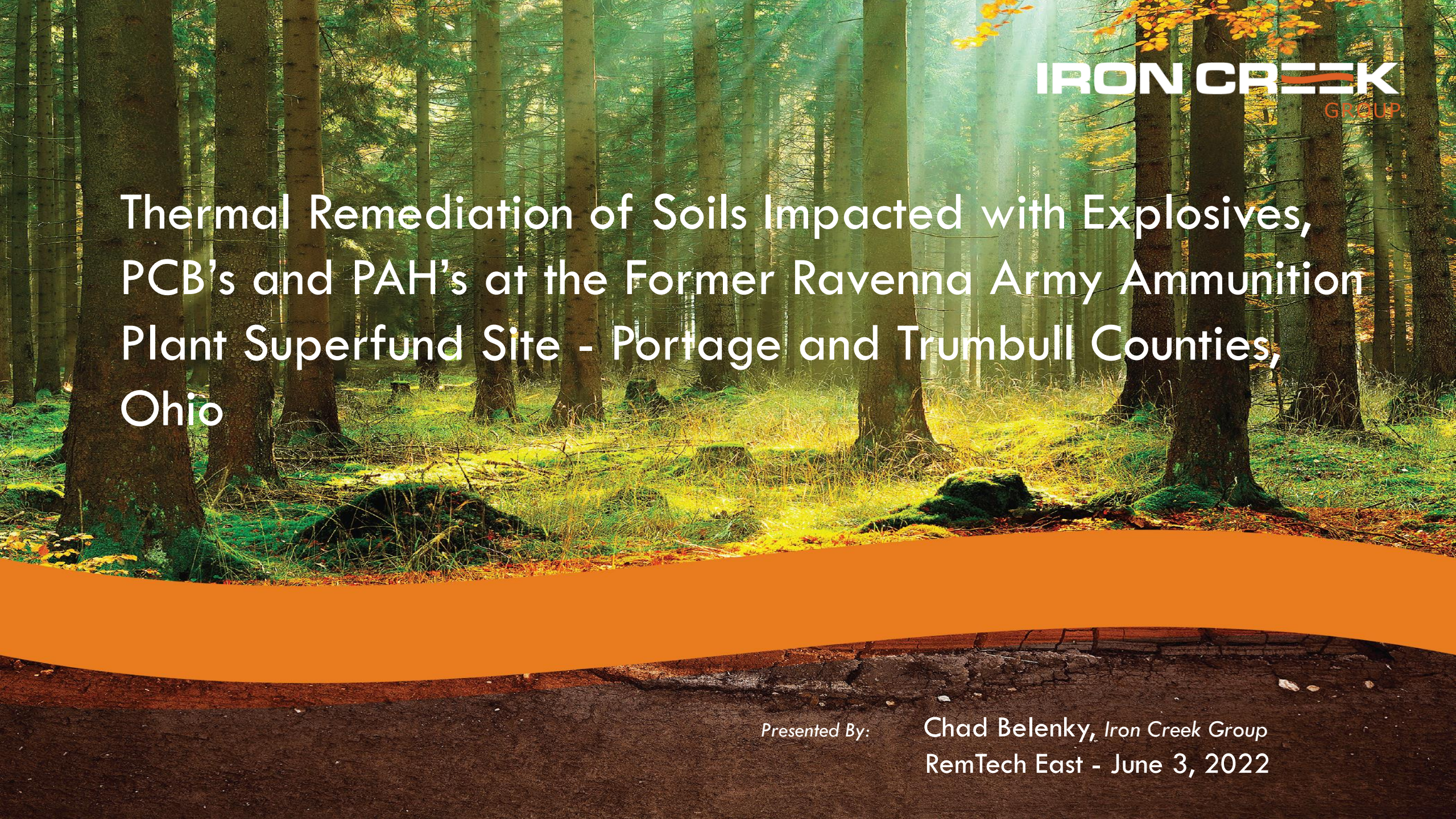


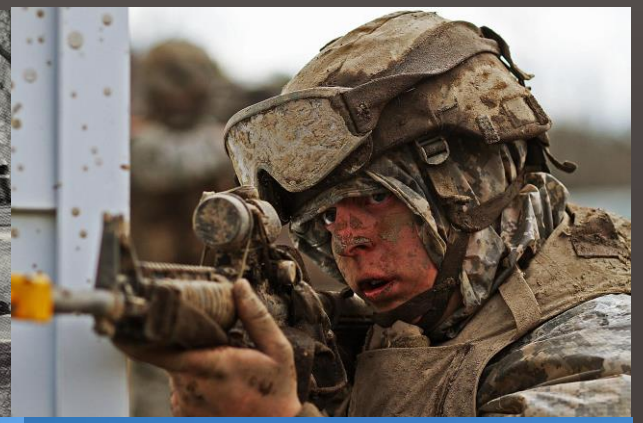
Thermal Remediation of Soils Impacted with Explosives, PCB's and PAH's at the Former Ravenna Army Ammunition Plant Superfund Site - Portage and Trumbull Counties, Ohio

Presented By: Chad Belenky, *Iron Creek Group*

RemTech East - June 3, 2022

Presentation Overview

- Introductions
- Site overview including setting and brief history
- Scope of remedial activities
- Pre job planning
- Site operations
- Treatment results
- Post treatment operations
- Review of successes and lessons learned



Who Is Iron Creek Group…

- Iron Creek Group Inc. is a Thermal Soil Remediation company based out of Calgary, AB, Canada & Bellingham, WA, USA;
- We deliver cost effective and proven thermal remedial technologies for environmental challenges across the globe;
- Our thermal technologies offer an alternative to not only traditional Thermal Desorption Units (TDU's) but conventional remediation techniques, as well;
- Our equipment is easy to transport, setup, and operate - making it a viable option for the most challenging locations, often where thermal treatment would never have been considered possible.

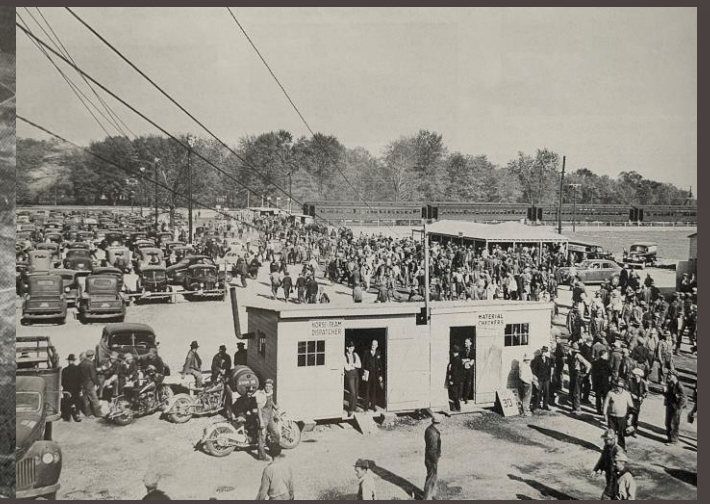



Ravenna Army Ammunition Plant (RVAAP)

- The former Ravenna Army Ammunition Plant (RVAAP) is an active US military training facility and Superfund site located approximately 1 hour southeast of Cleveland, OH in Portage and Trumbull counties;
- Roughly 22,000 acre manufacturing, assembly & storage facility for heavy munitions used in World War II, The Korean Conflict and The Vietnam War;

RVAAP Construction

- Construction of the facility started in 1940 in response to the rising challenges in pre-WWII Europe;
- After approximately two years of construction, RVAAP officially opened on March 23,1942;
- Roughly 14,000 workers on site to construct the facility.



Munitions Manufacturing & Facility Details

- A range of large caliber projectiles, mines & bombs were manufactured at the RVAAP facility;
- Demilitarization of munitions also took place at the facility after each of the conflicts;
- Munitions manufacturing facilities were abandoned in the early 1990's with demolition and site cleanup activities taking place following abandonment;
- Ongoing soil & groundwater remediation efforts for multiple COC's continuing to present day;
- Site renamed Camp James A. Garfield Joint Military Training Center on October 18, 2018
- The facility has been repurposed for use by the US Army and US Army National Guard for live fire exercises, troop maneuvers and combat training.




