Ravenna Army Ammunition Plant
Restoration Advisory Board (RAB) Meeting
Wednesday, December 11, 2024

1. Call to Order and RAB General Business

The Ravenna Army Ammunition Plant (RVAAP) Restoration Advisory Board (RAB) meeting for the Installation Restoration Program was called to order by Sarah Lock (Paris Township), Community Co-Chair, at 4:35 p.m. on Wednesday, December 11, 2024, at the Shearer Community Center in Paris Township, 9355 Newton Falls Road, Ravenna, Ohio 44266.

Sarah Lock opened the meeting by complimenting the November 2024 RVAAP Review newsletter that Katie Tait (OHARNG Restoration Representative) had assembled and emailed to the RAB members.

Sarah Lock acknowledged that the former RAB Administrator, Angela Cobbs, resigned from her position. Sarah Lock introduced the new RAB Administrator, Susan (Soo) Porter. Susan Porter gave a brief introduction and proceeded to take the roll call.

Of the current 22 RAB members (there is currently 1 vacant community position), the meeting attendance was recorded as 17 RAB members present, with 3 excused absences and 2 unexcused absences.

The RAB Members in attendance were as follows:

LTC Robinson (Army Co-Chair)
James Mayer (Garrettsville Vlg)
Adam Eskridge (Charlestown Twp)
William Irons (Newton Twp)
Sarah Lock (Paris Twp, Community Co-Chair)
Eileen Mohr (City of Kent)
Dan Spicer (Paris Twp)
Tom Tadsen (Franklin Twp)
Ryan Shackleford (Portage County Commissioner)
Nicholas Roope (Ohio EPA)
Brian Miller (Windham Twp)
Dorene Spicer (Paris Twp)
Brad King (Newton Falls)
Irene Glavies-Lutz (Newton Twp)
Denise Smith (Paris Twp)
Bill Steiner (Randolph Twp)
Delbert Woloski (Newton Falls Twp)

The Administrative/Advisory members in attendance were as follows:
Kevin Sedlak (Army National Guard (ARNG) Restoration Representative), Katie Tait (Ohio Army National Guard (OHARNG) Restoration Representative), Soo Porter (Chenega, RAB Administrator)

One public member was present at this meeting.

Since a quorum of RAB members were present for this meeting, the RAB could consider approval of RAB meeting minutes from June 5, 2024 and September 18, 2024. Ryan Shackelford (Portage County Commissioner) motioned to approve the minutes as final from June 5, 2024, and Denise Smith (Paris Township) seconded. The “Ayes” carried, and the “Nays” were none.

Ryan Shackelford motioned to approve the minutes as final from September 18, 2024, and Dan Spicer (Paris Township) seconded. The “Ayes” carried, and the “Nays” were none. Sarah Lock confirmed that the minutes from June 5, 2024 and September 18, 2024, were approved.

Status of the RAB Membership
Sarah Lock confirmed that they have not received any interest from the community regarding the RAB vacancy and asked all RAB members to spread the word about the vacancy. Denise Smith asked if the individual needs to be from a particular community. Sarah Lock replied that the candidate needs to reside in a local township adjacent to the arsenal. Sarah Lock indicated that the interest survey is located on the RVAAP.org website. She also reminded the members that the website is an excellent resource and stores all the previous RAB meeting minutes.

Scheduling of 2025 RAB Meetings
Sarah Lock proposed that three (3) meetings be scheduled for 2025 and suggested the April/May, September, and December timeframes, preferably on the 2nd or 3rd Wednesday of those months.

Sarah Lock asked if the new start time of 4:30 p.m. was more convenient for everyone. Ryan Shackelford acknowledged that with the level of attendance at the meeting, it would appear so. Sarah Lock agreed with Ryan Shackelford's comment.

Upon discussion, it was agreed that the following dates would be scheduled for the upcoming RAB meetings at 4:30 p.m., locations to be determined:
Wednesday, May 21, 2025
Wednesday, September 10, 2025
Wednesday, December 17, 2025

Sarah Lock indicated that the September 2025 date may include a RAB member tour.

Sarah Lock asked how the members felt about an electronic calendar invite for those dates. All members agreed that an electronic calendar invitation was helpful. Sarah Lock asked the RAB members to advise Soo Porter of any changes to their email addresses, mailing addresses, and/or phone numbers so that she could notify them of future events.

