Remedial Safety in In-Situ Chemical Oxidation, Crucial to Success

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Deb Schnell, Cascade

Sources:
Pac, Tim, Cohen, Elizabeth, Crimi, Michelle, Dombrowski, Paul, Duffy, Baxter, Lee, Michael, Klemmer, Mark, Pittenger, D. Scott and Robinson, Lance, "Remedial Safety in In-Situ Chemical Oxidation, Crucial for Success," Remediation, 32 (3): 195 – 209 (2022).
Pac, Tim, Lee, Michael, Byrd, Jennifer, Cohen, Elizabeth, Crimi, Michelle, Dombrowski, Paul, Duffy, Baxter, and Schnell, Deborah, "*Remedial Safety in In-Situ Chemical Oxidation, Crucial for Success*," 12th International Conference on Remediation of Chlorinated and Recalcitrant Compounds (2022).

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Those who cannot remember the past are condemned to repeat it.
– George Santanyana

Presentation Outline

Step changes in the evolution of “Safety” and Safety First

Personal advocacy for chemical safety

- Awareness of basics
- Advanced knowledge

“**Incidents**” of injection (Top 4)

Top 3 “**skills**” with mitigation strategies

What can <u>You</u> do?

Did We Need Safety?

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Evolution of Safety First in Remediation I

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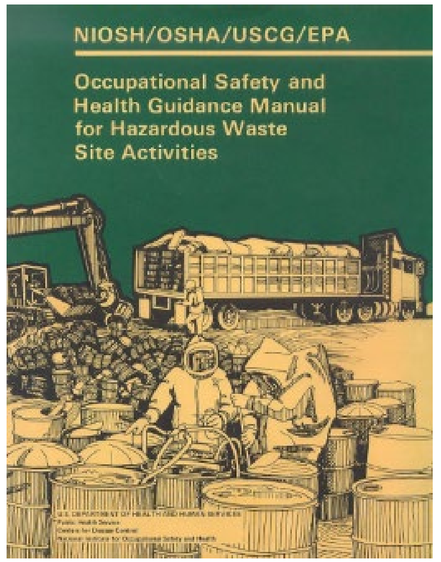
1985 –

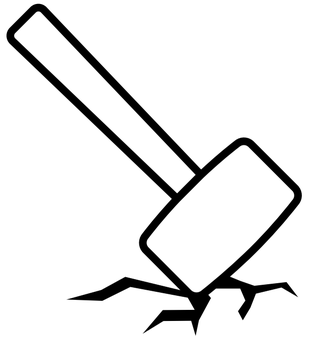
Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities required "… a site health and safety program… must provide:

- Comprehensive protection against all potential hazards and
- Specific protection against individual known hazards,
- It should be continuously adapted to new information and changing site conditions."



Responsibility of the employer, elicited response

- HAZWOPER 1910.120 (40 hour, annual, supervisor) in 1990
- Specialized worker training programs (construction, demolition, sampling)
- Selection and use of Personal Protective Equipment (PPE)
- Creation of Site-specific Health and Safety Plans (HSPs/HASPs)



Evolution of Safety-First In Remediation II

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2000

Recognition of “*what does safety mean to me*?”

- Safety awards, recognition – group and individual
- Targeted technical training
  - Classes, On-the-Job (OTJ), previous relevant experience
  - Observation / Supervision / Mentoring
  - Demonstration of competence/ Peer review
  - Examination / Certification / Licensure

Evolution of Safety-First In Remediation III

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2010

Individual empowerment and engagement - "*I am responsible for the safety of myself and my team*"

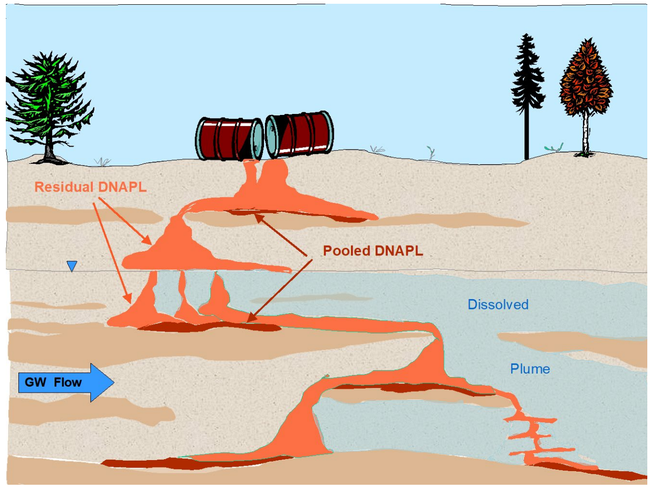
- **My knowledge** – awareness, recognition and knowledge
- **My actions** – observation, inspection and correction
- **My support for safety** – budget, equipment, team bias for action

