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| Minnesota Pollution Control Agency (MPCA), 520 Lafayette Road North, St. Paul, MN 55155-4194 | Pilot test report  Petroleum Remediation Program  Guidance document 7-06  *Doc Type: Corrective Action Design* |

**Instructions:** Complete this report to document the results of a pilot test of a remediation system or other in situ remediation technology. See [Corrective action design and implementation](https://www.pca.state.mn.us/sites/default/files/c-prp7-01.pdf) for more information and requirements found on the Minnesota Pollution Control Agency’s (MPCA) website at <https://www.pca.state.mn.us/waste/cleanup-guidance>. Do not revise or delete any text or questions from this report form. Items may be added if they are needed to support the pilot test results. If an item is not applicable, provide a brief explanation.

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| **MPCA Site ID:** | LS00 | **Date (mm/dd/yyyy):** |  |

**Responsible party information**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Individual or corporate name: | | | |  | | | | | |
| Mailing address: | | |  | | | | | | |
| City: |  | | | | | State: |  | Zip code: |  |
| Email: | |  | | | | | | Phone: |  |
| Alternative contact name (if any): | | | | |  | | | Phone: |  |

**Leak site information**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name: | |  | | | | | Phone: |  | |
| Leak site address: | | | |  | | | | | |
| City: |  | | | | State: |  | Zip code: | |  |
| County: | | |  | |  | | |  | |

**Environmental professional information**

*By signing this document, I/we acknowledge that we are submitting this document on behalf of and as agents of the responsible person or volunteer for this leak site. I/we acknowledge that if information in this document is inaccurate or incomplete, it will delay the completion of remediation and may harm the environment and may result in a reduction in Petrofund reimbursement. In addition, I/we acknowledge on behalf of the responsible person or volunteer for this leak site that if this document is determined to contain a false material statement, representation, or certification, or if it omits material information, the responsible person or volunteer may be found to be in violation of Minn. Stat. § 115.075 or Minn. R. 7000.0300 (Duty of Candor), and that the responsible person or volunteer may be liable for civil penalties.*

***By typing/signing my name below,*** *I certify the above statements to be true and correct, to the best of my knowledge, and that this information can be used for the purpose of processing this form.*

**Signatures** *(Electronically sign by typing name in signature field)*

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| **Report author(s)** | | | | |  | **Report reviewer(s)** | | | |
| Signature: | |  | | |  | Signature | |  | |
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| Signature: | |  | | |  | Signature | |  | |
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| Title: |  | | | |  | Title: |  | | |
| Date (mm/dd/yyyy): | | |  | |  | Date (mm/dd/yyyy): | | |  |
| Name(s) of field technician(s): | | | |  | | | | | |

**Company information**:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name: | |  | | | | | Phone: | |  |
| Mailing address: | | |  | | | | | | |
| City: |  | | | State: |  | Zip code: | |  | |

**Project manager information**:

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| --- | --- | --- | --- | --- |
| Name: |  | | | |
| Phone: |  | Email: |  |  |

## Section 1: Pilot test overview

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| 1. | If the completed pilot test was different than requested by the MPCA, identify the differences and explain why. |
| 2. | Identify the person responsible for conducting the pilot test. |
| 3. | Identify the remediation technology that was tested and the number of remediation and monitoring points that were used. |
| 4. | Provide a chronological list of all pilot test activities and the date each activity was completed. |
| 5. | Describe all permits, approvals, and variances needed prior to pilot test system installation and startup. |
| 6. | Describe any wastes that were generated during pilot test system installation and how they were handled and disposed of. Provide copies of waste disposal documents, permits, and related documentation that were not included in [Pilot test work plan](https://www.pca.state.mn.us/sites/default/files/c-prp7-05.docx) in Appendix A. |
| 7. | Describe any major problems encountered during pilot test system installation, including installation of remediation and monitoring points. Discuss how the problems were resolved and how they affect pilot test results. |
| 8. | Identify any data gaps or inconsistencies in the site investigation, risk evaluation, and monitoring data and discuss resulting major assumptions that affect the pilot test results. |

## Section 2: Target zone

Illustrate the target zone’s geometry, geology, hydrogeology, and preferential flow routes and flow barriers on a site figure and cross sections in Section 14. Include applicable tables and figures from the focused investigation in Appendix B.