James Mayer (Garrettsville Village) asked if the December 2025 meeting could be held at Camp James A. Garfield in the environmental office. Sarah Lock asked LTC Shaun Robinson (Army Co-Chair and CJAG Garrison Commander) if there would be an issue with having the meeting at the facility as the meeting would be open to the public. It was suggested that the conference room at the environmental office be used. Katie Tait (OHARNG) offered to investigate the possibility of this and report back.

2. CJAG Military Operations Summary/Updates
LTC Shaun Robinson advised that CJAG has opened the Multi-Purpose Machine Gun (MPMG) Range, which cost $7.6 million dollars to build. The OHARNG Adjutant General has been trying to encourage more OHARNG troop training in Ohio, and this past July, CJAG had 20,000 boots on the ground for training. This is the first time in 7 years that this number has been achieved. In the next 5 years, the Army is hoping to add more training areas as land becomes remediated.

LTC Robinson indicated that many obsolete and unsightly buildings have been demolished at CJAG, and continuing demolition is planned as funds become available. There are still over 600 earth-covered magazines that will remain for the foreseeable future.

LTC Robinson indicated that CJAG is planning on using the gate at State Route 5 and State Route 225 as a convoy entrance to avoid congestion at the main gate during large training events.

LTC Robinson indicated that there are plans to break ground this Fall for a new barracks at the Main Gate area, with room to accommodate 200 soldiers. Bill Irons (Newton Township) complimented LTC Robinson on the quality of the MPMG Range from what he saw on a facility tour.

Katie Tait mentioned the former George Road Sewage Treatment Plant that was visible from State Route 5, east of the Main Gate, had been demolished as well.

3. Update on RVAAP-50 – Atlas Scrap Yard, Former Storage Area, Ex-Situ Thermal Remediation.

Sarah Lock introduced Marco Mendoza (PIKA/Insight) and Brian Krumbholz (GEO Remediation Company, Inc.).

Marco Mendoza and Brian Krumbholz gave their presentation which consisted of a series of slides with their accompanying explanations. The presentation slides are attached to these minutes (Attachment 2).

At the conclusion of the presentation, Sarah Lock thanked the presenters for their presentation and opened the floor to the board members for questions.

Tom Tadsen (Franklin Township) asked who determines the sampling regimen at the end point on the pile. Brian Krumbholz explained that representative samples are taken from the pile at the long side, where they will take 3 from each long side, then 1 each from the short side. Additionally, 3 will be collected from the top. Then they will dig down a couple of feet along the sides and top and collect samples there to get a representative cross-section of the pile.

Tom Tadsen asked if this is a standard procedure that has been conducted elsewhere. Brian Krumbholz answered that this sampling procedure is an industry standard where one sample is typically collected for every 20-30 linear feet.

Tom Tadsen asked if the sampling procedures were something that was typically negotiated with the Ohio EPA. Kevin Sedlak (ARNG) stated that the contractors put together a work plan, which is reviewed and approved by the Army and Ohio EPA. The remediation project is then conducted by the contractor in accordance with the approved work plan.

Eileen Mohr (City of Kent) asked Nick Roope (Ohio EPA) if the Ohio EPA is still utilizing incremental sampling (ISM). Nick Roope replied that incremental sampling is still being utilized. However, discrete sampling is being used for this project.

Kevin Sedlak confirmed that discrete samples were being collected for this project. He explained that discrete grab samples are individual locations, while ISM covers more area and obtains an average result over that area. ISM is typically more decision based during investigations using multiple sub samples to categorize a unit as a whole.

Eileen Mohr commented that normally the project team would look at the size of the unit as a team to make sure each area was properly categorized.

Eileen Mohr asked where the Solid Waste Division stands in terms of reusing the soil after it has been thermally treated. She said that the project team might need to check with Ohio EPA's Solid Waste Division to make sure the soil is approved for post remediation use. Katie Tait explained that another thermal treatment project was conducted previously within Load Lines 1-4 and 12 and it was a successful thermal remediation project using a different contractor. She indicated that documents and methodologies were reviewed by the Ohio EPA on that project as well as this project. She indicated that specific comments from the Solid Waste Division were not received. She indicated that confirmation sampling was conducted after treatment on that project, and it will also be completed on this project. Katie Tait also commented that recent projects have been using more discrete samples instead of ISM.

Eileen Mohr commented that she felt it has been documented that ISM provides better sampling results, than discrete grab samples. Katie Tait added that the sampling regime for this project was proposed in a work plan and was reviewed and approved by the Ohio EPA.