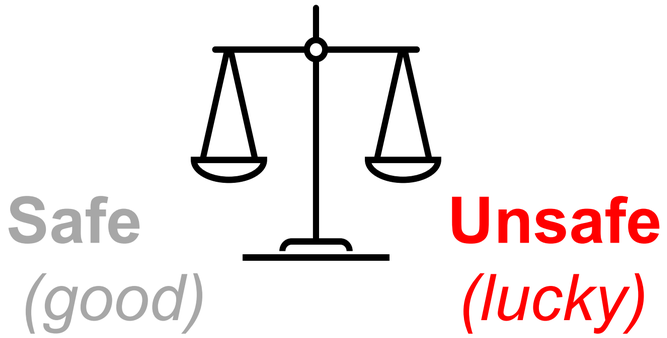
Present?

Mutual goal - everyone goes home, like they arrived!

Safety-First Key Topics

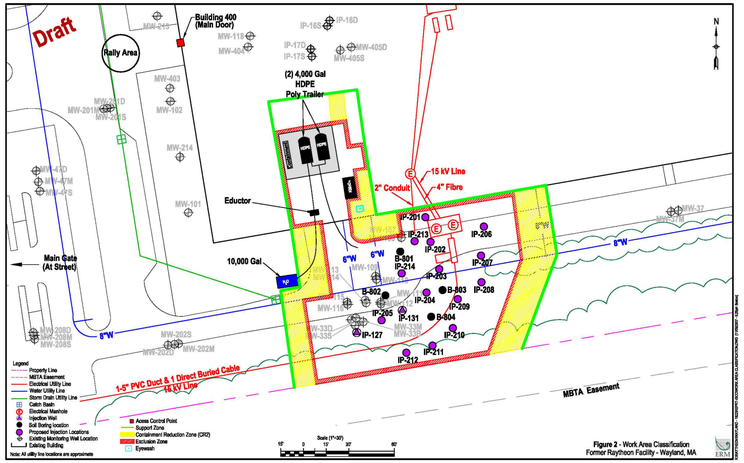
- **Knowledge** - training to provide understanding, increasing capabilities with ownership of activities, situational awareness, hazard recognition, anticipation of hazards and empowerment with stop work authority
- **Action** - active observation, chronic unease, continuous inspection, personal responsibility for correction and toughness and resilience in execution
- **Creating bias for safety** - budget, equipment, personal ownership, control, leadership, proactive change, and total team focus





Knowledge

- Promote and reinforce safety first culture
  - empowerment – shared authority and responsibility
  - engagement – contributions by all
  - inclusion – all observations and opinions matter
- Daily briefs - what has, is, and will be happening
- Set expectations – project and personal
- Use stop work practices – take a “pause” as needed to communicate and/or correct



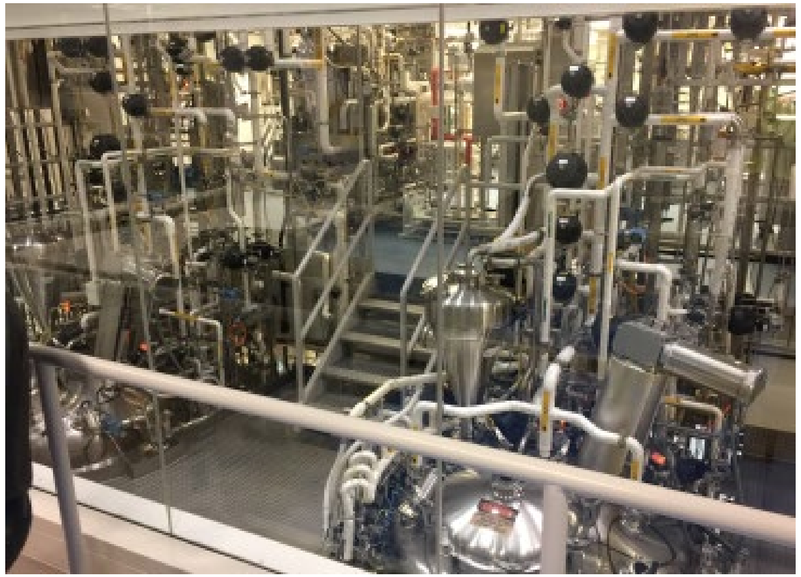
Action

- Proper **labelling** – every container, no “*unknowns*”
- **SDS** – accessible reference materials (PPE, fire fighting, first aid, exposure, hazards and concentrations)
- **Storage** – proper securement, separation of incompatibles, ventilation, spill prevention
- **HSPs/HASPs** – useful, relevant and complete
  - project objectives
  - Site-specific
  - timely and updated
  - project activities in appropriate detail

Bias for Safety

- Understand, accede and support
- Maintain consistency
- Assure knowledge (of proper practices) and training (gaps)
- Communicate monitoring (parameters, frequency, method, who/how/when?)
- Actively verify chemical management procedures
- Continuously implement risk management practices (observe and correct)

What?
When?
Where?
Why?
How?



