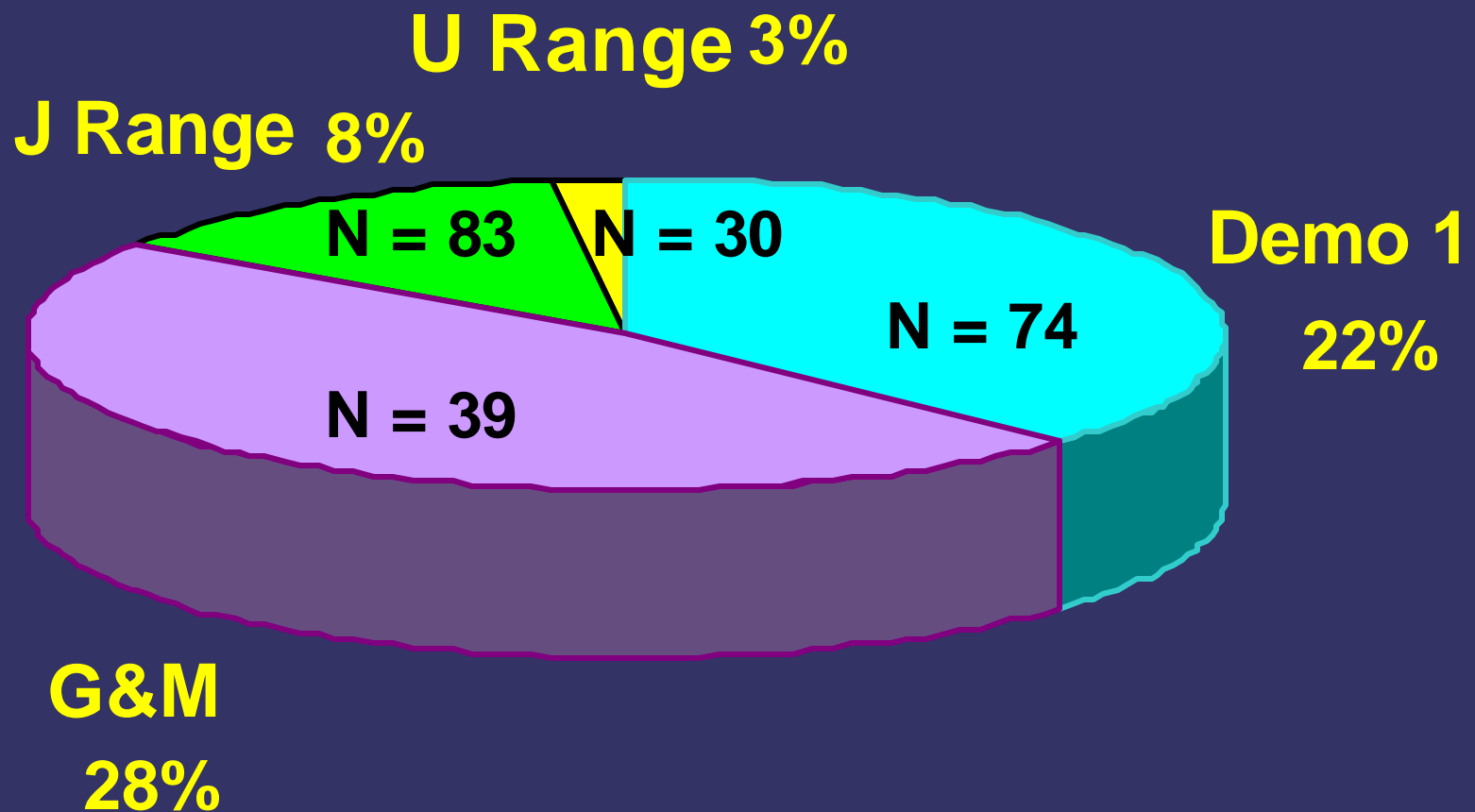


Possible Source(s) of Perchlorate

- Demo 1 and J Range Primary Source(s)
 - Disposal of rockets and propellants
 - Burning of fireworks
- Central Impact Area Potential Source(s)
 - Spotting charges for artillery rounds
 - Illumination & tracer rounds/pyrotechnics
 - Fuzes for many munitions



