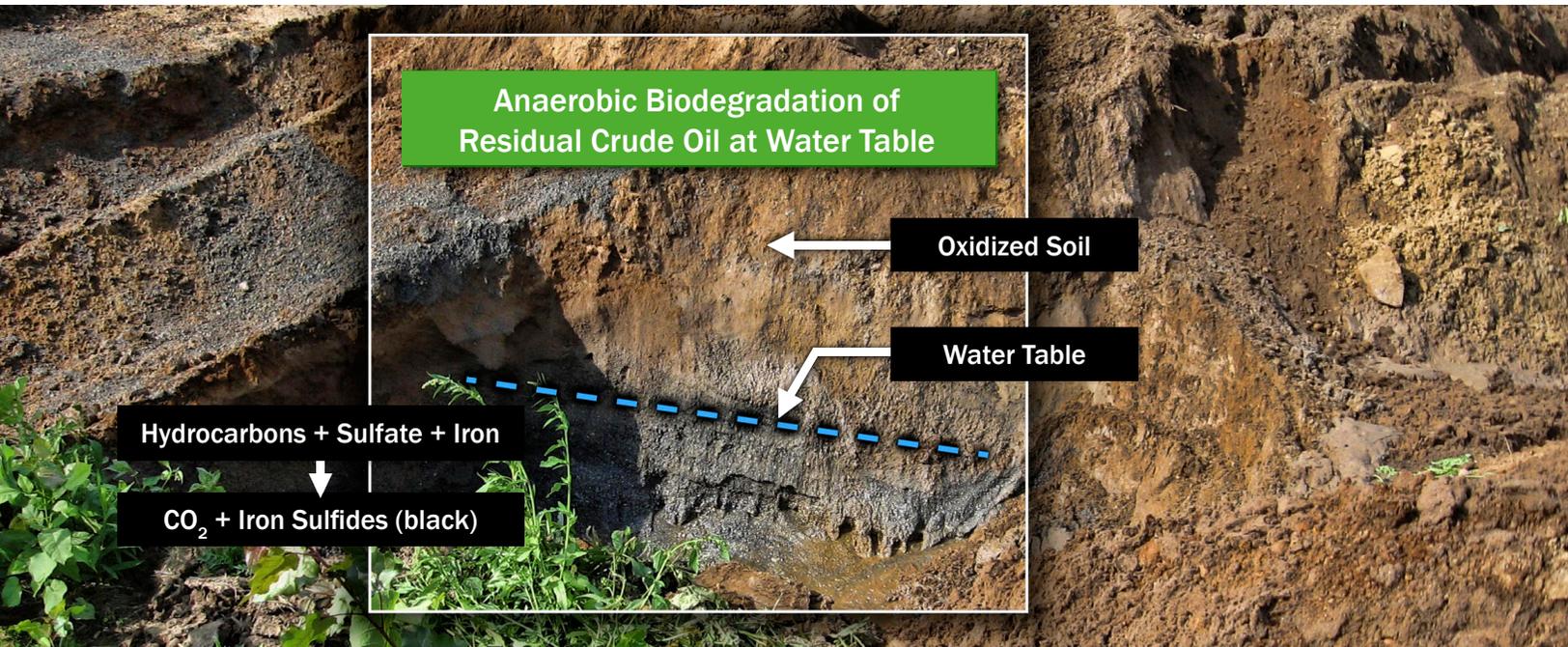


NAPL-Away®

Enhanced Natural Anaerobic LNAPL Biodegradation Process for Source Zone Remediation

