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| Minnesota Pollution Control Agency (MPCA), 520 Lafayette Road North, St. Paul, MN 55155-4194 | Remediation system detailed corrective action design (SDCAD) report Petroleum Remediation ProgramGuidance document 7-07a*Doc Type: Corrective Action Design* |

**Instructions:** Complete this report to propose a detailed corrective action design for 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 corrective action design. 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**

|  |  |
| --- | --- |
| 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**

|  |  |  |
| --- | --- | --- |
| **Report author(s)** |  | **Report reviewer(s)** |
| Signature: |       |  | Signature |       |
|  | *(This document has been electronically signed.)* |  |  | *(This document has been electronically signed.)* |
| Title: |       |  | Title: |       |
| Date (mm/dd/yyyy): |       |  | Date (mm/dd/yyyy): |       |
| Signature: |       |  | Signature |       |
|  | *(This document has been electronically signed.)* |  |  | *(This document has been electronically signed.)* |
| 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**:

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

## Section 1: 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 A. Include documentation of additional site investigation, site monitoring, and interim corrective actions in Appendix B. Also include copies of tables, figures, or other information from the focused investigation and/or pilot test if relevant to the site conceptual model or the detailed design in Appendix C.

|  |  |
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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.      |
| 4. | Provide recommendations for additional site investigation, site monitoring, and/or interim corrective actions to be completed prior to SDCAD approval, including their purpose and schedule for completion.      |

## Section 2: Detailed corrective action design overview

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| 1. | If the proposed SDCAD is different than requested by the MPCA, identify the differences and explain why.      |
| 2. | Identify the technical lead responsible for overseeing the design, implementation, and reporting of the proposed corrective action.      |
| 3. | Identify the person responsible for overseeing system installation field activities.      |
| 4. | Identify the person responsible for system startup and long-term operation activities, including overseeing implementing the operation strategy, evaluating operation monitoring data, and preparing implementation and system operation monitoring reports.      |
| 5. | Discuss the reason for the proposed corrective action.      |
| 6. | Discuss the corrective action goal relative to the corrective action reason.      |
| 7. | If interim corrective action was completed, describe how it complements the corrective action goal.      |
| 8. | Identify the remediation technology and the number of remediation and monitoring points that will be used.      |
| 9. | Provide a brief summary of the pilot test and describe how the results demonstrated economic and technical feasibility.      |
| 10. | Summarize the primary full-scale design criteria (e.g., radius of influence, flow rates, pressures, waste treatment) that are based on the pilot test results.      |
| 11. | Describe any proposed complementary corrective actions, including ongoing interim corrective actions, to be completed in association with system installation and operation.      |

## Section 3: Target zone

Illustrate the target zone’s geometry, geology, and hydrogeology and preferential flow routes and flow barriers on a site map and cross sections in Section 13.

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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 proposed system will induce and control over time to achieve permanent risk reduction. If applicable, integrate the risk-reduction components of any complementary corrective actions with the remediation strategy.      |
| 4. | If applicable, describe target-zone accessibility issues or subsurface conditions that could act as a barrier to or short-circuit the intended subsurface response and how they are accommodated by the system design.      |

## Section 4: Remediation and monitoring points

Provide a site map showing the locations of all existing and proposed remediation and monitoring points. Include construction diagrams for each proposed or existing point in Appendix D. If any existing points are to be used, associated boring logs, and if applicable, Minnesota Department of Health (MDH) *Well and Boring Records* must also be included in Appendix D. Provide an example remediation and monitoring point construction summary table in Appendix D.

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| 1. | Provide a rationale for the location and construction specifications (e.g., screen interval, distance from source) for each remediation and monitoring point.      Describe the drilling, sampling, and installation methods and procedures used for each existing and proposed remediation and monitoring point.      |
| 2. | Describe any proposed remediation and monitoring point installation and construction decisions that may be made in the field.      |
| 3. | Describe the methods and procedures for developing the remediation and monitoring points.      |

## Section 5: System equipment, process flow, and system controls

Provide a process and instrumentation diagram (P&ID) representing the full-scale equipment configuration and a site map showing where system equipment will be located in Section 13. Use unique identifiers to refer to specific items on the P&ID when describing system equipment, process flow, and monitoring of remediation 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 excerpts from manufacturer- or vendor-supplied manuals included in Appendix E.

