

**NOTE:** The “Light Non-aqueous Phase Liquid (LNAPL) Free Product Initial Recovery and Interim Remedial Measures” draft guidance that is posted at the SRRA Webpage has a Section “VIII. OPERATIONAL MONITORING” that is “reserved” and a Section “IX REPORTING REQUIREMENTS” that references the report writer back to N.J.A.C. 7:26E-4. The following guidance for operational monitoring and reporting was written by the LNAPL Guidance Stakeholder Committee as part of the LNAPL guidance which is currently under final review. In the absence of more detailed reporting guidance in the posted version of the LNAPL guidance, the Department is providing the following to help guide the preparation of the operational monitoring plan and Interim Remedial Measures Report.

The Department understands that some LNAPL reports are due March 1, 2011 and will be submitted by that date. The Department does not expect that those reports will follow this format on short notice.

## **OPERATIONAL MONITORING**

Once an interim remedial measure (IRM) is implemented, monitoring is required to assess the protectiveness and effectiveness of the chosen interim remedial measures. The type and frequency of monitoring should be based on the CSM developed for the site which identifies the LNAPL type, source and distribution, site specific receptor issues, hydrogeologic influences on LNAPL behavior and other factors affecting LNAPL migration and recoverability. The operational monitoring should validate the assumptions developed for the site and document that the selected IRM is effective in preventing migration, reducing mass, when practicable, and is protective of known human and ecological receptors.

The operational monitoring plan for the site should be designed to gather sufficient data to verify that the IRM specific goals, performance metrics and endpoints of the IRM, as defined by the investigator, have been or are being met. The operational monitoring plan should be modified, as necessary, to adapt to changing site conditions which may occur during IRM implementation. An effective operational monitoring plan could also be designed to generate additional data for site characterization and completion of RI activities which may be needed to design the final remedy for the site.

### A . Types of Monitoring

#### Monitoring the LNAPL Body.

Since a remedial investigation should have resulted in a detailed understanding of the source(s) and distribution of the LNAPL identified at the site, it is anticipated that an appropriate monitoring well network was installed during the RI phase. This monitoring well network should include wells located within the LNAPL body and an appropriate array of wells around the perimeter of the LNAPL body. The spacing of these wells should reflect and account for site specific subsurface characteristics as well as the characteristics of the LNAPL being monitored. A sufficient number of monitoring points shall be located within the LNAPL body

to establish and document LNAPL distribution, to predict behavior and migration and to assess recoverability. Perimeter wells should be located just beyond the LNAPL body, but close enough to verify that LNAPL is not migrating.

Monitoring should be conducted on a regular basis at all LNAPL sites during the IRM phase. Operational monitoring should include gauging events that collect depth to water, depth to LNAPL and LNAPL thickness measurements using appropriate field instruments. Adjustments in monitoring may be needed based on performance monitoring data and changing site conditions.

## 2. Receptor Monitoring

Receptor monitoring, if applicable, should be conducted to assess that the IRM is protective of known risks. The frequency will be based on the professional judgment of the investigator and should consider the CSM developed for the site. Receptor monitoring should be conducted in accordance with other relevant Guidance Documents and Regulations.

## 3. Interim Remedial Measure Monitoring

The specifics of remedial system monitoring will vary with the type of IRM selected for a site. All IRMs should include a means to monitor the response of the LNAPL body to remedial efforts and should include the collection of sufficient system data to allow an assessment of IRM effectiveness.

### a. An IRM monitoring protocol should include the following:

Hydraulic gauging which includes depth to water / depth to LNAPL / LNAPL thickness measurements in pertinent monitoring wells and recovery points both within, and along the perimeter of, the LNAPL body;

- ii. A determination regarding the amount of LNAPL recovered at each recovery point during the reporting period;
- iii. System-specific monitoring; and
- iv. NJPDES Permit parameters, if applicable.

As previously discussed, the monitoring protocol chosen for the site should be designed to gather sufficient data to verify that the objectives of the IRM have been, or are being, met. Examples are included below. This list is not comprehensive, but is intended only to provide examples of types of technologies and associated types of monitoring which may be considered.