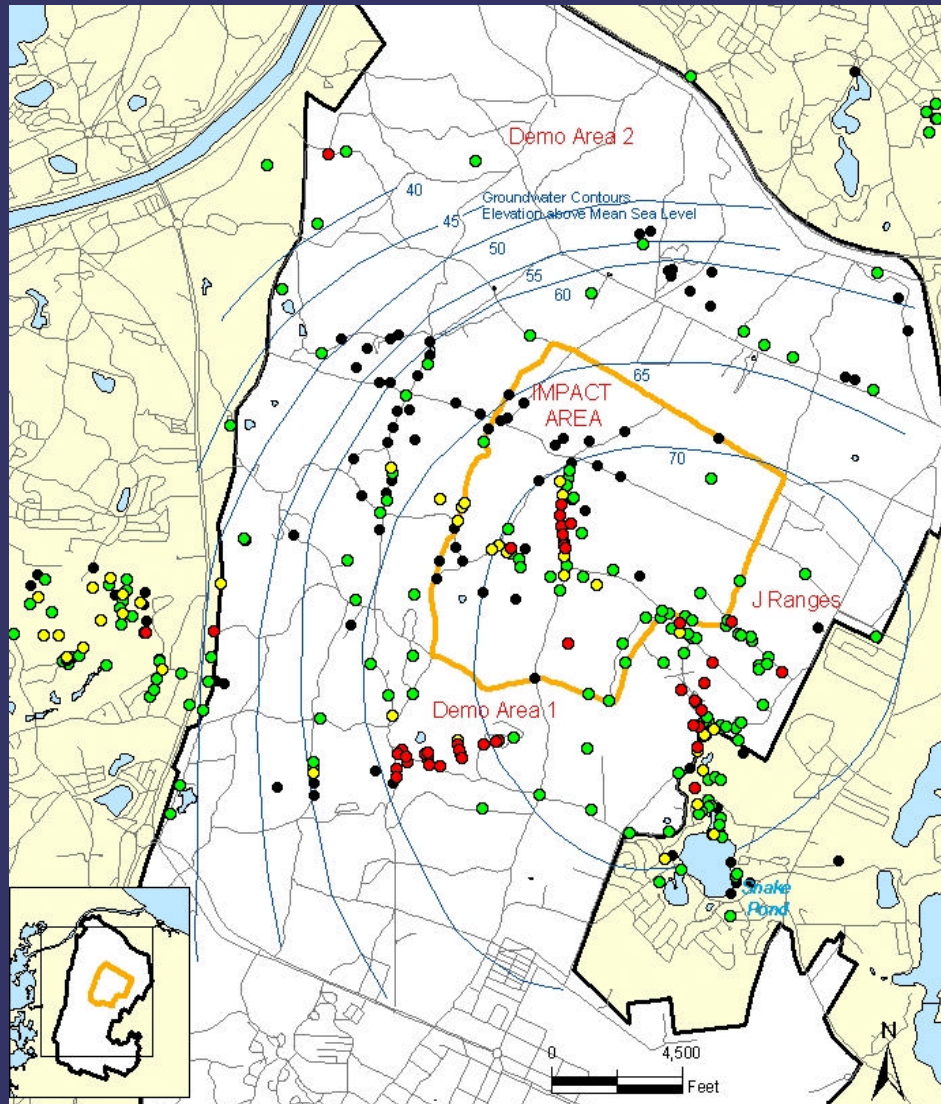
Frequency of Perchlorate Detections in Soil



Perchlorate Distribution in Soil (ug/kg)

	Demo 1	G&M	J Range	U Range
Mean of Detects	8.2	3.6	68	3.8
Mean w/ND	2.6	1.8	6.7	1.2
Minium	3.4	1.3	5.3	3.8
Maxium	27	7.5	5.3	3.8

Location of Perchlorate In Groundwater



- > 1.5 ug/L
- 0.35 - 1.5 ug/L
- Non-detect
- To be sampled

Location and Concentration in Groundwater

- Total # Samples = 2120; Total # of Detections = 315
- Demo Area 1 (112 detections)
 - Range = 0.35 to 300 ug/L
 - Mean = 28.9 ug/L
- Central Impact Area (74 detections)
 - Range = 0.35 to 34 ug/L
 - Mean = 1.3 ug/L
- J Ranges (0.35 to 310 ug/L)
- Off-Post In Bourne Area (0.35 to 1.8 ug/L)

Perchlorate Fate-and-Transport Conceptual Model

- Deposition of particulates to ground surface
- Rapid dissolution of particulates by precipitation
- Rapid movement through unsaturated zone, leaving little residual soil contamination
- Introduction to groundwater results in rapid transport away from source

Potential Remedial Technology

- Excellent results achieved using GAC
- Used 13,000 lbs GAC @ 510 gpm
- Average perchlorate influent 0.81 ug/L
- EBCT of 6.5 minutes
- Hydraulic loading rate of 8.8 gpm/ft²



Conclusions

- Perchlorate levels in groundwater are a concern to USEPA
- Occurs in groundwater with and without explosives
- Requires unconventional clean-up technologies
- Working with USEPA to establish national standard
- Findings are potentially applicable to other bombing ranges and battlefields