Remedial Action

- Contaminants of Concern in soil included explosives residue (TNT & RDX), PCB's, PAH's and some trace metals;
- An extensive Remedial Design process was completed by the project team and approved by USACE and the Ohio EPA prior to deployment to site;
- Thermal treatment of soil for the organic contaminants and disposal of a small volume of metals impacted soil;
- Target treatment criteria were RGO's consistent with Human Health exposure pathways related to soil contact during soldier training activities;
- Air emissions parameters per Ohio EPA requirements.

Excavation Activities

- Impacted soil located in 24 separate excavation locations across approximately 10 square kilometers of the facility;
- A small amount of concrete demolition (+/- 1,000 yd^3) was required to access some of the proposed excavation areas – mainly elevated walkways and some foundations;
- Excavation completed within surveyed boundaries;
- The network of former rail lines and internal access roads were used to move the impacted soil from the excavations to a centralized treatment area and then again, back post treatment;
- An all-terrain rock truck was the used to transport soil material as part of the remedial operations;
- Step outs required for additional soil excavation exceedances.

Enhanced Thermal Conduction (ETC) Process

- Impacted soils are treated ex-situ, in enclosed treatment cells;
- ETC is a batch process and soil remains static during the treatment cycle (6-10 days/batch);
- Treatment cells contain +/-400 m^3 of impacted soil;
- Multi fuel burners are utilized to heat the treatment cells via conduction;
- There is no requirement for soil pre-treatment or screening.

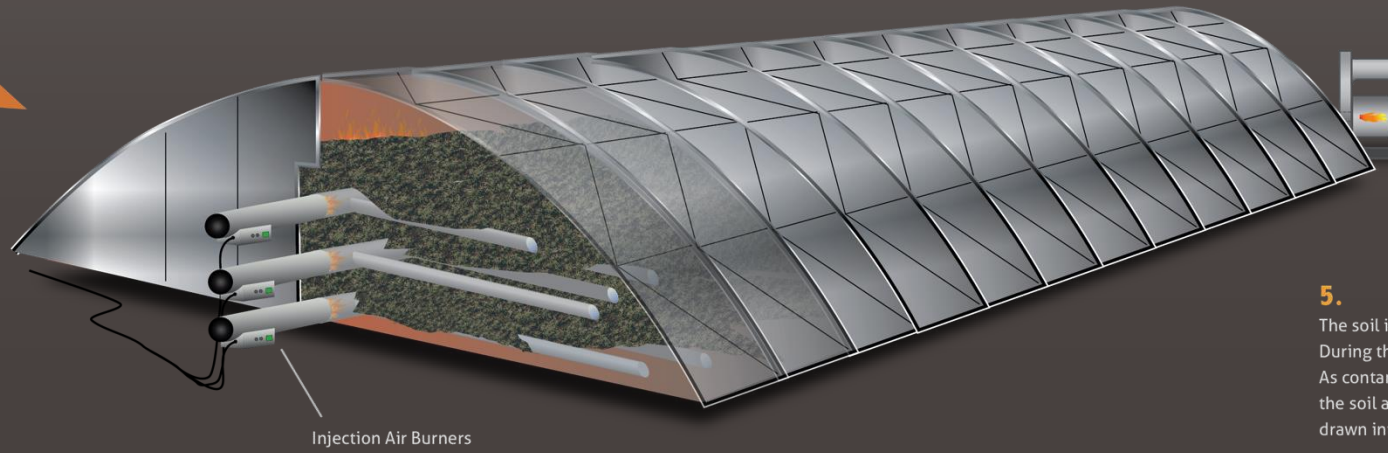


IRON CREEK GROUP

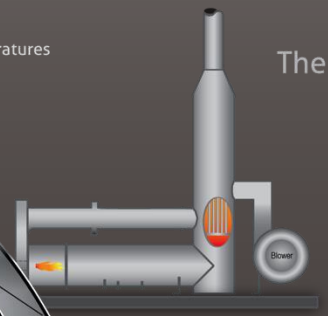
1.
Contaminated soil is placed into a three layered soil cell. Each layer contains steel pipes which are attached to larger manifolds running the length of the treatment cell.

