GES provides exceptional capabilities for the analysis of the behavior and multiphase flow dynamics of non-aqueous phase liquids (NAPL) in the subsurface.

We apply a highly-effective holistic approach for the development of a quantitative LNAPL Conceptual Site Model (LSCM). By concurrently examining LNAPL, aqueous-phase, and vapor-phase impacts, one can better determine the potential risks – and make more informed decisions – regarding plume management, remediation, and negotiated closure.

Characterization of LNAPL plumes via laboratory core analysis and LNAPL baildown tests helps to refine the conceptual model. By quantifying the soil and fluid properties controlling LNAPL volume, mobility, and recoverability estimates, a more realistic evaluation of the potential for free LNAPL recovery and the fate of residual contamination are developed.

GES’ approach, which is consistent with ASTM standards, allows for the integration of diverse information and stakeholder viewpoints to:

• develop more realistic expectations for the long-term management of LNAPL plumes;
• support more effective conceptual engineering design;
• provide a technically-sound framework for defining risk-based endpoints to remedial actions;
• better assess risks to human health and the environment;
• obtain the best technical basis for liability evaluation; and
• support negotiated regulatory closure.

LCSM and LNAPL-related assessments have been performed on hundreds of projects across the US, Caribbean and Central America. Sites range from active refineries to petroleum terminals and pipelines, manufacturing plants, airports, military bases, Superfund sites, and large-scale rapid response actions.

About GES’ Environmental Informatics Group:

GES’ Environmental Informatics (EI) Group supports our clients with leading-edge services for the analysis, modeling, and visualization of complex hydrogeological issues.

Among their credentials: co-authorship of the API Interactive LNAPL Guide, an electronic information system to provide better understanding and tools for risk evaluation and conceptual site model development of petroleum-impacted sites.

GES professionals are sought-after speakers and educators for organizations such as US EPA, NGWA, and MA LSPA, and are active with the ASTM LNAPL task group.
### Representative Projects

**AST FUEL OIL SPILL AT A TERMINAL FACILITY**

Approximately 35,500 gallons of No. 2 fuel oil leaked from the bottom of an aboveground storage tank. Aggressive emergency remedial actions were implemented that contained and recovered approximately 58% of the release volume within 60 days of its discovery. Declining LNA PL recovery rates and thinning of observable oil thicknesses in wells lead the team to perform an assessment of LNA PL mobility and recoverability. The study was designed to demonstrate that the LNA PL plume had been recovered to the degree practicable. Field and laboratory investigations yielded site-specific fluid and soil matrix properties used in the LNA PL modeling analyses. Results of the modeling showed good mass balance between reported release volume and recovered volume plus calculated oil volume remaining at near residual saturations in soils. Quantitative estimates of oil conductivity and transmissivity were made to support the position that a practical limit on recovery had been reached at this site. GES was able to complete a comprehensive characterization and a site conceptual model rapidly, maximizing recovery and saving the client over $1M worth of remediation costs by negotiating a risk-based closure. These proactive steps allowed the client to get its fuel-oil AST back in service sooner than expected, and the regulatory agency granted a No Further Action status and issued a spill closure letter for this site.

**RISK AND MOBILITY TO DEFINE LNA PL CLEANUP CRITERIA FOR REFINERY**

The site is impacted with LNA PL and dissolved-phase hydrocarbon constituents as a result of leaks from process and storage areas. Cleanup at this site is being addressed by the US EPA, under authority of the Resource Conservation and Recovery Act (RCRA). Assisting the client for more than 15 years, GES has acceptably demonstrated to the US EPA, via groundwater modeling studies and monitoring well data, that the hydrocarbon recovery system maintains hydraulic control along the boundaries of the facility and prevents off-site migration of hydrocarbon plumes.

The US EPA approved a remedial workplan developed by GES that delineated remedial action areas and cleanup levels based on risk and mobility for free product. Approval of the workplan aided the client by providing quantitative and reachable goals for the remediation of multiple LNA PL plumes across the 2.3 square mile facility. The workplan was based on a technical understanding of LNA PL impacts at the site in contrast to accepting a predetermined apparent well product thickness as the goal, which is neither realistic nor practicable at this large site. The acceptance of mobility and risk as the basis for defining cleanup levels was a significant step in managing the LNA PL plumes at the refinery.

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