Eileen Mohr asked if the Ohio EPA's Solid Waste Division was involved in this project. Nick Roope replied that he did not know if the Solid Waste Division was specifically involved as he was not assigned to this project, but he indicated that he could find out and get additional information. He added that the use of ISM or discrete sampling would depend on what you are trying to represent and what you are trying to achieve for data goals for the Data Quality Objectives (DQO). He said the Ohio EPA is moving more towards discrete sampling because it gives a better representation for that individual column area vs the widespread area for ISM. He added that a quarter of an acre area is typically used as a maximum size for ISM and the results are a representative average.

Eileen Mohr said she thought they would want to use the same methodology which would be ISM vs discrete. She stated that the Ohio EPA's Solid Waste Division should be involved because they have come back previously with concerns on plans for remediated soil that they had not reviewed. Nick Roope said he would investigate it further and would circle back with the regulator who was assigned to it.

Denise Smith (Paris Township) asked about the systems that are used for heating the soil and how they are monitored. She asked if they were monitored daily, weekly, or monthly. Brian Krumbholz (GEO Remediation Company) said they have a technician on site, who will be there pretty much every day monitoring the system. The system can be monitored remotely as well, and will indicate if all the heaters are on, pumps are working etc. Denise Smith then asked if once the remediation project is complete and the soil is sanitized, what happens to all the equipment that is on site. Brian Krumbholz responded that the equipment is transported off site.

Denise Smith asked what would happen to the concrete pads at the remediation site. Katie Tait answered that the concrete pads would remain, as they could be used for military training.

James Mayer (Garrettsville Village) stated that he shares Ms. Mohr's concerns about the sampling and wants a very wide cross representation of what is in the pile. He also mentioned that there is no incinerator on site, and it would be good to have one. He stated that it is concerning if minimum treatment is being used when reusing materials for backfill. He stated that it is a concern when spending millions of dollars to do the remediation only to put the soil right back. He stated that transporting it off site may not be a better option either.

Kevin Sedlak (ARNG) stated that the thermal treatment is not considered minimal treatment. He indicated that the soil is heated to the required temperatures and monitored with temperature probes to make sure that the entire pile reaches the required remedial temperature. He stated that it must reach the required temperature for the specific remediation chemical. He said this gives confidence that the chemicals are removed from the soils. Additionally, he stated that the contractor is regularly monitoring the output for vapors, water etc. to make sure the equipment is doing what it is supposed to do.

James Mayer understood the process and remarked that it was too bad that the incinerator that was previously present at the Atlas Scrap Yard could not have been kept and repurposed to do the thermal remediation of contaminated soil.

Katie Tait (OHARNG) suggested that an addendum to the meeting minutes be included to provide the approved confirmation sampling methods for the thermally treated soil and the rationale for the use of discrete confirmation sampling instead of ISM. She commented that all methods are considered and reviewed technically with a lot of input from the Corps of Engineers, Ohio EPA, and the Army. She indicated that a detailed sampling plan is included in the project's work plan, and it has many levels of review and approval before it is finalized. Katie Tait assured the board that the remediated materials used for backfill for this project will be clean based on confirmation sampling, and that the details can be provided to the board.

An unidentified RAB member asked how the internal temperatures will be monitored. Marco Mendoza (PIKA/Insight) responded that there are 1-inch thermal wells, placed in the upper left corner, one in the middle and one in the lower right area. They try and purposefully choose target areas, so the cold spots where the temperature is not expected to get as hot can be monitored. So, if temperature is achieved in these cold spots, it can safely be assumed that it is reached at other locations. There are 3 representative locations that each have a depth of 1ft, 2ft and 4ft below the surface. The unidentified RAB member asked if they are monitoring that on site and remotely. Marco Mendoza stated that the temperatures are constantly monitored both on-site and remotely. He said that the temperatures are tracked, graphed and adjustments made accordingly. The question was then asked how much propane is expected to be used. Marco Mendoza replied that he did not have that information on hand. Kevin Sedlak said the amount of fuel used would be included in the final completion report. Marco Mendoza said the project is just starting, so they will be adjusting fuel and propane consumption, and if they can lessen that and still be effective, they will do that.

