PROTOCOL FOR THE *CONTAMINATED SITES REGULATION* UNDER THE *ENVIRONMENT ACT*

PROTOCOL NO. 13 Adaptive Management

Prepared pursuant to Part 6 – Administration, Section 21,
Contaminated Sites Regulation, OIC 2002/171

Rev 04
September 2019

ADAPTIVE MANAGEMENT

1.0 Introduction

Adaptive management is the process of planning a response to circumstances or events that may not be fully predictable or expected. Adaptive management identifies, in advance, actions that must be taken to gather information and respond appropriately in the event of an unanticipated or unpredictable circumstance.

Section 21(1) of the *Contaminated Sites Regulation*, O.I.C. 2002/171 (CSR), authorizes the Minister or his/her delegate to approve or adopt protocols. In accordance with Section 21(1), this protocol has been designed to ensure consistency in identifying and responding to impacts from activities that may adversely impact water quality, including operation of a land treatment facility or a solid waste disposal facility.

2.0 Water quality monitoring requirements

All solid waste disposal facilities, some modified transfer station facilities and all land treatment facilities that accept highly contaminated material or have a capacity of 3000 m^3 or greater, are required to complete a hydrogeological assessment and conduct ongoing groundwater monitoring as per the conditions of their permits issued under the *Environment Act*.

Other permitted activities may be required to complete a hydrogeological assessment and conduct ongoing groundwater monitoring in accordance with their permit, on a site-by-site basis. The hydrogeological assessment and water quality monitoring must be completed in accordance with the permit issued to the facility and all applicable protocols pursuant to the CSR.

Collecting and analyzing samples of groundwater and surface water near the facility is important to detect potential impacts to water quality the permitted activity. Analytical results are compared to the generic numerical water standards specified in Schedule 3 of the CSR, which identify acceptable limits for contaminant concentrations in groundwater and surface water, depending on the applicable water use(s) of the site, in accordance with CSR Protocol 6: Application of Water Quality Standards.

3.0 Triggers for adaptive management - land treatment facilities

Land treatment facility permit holders must develop an adaptive management plan if hydrocarbons are detected in any monitoring well at their facility in two consecutive sampling events. Detection of hydrocarbons may indicate a breach in the liner system designed to contain contaminants within the land treatment facility.

4.0 Triggers for adaptive management - solid waste disposal facilities

Solid waste disposal facility permit holders must develop an adaptive management plan if there is evidence of any contaminant at a concentration equal to or greater than the appropriate generic numerical water standards specified in the CSR for a sustained period of time as outlined below.

Environmental Programs Branch recognizes that a one-time exceedance of standards may not indicate long-term deterioration of water quality. Thus, an adaptive management plan will be required if one of the following triggers occurs within any groundwater monitoring well or surface water body potentially impacted by the facility, based on the permit requirement for water quality sampling:

- Exceedances of a parameter in four consecutive bi-annual sampling events;
- Exceedances of a parameter in five out of six bi-annual sampling events; or
- Three seasonally-consecutive exceedances (e.g. three spring exceedances in a three year period or three fall exceedances in three year period).

5.0 Triggers for adaptive management for other permitted activities

Permit holders for other permitted activities where water quality is monitored may be required to develop an adaptive management plan in accordance with the permit issued for their activity, on a site-by-site basis.

6.0 Preparation of Adaptive Management Plan

When one of the triggers described above or in the permit issued for the facility occurs, the permittee must:

1) attempt to demonstrate that adaptive management is not required; or
2) prepare an adaptive management plan for approval.

A demonstration that adaptive management is not required may be based on one of the following premises:

- The contamination observed is caused by a source other than the permitted activity; or
- For solid waste disposal facilities, the contamination observed is consistent with local, natural background water quality (based on analysis of upgradient water quality or local background water quality).

The rationale for these exemptions must be submitted to an Environmental Protection Analyst for review. The analyst will determine whether the demonstration is adequate.

If an adaptive management plan is required, the plan must describe the current water quality at the site and predict a number of **possible future scenarios** for short term (5 -10 years from current

the date) and longer term (20-50 years from the current date) regarding water quality, in order to inform decision-making.

The short term analysis should include the outcomes any planned expansion/changes/closures to the facility as outlined in the approved Solid Waste Management plan for that facility.