Specialized Chemical Knowledge (e.g., persulfate)

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- Class 1 oxidizer *(**may ↑burning rate of combustibles**)*
- High solubility (*42% w/w*)
- **Corrosive (***pH < 2 SIU*)
- Inhalation (*dust during transfer*)
- Splash hazard (*eye wash, wash down & shower*)
- **Pressure and over pressurization (*unintended reaction*)**
- **Incompatibles (*proper storage, day tankage*)**

Corrosion is Real

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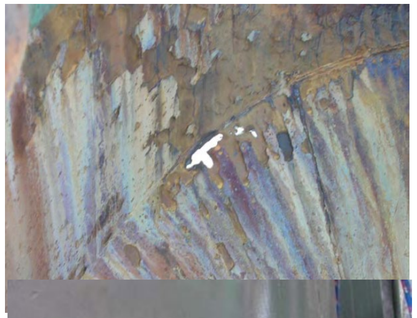
Virginia (2008)

Geoprobe Rods

Eductor

Texas (2010)

Mixing tank



Steel manifold

New Jersey (2022)

Geoprobe Rods

Fittings

Risk Management

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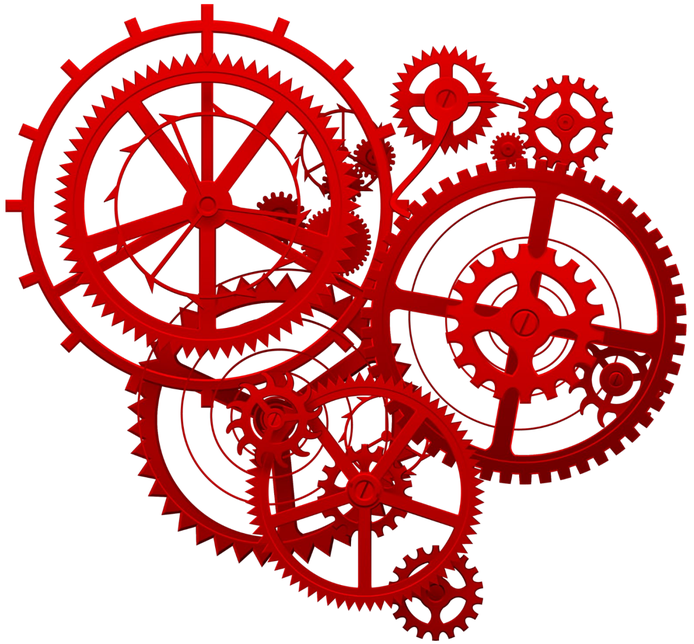
INCIDENTS (Top 4)

1. Storm Sewers
2. Other Utilities and Structures
3. Errors and Omissions
4. Contingency Planning



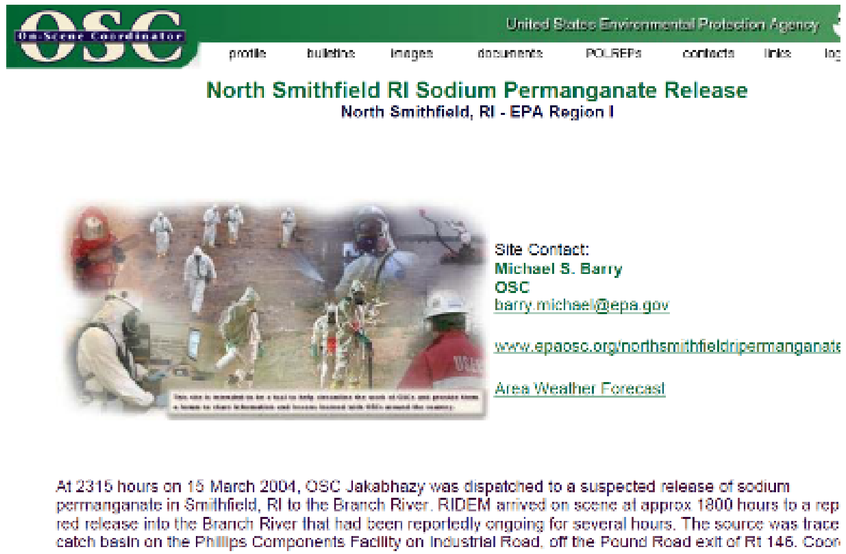
MITIGATIONS

- Planning
- Executing
- Correcting

Top Risks #1 – Storm Sewers

Injected materials entering, following and/or discharging via sewer or backfill due to