Dan Spicer (Paris Township) asked Katie Tait if the levels of soil contamination at the start and end of the project could be included in the meeting minutes. Katie Tait replied that both the beginning and final contaminant concentrations would be included in the remedial action completion report and could not be included in the meeting minutes as the minutes will be issued before the final report is finished. She added that the remediation must achieve the 1.1 parts per million cleanup goal (for benzo(a)pyrene).

Dan Spicer asked if this is the only soil to be thermally treated. Kevin Sedlak replied that at this time, this is the only soil that will be thermally remediated.

Bill Irons (Newton Township) asked if benzene has leaked into the ground. Kevin Sedlak answered that benzene is not one of the chemicals detected above the clean-up goals.
Bill Irons asked about the required temperature to be achieved to remediate the soil. Brian Krumbholz (GEO) replied that desiccation starts around 300 degrees Celsius and the target temperature they want to achieve is 325 degrees Celsius. He added that tests have been

done in labs with different temperatures and certain amounts of time to determine where the target chemicals desiccate. He said that the temperatures could be hotter to desiccate the chemicals quicker, but that a lot of energy needs to be put into the system, and it is more cost effective to do lower temperatures over a longer period of time.

Eileen Mohr commented to James Mayer that incineration was previously discussed several times, and at the time, the Ohio Governor indicated that no incineration facilities would be built on State land in Ohio.

Eileen Mohr asked about the disposal of the liquids from the treatment unit. Brian Krumbholz stated that extraction wells have been installed at the bottom of the pile to collect any drained liquids. He indicated as the soil reaches the remediation temperature, there may be some condensation. He said that the remediation system has 13 vapor extraction wells which will collect the resulting vapors. Eileen Mohr asked if the accumulated liquids would be characterized. Brian Krumbholz answered that as the vapor and liquid goes through the system, they will drop out in the vapor liquid separators and then into a collection tank. He indicated that the liquid will be characterized before disposal.

Dan Spicer asked about safety protocols for the workers. Brian Krumbholz stated that their safety officer is involved to make sure all safety procedures are being followed, and that the workers are very familiar with the required safety protocols. Marco Mendoza (PIKA/Insight) added that daily safety meetings are conducted, and that they have established and approved hazard analysis sheets. He added that safety is vital to the project.

Nick Roope (Ohio EPA) asked about the effects of treatment for different soil types. Brian Krumbholz answered that he did not know if different soil types were observed during the excavation, but that different soil types should not affect the thermal remediation system as it is effective on all types of soil.

Nick Roope observed that in the presentation, residential cleanup goals vs. commercial industrial cleanup goals for benzo(a)pyrene were listed. He asked if there was a reason that the site will not be remediated to achieve residential cleanup goals. Kevin Sedlak (ARNG) responded that the ditch line being remediated is in the middle of an area that has already met commercial industrial use, so there is no reason to achieve residential. He stated that both residential and commercial industrial were evaluated in the Feasibility Study, but the cost difference was several million dollars. He stated that it was determined that it was most feasible to clean up the ditch line to commercial industrial use as the entire area could still be used for military use at a fraction of the cost.

Nick Roope asked if benzo(a)pyrene breaks down to any other hazardous constituents. Brian Krumbholz answered that the treatment desiccates everything in the soil when the target temperatures are reached.

Nick Roope asked if a trench was constructed around the treatment unit pad to catch surface runoff. Brian Krumbholz responded that no trench was constructed around the pad.

Sarah Lock asked if there were any additional questions from the RAB members. Seeing that there were no additional questions from the board members, she asked if there were any questions from the public. Hearing that there were no questions from the public, she thanked the presenters for their time and the presentation.

Sarah Lock asked Katie Tait if there were any other upcoming public meetings other than the scheduled RAB meetings that they needed to be aware of. Katie Tait responded that she was not aware of any other public meetings.

Sarah Lock then asked if there were any further questions, and hearing none, she adjourned the meeting at 5:52 p.m.