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| 1. | Identify and describe the system’s major equipment and where it will be housed. Discuss the operation principles, performance specifications, operating ranges, and the rationale for selecting each piece of major equipment based on site-specific performance needs and cost effectiveness.      |
| 2. | Describe how the major equipment will be connected to each other and to 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 will control and the purpose for controlling the process at that location. Describe the operation principles for each device, including manual adjustment methods and procedures and logic for automated controls.      |
| 5. | Identify the control settings that will be monitored over the course of system operation. Describe the measurement units, range, accuracy, and data collection methods and procedures as appropriate for each control setting.      |
| 6. | Identify all locations where process material physical parameters (e.g., flow, pressure, temperature, fluid levels) will be measured along conveyance lines from intake to discharge points and at active remediation points. For each location, describe what material and properties are being measured and why they are being measured at that location. Describe the operation principles, measurement units, range, and accuracy of the instruments. 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 will be used to monitor equipment operation parameters such as equipment run-time and on/off cycles. Describe what parameters will be monitored and the purpose for monitoring them. Describe each instrument’s operation principles, measurement units, range, and accuracy.      |
| 8. | If the system will be monitored or controlled via remote telemetry, identify the equipment and processes that can be monitored and the devices that can be controlled remotely.      |
| 9. | If the system is to be operated year-round, identify and briefly describe any equipment and methods for mitigating potentially detrimental seasonal effects on system operation.      |

## Section 6: Process material chemistry

Refer to the P&ID, and if necessary, other figures and diagrams when describing the location and rationale for where process materials (e.g., groundwater, air) will be 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 will be monitored or sampled, the chemical parameters that will be measured, and the purpose for collecting the data at that location.      |
| 2. | Describe field monitoring methods and procedures. For each monitoring point, describe monitoring equipment and/or instrumentation, including operation principles, measurement units, range, and accuracy.      |
| 3. | For each parameter to be 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 to be used in mass balance calculations or for other reasons requiring associated flow, identify the flow measurement locations and instruments (described in Section 5) associated with respective monitoring or sampling points.      |

## Section 7: Waste generation, handling, and disposal

Refer to applicable diagrams and figures when discussing system waste disposal. Include copies of waste disposal documents, permits, and related documentation in Appendix F.

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| 1. | Identify all contaminated materials such as light non-aqueous phase liquid (LNAPL), water, condensate, air, and solid wastes that will be generated during system operation. Describe expected maximum flow rates and flow rate trends for LNAPL, water, and air. Also describe expected maximum chemicals-of-concern concentrations and trends for water and air prior to any treatment.      |
| 2. | Describe how each type of contaminated material will be handled and where it will be disposed of. Identify all contaminated waste collection or discharge points.      |
| 3. | Describe how disposal volumes of LNAPL will be measured and documented.      |
| 4. | For wastewater discharges, identify the type of permit, approval, or requirements regulating the discharge and the issuer of the permit or approval. Describe discharge quantity and quality limitations. Describe permit/approval compliance monitoring and reporting requirements, including sampling parameters and schedules.      |
| 5. | For air emissions, identify the type of permit, approval, or requirements regulating the emissions and the issuer of the permit or approval. Describe emission quantity and quality limitations. Describe permit/approval compliance monitoring and reporting requirements, including sampling parameters and schedules.      |

## Section 8: Installation activities

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| 1. | Describe all permits, approvals, and variances needed prior to system installation and startup. Discuss the schedule for acquisition, and identify those that have been applied for or acquired.      |
| 2. | Describe major installation activities that must be completed prior to system startup, including installation of remediation and monitoring points and other remediation equipment. Discuss the schedule for completing these activities.      |
| 3. | Describe any wastes that will be generated during system installation and how they will be handled and disposed of. Specify estimated waste volumes or mass as appropriate to anticipated disposal methods.      |
| 4. | Describe any remediation and monitoring point testing, such as pressure testing, that will be completed prior to system startup to confirm that they are not short circuiting, leaking, or otherwise compromised and are in hydraulic or pneumatic connection with the target zone. Describe testing methods and procedures.      |
| 5. | Describe any conveyance line, manifold, and equipment testing (such as pressure testing) that will be completed prior to system startup to confirm that they are not leaking or otherwise compromised. Describe testing methods and procedures.      |

## Section 9: Operation strategy and performance objectives

Attach an operation strategy schedule in Section 14 (Table 1) summarizing the expected operating periods and their duration contingent upon system startup.