- **Construction-** storm sewers are, by definition, unsealed (leaky)
- **Placement** - permeable backfill/ filled / disturbed area provides enhanced migration
- **Changed condition** – raises in local water table
- **Over pressurization** – resulting in inadvertent soil lift and fracture



Top Risks #1 – Storm Sewers – Why?

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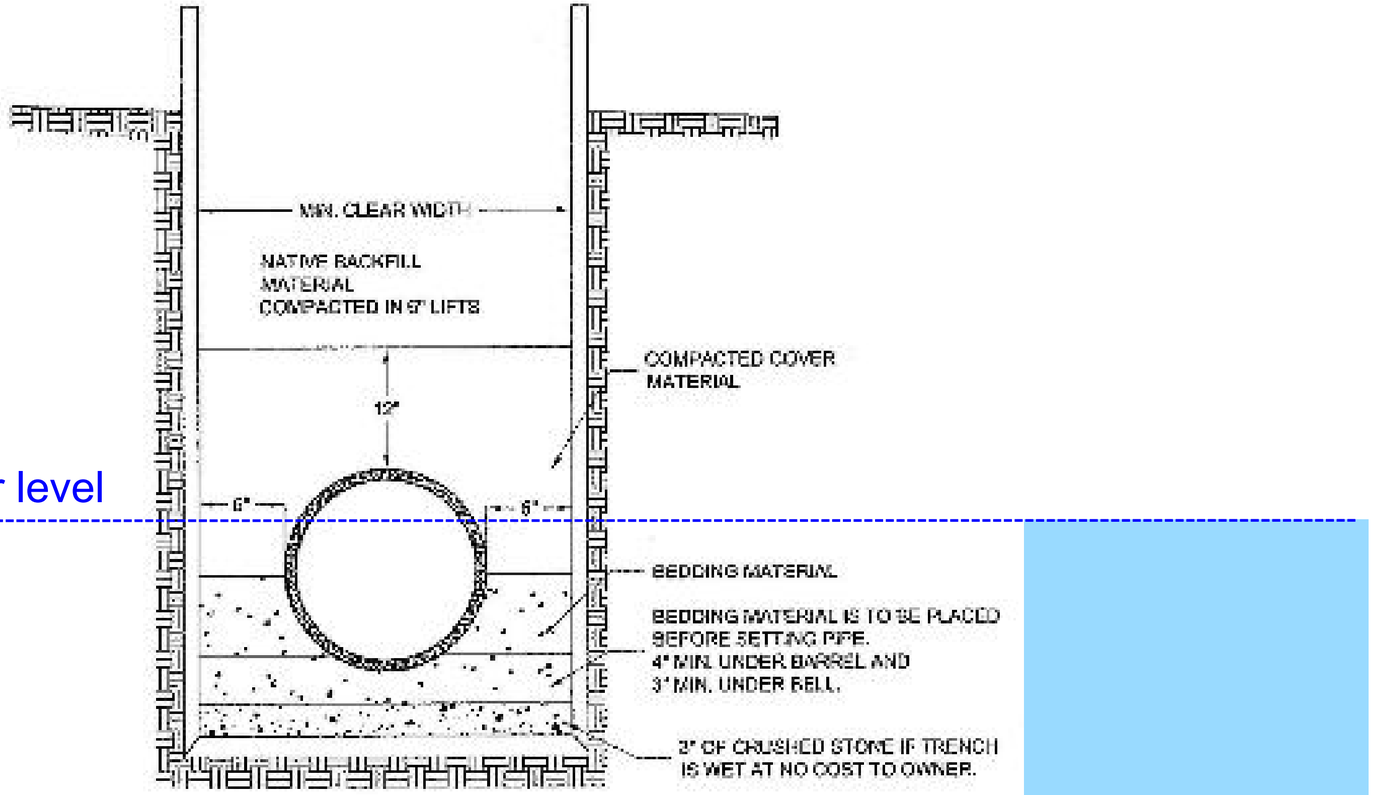
Rise in water table due to injection