Respectfully submitted,
Susan Porter, RVAAP RAB Administrator

Attachment 1 – Meeting Minutes Addendum with Follow-up Information for 11 December 2024 RAB Meeting

Attachment 2 - RAB Meeting Presentation Slides – RVAAP-50 Atlas Scrap Yard Former Storage Area Ex-Situ Thermal Remediation

STATE OF OHIO
ADJUTANT GENERAL'S DEPARTMENT
2825 West Dublin Granville Road
Columbus, Ohio 43235-2789

NGOH-IMR-EE 4 February 2025

MEMORANDUM FOR RECORD

SUBJECT: Responses to Restoration Advisory Board (RAB) Member Questions from the 11 December 2024 Meeting, Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Camp James A. Garfield Joint Military Training Center (CJAG), Portage and Trumbull Counties, Ohio

1. During the RAB meeting held on 11 December 2024, several questions from the RAB members were raised which could not be answered in the meeting and required follow-up information to answer/respond to the questions. It was determined that the questions could be answered in a Memorandum (Memo) that could be attached to the meeting minutes for the 11 December 2024 meeting. The following is a summary of RAB member questions from the 11 December 2024 meeting that required follow-up information with applicable responses.
2. Question 1 - Per Page 2 of the Draft meeting minutes from 11 December 2024, the following question was asked:
   James Mayer (Garrettsville Village) asked if the December 2025 meeting could be held at Camp James A. Garfield in the environmental office. Sarah Lock (Paris Township and Community Co-chair) asked LTC Shaun Robinson (OHARNG) if there would be an issue with having the meeting at the facility as the meeting would be open to the public. It was suggested that the conference room at the environmental office be used. Katie Tait (OHARNG) offered to investigate the possibility of this and report back.
   Response 1 – After consideration of future meeting dates and locations, it was realized that the meeting in September 2025 (currently proposed for 10 September 2025) would most likely be a RAB tour at the facility. Therefore, the September 2025 meeting will be held at the facility and not the December 2025 meeting.
3. Question 2 - Per Page 4 of the Draft meeting minutes from 11 December 2024, the following question was asked:
   Eileen Mohr (City of Kent) asked if the Ohio EPA's Solid Waste Division was involved in this project. Nick Roope (Ohio EPA) replied that he did not know if the Solid Waste Division was specifically involved as he was not assigned to this project, but he indicated that he could find out and get additional information.
   Response 2 – Based on coordination with the Ohio EPA after the meeting, Ohio EPA's Division of Materials and Waste Management (DMWM) was involved during the evaluation of remedial options for this project where thermal treatment of soil was proposed as an option. However, the DMWM did not specifically review the Remedial Design or Quality Assurance Project Plan (QAPP) for Atlas Scrap Yard, as the soil in this Area of Concern (AOC) does not meet the definition of a solid waste.
4. Question 3 – Per Page 3 of the Draft meeting minutes from 11 December 2024, the following question was asked:
   Eileen Mohr asked if the Ohio EPA is still utilizing incremental sampling (ISM). Nick Roope (Ohio EPA) replied that incremental sampling is still being used. However, discrete sampling is being used for this project. Additionally, there were several additional related questions as well as discussion about ISM and the type of confirmation sampling to be used for the thermal treatment pile.
   Response 3 – Based on coordination with the Ohio EPA after the meeting regarding this question/discussion, at the Atlas Scrap Yard, one sample per 50 cubic yards of treated material will be collected and analyzed per the approved Remedial Design. This sampling protocol is within typical confirmation sampling approved by the Ohio EPA. This soil will be well mixed after the treatment,

further increasing confidence with the results. The Division of Environmental Response and Revitalization recommends discrete sampling methods be used for confirming completion of soil remediation and demonstrating that standards are met.

This Memorandum provides follow-up responses to questions from the 11 December 2024 RAB meeting and is an Addendum to the meeting minutes for that meeting. This Memorandum was prepared by Ms. Kathryn S. Tait, OHARNG Environmental Specialist 3. Ms. Tait can be contacted at (614)336-6136 or kathryn.s.tait.nfg@army.mil.

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KATHRYN S. TAIT
OHARNG Environmental Specialist 3

RVAAP-50 – Atlas Scrap Yard Former Storage Area Ex-Situ Thermal Remediation

PIKA INSIGHT JV, LLC

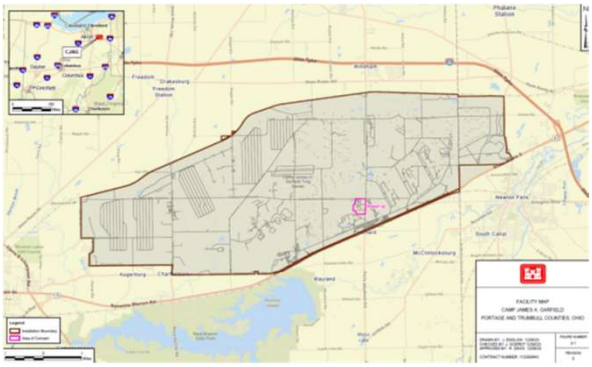
Presenter: Marco Mendoza of PIKA-Insight, Project Manager