### b. For IRMs which include ground water extraction as a component of remedial system design, system monitoring should include:

- Regular hydraulic gauging of both pumping and non-pumping wells;
- Verification of depths of pump intakes in all dewatering points;
- iii. The pumping rate established at each dewatering point during the reporting

period; and

iv. The degree of drawdown established in both active pumping wells and nearby monitoring points.

c. For IRMs which utilize total fluids extraction using a drop tube technology, system monitoring should include:

The depth to which the drop tube is placed in each extraction point;

Measurements of total applied system vacuum during system operation;

iii. The casing vacuum as determined in each extraction point during system operation;

iv. PID readings of the extracted vapor phase mass (if applicable) at each extraction point;

v. Hydraulic gauging and vacuum gauging at nearby monitoring points; and

vi. The amount of ground water and LNAPL recovered from each extraction point during the reporting period.

d. For IRMs which include the injection of surfactants to increase the mobility of LNAPL in order to enhance recovery rates in the liquid phase, system monitoring should include:

i. pre-injection ground water sampling for both the compounds of concern and compounds / by-products associated with the injected material;

ii. details regarding the volume, rate, duration, and depth of introduction of the injected material at each injection point;

iii. details regarding the recovery phase of the IRM including depth of pump intake(s), pumping rate at each extraction point and duration of the recovery phase;

iv. hydraulic gauging during the recovery phase at both the recovery points and nearby monitoring wells to determine pumping zone of influence;

v. post-injection ground water sampling for both the compounds of concern and the compounds / by-products associated with the injected material; and

vi. NJPDES DGW permit parameters.

## XI. REPORTING

### Immediate Reporting Requirement:

The identification of LNAPL at a site can trigger the requirement to make immediate telephone notification to the Department Hotline at 1-800-WarnDEP. The call to the Department Hotline is required if the LNAPL identified is not related to a previously reported discharge or if the discharge is first discovered as a result of the LNAPL discovery. The 60-day reporting form does not take the place of the call to the Department's Hotline reporting the discharge. The investigator should evaluate the need for the Hotline call.

### Initial Reporting Form Requirement:

As per the regulatory timeframes established in N.J.A.C. 7:26E, the person responsible for conducting the remediation at a site where measurable LNAPL is identified is required to submit the LNAPL Reporting Form, available on the Department's website.

### LNAPL Interim Remedial Measures Report

As per the regulatory timeframes established in N.J.A.C. 7:26E, the person responsible for conducting the remediation at a site where LNAPL is identified is required to submit an updated LNAPL reporting form, available on the Department's website, within one year of the identification of LNAPL at the site. A LNAPL "Free Product Interim Remedial Measures Report" is required to be included with the updated LNAPL Reporting Form submission. A suggested format of the report is listed in Appendix C.

The purpose of the IRM Report is to document the investigative and remedial work conducted at the site in response to the discovery of the LNAPL. This report should provide information regarding LNAPL source, LNAPL extent, a full description and justification for the selected IRM, a discussion of the specific remedial goals to be achieved and the performance metrics by which the goals will be determined to have been met, the results of the operational monitoring which has been conducted during the IRM phase and a detailed assessment, to date, regarding the effectiveness of the chosen initial recovery effort, and IRM, if implemented.

When reporting to the Department, the investigator should be able to describe the conceptual site model developed for the site and document that the chosen IRM is supported by the CSM. Based upon the conceptual site model, the person responsible for remediating the site should be able to depict the extent of LNAPL on a site map, depict groundwater flow direction, and document the evaluation of preferential pathways for LNAPL migration.

1. The LNAPL "Free Product Interim Remedial Measures Report" due at the end of the 1-year regulatory timeframe should include one of the following as applicable:

a. if measureable LNAPL remains in wells and IRM specific goals have not yet been met, the IRM Report should include a detailed plan to continue or implement LNAPL IRM activities until the IRM specific goals and endpoints are achieved or until the final remedy is implemented;

if LNAPL removal is considered complete, the IRM Report should present a detailed discussion supporting this finding, and a monitoring plan to, at a minimum, continue hydraulic gauging to verify that measurable LNAPL does not reappear under the full range of water table conditions at the site, or until the final remedy is implemented; or

c. if LNAPL remains in monitoring wells and continued removal or treatment is not practicable, the LNAPL IRM Report should clearly document the technical

rationale supporting this conclusion, and at a minimum provide a maintenance and monitoring plan to demonstrate continued control and no LNAPL migration until a final remedy is implemented.