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| 1. | Identify the primary contaminant phase targeted by the system and describe its physical and chemical properties as relevant to the remediation strategy. |
| 2. | Describe the geometry, geology, and hydrogeology of the target zone. |
| 3. | Describe the remediation strategy for remediating the target zone in terms of the subsurface physical, chemical, and biological processes that the full-scale system will be designed to induce and control over time to achieve permanent risk reduction. |
| 4. | If applicable, describe target-zone accessibility issues or subsurface conditions that act as a barrier to or short-circuit the intended subsurface response and how they were accommodated by the pilot test system design. |

## Section 3: Remediation and monitoring points

Provide a site map showing the locations of all pilot test remediation and monitoring points. Include construction diagrams, borings logs, and, if applicable, Minnesota Department of Health (MDH) well and boring records in Appendix C. Provide a remediation and monitoring point construction summary table in Section 15 (Table 1).

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| 1. | Provide a rationale for the location and construction specifications, such as screen interval or distance from source, for each remediation and monitoring point based on the target zone, remediation strategy, and conceptual design of the full-scale system. |
| 2. | Describe remediation and monitoring point installation activities, including the methods and procedures used for drilling and installation of each remediation and monitoring point. |
| 3. | Describe the results of any sampling, monitoring, or laboratory analyses completed during installation. Provide data summary tables in Section 16 and laboratory analytical reports in Appendix D. |
| 4. | Describe any remediation and monitoring point installation and construction decisions that were made in the field and what criteria were used. |
| 5. | Describe the methods and procedures for developing remediation and monitoring points and the development results. |
| 6. | Discuss the status of each remediation and monitoring point after the test was completed. |

## Section 4: System equipment, process flow, and system controls

Include a process and instrumentation diagram (P&ID) representing the equipment configuration(s) that was pilot tested in Section 14. Use unique identifiers to refer to specific items on the P&ID when describing system equipment, process flow, and monitoring of pilot test system functions. Refer to remediation point construction diagrams, site maps, or other figures as necessary to describe specific system equipment and processes. When describing major equipment or instrumentation, refer to appropriate manufacturer- or vendor-supplied manuals or excerpts included in Appendix E.

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| 1. | Identify the pilot test system’s major equipment and discuss their operation principles, performance specifications, and operating ranges. |
| 2. | Describe how the major equipment was connected to each other and to the remediation points through conveyance lines and manifold design. |
| 3. | Describe process flow for all gases, liquids, solids, and their mixtures through the system from intake points to discharge points. Identify passive control features such as gravity drainage and backflow prevention. |
| 4. | Identify the locations of process control devices, including those located along conveyance lines from intake points to discharge points and at remediation points. For each location, describe what process the device controlled and the purpose for controlling the process at that location. Describe the operation principles for each device, including manual adjustment methods, procedures, and logic for automated controls. |
| 5. | Identify the control settings that were monitored over the course of the test. Describe the units of measurement, range, accuracy, and data collection methods and procedures as appropriate for each control setting. |
| 6. | Identify all locations where process material physical parameters, such as flow, pressure, temperature, or fluid levels, were measured along conveyance lines from intake to discharge points and at active remediation points. For each location, describe what materials and properties were measured and why they were measured at that location. Describe the operation principles, measurement units, range, and accuracy for each instrument. Describe data collection methods and procedures for each instrument. Include an excerpt from the airflow measurement instrument’s manual describing how to convert measured flow rates to standard temperature and pressure conditions in Appendix E. |
| 7. | Identify instruments (or methods) that were used to monitor equipment operation parameters, such as equipment run time and on/off cycles. Describe what parameters were monitored and the purpose for monitoring them. Describe each instrument’s operation principles, measurement units, range, and accuracy. |
| 8. | Describe the results of any testing, such as pressure testing, that was completed prior to system startup at the conveyance lines, manifolds, and equipment from the remediation points through the rest of the system to confirm that they were not leaking or otherwise compromised. Describe testing methods and procedures. |

## Section 5: Process material chemistry

Refer to the P&ID, and if necessary, other figures and diagrams when describing the locations where process materials, such as groundwater or air, were monitored or sampled for chemical parameters.

