

# LNAPL Solutions



## Areas of Expertise

- LNAPL Regulatory Advocacy
- LNAPL Conceptual Site Models
- LNAPL Assessment – Presence, Mobility, and Recovery
- Human Health and Ecological Risk Assessments
- Innovative Site Investigation and Remediation Technologies
- Vapor Intrusion Pathway Management
- Visual Imagery Services
- Design, Engineering, and Construction Management
- System Operations, Maintenance, and Monitoring (OM&M)
- Regulatory Negotiations and Stakeholder Relations
- Green & Sustainable Remediation

## Overview

Cost-effective management of light nonaqueous phase liquid (LNAPL) sites is an ongoing challenge for petroleum companies, railroads, manufacturers, and many other industries. LNAPL policy in most regulatory jurisdictions has historically mandated that all LNAPL be recovered via active remediation. However, there has been a broad push to embrace a science-based approach for LNAPL site management, which results in pragmatic rather than punitive approaches to LNAPL management.

AECOM is the long-standing industry leader in championing science-based solutions for LNAPL sites through technical innovation and regulatory advocacy. We actively participate in LNAPL committees founded by the Interstate Technical and Regulatory Council and ASTM that generate industry-wide best practices documents for LNAPL site management. Our global LNAPL experts leverage the knowledge gained addressing technical challenges at large complex LNAPL sites in our portfolio to develop technical solutions that inform both the industry-wide technical documents and our internal best practices.

We have a sophisticated approach to LNAPL assessment and remediation that is scalable to fit the size and significance of the problem. We routinely work with clients and regulators to advance their understanding of the occurrence and risks associated with LNAPL. Our best-in-class technical solutions and project delivery and our technical credibility within the regulatory community results in more sustainable solutions and decreased costs for our customers while maintaining a high degree of protection for the community and environment.

## Our Approach

AECOM develops and implements practical, risk-based management strategies for LNAPL that are consistent with future land use. Our approach minimizes project costs and accelerates site closures by applying innovative investigation technologies, including rapid site characterization techniques and LNAPL remediation strategies that attack the concerns posed by the LNAPL rather than focusing on bulk LNAPL recovery. AECOM's approach first inspects whether remediation is necessary and, if so, focuses remediation efforts where they provide the most benefit.

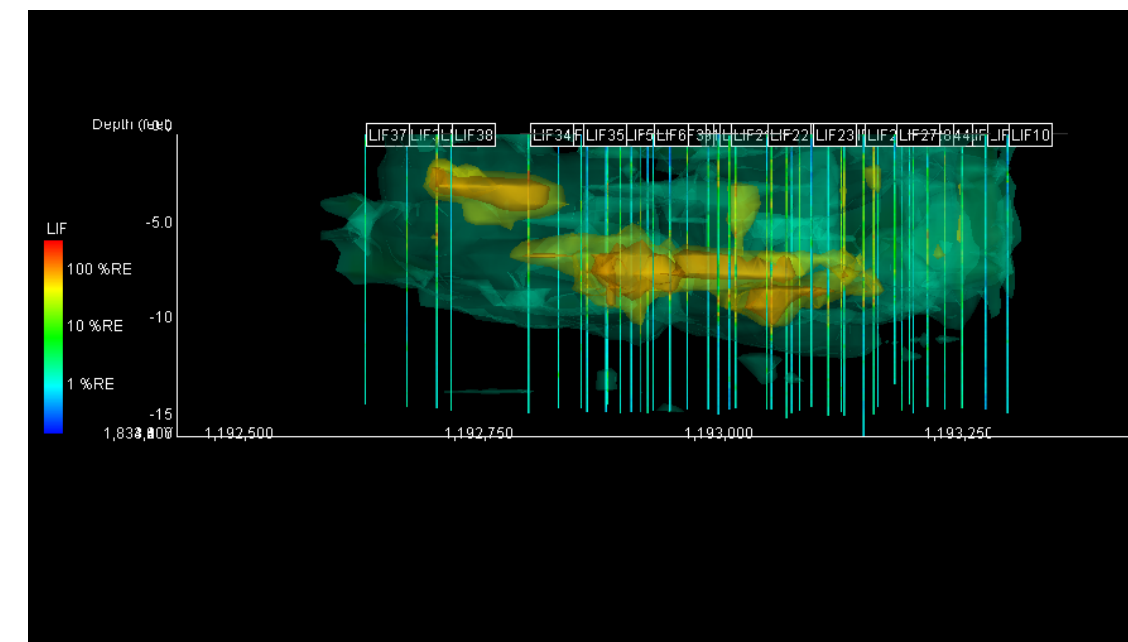
**LNAPL CSM.** We develop LNAPL conceptual site models (CSM) using available site data to understand the physical and chemical nature, three-dimensional distribution, and the mobility and recoverability of the LNAPL. The CSM is rounded out with an evaluation of potential receptors, non-technical concerns, and regulatory framework.

**RISK-BASED CLOSURE.** Our team advocates for closure of sites with LNAPL in place based on a demonstration that the LNAPL does not pose an unacceptable risk and will naturally deplete over time.

