

Comparison of Innovative Technologies for Groundwater Remediation at Camp Edwards, Massachusetts

3rd Annual Conference on Remediation of Chlorinated and Recalcitrant Compounds

May 21, 2002

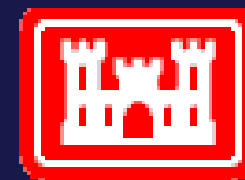
*David Hill, Benjamin Gregson
(IAGWSP)*

*Katherine Weeks, Scott Veenstra,
Deborah Taege (AMEC)*



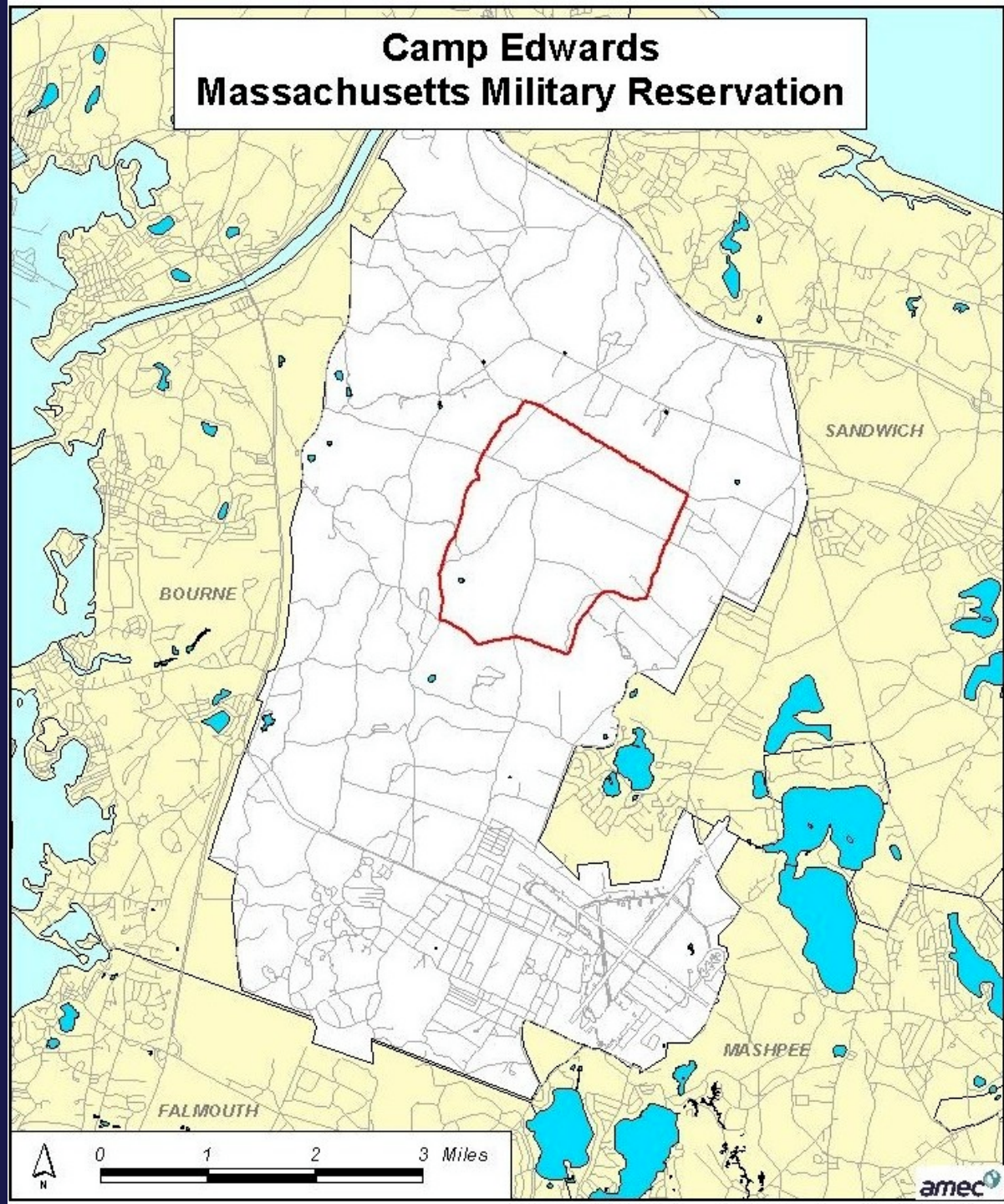
Innovative Technology Evaluation Team (ITE)