Injection water level



Static water level

5 TRENCH DETAIL

NOT TO SCALE

Top Risks #2 – Other Utilities and Structures

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- Injected material following **other known or unknown** lines, structures (basements, foundations), previously disturbed areas (excavations) and (former) USTs
- Structures with **ambiguous location** or construction – no “as-built” or facility knowledge
- **Undetected** during subsurface clearance and inspection
- **Improperly abandoned** historical activities (e.g., borings or disturbed areas)

Top Risks #3 – Errors and Omissions (design and execution)

- **Material compatibility** - enhanced corrosion, decomposition
- **Improper/incomplete** - procedures, operations, supervision, instrumentation
- **Equipment failure** - mechanical, seals, pressure rating, verification prior to use, inspection
- **Insufficient training/engagement** – breakout, spill response, inattention, inexperience, nuetralization
- **Management of change** - personnel, equipment, weather, unknown contaminants

Top Risks #3 – Errors and Omissions (design and execution)

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Material	Oxidants				Biologic Amendments		NAPL			
	Sodium Persulfate *15%*	Perman-ganate *5%*	Hydrogen Peroxide *50%*	Ozone	Lactic Acid	Soybean Oil	Benzene	Gasoline (GRO)	Diesel (DRO)	TCE
Ferrous Metals										
304 SS										
616 SS										
Black Iron										
Galvanized Iron										
Carbon Steel										
Non ferrous Metals and Alloys										
Aluminum										
Brass										
Copper										
Fibers										
Cotton										
FRP										
Plastic and Elastomers										
Nitrile										
EDPM										
Neoprene										
Natural Rubber										
Polyethylene (LD & HD)										
PVC										
Teflon										
Viton										

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Cole Parmer Instrument Company, Chemical Compatibility, online (2022).

Industrial Special Metals, Chemical Compatibility Cart, online (2022).

McCaulou, Douglas R., Jewett, David G. and Huling, Scott G., *"Compatibility of NAPLs and Other Organic Compounds With Materials Used in Well Construction, Sampling, and Remediation,"* GWMR, fall: 125 - 131 (1996).

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Peroxychem, "*Corrosion and Material Compatibility with Klozur Persulfate Technical Bulleti* n," (2015).

United Initiators, NPS Safety Data Sheet (2018).

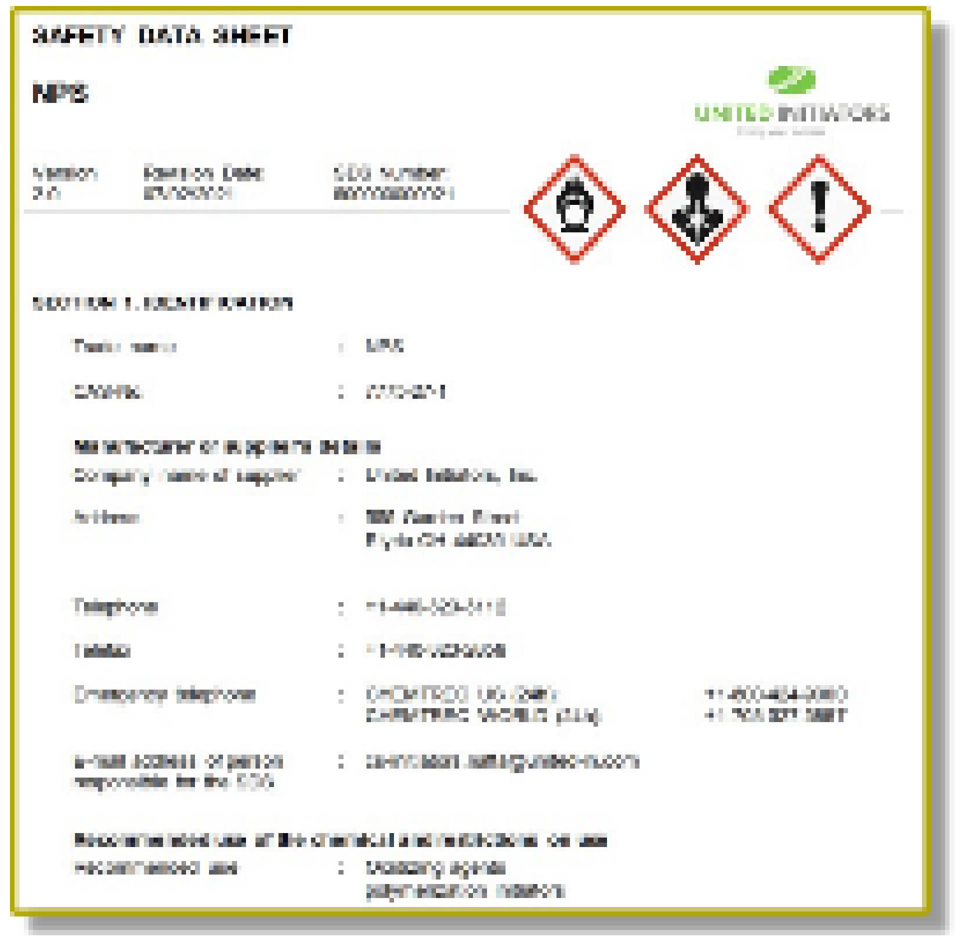
Key	
	Recommended
	Use with caution
	Not Recommended