Presenter: Brian Krumbholz of GEO, VP of Operations

GEO Environmental Remediation Company

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SITE LOCATION MAP



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Site Background- Atlas Scrap Yard

- Site Uses
  - 1940-1945 - used to house construction worker families
  - Grounds maintenance activities through the 1950's
  - Storage and stockpiling of various materials including railroad ties, railroad ballasts, gravel, sand, culvert piping, and telephone poles from the mid 1970's.
- All remaining stockpiled materials removed in 2017

3

Site Background- Atlas Scrap Yard

- 2 remediation areas located within Atlas Scrap Yard
  - Former Incinerator Area (FIA) containing a former incinerator building





  - Former Storage Area (FSA) encompassing a drainage ditch with the FSA

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Site Plan- Atlas Scrap Yard

AOC boundary

FSA/FIA boundary



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Previous Investigations -Atlas Scrap Yard

- Relative Risk Site Evaluation for Newly Added Sites (USACHPPM, 1998)
- 2004/2005 Characterization of 14 AOCs (MKM, 2007)
- 2010 Remedial Investigation
- 2011 Supplemental Sampling
- Remedial Investigation Report for Soil, Sediment, and Surface Water at RVAAP-50 Atlas Scrap Yard (Leidos, 2017)
- Feasibility Study for Soil, Sediment, and Surface Water at RVAAP-50 Atlas Scrap Yard (Leidos, 2019)
- Proposed Plan for Soil, Sediment, and Surface Water at RVAAP-50 Atlas Scrap Yard (Leidos, 2020)

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Previous Investigations -Atlas Scrap Yard

Investigation results were used to evaluate the nature and extent of contamination, assess potential future impacts to groundwater, conduct human health risk assessments and ecological risk assessments, and evaluate the need for remedial alternatives.

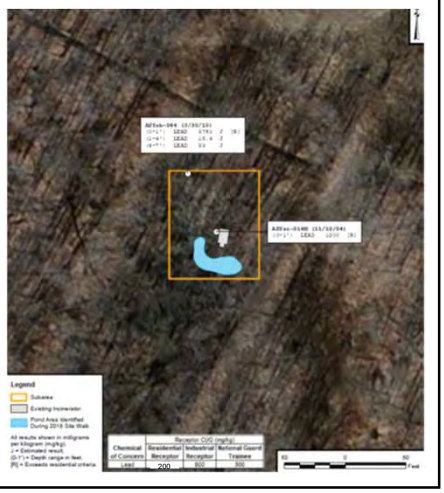
- The selected remedial alternative for the FIA and FSA is detailed in the Record of Decision (ROD) for Soil, Sediment, and Surface Water at RVAAP-50 Atlas Scrap Yard (Leidos, 2022). The remedy will address:
  - Lead in surface soil at the FIA through excavation, transport and disposal to achieve the residential cleanup goal
  - Polycyclic Aromatic Hydrocarbons (PAHs) [benzo(a)pyrene] in surface soil at the ditch line at the FSA through excavation and thermal treatment to achieve the commercial/industrial cleanup goal

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Former Incinerator Area Site Plan

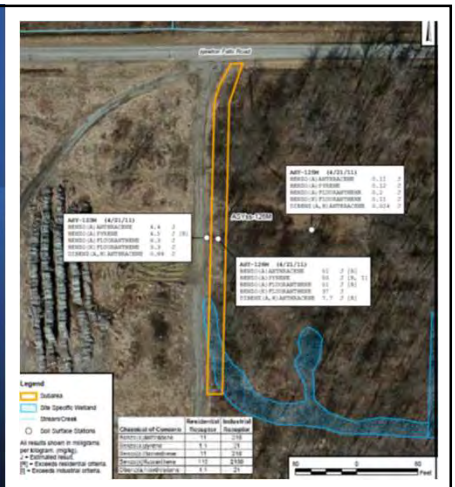
FIA boundary

*Boxes depict historical Lead results



8

Former Storage Area Site Plan



FSA boundary

*Boxes depict historical PAH results

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Overview of Remedial Action

Former Incinerator Area

- Demo and remove the former incinerator building
- Excavation and offsite disposal of an estimated 366 cubic yards of lead impacted surface soil
- Collect and analyze confirmation soil samples to confirm if the cleanup goal (CUG) for lead has been met
- Backfill with clean soil and restore the area
- Reseed and plant per approved wetlands restoration plan