- Army National Guard
 - LTC Joe Knott, Ben Gregson, Dave Hill
- Army Corps of Engineers
 - Heather Sullivan, Ian Osgerby
- Army Environmental Center
 - Wayne Sisk, Mark Hampton
- AMEC Earth and Environmental
 - Scott Veenstra, Katy Weeks, Deb Taege



Camp Edwards

- 14,000 acres on Cape Cod
- Impact Area and training ranges used for target practice and range training operations since 1940s



ITE Mission

- Support responses to EPA Administrative Orders to protect groundwater at Camp Edwards
- Select innovative soil and groundwater remediation technologies to address low levels of explosives contamination at MMR
- Support future application at other DoD/ARNG training installations



ITE Performance Goals

- Low for groundwater protection

<i>Compound</i>	<i>ITE Performance Goal (µg/L)</i>	<i>Initial Concentration (µg/L)</i>	<i>Reporting Limit (µg/L)</i>
<i>RDX</i>	0.61	100 - 127	0.25
<i>HMX</i>	180	10 - 25	0.25
<i>MNX</i>	Not established	3.3	0.25
<i>DNX</i>	Not established	0.44	0.25
<i>TNX</i>	Not established	0.44	0.25
<i>Perchlorate</i>	Not established	140 - 210	1.0

- Reduction of MNX, DNX, TNX considered a desirable outcome
- Reduction of perchlorate not required for ITE studies, but has become a recognized contaminant of concern in Camp Edwards groundwater

Treatability Study Technologies

<i>Parameter</i>	<i>Cometabolic Reduction</i>	<i>Permanganate Oxidation</i>	<i>Fenton-like Oxidation</i>	<i>Fluidized Bed Reactor</i>
<i>Additive</i>	HRC [®] - polylactate glycol ester	KMnO ₄ / NaMnO ₄	H ₂ O ₂ + iron-organic ligand	Molasses / acetic acid
<i>Concentration of additive</i>	1,000 mg/L	400, 4,000 & 10,000 mg/L	10,000 mg/L (1, 2, 3 doses)	2X, 5X theoretical
<i>Study media</i>	Soil and groundwater	Groundwater	Groundwater	Groundwater
<i>Temperature</i>	16°C to 19°C	9°C to 12°C	Room	~12°C
<i>Duration</i>	27 days	21 days	1 day	27 days
<i>Target COCs</i>	Explosives	Explosives	Explosives	Explosives, Perchlorate

Treatability Study Technologies

- In Situ Cometabolic Reduction - Earth Tech/Regenesis
 - HRC[®] a food grade compound
 - Slow release to groundwater
 - Demonstrated success at Pueblo Chemical Depot in Colorado