Top Risks #4 – Contingency Planning

- Lack of Plans - spill response, release notification plan
- Communications – responsibilities, timeliness
- Hazard (HAZID) review – external review
- Spill response prioritization – focus on personnel safety
- Availability and quantity of supplies on site – PPE, spill control, contractors, neutralization

Top Skills – I. Planning

- Understanding and **acceding** the plans
- **Plan** completeness, relevance, timeliness, Site-specific, harmonized to the Site requirements
- **Aligned** with Conceptual Site Model (CSM)
- Foresee **reasonable occurrences**
- **Externally reviewed** by subject matter expert / experienced person



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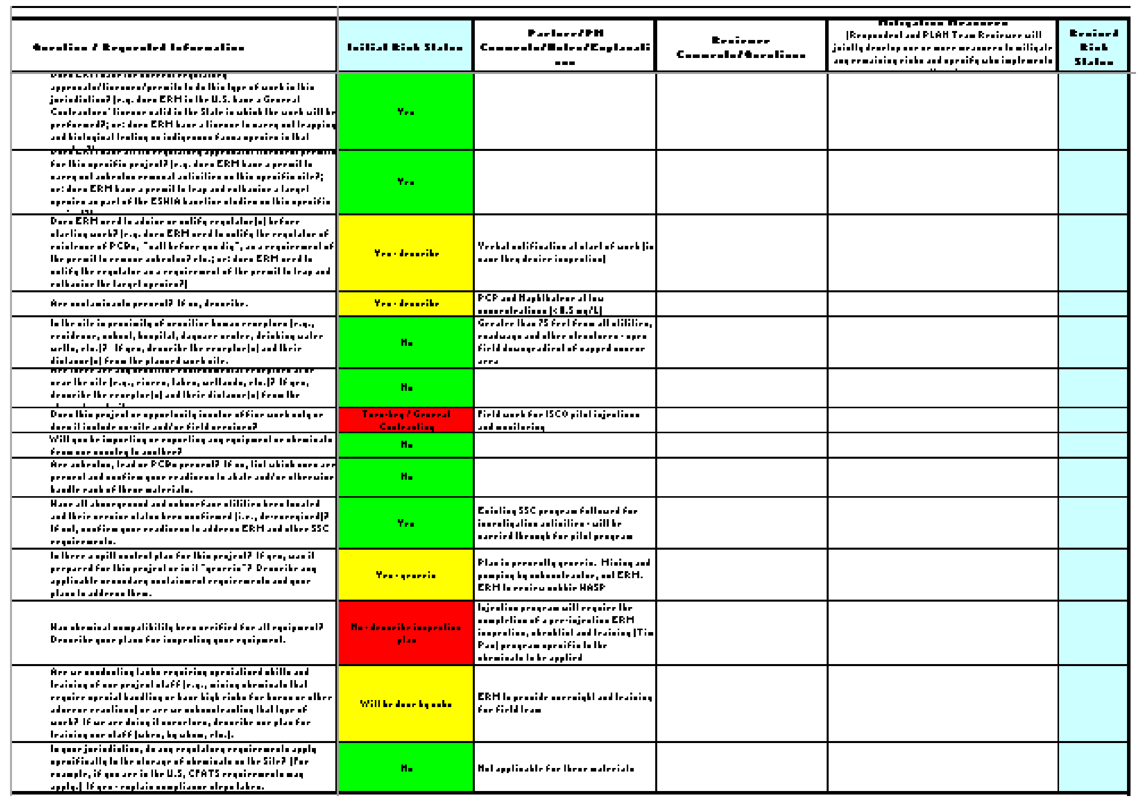
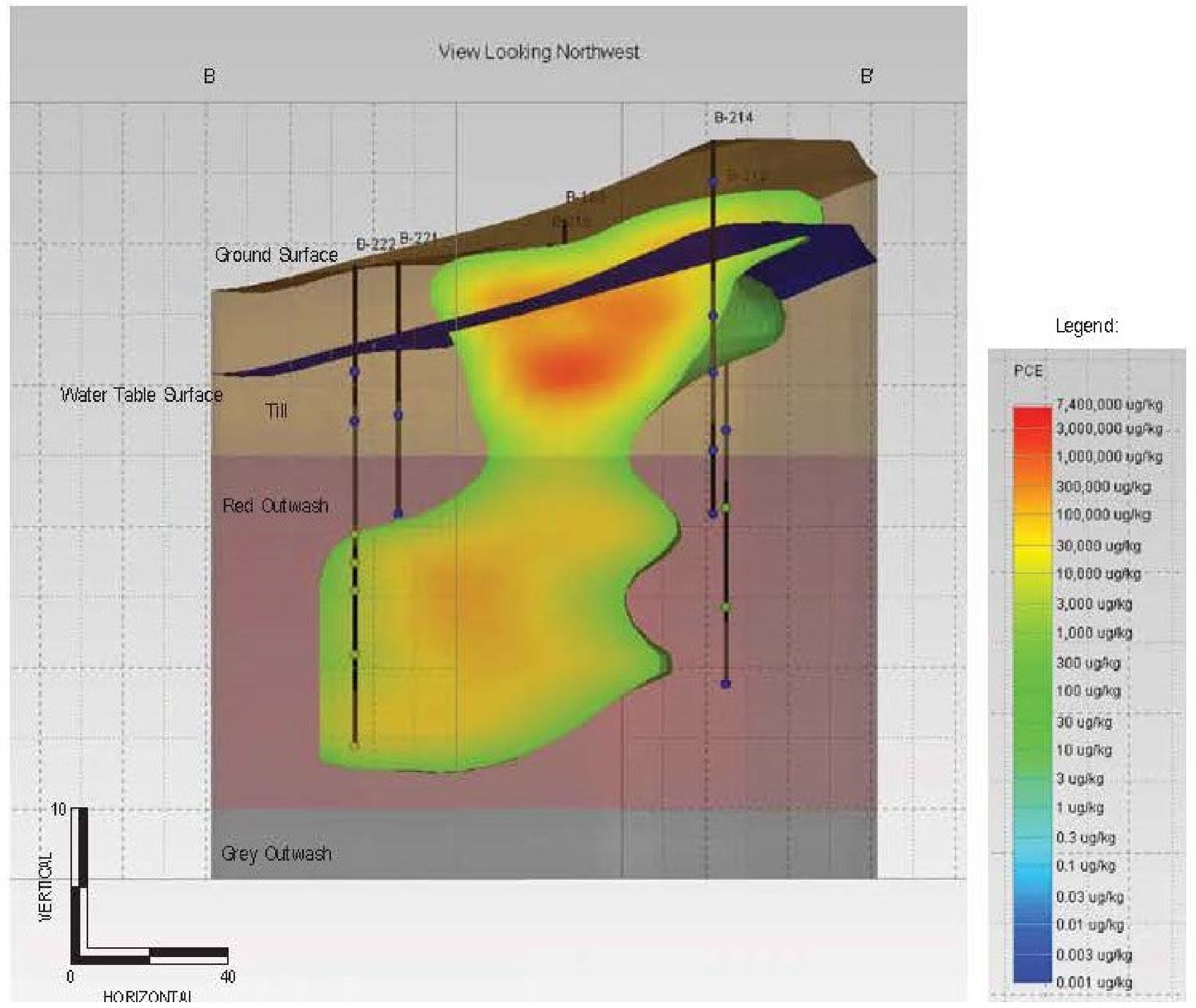
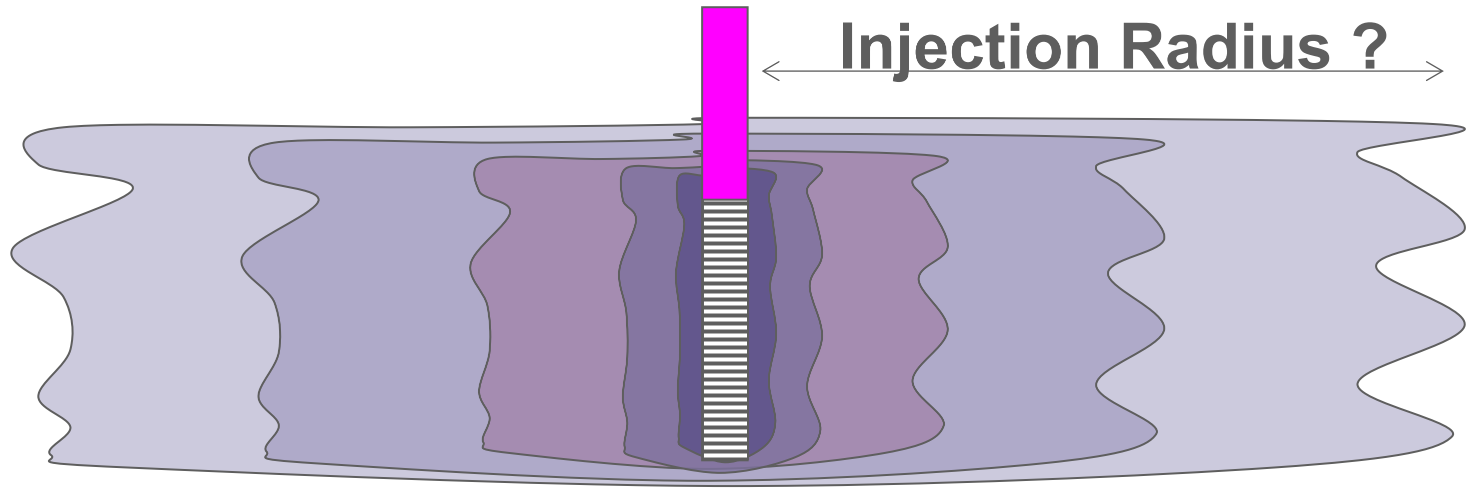