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| 1. | Describe any baseline data (e.g., groundwater elevations, LNAPL thicknesses) that will be collected prior to system startup and how they will be used to evaluate system effectiveness. Provide example tables, figures, and/or calculations in Appendix G.      |
| 2. | Describe the operation strategy over the expected life of the system beginning with the start-up period, through each subsequent operation period, to shutdown. The description must include measurable performance objectives in terms of system efficiency and system effectiveness for each operation period and remediation endpoints.      |
| 3. | Describe and provide a rationale for a post-shutdown monitoring plan. Describe the type of data that will be collected, collection locations, methods, and procedures, and a schedule contingent upon system shutdown.      |
| 4. | Describe how post-shutdown monitoring data will be evaluated to confirm system effectiveness. Provide example tables, figures, and/or calculations in Appendix G.      |
| 5. | Describe a contingency plan for reactivating the system or taking other actions if post-shutdown monitoring demonstrates insufficient risk reduction.      |

## Section 10: Operation monitoring plan

Refer to appropriate figures or diagrams to identify specific data collection locations. Provide example data tables, figures, and calculations that will be used to present operation monitoring data in [Remediation system operation monitoring (RSOM) report](https://www.pca.state.mn.us/sites/default/files/c-prp7-08.docx) in Appendix G. Schedules requested in the following questions are to be contingent on system startup.

|  |  |
| --- | --- |
| 1. | Identify routine or other anticipated preventative maintenance activities that will be performed during each operation period. Describe the schedule for maintenance activities.      |
| 2. | Describe how system efficiency will be measured, calculated, and tracked incrementally and cumulatively over each operation period. Provide example tables, figures, and/or calculations in Appendix G.      |
| 3. | Describe the extent of unplanned system downtime or major equipment malfunction time that can be tolerated during each operation period before efficiency objectives will be missed. Specify the maximum length of time that could elapse before an unplanned shutdown or major malfunction will be detected given the monitoring schedule.      |
| 4. | Identify system equipment configurations (e.g., active versus inactive or passive remediation points) that will be monitored and tracked over each operation period.      |
| 5. | Identify system control settings and adjustments that will be monitored and tracked over each operation period.      |
| 6. | Describe and provide a rationale for the data collection schedule for process material physical parameters identified in Section 5, item 6.      |
| 7. | Describe and provide a rationale for the data collection schedule for process material chemical parameters that will be measured in the field (e.g., organic vapor concentrations, carbon dioxide, dissolved oxygen, pH) identified in Section 6.      |
| 8. | Describe and provide a rationale for the data collection schedule for process material chemical parameters that will be collected for off-site laboratory analysis identified in Section 6.      |
| 9. | Identify the monitoring points where the system’s effects on the target zone’s physical conditions (e.g., fluid levels, pressure, and temperature) will be measured and tracked over each operation period. Describe the type of physical data that will be collected at each monitoring point. Describe and provide a rationale for the data collection schedule.      |
| 10. | Identify the monitoring points where the system’s effects on the target zone’s chemical conditions (e.g., organic vapor concentrations, dissolved oxygen, redox potential) will be measured in the field and tracked over each operation period. Describe the chemical parameters that will be measured in the field at each monitoring point. Describe and provide a rationale for the data collection schedule.      |
| 11. | Identify the monitoring points where the system’s effects on the target zone’s chemical conditions will be measured by laboratory analysis (e.g., volatile organic compounds (VOCs), gasoline range organics (GRO), diesel range organics (DRO)) and tracked over each operation period. Describe the chemical parameters that will be analyzed for at each monitoring point. Describe the laboratory method that will be used to measure each parameter. Describe and provide a rationale for the data collection schedule.      |
| 12. | If remote telemetry will be used to monitor system operation, describe the role it will play in monitoring and controlling system operation. Describe any telemetry-acquired operation monitoring data that will be collected and tracked over each operating period and how those data will be integrated with the above-described operation monitoring data.      |
| 13. | Describe the technical lead’s plans for reviewing and evaluating operation monitoring data as it becomes available and for taking appropriate action such as optimizing system operation, making system adjustments, or completing maintenance or repairs as soon as practical to ensure timely implementation of the operation strategy.      |
| 14. | Attach an operation monitoring schedule in Section 14 (Table 2). Describe the schedule for completing system monitoring and maintenance site visits and submitting [Remediation system operation monitoring (RSOM) report](https://www.pca.state.mn.us/sites/default/files/c-prp7-08.docx).      |

## Section 11: Data evaluation

Provide example tables and figures that will be used present data evaluation results in the RSOM in Appendix G.