Each scenario in the adaptive management plan shall be associated with a series of specific actions that will be taken if that scenario occurs. Initial actions associated with any scenario may be simple, such as increasing the frequency of water quality monitoring or establishing additional water quality monitoring locations. Subsequent actions may be more complex, such as delineating, containing, reducing, or assessing the risk of the observed contamination. This will likely also involve identification of receptors (such as nearby drinking water wells or surface water bodies).

Please see the guidance document associated with this protocol for an example.

More advanced actions associated with adaptive management generally fall under the following categories:

1) Source Control – The purpose of source control is to reduce or eliminate the source of the observed contamination. Examples of source control include:
    a. Banning certain types of material from the facility;
    b. Repairing or installing liners;
    c. For a solid waste disposal facility, ensuring that completed cells are properly capped and contoured; and
    d. For a solid waste disposal facility, excavating the offending material.

2) Monitored Natural Attenuation – Natural attenuation refers to physical, chemical, or biological processes, occurring without human intervention, that act to reduce the concentration of contaminants in soil or groundwater. Monitored natural attenuation (MNA) is a controlled approach to site remediation in which natural attenuation processes are used to achieve compliance with the generic numerical water standards in the CSR within a reasonable timeframe. It is frequently combined with source control measures. MNA must be conducted in accordance with CSR Protocol 8. In particular, MNA shall only be used at sites where a quantitative risk assessment has been conducted unless otherwise authorized by the Standards & Approvals section of the Environmental Programs Branch, the CSR, or another Protocol approved under section 21(1) of the CSR.

3) Plume Containment – The aim of plume containment is to prevent contaminants from migrating and impacting potential receptors. Containment may be achieved with physical methods (*e.g.*, caps, sheet piles, slurry walls, grouted barriers), hydraulic methods (*e.g.*, extraction wells, injection wells, subsurface drains), or a combination thereof.

4) In-Situ Restoration – In-situ restoration involves taking action to reduce contamination without extracting the groundwater or surface water. Examples of in-situ restoration include:
    a. Addition of microorganisms and/or nutrients to promote natural degradation of contaminants;
    b. Permeable reactive barriers;
    c. Thermal desorption;
    d. Vapour extraction; and
    e. pH control.

5) Ex-Situ Restoration – Ex-situ restoration (commonly referred to as "pump and treat") involves removing the affected water and treating it. The treated water can potentially be injected to an aquifer or discharged to a surface water body or sewer system.

The actions proposed in an adaptive management plan must reflect site-specific considerations, including the concentration and types of contaminants observed, the known extent of contamination, the groundwater flow speed and direction, and the distance to receptors. If remedial options are proposed, the plan must compare the different remedial options considered and describe how the contaminants of concern are expected to respond to each proposed remedial option.

An adaptive management plan must also describe how progress will be measured, including water quality monitoring locations and sampling frequency and the statistical methods that will be used to analyse the data gathered.

Please be aware that some activities under an adaptive management plan may trigger an assessment under the *Yukon Environmental and Socio-economic Assessment Act*.

7.0 Adaptive Management Plan Approval

An adaptive management plan must be prepared by a qualified professional. The timeline for submission of the adaptive management plan will be identified in writing by an Environmental Protection Analyst when notice is issued that a plan is required in accordance with sections 3.0, 4.0 and 5.0 of this protocol.

The permit holder must incorporate any changes to the adaptive management plan as requested by an Environmental Protection Analyst and implement the adaptive management plan as of the approval date. The permit holder must not undertake any of the actions described in the adaptive management plan prior to the plan being approved, with the exception of additional water quality monitoring. If some actions in the proposed adaptive management plan should be undertaken immediately (for example, an emergency or spill containment), the permit holder must notify an Environmental Protection Analyst in writing.

If an environmental protection analyst requests, in writing and with reasons, that an approved adaptive management plan be amended, the permit holder must prepare the required amendment and submit the revised adaptive management plan for approval to an environmental protection analyst within the period specified in the analyst's request.

8.0 Effective Date

This version replaces previous versions of this protocol. The effective date of this protocol shall be September 20, 2019 and it shall remain in effect until replaced or rescinded by the Environmental Programs Branch.

9.0 Additional Information

For more information on contaminated sites, please contact:

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Approved: Date: September 20, 2019

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