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| 1. | Identify all monitoring and sampling locations between intake points and discharge points, including remediation points. For each monitoring and sampling location, describe the process material that was monitored or sampled, the chemical parameters that were measured, and the purpose for collecting the data at that location. |
| 2. | Describe field monitoring methods and procedures. For each monitoring location, describe monitoring equipment and/or instrumentation, including operation principles, measurement units, range, and accuracy. |
| 3. | For each parameter collected for off-site laboratory analysis, describe collection methods and procedures, selected laboratory analytical methods and their rationale, and quality assurance and quality control (QA/QC) measures. |
| 4. | For chemistry data used in mass balance calculations or for other reasons requiring associated flow, identify the flow measurement locations and instruments (described in Section 4) associated with respective monitoring or sampling points. |

## Section 6: Subsurface response monitoring

For each item below, identify the monitoring points where the system’s effects on the specified target-zone conditions were measured over the course of the pilot test. Describe the types of data that were collected at each monitoring point and provide a rationale for collecting each type. Describe data collection methods and procedures including the type, operation principles, measurement units, range, and accuracy of field instruments. Refer to appropriate figures and diagrams to identify measurement locations and to support monitoring methods and procedures.

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| 1. | Target zone’s physical conditions, such as fluid levels, pressure, or temperature: |
| 2. | Target zone’s chemical conditions, such as organic vapor concentrations, dissolved oxygen, or redox potential, as measured in the field: |
| 3. | Target zone’s chemical conditions, such as volatile organic compounds (VOCs), gasoline range organics (GRO), or diesel range organics (DRO), as measured by laboratory analysis: |

## Section 7: Pilot test description and data presentation

Refer to appropriate tables, figures, and appendices when describing system configurations, control adjustments, and data collection locations. Provide pilot test figures and data tables in Sections 14 and 15, respectively. Include laboratory analytical reports in Appendix D and attach field or sampling data sheets in Appendix F. All data must have a temporal reference point relative to the start of the pilot test or given stage. This section is to include mass removal and waste treatment data, if applicable.

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| 1. | Briefly summarize the pilot test from start to finish, including baseline monitoring, equipment testing, start and stop times of stages and step tests, downtime between stages, and rebound monitoring, as applicable. |
| 2. | Describe any baseline data, such as groundwater elevations or light non-aqueous phase liquid thicknesses, collected prior to initiating the pilot test. Provide a rationale for the types, locations, and collection frequency of the data that were collected. |
| 3. | Describe baseline data collection methods and procedures, including field equipment and laboratory analytical methods, if applicable. |
| 4. | Describe the results of any remediation and monitoring point testing, such as pressure testing, that was completed prior to system startup to confirm that they were not short circuiting, leaking, or otherwise compromised and were in hydraulic or pneumatic connection with the target zone. Describe testing methods and procedures. |
| 5. | Describe the results of any conveyance line, manifold, and equipment testing, such as pressure testing that was completed prior to system startup to confirm that they were not leaking or otherwise compromised. Describe testing methods and procedures. |
| 6. | Describe the equipment configuration and remediation and monitoring points that were used during each stage of the pilot test in order of stage completion. Provide a rationale for the configuration and order. Describe the transition between each stage, including any downtime due to equipment reconfiguration. Describe any major problems encountered during operation, how the problems were resolved, and how they affected the results. |
| 7. | Describe the types, collection locations, and collection frequency of operation monitoring data, such as system control settings, process material parameters, or subsurface response, that were collected during each stage. Provide the rationale for collecting each data type at the locations and frequency. |
| 8. | Identify the process and/or operation monitoring data that were used as criteria to determine when a given stage was complete. |
| 9. | Describe and provide the rationale for system control adjustments that were made over the course of each stage, including adjustments for step tests. Describe what process flow parameter(s) was controlled, such as flow rate or pressure), how it was controlled, and what process and/or subsurface response was monitored for effect. |
| 10. | If a step test was conducted, describe and provide the rationale for the number and sequence of steps. Specify what parameter, such as flow rate or pressure, was adjusted, how it was adjusted, and whether it was a step up or step down. |
| 11. | Identify the process and/or operation monitoring data that were used as criteria to determine when a given step was complete. |
| 12. | Describe any rebound data collected after pilot test completion. Provide the rationale for the types, locations, and collection frequency of the data that were collected. |
| 13. | Describe rebound data collection methods and procedures, including field equipment and laboratory analytical methods, if applicable. |

