Alaska Department of Environmental Conservation
Division of Spill Prevention and Response
Contaminated Sites Program

Technical Memorandum – 23-001	**Effective Date**	April 17, 2023

Light Non-Aqueous Phase Liquid Recovery

Purpose

The purpose of this technical memorandum is to provide guidance on determining when a light non-aqueous phase liquid (LNAPL) in groundwater has been recovered to the maximum extent practicable (MEP) in accordance with 18 AAC 75.325(f)(1)(B) and 18 AAC 78.240(b). While dense non-aqueous phase liquids (DNAPL) are also subject to these requirements, this guidance is specific to LNAPL.

Background

LNAPL, referred to as "free product" in State of Alaska regulations, means a concentration of a hazardous substance that is present as a light, non-aqueous phase liquid which is not dissolved in water, with a specific gravity less than that of water. LNAPL can often be present in the subsurface after a petroleum release. Under 18 AAC 75.325(f)(1)(B) and 18 AAC 78.240(b), a responsible person shall to the MEP recover free product in a manner that:

- minimizes the spread of contamination into an uncontaminated area by using containment, recovery, and disposal techniques appropriate to site conditions;
- avoids additional discharge; and
- disposes of the recovered free product in compliance with local, state, and federal requirements.

The cleanup of petroleum-contaminated sites with LNAPL in accordance with 18 AAC 75 and 18 AAC 78 requires evaluating LNAPL recoverability and disposal options. During the cleanup process, strategies to recover, characterize, and dispose of LNAPL shall be provided in a work plan that is approved by the Contaminated Sites Program (CSP) staff before implementation. LNAPL must be recovered to the MEP and is required before contaminated site cleanup is complete.

Determining MEP

The ability to recover LNAPL is dependent on the types of remedial technologies being used and the mobility of subsurface LNAPL at a given location. LNAPL may be left in place and may still accumulate in monitoring wells after CSP determines that LNAPL recovery has been performed to the MEP. As LNAPL is recovered, subsurface LNAPL saturation will decrease over time which results in declining recovery rates; however, the recovery rate may not reach zero before recovery to the MEP is achieved. The extent of the LNAPL body must be delineated before CSP will consider if recovery to the MEP has been achieved.

LNAPL recoverability is not directly correlated with the thickness of LNAPL in a monitoring well and can vary over time. However, LNAPL transmissivity tends to correlate with LNAPL recovery from a well. LNAPL transmissivity represents the rate of LNAPL movement through an aquifer unit under an LNAPL hydraulic gradient and can be quantified for evaluating LNAPL recoverability. Transmissivity is expressed in units of square length over time (e.g., feet^2/day). Consequently, transmissivity provides a metric of the extent LNAPL is recoverable and is used to determine when LNAPL recoverability is no longer practicable.

In general, transmissivity measurements will decrease over time as free product recovery efforts are ongoing due to a decrease in subsurface LNAPL saturation. An example of transmissivity calculations over time during LNAPL product recovery is presented in Figure 1. The graph shows the groundwater recovery trends of water and LNAPL for an LNAPL recovery system that operated for eight years at a rail yard. The graph shows that water and LNAPL recovery volumes peaked in 2013 as the result of the recovery system operation upgrades and improved management of the system. Transmissivity measurements in general decreased throughout the operation of the LNAPL recovery system. This example highlights the fact that transmissivity measurements tend to track with LNAPL recoverability even in instances where an LNAPL recovery system is improved over time.