“Plans are nothing; planning is everything”

Dwight D Eisenhower



Top Skills – II. Executing

- Seeing and understanding
- Team engagement
- Premobilization meeting
- Control access to work area
- Use of state-of-the-art techniques and equipment
- Consistent reconciliation and progress tracking
- Site observations used to update conceptual model

"The fun for me in collaboration is, one, working with other people just makes you smarter, that's proven."

Lin-Manuel Miranda

Top Skills – III. Correcting

- Timely and relevant **communication**
- Procedure **modification** – recognize what is “working” and change what isn’t
- Recognize the law of “**unknown unknowns**” applies

“But I canna change the laws of physics, Captain!”

Scotty

What Can You Do?

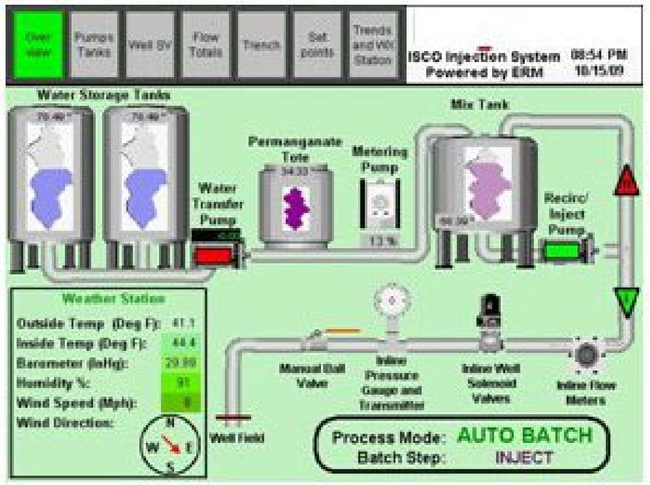
- **Engage** all individuals at the implementation site, to create a true team atmosphere. Project success depends on a united approach toward preservation of safety and minimizing risk to the team, the Site, and the environment
- **Empower** teams to find, respond to and correct problems during all phases of activity from planning, through execution and closure

“There is no ‘I’ in the word ‘team’”

Peter Drucker

What Can You Do?

- **Vigilance** of everyone during all phases of the works, especially during implementation, to eliminate deficiencies and detect unwanted conditions
- **Share** information on incidents, near-misses, and continuous improvements within the industry to increase the state-of-the-art processes, provide safe procedures for all and facilitate the completion of safe and effective remedial programs into the future



If you are onsite, you are a part of the team!

If you are not onsite, you are still part of the team!

“Only a fool learns from his own mistakes.
The wise man learns from the mistakes of others”

Otto von Bismarck

QUESTIONS?

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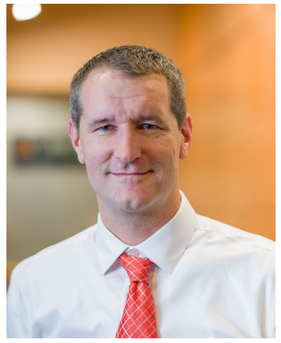

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