Former Storage Area

- Excavation of an estimated 473 cubic yards of PAH impacted surface soil
- Stockpiling of the surface soil into a thermal treatment system to remove benzo(a)pyrene
- Collect and analyze confirmation soil samples to confirm the CUG for benzo(a)pyrene within the excavation has been met
- Operate thermal system to strip soil of contamination and collect and analyze soil after treatment to confirm CUGs have been met
- Backfill with treated soil and reseed and plant per approved wetlands restoration plan

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Ex-Situ Thermal Treatment Area at the Former Storage Area

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GEO Environmental Remediation Company

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ESTD Introduction

The ESTD technique represents a groundbreaking advancement in highly contaminated soil treatment. Combining high vacuum extraction and soil desorption processing within a compact setup; PAHs, Total Petroleum Hydrocarbons (TPH), and other Volatile Organic Compounds (VOCs) and Semi Volatile Organic Compounds (SVOCs) are efficiently removed from the soil. Benzo(a)pyrene (PAH) is the main constituent of concern for removal at the FSA. This innovative approach reduces the need for pre-treatment and minimizes secondary pollution.





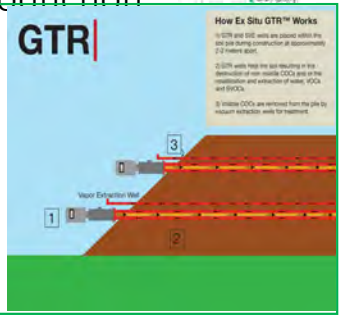
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Technology introduction

ESTD involves placing contaminated soil or sludge into a pit or pile, inserting heating well and vapor extraction wells, and applying thermal conductive heating. This process involves a combination of liquid extraction, steam stripping, and vaporization.

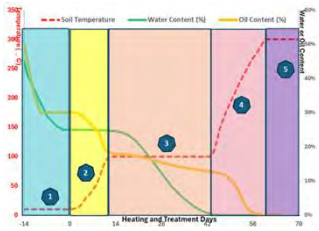


GTR= Gas Thermal Remediation Vapor Extraction



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Removal Mechanism



Phase 1: SVE Extraction (before heating, Days): Utilizes high vacuum extraction wells to remove mobile oil phases before heating begins. Not applicable to the FSA.

Phase 2: Initial Heating (Pre-Boiling, up to 80-90°C, days to weeks): enhance the mobility of NAPLs by reducing their viscosity and enhance solubility of contaminants for removal.

Phase 3: Steam Stripping (Plateau at 90-110°C, weeks to months): Generates steam to strip TPH significantly aided by vapor extraction systems.

Phase 4: High-T after Desiccation (100°C to 300-350°C, weeks to months): Increases soil permeability and cracking, enhancing desorption and vaporization

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ESTD Design and Practice Based on Projects

RVAAP-50 ESTD Project
Former Ravenna Army Ammunition Plant Restoration Program



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Summary of Project Characteristics

Treatment Soil Information		
Item	Quantity	Unit
Average Dry Soil Density	120.00	lbm/ft3
Moisture Content	0.30	
Total Treatment Volume	570	yard3
Total Dry Soil Mass	923	tons
Total Treatment Mass	1,201	tons

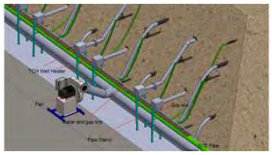
Summary of Site Contamination in Soil			
COC (mg/kg)	Average	Treatment Goal	% Reduction
Benzo[a]pyrene	1.00E+02	2.10E+01	79%

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ESTD Pile Design, Construction and Operation

Contaminated Soil Displacement						
Ex-situ Treatment Type	Batch #	Volume (ft3)	Length (ft)	Width (ft)	Height (ft)	slope
by Soil Pile	1	9,710	92	31	4.1	1

