



Utilizing Groundwater Remediation to Drive Water Conservation, Sustainability, and Support of Area Wildlife Habitat Corridors

Beede Waste Oil Superfund Site



Overview/ Summary
Surrounded by residential properties with private drinking water wells and in a small southern New Hampshire town with limited drinking water resources, this former waste oil disposal and recycling facility is tackling groundwater remediation and conservation through a combination of remedies and a focus on greener cleanups. Impacted by PCBs in surface soils and chlorinated and aromatic volatile organic compounds (VOCs) from waste oil permeating down to the water table in multiple locations across the site, a combined remedy approach has been implemented to reduce risk and address both the source areas and downgradient plume migration. Chlorinated and aromatic VOCs, including 1,4-dioxane identified during the design, dissolved from the oil saturated source areas and migrated through the aquifer due to influence from downgradient private residential drinking water wells. With no municipal drinking water and limited water resources available in the town, the combined remedies focus on restoration and conservation of the aquifer and prevention of impacts to the adjacent Kelly Brook.

Resequencing of the Remedy
After signing the Consent Decree, the Beede Site Group (BSG) selected Woodard & Curran as the Supervising Contractor to design and oversee the implementation of the remedy outlined in the Record of Decision (ROD). During the initial design phase, the project team worked collaboratively with the Agency team to strategically re-sequence the ROD remedy to prioritize operation of the groundwater pumping and treatment (MOM) system prior to multiple source removal efforts to 1) mitigate the highest level of identified risk (i.e., downgradient drinking water impacts) and 2) utilize the treatment system for process water supply during future source removal remediation/construction activities. This resequencing has not only been beneficial to the success of the groundwater remedy but has also provided opportunities for water conservation, reuse, and overall sustainability of the project.



KEY ACHIEVEMENTS



Aquifer Restoration

- **Treating downgradient plume, treating over 440 million gallons of groundwater treated to drinking water standards and discharged back to the ground**
 - » Chlorinated and aromatic VOC levels in groundwater have dropped below clean-up standards and/or are showing declining trends
 - » Treatment system constructed proactively to address a likely reduction in 1,4-dioxane standard. After almost 5 years of operation during which over 290 million gallons of groundwater was treated, the state reduced the standard from 3 to 0.32 ug/l in September 2018 and the system was immediately in compliance, requiring no additional system modifications.
 - » System has been successful in maintaining base flow of Kelly Brook and supporting wildlife habitat
 - » Hydraulic evaluations demonstrate capture of over the overburden aquifer across the property line and that the system is not negatively impacting water levels at downgradient private drinking water wells.
- **Thermal treatment of two source areas to remove oil and reduce soil concentrations below leachability goals**
 - » Removed over 500,000 lbs VOC mass
 - » Recovered over 70,000 gallons of oil

Focus on Restoration of the Drinking Water Aquifer
To expedite containment of the off-property groundwater plume, construction and operation of the groundwater extraction and treatment system was initiated prior to source area remediation. The 130 gallon per minute (GPM) treatment system treats groundwater metals precipitation, microfiltration, advanced oxidation and granular activated carbon to address naturally occurring metals (iron, manganese, and arsenic), chlorinated VOCs, 1,4-dioxane and PFAS.

The potential to dewater adjacent Kelly Brook due to groundwater extraction was assessed and the system was designed to minimize base flow loss in the brook by discharging treated groundwater back to the subsurface and locating the rapid infiltration basins and injection wells such that surface water flow in the brook would not be impacted by nearby groundwater extraction.



Sustainable Water Use – Thermal Integration
Following the construction of the groundwater treatment system, efforts shifted to address the impacts to deeper source area soil which were acting as a continuing source to groundwater. In-situ thermal remediation treatment via steam-enhanced extraction (SEE) was successfully implemented in the two main source areas onsite (former Lagoon Area in 2015-2016 and former UST/AST area in 2018-2019). With no municipal water source (or sewer system), the groundwater system provided a critical sustainable solution that provided both process water for thermal treatment steam generation and polishing treatment of the thermal effluent prior to subsurface discharge. Treated groundwater from the groundwater system was used to generate steam which was injected into the subsurface. At the same time, groundwater, oil and vapor were extracted via a series of multi-phase extraction wells. Extracted vapor was treated via a thermal oxidizer and after oil and groundwater separation, the groundwater was pre-treated and then sent to the main groundwater system for final treatment polishing to meet drinking water discharge requirements. The treated water was then discharged to the subsurface or recirculated back to the thermal treatment system.

Synergy of these remedial systems has been critical to the successful sustainable approach of mass removal, addressing source and downgradient groundwater impacts, and more importantly, conserving the water resources in the area and maintaining base flow conditions in the adjacent surface water body.