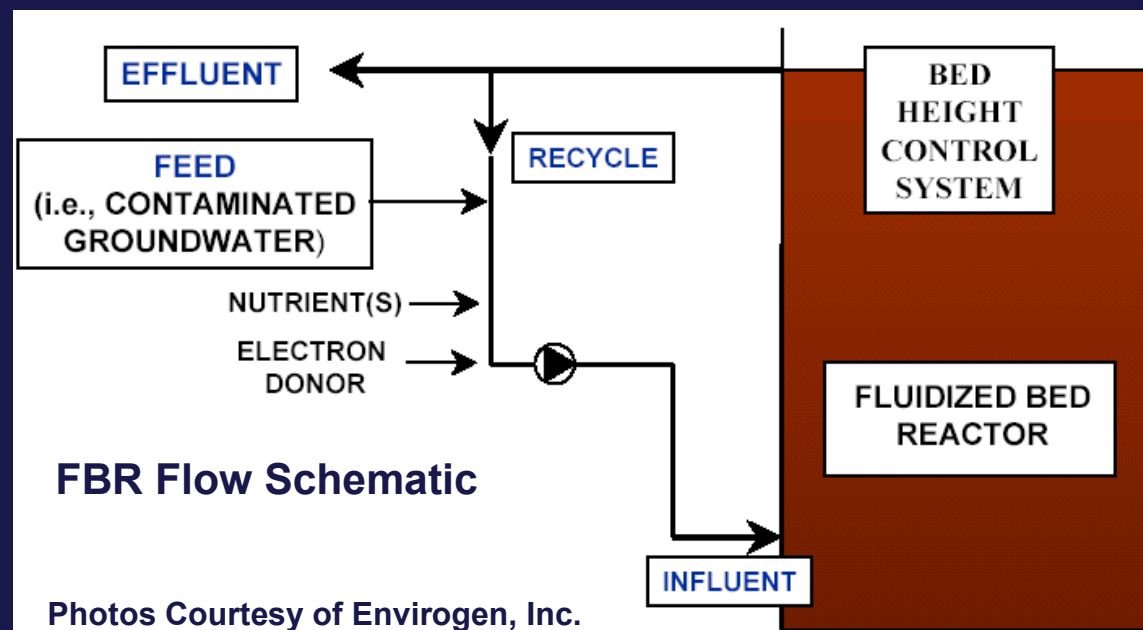


EARTH  TECH
A tyco INTERNATIONAL LTD. COMPANY

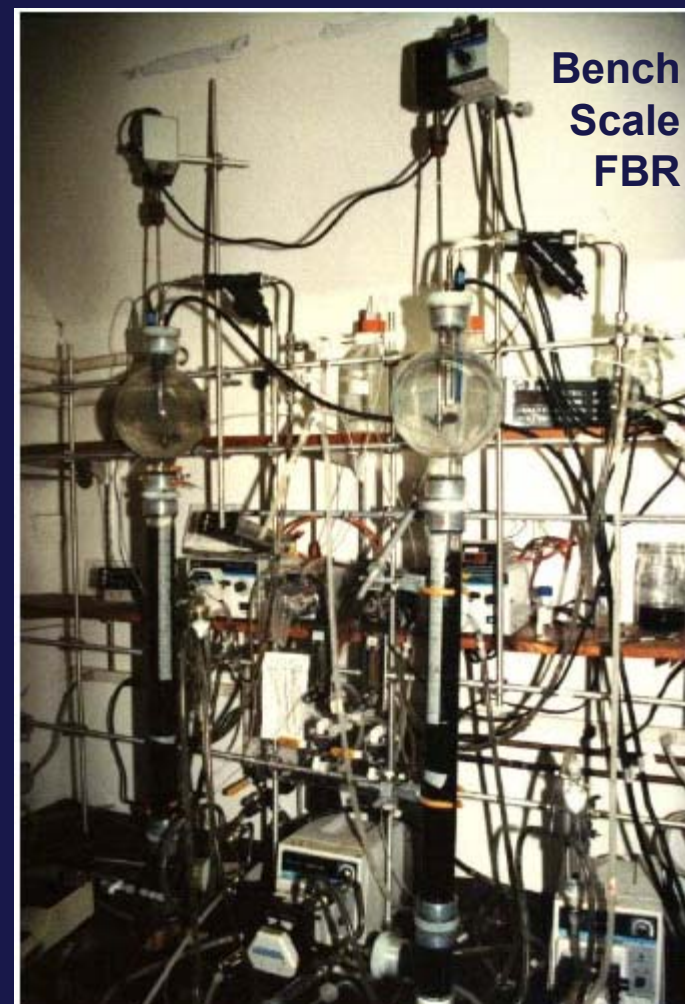
MMR-2

Treatability Study Technologies

- Ex Situ Fluidized Bed Reactor (FBR) - Envirogen
 - Uses GAC as substrate for microbial growth
 - Demonstrated at Aerojet site in California
 - Study in process - results expected Fall 2002



Photos Courtesy of Envirogen, Inc.