**LNAPL TRANSMISSIVITY AND NATURAL SOURCE ZONE DEPLETION.** LNAPL transmissivity is used to quantify LNAPL recoverability and NSZD to determine the ongoing rate of natural LNAPL depletion. We deploy these tools when they provide benefit to guide decision making on the benefit and practicality of active LNAPL remediation.

**REMEDIAL TECHNOLOGIES.** AECOM identifies the remediation technology that addresses the concern posed by the LNAPL and focuses the remediation in a manner to address those concerns. The remedy is implemented to meet both the technical objectives and our customers' non-technical objectives.

**STAKEHOLDER ENGAGEMENT.** AECOM works with all stakeholders to communicate the technical basis for and benefits of risk-based closure approaches. AECOM has been invited by regulators to provide in-house LNAPL technical trainings and participate in regulator-lead conferences. We have served as technical advisors for regulatory LNAPL technical guidance development and invited to review draft guidance documents under preparation by regulators.



## LNAPL Solutions *(continued)*



### Areas of Expertise

**LNAPL CONCEPTUAL SITE MODELS.** AECOM develops an LNAPL conceptual site model (CSM) that integrates conventional fluid level and geologic data to identify the factors that govern LNAPL appearance, mobility, and recoverability at each site. Our team uses CSMs to direct investigation of the processes affecting LNAPL distribution, mobility, and attenuation to better understand the factors that affect risk at individual NAPL sites and determine the practical limits of NAPL recoverability, which allows remediation efforts to be focused where they will provide the most benefit.

**LNAPL ASSESSMENT - OCCURRENCE, MOBILITY, AND RECOVERABILITY.** AECOM applies proven methods from petroleum engineering and environmental investigation to quantify the magnitude and behavior of LNAPL in the subsurface. In doing so, AECOM has led the use of physical and chemical LNAPL properties to evaluate LNAPL risk, quantify LNAPL recoverability, and develop remedial endpoints. Using industry standard techniques such as quantitative baildown testing, Ultraviolet Optical Screening Technology (UVOST) and intact soil core testing, AECOM can reliably and cost-effectively evaluate the distribution, mobility, and recoverability of LNAPL.

**HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS.** AECOM develops risk-based management strategies to focus treatment areas and drastically cut remediation costs. Risk assessments help refine assessment goals, develop practical endpoints, and accelerate closure timeframes.

**INNOVATIVE SITE INVESTIGATION TOOLS.** AECOM developed a patent-pending device that automatically measures and records LNAPL thicknesses in wells. The device enhances the understanding of LNAPL occurrence, mobility, and recoverability by safely acquiring high-resolution data at a lower cost than manual fluid level measurement.

**INNOVATIVE REMEDIATION TECHNOLOGIES.** AECOM evaluates the need for innovative technologies, where appropriate, to reduce the risk of exposure to site constituents. Where LNAPL removal technologies are necessary, AECOM develops endpoint objectives for LNAPL remediation that are feasible, measurable, and cost-effective. Our team incorporates NSZD to quantify the significance of natural attenuation of LNAPL and provide context to evaluate the benefits and costs of active remediation.

**VAPOR INTRUSION PATHWAY MANAGEMENT.** AECOM offers services to measure, model, and mitigate soil gas affected by LNAPL that could potentially affect indoor air. We develop detailed conceptual site models for vapor intrusion, incorporating site-specific geologic models, fate and transport principles, and biodegradation of petroleum vapors to evaluate potential risks associated with vapor intrusion, using a weight-of-evidence approach. Where necessary, we install and operate low-maintenance vapor mitigation systems to control this potential pathway.

**VISUALIZATION SERVICES.** AECOM offers visual imagery services to clearly communicate the complex interaction between subsurface geology and LNAPL. Visual synthesis of diverse datasets, such as UVOST logs, boring logs, fluid level data, and analytical data makes our LNAPL CSMs more effective for communicating with regulators and stakeholders. For complex sites, AECOM applies Environmental Sequence Stratigraphy concepts to construct geologically defensible 3-D frameworks of the subsurface that accurately predict preferential pathways to improve the success of remediation projects.

**DESIGN, ENGINEERING, AND CONSTRUCTION MANAGEMENT.** AECOM offers detailed design and specifications to be used for construction of a wide variety of LNAPL remediation systems, using the project endpoint and site conceptual model to guide the selection of LNAPL remediation technologies. We also provide construction management services to ensure these systems are implemented in a safe and cost-effective manner.

**SYSTEM OPERATIONS, MAINTENANCE, AND MONITORING (OM&M).** AECOM works to ensure that active remediation systems are operated safely and cost-effectively, while optimizing field resources and streamlining compliance and reporting. We apply continuous improvement principles and perform value engineering to optimize systems and accelerate closure strategies with regulators.

**REGULATORY NEGOTIATIONS AND STAKEHOLDER RELATIONS.** AECOM blends education and client advocacy in a proven collaborative process to engage agencies and external stakeholders to gain acceptance of proposed LNAPL management strategies.

**GREEN & SUSTAINABLE REMEDIATION.** AECOM's team incorporates key sustainability elements into our remediation projects, including adaptive site reuse to integrate site cleanup with the design of site structures and landscaping for future use while controlling risk through focused active remediation efforts, where appropriate.