Water Conservation

- **Over 400 million gallons of groundwater treated and discharged back to the aquifer**
- **Successful use of treated groundwater for steam generation during thermal remediation (conserving over 27 million gallons of water!)**
- **Avoided transport of over 11.3M gallons of water to the site by using treated water**



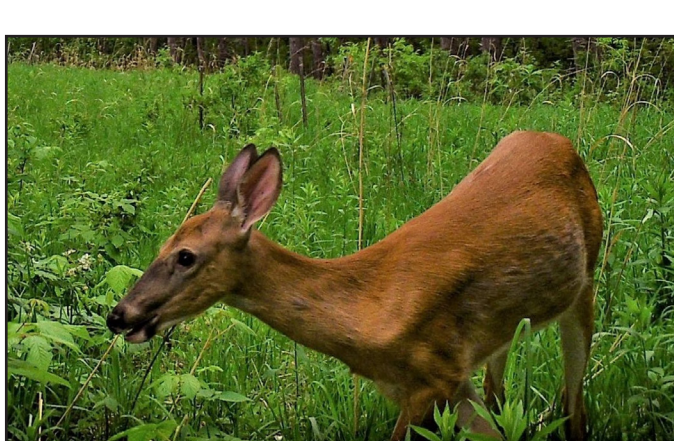
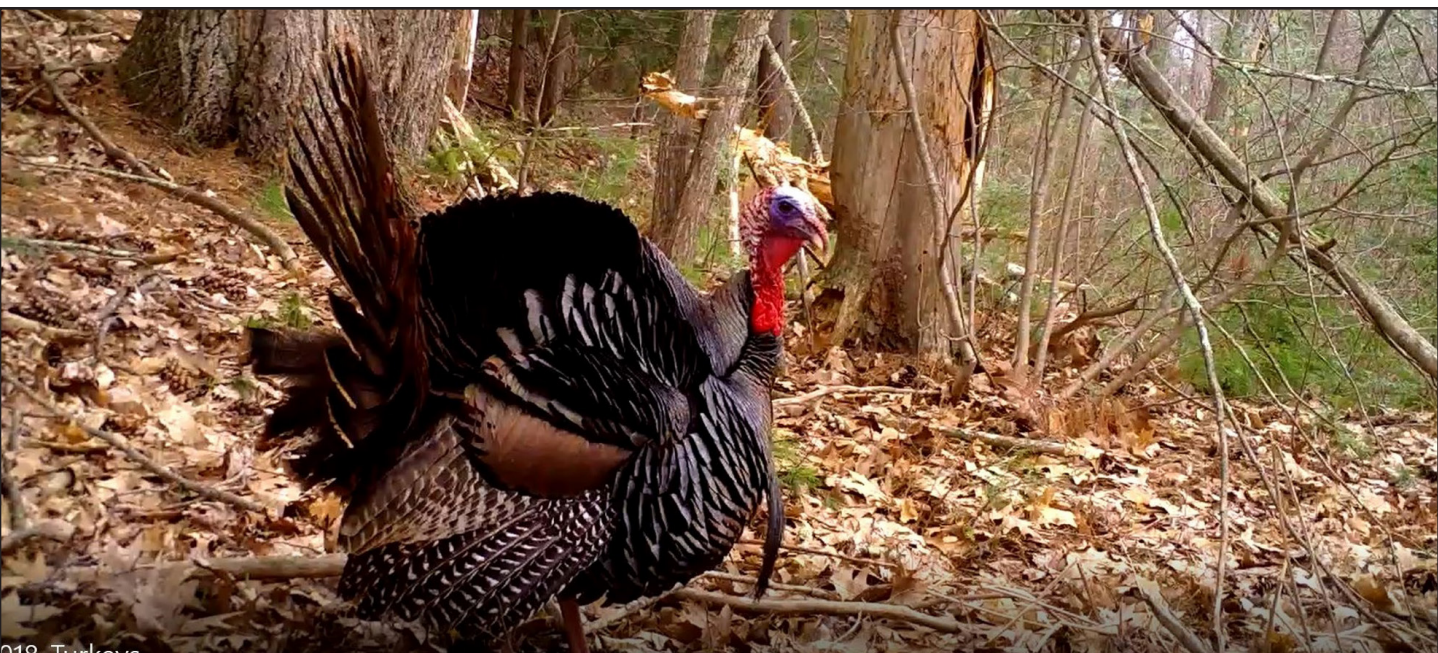
Sustainability
While our team focuses on integrating the five core elements of EPA's Greener Cleanup program in each remedy component, water conservation and land & ecosystems have been a key focus for the remedy components conducted to date. From an overall sustainability effort, the Beede project team has implemented over 172 sustainable actions onsite to date, including 42 ASTM Best Management Practices (BMPs) for Greener Cleanups. These actions have focused on materials reuse, reduction in waste, optimization of monitoring programs, efficiency, and use of remote telemetry, along with many others.