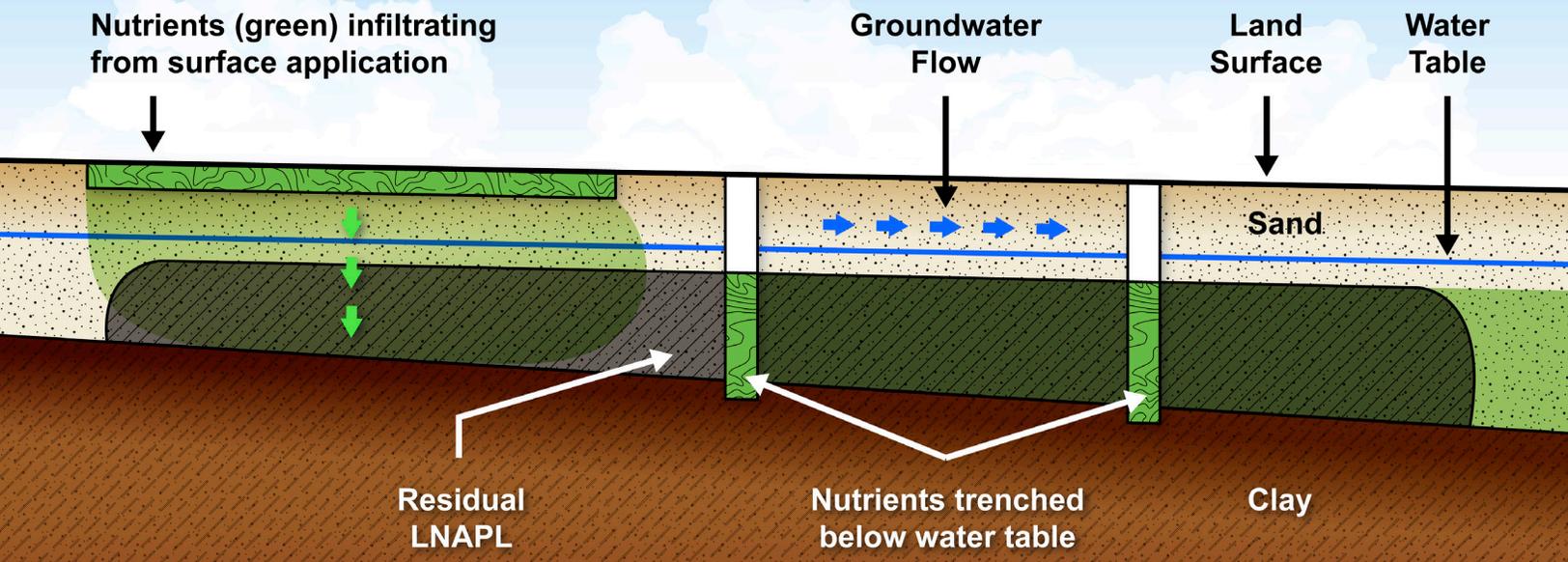


Remediation Methodology

Parsons holds a patent for the bioremediation of light nonaqueous-phase liquid (LNAPL) using enhanced natural anaerobic biodegradation. LNAPLs are a continued source of contamination in subsurface soil and groundwater at many petroleum sites, and recovery or treatment via traditional remediation technologies is expensive and inefficient. At many sites, residual LNAPL remains in the soil even after mobile LNAPL is recovered by pumping. This residual LNAPL often serves as a continuing source of dissolved hydrocarbon plumes, including benzene, toluene, ethylbenzene, and xylene (BTEX). Regulatory agencies within many states do not allow residual LNAPL to remain in place unless it is treated to the maximum extent practicable. Existing technologies are costly and/or ineffective for treating residual LNAPL, especially over large areas. Parsons has developed an environmental remediation method that promotes the sustainable and natural biodegradation of LNAPL through our NAPL-Away® process. This is accomplished through the addition of nutritional supplements and other means that promote the growth of naturally occurring anaerobic microorganisms that digest LNAPL.

Company Overview

Parsons is a technology-driven engineering services firm with more than 70 years of experience in the oil and gas, engineering, construction, technical, and professional services industries. The corporation is a leader in many diversified markets with a focus on infrastructure, defense, security, and construction. Parsons delivers design/design-build, program/construction management, systems design/engineering, cyber/converged security, environmental, and other professional services packaged in innovative alternative delivery methods to federal, regional, and local government agencies, as well as to private industrial customers worldwide.



Benefits of NAPL-Away®

- Less costly to implement than other forms of remediation, including excavation, surfactant and/or solvent flooding, in situ heating approaches, air sparging, and in situ chemical oxidation
- Addresses the source of dissolved plumes (including BTEX)
- Scalable implementation as a result of cost-effective nutrient application techniques and high-nutrient migration, and because the process is compatible with anaerobic conditions that are typical at petroleum release sites.
- Reduces the time required for monitored natural attenuation
- Viable alternative where removal or containment may not be the most appropriate or cost-effective solution

How the Process Works

- Compared to remediation techniques for dissolved plumes, larger quantities and/or longer-lasting nutrients are used to stimulate and sustain the anaerobic biodegradation of residual LNAPL
- Nutrients can be applied to surface soils, placed in trenches for vertical infiltration, or injected into target zones.
- Biodegradation is monitored and maintained until objectives are met
- Maintenance may include periodic nutrient addition, removal of inhibitors, and/or addition of water to LNAPL zones.
- A desired endpoint is a highly biodegraded, immobile residual hydrocarbon that does not contribute to dissolved plumes.

Site Applicability

- Applicable to the environmental remediation of most types of petroleum, including gasoline, diesel, jet fuel, crude oil, and other oils
- Applicable for sites with primarily residual LNAPL or low LNAPL thickness
- Modified to meet site-specific conditions including, depth to the water table and residual LNAPL, soil type, groundwater flow velocities, and site-specific nutrient requirements
- Integrated with other remediation technologies and infrastructure methodologies, including monitoring, recovery, and remediation wells, and associated piping, if appropriate, can be used to reduce implementation costs

Please note: The process is not applicable under aerobic conditions, but such conditions are rare at petroleum release sites.

Where Natural Anaerobic LNAPL Biodegradation Occurs:

- Oil reservoirs throughout the world in the absence of extreme temperature and salinity
- Aquifers affected by a variety of petroleum products (jet fuel, diesel fuel, gasoline, crude oil, etc.)
- Marine sediments affected by petroleum products

Selected References

- Baedecker, M.J., R.P. Eganhouse, B.A. Bekins, and G.N. Delin. 2011. "Loss of volatile hydrocarbons from an LNAPL oil source." *J. Contamin. Hydrol.* 126 (3-4): 140-152.
- Peters K.E., C.C. Walters, and J.M. Moldowan. 2005. *The Biomarker Guide*, Second Ed. Cambridge University Press.