Treatability Study Technologies

- Chemical Oxidation (Permanganate) - IT Corporation
 - pH not impacted
 - More long-lived oxidant than hydrogen peroxide
 - Demonstrated at Pantex Facility, Texas

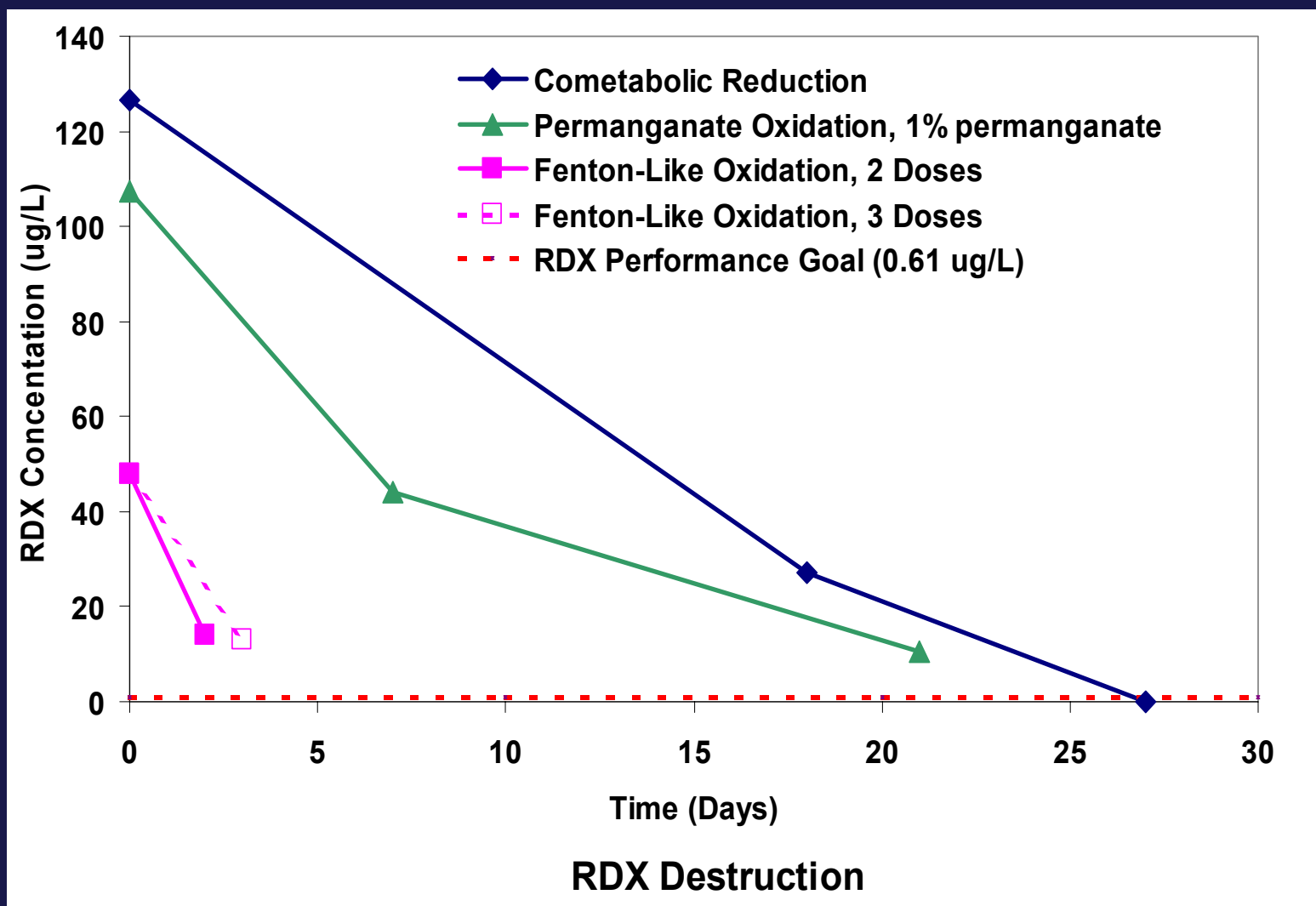