EPA Grenner Cleanup		
Number of Green Actions by Core Element		
Materials and Waste		72
Air		52
Land and Ecosystems		24
Water		10
Energy		9



Sustainability

- **Implemented 172 sustainable actions to date, 140 focused on environmental sustainability efforts**
- **Use of treated groundwater for steam generation during thermal remediation and for dust suppression during subsequent construction and remediation activities reducing greenhouse gas emissions by 65.4 metric tons!!**
- **Reuse of materials across the site – soil, piping, cleared logs/ brush (for habitat enhancement!), etc.**
- **Use of extracted groundwater for geothermal heating of the treatment building**
- **Use of remote technology enhances safety and reduces the number of trips to the site (reducing GHG emissions)**
- **Solar powered remote monitoring stations and oil recovery belt skimmers**



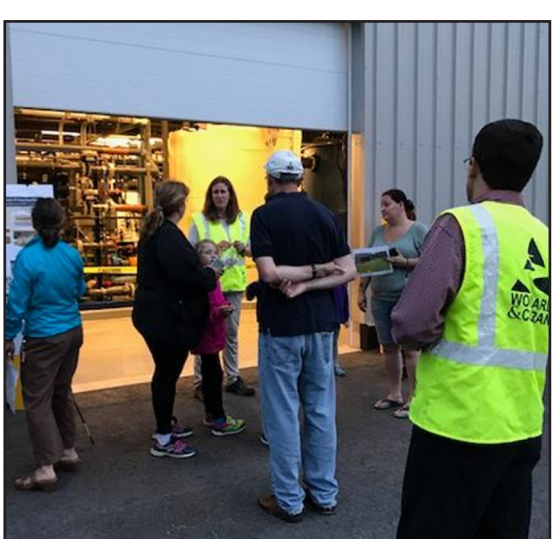
Sustainability, Kelly Brook, and Supporting a Wildlife Habitat Corridor
Water conservation efforts onsite focus on restoring the drinking water aquifer, conservation and reuse of water, and maintaining base flow of the adjacent brook which has been identified as a wildlife habitat corridor by the Nature Conservancy's Connect the Coast efforts. This ties in with the team's restoration of an area disturbed during the installation of groundwater system injection well network which has sparked a multi-year conservation effort to rehabilitate and foster habitat for area wildlife at the Site. These conservation efforts, initially driven as part of incorporating EPA's Principles of Greener Cleanups, have not only provided restoration of habitat to the local wildlife, but have also blossomed into in-person (pre-COVID19) and online community, academia, and other stakeholder engagement opportunities. Starting with establishing a native wildflower meadow and additional habitat for local birds and small mammals, the efforts were recognized by the Wildlife Habitat Council with certification in 2015. Building on the success of these early actions, the habitat work has expanded, teaming with the local school STEM program and scout troops and providing public open houses to share the habitat efforts and remediation updates. Additional projects have been added since that time which focus on providing habitat for bats, native pollinators, monarch butterflies, and wood ducks living in and around Kelly Brook. Documentation of the varied wildlife with game cameras at the Site has not only provided opportunity to share with our neighbors more regularly [via social media and virtual open houses] but also allowed the team to note that wildlife is not just passing through the Site but were also breeding and starting families (raccoons, bobcats, rabbits, etc.) in this conservation area. This supports the Nature Conservancy's Connect the Coast work, which identifies the Site's value located at the junction of three wildlife habitat corridors, providing both a safe transfer point, as well as a secluded spot, away from the busy commercial district not far from the Site. Maintaining brook flow and preventing impacts to surface water has been an integral component of the overall approach since the beginning and has blossomed into a much larger conservation effort.



Wildlife Habitat Restoration & Enhancement

- Restoration and maintenance of native meadow
- Monitoring and refurbishing habitat-enhancing brush piles
- Acoustic monitoring, bat box installation, & community involved bat colony counts
- Returning and thriving milkweed plants for the previous 3 years
- Wood duck nesting boxes in Kelly Brook – eggs within the first couple weeks!
- Invasive species and vegetative management plan
- Turtle tracking plan
- Installation of game cameras in habitat areas
- Installation of native pollinator hives
- CONSERVATION CERTIFICATION GOLD

- Annual open houses and bat counts (virtual open houses during COVID)
- Engagement with the local high schools STEM programs
- Working with the local Girl Scouts who help support habitat work
- UNH class tours of the treatment plant
- Plaistow pride day – cleanup of surrounding roadways
- Supporting local businesses
- And more!



Community Outreach