#### 4. Compliance with the LNAPL Regulatory Timeframe

The overall intent of the LNAPL timeframes is to require the person responsible for the remediation to proactively characterize the LNAPL body identified and to implement an appropriate response. Completing the requirements of N.J.A.C. 7:26E-1.12 will result in compliance with LNAPL regulatory and mandatory timeframes. However, there may be circumstances where the collection of data and implementation of the IRM cannot be completed within the regulatory and mandatory timeframes. The person responsible for conducting the remediation should then complete and submit to the Department a Remediation Timeframe Extension Request Form.

There may be situations where the selection and implementation of an IRM cannot be completed within the regulatory and mandatory timeframe. In this case the extension request should be documented in a report which contains the applicable components outlined for inclusion in the LNAPL “Free Product Interim Remedial Measures Report” along with justification for the reasons for the extension and detailed schedule for additional RI activities and IRM, as appropriate.

In cases where the person responsible for the remediation believes the specific site conditions justify the deferment of IRM implementation, an extension request should be submitted with that justification and a detailed schedule. Generally in these cases, the LNAPL body will be well understood and the selected IRM will be implemented within a reasonable timeframe and is either incorporated within a planned final remedy for the LNAPL or the LNAPL IRM is a component of a more comprehensive multiphase remedy. The Request for Extension should be supported and justified by the key provisions outlined for inclusion in a LNAPL “Free Product Interim Remedial Measures Report” and includes the proposal for implementation of the remedy. An example of this situation could involve #4 or #6 fuel oil (limited dissolved phase contamination with no LNAPL migration and shallow ground water) at a site with planned redevelopment and demolition/excavation work. Rather than implement a remedy that is hindered by onsite buildings that will be demolished as part of redevelopment within one year, the implementation of the IRM using excavation could be deferred for one year until demolition is complete.

The redesign of an IRM that is not achieving the objective or goals established for the IRM at the site does not restart the regulatory or mandatory timeframe clock. In this situation, subsequent key document submissions (i.e. completion of the remedial investigation and submission of a remedial action workplan) would be sufficient to report the information regarding any updates/changes implemented since the prior LNAPL reporting.

The IRM, or aspects of the IRM, may be discontinued prior to implementation of the final remedy if it is documented that the IRM has met its overall objectives, and any specific IRM goals and performance endpoints established by the investigator. This includes situations where

LNAPL removal or treatment has resulted in reducing LNAPL thickness to less than 0.01 feet in monitoring wells; where further recovery or treatment is determined to be impracticable; or where other specific IRM goals and performance endpoints are met. If LNAPL remains at cessation of the IRM, then the selected final remedy for the site should address the remaining LNAPL.

Professional judgment should be used to determine the minimum ongoing maintenance approach for removal of available LNAPL from monitoring wells pending implementation of a final remedy. This may include the use of active or passive LNAPL collection techniques. It should be noted that for some LNAPL plumes or portions of LNAPL plumes, such as high viscosity, low solubility or highly weathered situations where the LNAPL is immobile and does not contribute to a dissolved or vapor phase plume or present other risk to receptors, a monitoring only approach may be appropriate as an IRM until the final remedy is implemented. In this case, the IRM Report should provide a detailed discussion supporting the approach, the steps taken to evaluate both the LNAPL and any potential receptor risks and schedule for the anticipated final remedy and management approach that will address the remaining LNAPL.

If at any time during implementation of a monitoring plan LNAPL reappears that is related to the original LNAPL reporting/response, the investigator should continue with LNAPL management consistent with the objectives of the IRM. If the LNAPL reoccurrence is from a new discharge, a new discharge shall be reported to the DEP Hotline at 1-888-WARN DEP and new LNAPL response initiated pursuant to N.J.A.C. 7:26E-1.12 with a new “ timeframe clock” being initiated.