## Section 8: Data evaluation

Provide data evaluation figures and tables in Sections 14 and 15, respectively. Refer to appropriate figures and tables when describing evaluation results.

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| 1. | Provide and explain the equation(s) that were used for converting airflow velocity measurements to volumetric airflow rates and/or volumetric airflow rates to standard temperature and pressure conditions. Describe each equation variable, including its data source, namely instruments, and measurement unit. Provide example calculations using pilot test data. |
| 2. | Provide and explain the equations that were used for calculating mass removal. Describe each equation variable, including its data source and unit of measurement. Provide example calculations using pilot test data. |
| 3. | Discuss pilot test data evaluation results. Describe the methods, such as contour maps or graphs, and calculations used to evaluate each data set. |

## Section 9: Technical feasibility determination

For each applicable category below, discuss whether and how the results confirm the technical feasibility of the technology and equipment configuration when employed as the full-scale system envisioned in the conceptual design from Section 5 of [Conceptual corrective action design (CCAD) report](https://www.pca.state.mn.us/sites/default/files/c-prp7-02.docx).

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| 1. | Subsurface response and control within the target zone |
| 2. | Targeted contaminant phase mass removal or in situ elimination |
| 3. | Light non-aqueous phase liquid (LNAPL) handling, storage, and disposal |
| 4. | Wastewater treatment and/or discharge |
| 5. | Air emissions control |
| 6. | Other elements of the full-scale system’s conceptual design |
| 7. | Do the pilot test results demonstrate technical feasibility of the technology and equipment configuration? **Double click checkboxes to select *Checked* and select *OK*.**  Yes (Go to section 10)  No (Skip sections 10 and 11, go to section 12) |

## Section 10: Conceptual design update

For each applicable category below, discuss how the results affect the full-scale system’s conceptual design assumptions made in Section 5 of the CCAD.

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| 1. | System mechanical components, instrumentation, and controls |
| 2. | Remediation point construction and well field layout |
| 3. | LNAPL handling, storage, and disposal |
| 4. | Wastewater treatment |
| 5. | Air emissions control |
| 6. | Operation monitoring schedule |
| 7. | Remediation endpoints and operation duration |
| 8. | Equipment maintenance schedule |
| 9. | Other elements of the full-scale system’s conceptual design |

## Section 11: Economic feasibility determination

Based on the information discussed in Section 10, provide an updated life-cycle cost estimate for the proposed full-scale system in Appendix G. Update focused investigation and pilot test costs to reflect actual costs.

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| 1. | Discuss the updated life-cycle cost estimate. Describe any major assumptions that were made in order to estimate costs. |
| 2. | Compare the updated life-cycle cost estimate to the life-cycle cost estimate presented in the CCAD and discuss the results of this comparison. |
| 3. | Discuss whether the pilot test results significantly affect the assumptions made when preparing life-cycle cost estimates for the non-selected corrective action alternatives evaluated in the CCAD. |
| 4. | List the corrective action alternatives evaluated in the CCAD with their corresponding and, if applicable, updated life-cycle cost estimate totals. Compare the life-cycle costs of the alternatives with the updated life-cycle cost estimate of the proposed full-scale system. |
| 5. | Based on the cost-estimate comparison and any other relevant factors, discuss the economic feasibility of the full-scale system. |

## Section 12: Site conceptual model update

Include updated cumulative tables and figures from [Investigation report](https://www.pca.state.mn.us/sites/default/files/c-prp4-06.docx) in Appendix H. Include documentation of additional site investigation, site monitoring, and interim corrective actions in Appendix I. Also include copies of tables, figures, or other information from the focused investigation if relevant to the site conceptual model or the pilot test design in Appendix B.