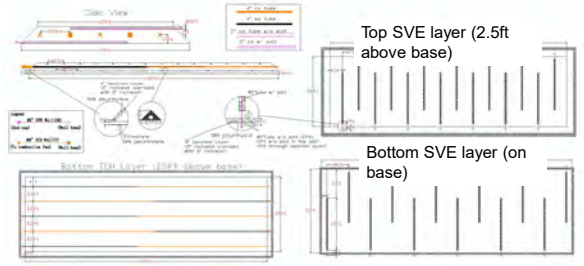
Wellfield Design	
TTT(°F)	617
Well Spacing (ft)	5.5
GTR Heater Units	5
TCH Heating Wells #	5
SVE Wells #	26
Thermal Monitoring Wells #	3
Wells Length (ft)	89
Pressure Monitoring #	3



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ESTD Pile Design

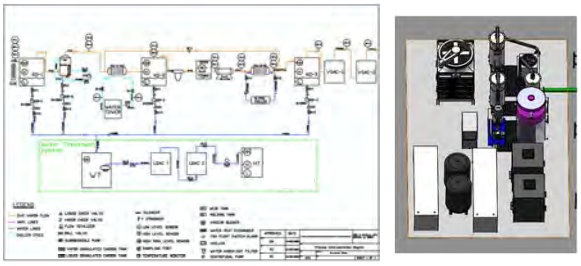
ESTD pile design detailed drawing



19

ESTD Pile Design

ESTD pile vapor treatment system



20

ESTD Pile Design

ESTD pile 3D Design drawings



ESTD pile as build





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ESTD Pile Construction

Pile Construction Sequencing







(1) Area the soil pile will be built upon must be cleared and be somewhat level prior to construction.

(2) A foundational drainage layer was placed along the base of the pile to insulate the pile from the ground to prevent heat loss from the pile, and to drain liquids from the bottom of the pile. A layer of crushed rock on top of the concrete is generally used, with slotted steel piping placed as drainage through the crushed rock.

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ESTD Pile Construction

Pile Construction Sequencing





(3) An excavator placed the soil onto the concrete, one section at a time. Each layer must be done one at a time to allow for the heating pipes and SVE pipes to be placed into the pile.

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ESTD Pile Construction

Pile Construction Sequencing







(4) The excavator was used to place the heating wells onto the dirt after the first layer was placed. The excavator lifted the pipes up using a spreader bar.

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ESTD Pile Construction

GEO Environmental Remediation Company

Pile Construction Sequencing





(5) After the first row of heating pipes has been placed, more contaminated soil is placed on top of the heating pipes.

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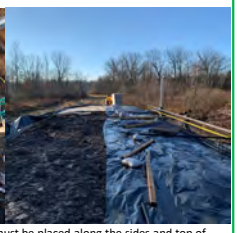
ESTD Pile Construction

GEO Environmental Remediation Company

Pile Construction Sequencing







- (6) After the construction has been completed, insulation material(s) must be placed along the sides and top of the pile to mitigate heat loss to the atmosphere.
- (7) Once the insulation has been placed, supplemental material may be placed on the outside of the pile to limit precipitation from infiltrating the pile, cooling the soil.

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ESTD Pile Construction

GEO Environmental Remediation Company

Vapor Treatment System Set Up





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ESTD Pile Construction

GEO Environmental Remediation Company

ESTD Project As-Build



Pile As-Build



Vapor Treatment System As-Build

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ESTD Pile Operation

GEO Environmental Remediation Company

Daily Site Logs for on-site data record



Weekly Report Summary Table

ITEM	number	COMMENT
General Operational Parameters		
Actual Days of Operation (days)	XX	Startup on XX/XX/2024
Actual Days of Heater Operation (days)	XX	Actual heating days
Planned Total Heating Days	68	Expected end date is XX/XX/2024
% of Project Completion	XX%	Based on Heating Days
Electrical Usage (kWh)	XX	electrical meter readings (Dated to XX/XX/2024)
Natural Gas Usage (MMBTU)	XX	Based on gas meter readings (Dated to XX/XX/2024)
Average/Maximum T (°C)	XX/XX	Based on TPMP data output on XX/XX/2024
Average Vapor Extraction Rate (CFM)	XX	Flow in Vapor Treatment System (During Reporting Period)
Total Volume water discharged (gal)	XX	From discharge (Dated to XX/XX/2024)
Total VOC Mass Removed (lbs)	XX	Mass removal is calculated based on the sampling data (Dated to XX/XX/2024)
Vapor inlet temperature (°C)	XX	TI-1 Reading (During Reporting Period)

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- Collect and analyze confirmation soil samples from the treatment pile to confirm the CUG for benzo(a)pyrene has been met
- Use the treated soil pile as backfill for the excavation



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