Treatability Study Technologies

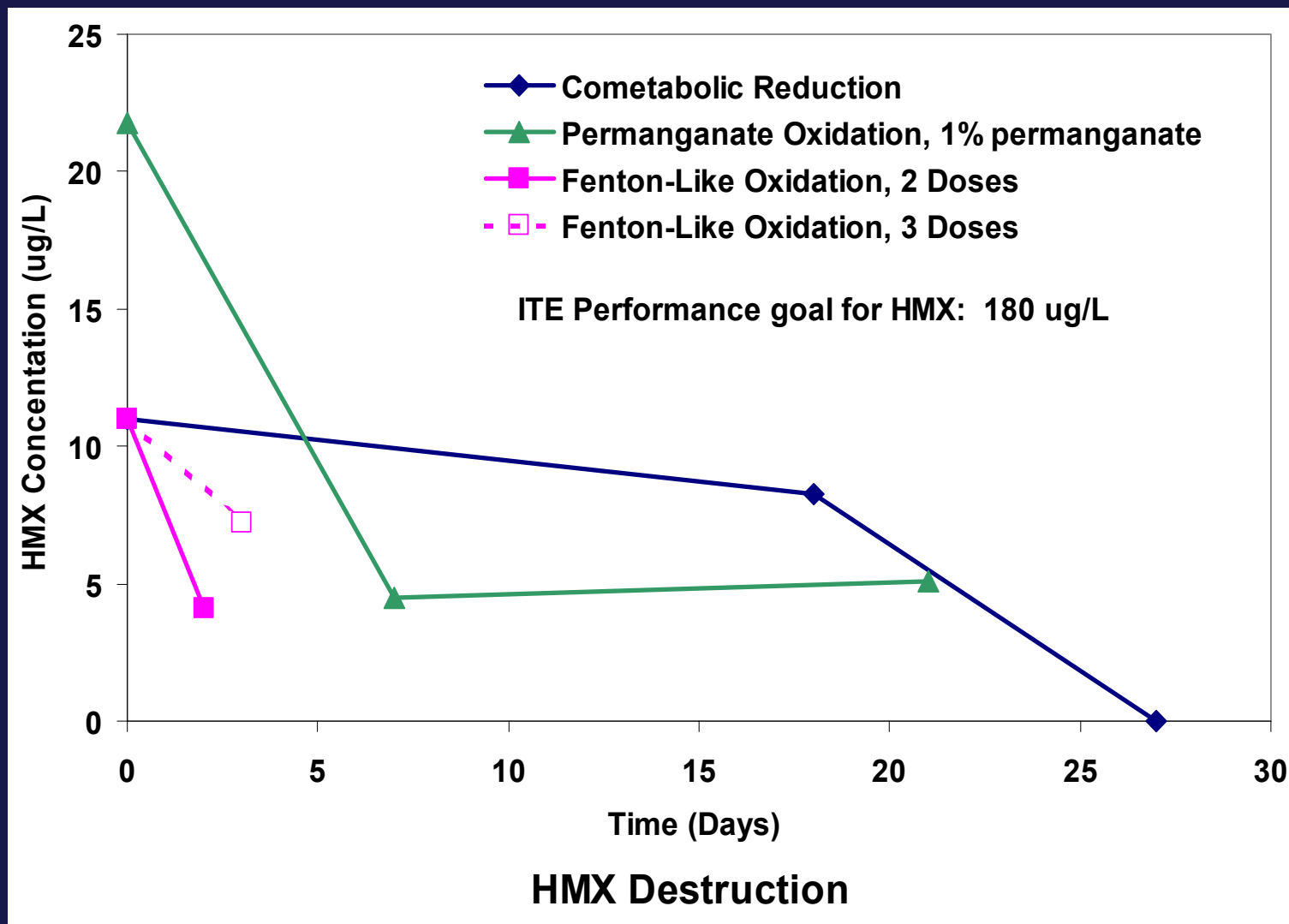
- Chemical Oxidation (Fenton-like) - ISOTEC, Inc.
 - pH only slightly lowered
 - hydrogen peroxide catalyzed by ferrous iron
 - Reaction slowed by addition of organic ligand to the iron