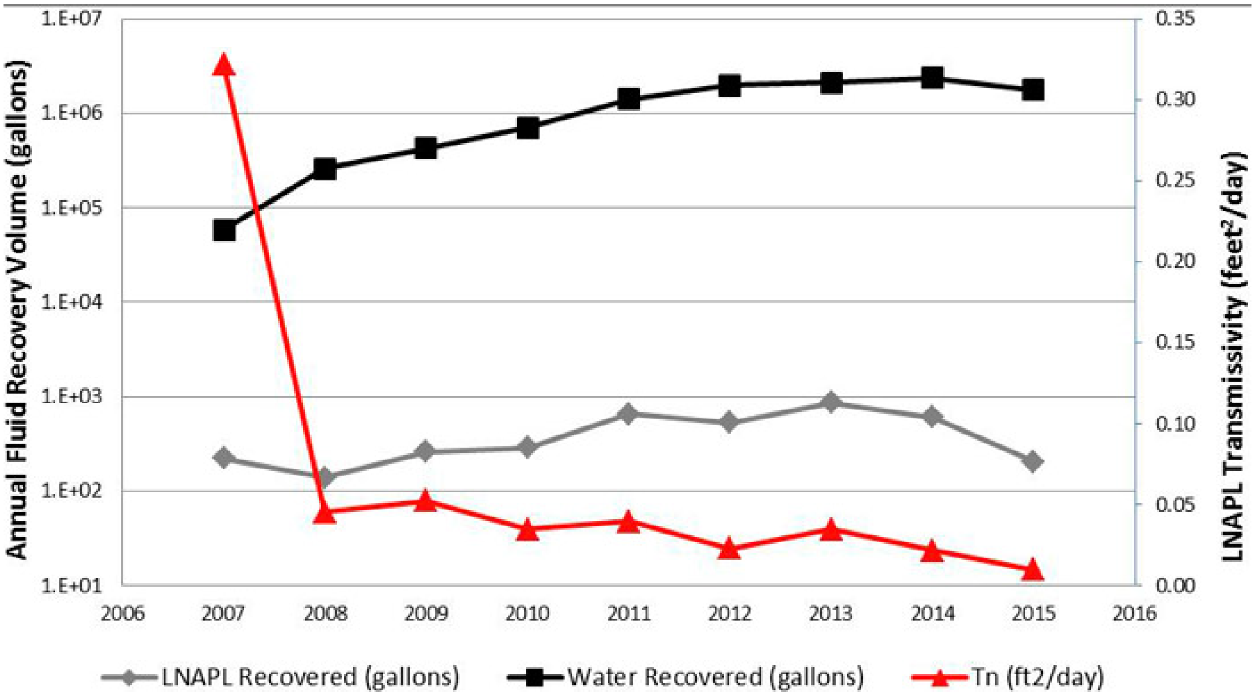

Figure 1. Example Site of Transmissivity Measurement Over Time During LNAPL Recovery (Courtesy of ITRC)

> **LNAPL Recovery to the MEP:**
>
> LNAPL transmissivity of 0.5 ft²/day or less within the source area may be used to justify that LNAPL has been recovered to the MEP.

CSP recommends measuring transmissivity to determine when LNAPL has been recovered to the MEP. There are several equations available to calculate LNAPL transmissivity, and the equation chosen to calculate transmissivity should match the recovery method chosen and the data collected from an LNAPL recovery well. Transmissivity testing and calculations should follow the American Society of Testing Materials (ASTM) *Standard Guide for Estimation of LNAPL Transmissivity E2856-13* (ASTM, 2021) and can include one of the following methods:

- baildown test (preferred method);
- skimming testing; or
- recovery data-based methods.

Transmissivity measurements can vary spatially; therefore, transmissivity testing should be performed in each LNAPL recovery well. The results of the transmissivity measurements can be used to determine on a well-by-well basis if LNAPL has been recovered to the MEP. LNAPL mobility and recoverability are generally lower during seasons or periods of high-water saturation. Therefore, LNAPL transmissivity testing should be completed when groundwater tables are seasonably low or at low tide if tidal cycles are influencing groundwater elevations.

If transmissivity measurements are not feasible, the following site-specific conditions should be used to determine whether LNAPL has been recovered to the MEP:

- LNAPL recovery data has been collected during different seasons and for a minimum of one year and rates show a stable or decreasing trend;
- LNAPL recovery rates are low (i.e., less than 0.25 gallons per well per day) and have diminished over multiple seasons; and
- LNAPL body is spatially stable, is not migrating, and is not expected to migrate in the future. Contaminant data collected from monitoring wells downgradient of the LNAPL body shows a stable or decreasing trend over multiple seasons.

Once LNAPL is recovered to the MEP, human and/or ecological exposure from dissolved LNAPL constituents and volatile organic compound gases should also be evaluated in accordance with 18 AAC 75 and 18 AAC 78 regulations and guidance. Additional cleanup efforts (such as hot-spot soil removal, and/or groundwater cleanup strategies involving active treatment or Natural Source Zone Depletion) besides LNAPL recovery may be needed to reduce future risks to human health and the environment.

Disposal of recovered LNAPL must be in accordance with 18 AAC 75.325(f)(1)(B), any federal or local requirements, and approved by CSP staff. LNAPL disposal should be documented in CSP's *Contaminated Media Transport and Treatment or Disposal Approval Form* (ADEC, 2022).

References

Alaska Department of Environmental Conservation, Division of Spill Prevention and Response, Contaminated Sites Program. (2022). *Contaminated Media Transport and Treatment or Disposal Approval Form.*

American Society of Testing Materials. (2021). *Standard Guide for Estimation of LNAPL Transmissivity, Publication E2856-13*. West Conshohocken, PA: American Society for Testing and Materials.

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