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| 1. | Describe any additional site investigation, site monitoring, and/or interim corrective actions completed since the last submitted report. |
| 2. | Discuss the results of the additional site investigation, site monitoring, and/or interim corrective actions. |
| 3. | Provide an updated and comprehensive site conceptual model. |

## Section 13: Recommendations

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| 1. | If the pilot test results support the proposed corrective action, provide a schedule for submitting [Remediation system detailed corrective action design (SDCAD) report](https://www.pca.state.mn.us/sites/default/files/c-prp7-07a.docx). If not, recommend an alternative course of action and a schedule for submitting a revised CCAD. |
| 2. | Provide recommendations for additional site investigation, site monitoring, and/or interim corrective actions to be completed prior to corrective action design approval, including their purpose and schedule for completion. |

## Section 14: Figures

Attach new figures specific to this report in order of discussion in the text. All figures must include a north arrow, scale, and legend as applicable. Approximate scales are not acceptable. Figures required in Appendix H should not be included in this section. New figures must include those listed below. Attach additional figures as needed and list below.

|  |  |
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|  | One or more site maps showing (as applicable):   1. Structures 2. Boring and well locations (including any drinking water wells on site) 3. Suspected source(s) of LNAPL 4. Locations and depths of on-site buried utilities 5. All past and present petroleum storage tanks, piping, dispensers, and transfer areas 6. Horizontal extent of LNAPL 7. Horizontal extent of the target zone 8. Remediation and monitoring points, conveyance lines, equipment shed, and waste discharge locations   Distinguish sequential elements of investigations by dates, symbols, etc. in the legend. |
|  | Cross sections depicting target-zone geometry, geology, and hydrogeology and preferential flow routes and barriers to flow |
|  | Process and instrumentation diagram |

## Section 15: Tables

Attach new tables specific to this report in order of discussion in the text. Tables required in Appendix H should not be included in this section. New tables must include those listed below. Attach additional tables as needed and list below.

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| --- | --- | --- |
|  | *Table 1* | Remediation and monitoring point construction summary |

## Section 16: Appendices

Attach all required or applicable appendices in the following order. Indicate those appendices that are included in this report by marking the check box. All reproduced data must be legible. Attach additional appendices as needed and list below.

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|  | *Appendix A* | Waste handling and disposal documentation, required permit/approval applications and/or acquired permit/approvals, and air emissions [Risk assessment screening spreadsheet (RASS)](https://www.pca.state.mn.us/sites/default/files/aq9-22.xlsx) documentation. |
|  | *Appendix B* | Focused investigation tables, figures, and other information, if applicable. |
|  | *Appendix C* | Boring logs, construction diagrams, and MDH well and boring records for all remediation and monitoring points. |
|  | *Appendix D* | Copies of laboratory analytical reports, including a copy of the chain-of-custody form. Include laboratory QA/QC data, chromatograms, and MDH laboratory certification number. |
|  | *Appendix E* | Excerpts from manufacturer or vendor supplied equipment and instrumentation manuals. |
|  | *Appendix F* | Field or sampling data sheets or logs (sampling forms, field crew notes, etc.). |
|  | *Appendix G* | Updated life-cycle cost estimate for the proposed corrective action and, if applicable, updated life-cycle cost estimates for non-selected alternatives. |
|  | *Appendix H* | Cumulative and updated tables and figures from [Investigation report](https://www.pca.state.mn.us/sites/default/files/c-prp4-06.docx). |
|  | *Appendix I* | Additional site investigation, site monitoring, and interim corrective action methods and procedures and associated documentation (boring logs, sampling information forms, laboratory analytical reports, etc.). |