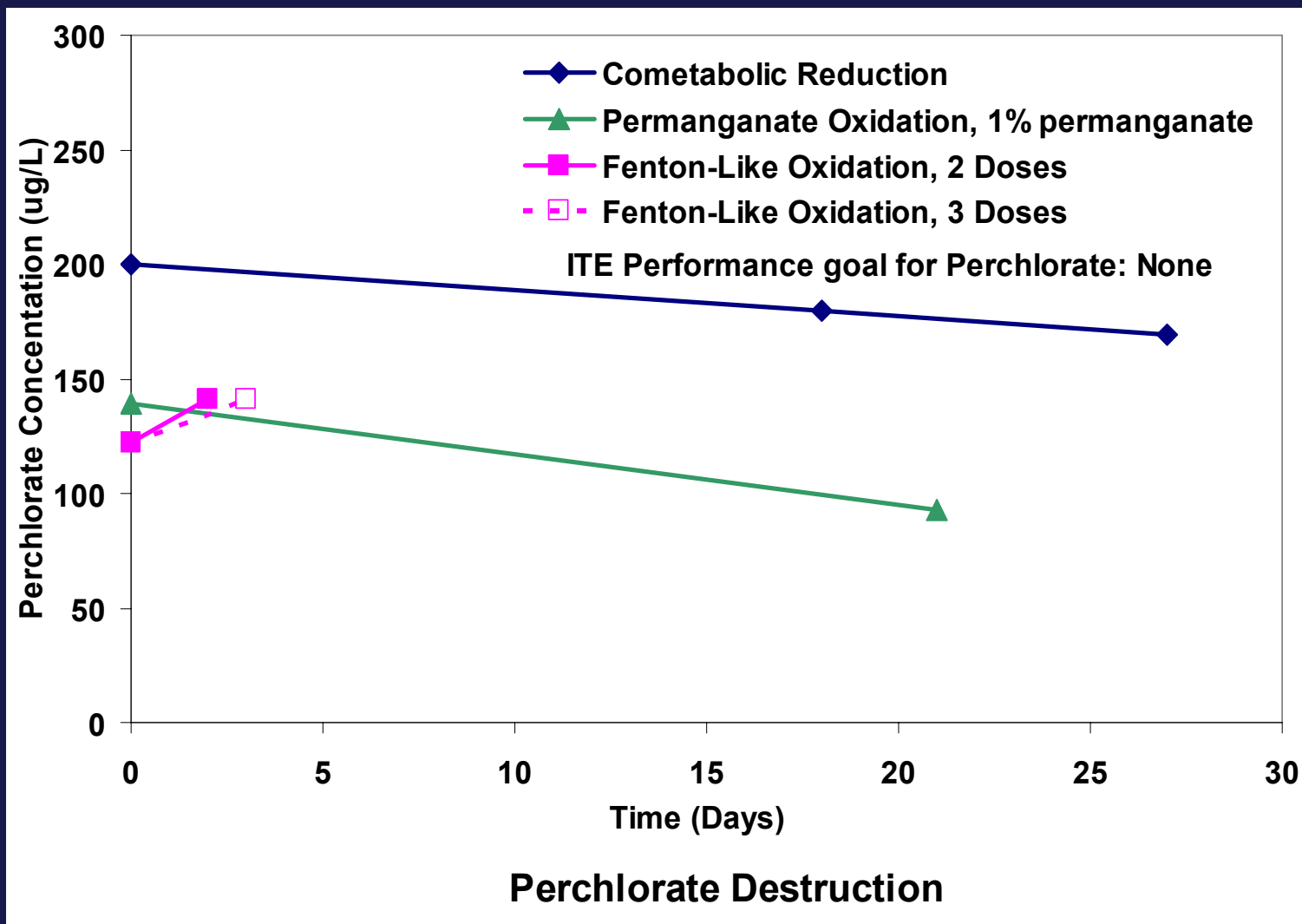
ITE Treatability Study Results



ITE Treatability Study Results



ITE Treatability Study Results



ITE Treatability Study Conclusions

<i>Analyte</i>	<i>Cometabolic Reduction</i>	<i>Permanganate Oxidation</i>	<i>Fenton-like Oxidation</i>
<i>RDX, HMX</i>	Complete destruction	Decrease but not complete destruction - oxidant may still be present for degradation	Decrease but not complete destruction
<i>MNX, DNX, TNX</i>	Slight increase, then complete destruction - expected	Complete destruction	Not analyzed
<i>Perchlorate</i>	19% destruction - preferential destruction of RDX et al.?	30% destruction - likely not due to oxidation	No destruction - expected

ITE - Moving Forward

- Remediation of explosives and perchlorate
 - Oxidation generally does not destroy perchlorate
 - In situ microbes may prefer explosives to perchlorate
- Concurrent Feasibility Study Recommendations
 - Premise: In situ may be cost effective for “hot spots”
 - Finding: plumes are disperse, with low concentrations
 - Preliminary Conclusion: One or more technologies may be considered as part of full scale implementation
- Subcontractor field scale estimates - \$250,000
- Ex situ solutions such as FBR now being tested