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| 1. | Provide and explain the equation(s) that will be 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 (i.e., instruments) and measurement unit. Provide example calculations using representative example data.      |
| 2. | Provide and explain the equations that will be used for calculating mass removal. Describe each equation variable, including its data source and unit of measurement. Provide example calculations using representative example data.      |
| 3. | Describe how the operation monitoring data identified in Section 10 will be evaluated and used to determine system effectiveness and implementation of the operation strategy.      |

## Section 12: Cost-effectiveness evaluation

Provide an updated the life-cycle cost estimate in Appendix H. Update design phase costs to reflect actual costs.

1. Summarize the updated life-cycle cost estimate below. Describe any major assumptions that were made in order to estimate costs.

|  |  |
| --- | --- |
|  | **Design phase (incurred costs)** |
|  | Focused investigation stage | $       |  |
|  | Pilot test stage | $       |  |
|  | SDCAD stage | $       |  |
|  | Design phase subtotal | $       |  |
|  |  |  |  |
|  | **Implementation phase (estimated costs)** |
|  | Installation stage | $       |  |
|  | Operation stage | $       |  |
|  | Post-shutdown monitoring stage | $       |  |
|  | Dismantlement stage | $       |  |
|  | Implementation phase subtotal | $       |  |
|  | **Life-cycle cost estimate total** | **$** |  |

|  |  |
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| 2. | Compare the updated life-cycle cost estimate to the life-cycle cost estimates provided in [Conceptual corrective action design (CCAD) report](https://www.pca.state.mn.us/sites/default/files/c-prp7-02.docx) and in [Pilot test report](https://www.pca.state.mn.us/sites/default/files/c-prp7-06.docx) and discuss the results of this comparison.      |
| 3. | 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.      |
| 4. | Provide justification for whether the proposed system remains the most cost-effective alternative for achieving the corrective action goal.      |

## Section 13: 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 A should not be included in this section. New figures must include those listed below. Attach additional figures as needed and list below. **Double click checkboxes to select *Checked* and select *OK*.**

|  |  |
| --- | --- |
| [ ]  | 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 14: Tables

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

|  |  |  |
| --- | --- | --- |
| [ ]  | *Table 1* | Operation Strategy Schedule |
| [ ]  | *Table 2* | Operation Monitoring Schedule |

## Section 15: 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.

|  |  |  |
| --- | --- | --- |
| [ ]  | *Appendix A* | Cumulative and updated tables and figures from [Investigation report](https://www.pca.state.mn.us/sites/default/files/c-prp4-06.docx)*.* |
| [ ]  | *Appendix B* | Additional site investigation, site monitoring, interim corrective action methods and procedures, and associated documentation (boring logs, sampling information forms, laboratory analytical reports, etc.). |
| [ ]  | *Appendix C* | Focused investigation and/or pilot test tables, figures, and other information, if applicable. |
| [ ]  | *Appendix D* | Boring logs, construction diagrams, and MDH *Well and Boring Records* for all existing remediation and monitoring points. Construction diagrams for all proposed remediation and monitoring points. Example remediation and monitoring point construction summary table. |
| [ ]  | *Appendix E* | Excerpts from manufacturer or vendor-supplied equipment and instrumentation manuals. |
| [ ]  | *Appendix F* | Waste handling and disposal documentation and required permit/approval applications and/or acquired permit/approvals. |
| [ ]  | *Appendix G* | Example operation monitoring tables, figures, and calculations requested in Sections 9, 10 and 11. Example tables, figures, and/or calculations must include unique identifiers from the P&ID to identify the data source. Include units of measurement. Example tables and figures can be combined as practicable. |
| [ ]  | *Appendix H* | Updated life-cycle cost estimate for the proposed corrective action, and if applicable, updated life-cycle costs estimates for non-selected alternatives. |

Section 4: Tables (Add additional rows as needed.)

**Table 1**

**Operation Strategy Schedule**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Operation period** | **Configuration****and control settings** | **Schedule (Day “X” to Day “Y”)** | **Period duration (Days)** | **Measurable objectives1** |
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1Measurable objectives must include both efficiency and effectiveness objectives derived from the operation strategy with remediation endpoints as measureable objectives for the final operation period.

***Add additional rows as needed.***

**Notes:**

Enter any notes here.