2.
Multi-fuel burners attached to the manifolds generate the heated injection air.

3.
A stainless steel Quonset Hut is assembled over the entire soil cell to prevent the escape of air during the soil treatment process.



4.
Heat is transferred from the pipes to the soil via conduction and the soil is heated to temperatures between 260 and 425 degrees C.



Thermal Oxidizer

5.
The soil is typically heated over a period of 4 to 12 days. During this time, all contaminants in the soil will vaporize. As contaminants vaporize, they migrate to the space between the soil and the steel cover. Vaporized contaminants are drawn into the thermal oxidizer and destroyed.

SIDE VIEW OF BURNERS ATTACHED TO CELL

FRONT VIEW OF ASSEMBLED SOIL CELL

MULTI-FUEL BURNERS

THERMAL OXIDIZER

MULTIPLE CELLS RUNNING

800 CUBIC METER CELL

Benefits of Enhanced Thermal Conduction (ETC)

- Cost effective thermal remediation;
- Effective with persistent and difficult to treat waste matrices;
- Logistics simplicity & flexibility of operational deployment;
- Scalability;
- Zero reject, no matter the treatment material soil type or moisture content;
- Significantly reduced safety exposure (no rotating equipment – screeners, drums, conveyors, etc.);
- Quiet operations;
- Removes contingent liability and eliminates the need for trucking, landfilling, etc.;
- Guaranteed treatment timelines & treatment outcomes;
- All weather capability.

Operational Challenges

- Operating during the initial peak of the COVID 19 pandemic;
- High volume of wildlife on the facility;
- Extensive network of underground site drainage infrastructure still in place;
- Large scale SWPPP implemented at site;
- Coexisting with military training operations (eg: long range live fire, night vision training, etc.);
- Coordinating base access during off hours and holidays;
- Variable weather (eg: lake effect).

Treatment Results

- Approximately 6,000 yd^3 of impacted soil was treated over 10 weeks (treatment schedule driven by soil sampling activities);
- Initial TNT concentrations of up to 2,700 mg/kg;
- Initial RDX concentrations of up to 1,500 mg/kg;
- Initial PCB concentrations of up to 100 mg/kg;
- Initial PAH concentrations of up to 63 mg/kg;
- All analytes were near or below detection limits, post treatment;
- Post treatment soil temperatures ranging from 275°C to 400°C;
- All soil treated with the ETC system met the required treatment guidelines with a single treatment cycle.

Backfill & Revegetation of Thermally Treated Soil

- Impacted soil treated with the ETC process was used as backfill for the excavation areas following treatment activities;
- Cereal straw was incorporated into the soil surface of the disturbed areas
- Excavation areas were then dormant seeded to facility specific native seed mixtures;
- Seeding of the disturbed areas was completed in February 2021 and all of the sites met the 80% vegetative cover requirements by late July 2021.

Successes & Lessons Learned

- ETC provided a robust and cost effective treatment process to handle challenging contaminants of concern on-site;
- Onsite treatment allowed for the removal of liability and reuse of the treated soil;
- The flexibility of the process was useful to accommodate challenging base access restrictions;
- Strong, proactive communication with Range Control and base personnel is essential;
- Allow time to work through the many US Army process;
- Be flexible and learn to pivot – especially operating during a global pandemic!

Acknowledgments

- Kevin Sedlak, USARNG;
- Katherine Tait, OHARNG;
- Nat Peters, USACE
- Jason Cole, Fred Williams & Sarah Meyers, Jacobs
- Ralph A. Pfingsten, Author – The History of The Ravenna Arsenal

IRON CREEK GROUP

For more information on our technologies, please contact:

Chad Belenky, President
Email chad@ironcreekgroup.com
Phone (403) 831-7275

PO Box 2166 Station M
Calgary, Alberta, CANADA
T2P 2M4