## Appendix C

### Contents of a Typical LNAPL “Free Product Interim Remedial Measures Report”

A typical report should include the following elements:

#### I. General Information

- A. Site name;
- B. Case identifiers, such as the PI number;
- C. Site location;
- D. Investigator name;

#### II. Physical Setting with a discussion of the:

- A. Topography;
- B. Site soils, geology, hydrogeology, and groundwater flow direction;
- C. Location and description of any nearby surface water bodies or wetlands;

#### III. Components of the receptor evaluation, known at the time of the initial LNAPL investigation, such as:

- A. Location of wells and other collection points near the LNAPL body;
- B. Land use near the LNAPL body;
- C. Location and details regarding potential preferential pathways for LNAPL migration;
- D. Identification of real or suspected vapor concerns associated with the LNAPL body;
- E. Location of any real or potential ecologic receptors affected by LNAPL;

IV. A Technical Overview that should provide a:

- A. Summary of the LNAPL discharge;
- B. Summary of activities conducted to delineate the LNAPL;
- C. Summary of recovery efforts to date, including technologies utilized;
- D. A discussion of the reliability of the analytical data;
- E. A discussion of any problems or difficulties encountered while conducting the investigation;

V. Investigative Findings, which may include a discussion of:

- A. The physical characteristics and chemical composition of the LNAPL;
- B. The horizontal and vertical extent of the measurable LNAPL;
  - C. The migratory path of LNAPL from the discharge point to its current distribution;
- D. Changes in product thickness with water table fluctuation;
  - E. Stratigraphic and/or structural controls that may be influencing product distribution;
  - F. Stability of the LNAPL body;
  - G. Results of any aquifer tests;
  - H. Results of any LNAPL mobility, recoverability, or treatability tests;
  - I. Results of any tests necessary for the development of any permits;

VI. Conclusions and IRM Selection, which should include items such as:

- A. A description of chosen IRM;
- B. Methodologies and data used to support the chosen IRM;
- C. Monitoring plan associated with the LNAPL plume
- D. Metrics that have or will be used to evaluate the effectiveness of the IRM;
- E. Metrics to be used to document future stability of the LNAPL body;
- F. A discussion of possible changes to the IRM based on metrics;

VII. A typical report should also include maps and diagrams, scaled to be clear and legible, such as:

- A. A portion of a 7.5 minute topographic map locating the site;

- B. A map depicting relevant components of a receptor evaluation if appropriate;
- C. Site map depicting all well, boring, and/or test pit locations;
- D. Map depicting the extent of measurable LNAPL and the suspected discharge location;
- E. A groundwater contour map;
- F. Top of bedrock map or lower permeability horizons, if present;
- G. Cross-sections through the LNAPL body which should depict items such as:
  - 1. Stratigraphy;
  - 2. Depth to water;
  - 3. Observed LNAPL thicknesses in wells and borings;
  - 4. Interpreted location of mobile product;

VIII. Additionally, a typical report should include the following additional information:

- A. Summary table of well construction, including information such as:
  - 1. Well id, well permit number, date of installation;
  - 2. Top of casing elevation, ground surface elevation;
  - 3. Well depth, depth to the top and bottom of the open-hole/screened interval;
  - 4. State plane coordinates; Lat and longitude.
- B. Copies of all well and boring logs used in the LNAPL investigation;
- C. A Summary table of product thickness measurements and water table elevations;
- D. Summary table of volume of product recovered, with date and method of recovery;
- E. Summary tables of any analytical results associated with the LNAPL investigation;
- F. Sampling results summary tables for all relevant analyses, including location and depth;
- G. Results of all studies or tests used to delineate the LNAPL and to select the IRM;
- H. A Summary table of analytical methods;
- I. Relevant laboratory QA/QC data;
- J. Groundwater field sampling summary sheets if appropriate;
- K. Groundwater contour map reporting forms;
- L. Any other data that was collected related to the measurable LNAPL investigation.

(Note: A report may be in the form of or include a Conceptual Site Model that incorporates all data gathered and results of testing to support the LNAPL delineation and the Interim Remedial Measure selected.) “