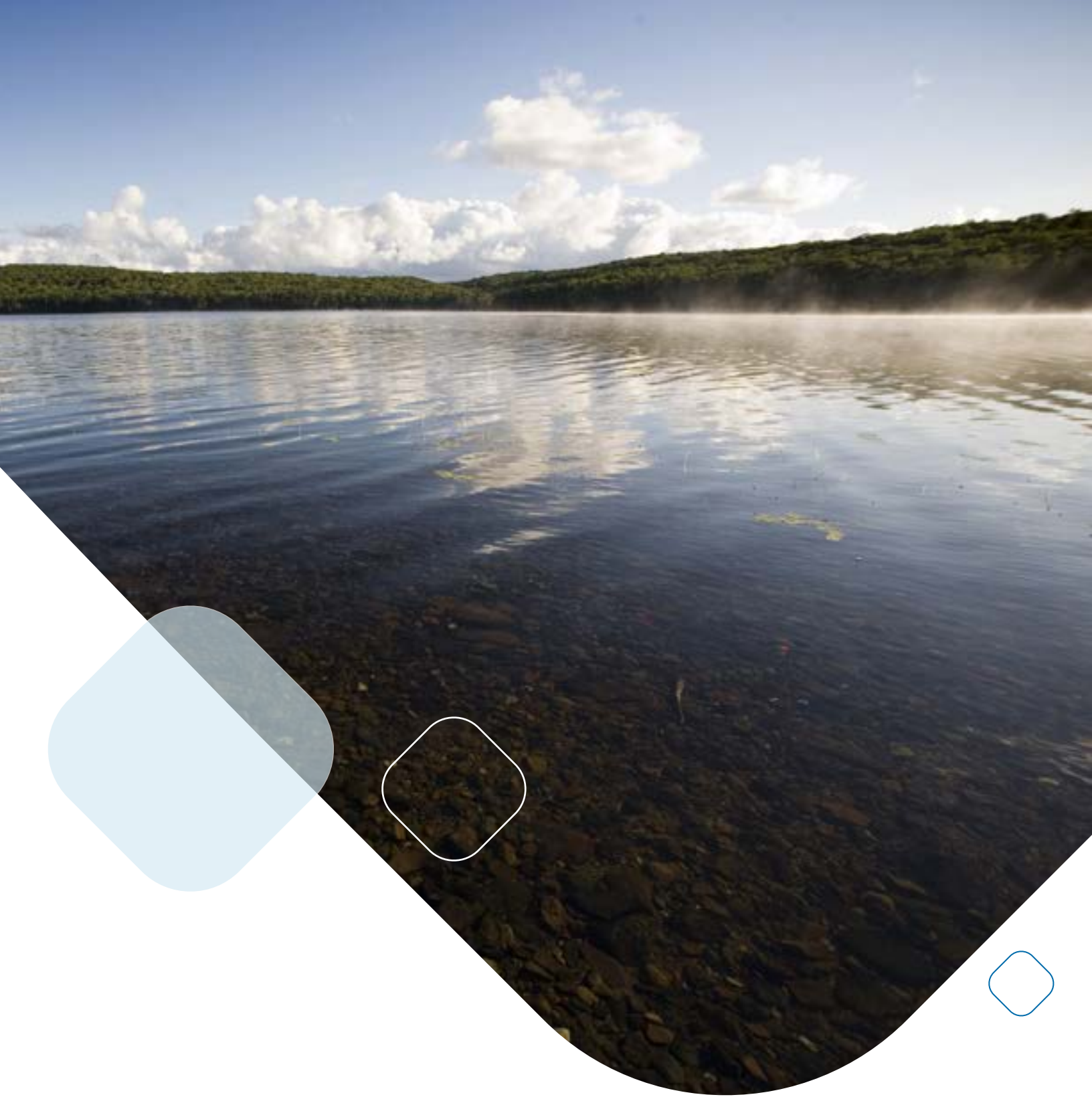


GUIDE FOR DEVELOPING A SURFACE WATER MANAGEMENT PLAN AT METAL MINES IN NOVA SCOTIA

2025

NOVA SCOTIA

Table of Contents

1. Introduction

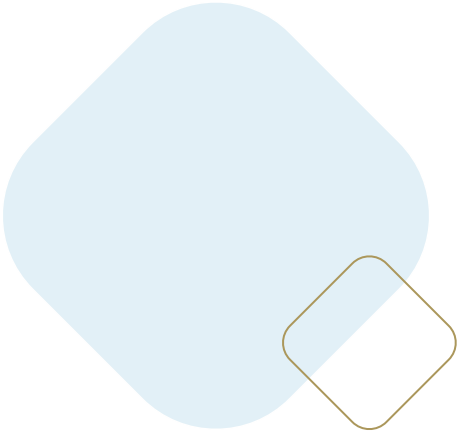
A surface water management plan is a strategy document that outlines how surface water is managed on a project site. It helps to inform planning and design decisions to prevent adverse effects such as flooding, sediment releases and pollution to nearby watercourses and wetlands.

This Guide includes best practices to be considered in the development of a Surface Water Management Plan for a metal mine in Nova Scotia.

1.1 Using the Guide

The Guide is designed to be flexible and scalable for various project sizes and complexity to fit the unique features of each site. It includes guidance about the information needed to describe potential changes to surface water quantity, quality and monitoring.

A summary of information to consider for your plan is included in Appendix A.



2. The Importance of Surface Water Management

Large projects that change land uses may negatively impact the hydrological cycle of watershed(s). For example, increased runoff from rain and snowmelt from a project site can lead to increased flow and degradation of water quality in watercourses and wetlands, and increased erosion and flooding. Changes to the hydrological cycle in the watershed(s) can also lead to loss of aquatic and wildlife habitats, reduction of clean water resources for human use, and impact health and safety.

Managing surface water is crucial to support sustainable water use and environmental protection, and to protect infrastructure and public safety. A good surface water management plan outlines how surface water (e.g., surface runoff, or storm water) is managed during and after the project to prevent adverse effects on the environment, infrastructure, and surrounding communities.

Below are some examples of when the Nova Scotia Environment and Climate Change (Department) may require a surface water management plan:

- as part of an approval application,
- as a requirement of a term and condition of an approval, or
- on the direction of a Department of Environment and Climate Change Inspector.

2.1. Determine Who Should Prepare a Surface Water Management Plan

Developing a surface water management plan requires specialized knowledge in hydrology and water management. A qualified professional with a level of experience appropriate for the scale of the projects should lead the development of the surface water management plan. For large-scale projects it is good practice to involve a team of professionals with expertise in all related fields (e.g., water resource management, environmental science and protection).

Appendix B presents a summary table for professionals who may be involved in developing a surface water management plan. The table is not an exhaustive list of professionals needed for a specific project. A professional may hold multiple roles in developing surface water management plans for a project.

It is the overall responsibility and due diligence of the project owner to ensure all qualified professionals retained in developing their surface water management plans can meet the needs of the project and regulatory requirements.

2.2. Essential Components of a Surface Water Management Plan

Surface water management plans will differ for each project due to the unique characteristics of each metal mine site. An effective surface water management plan includes the following information:

1. Project and Site Information
2. Scope of the Plan
3. Hydrological assessment
4. Planning and Designing of Surface Water Management Measures
5. Monitoring Program
6. Contingency Plan
7. Project Completion

3. Develop Your Surface Water Management Plan

3.1. Compile Project and Site Information

The project description is intended to provide an overview of the project and site features. This information is used to identify potential project interactions with groundwater, surface water and wetlands during all project phases. The following information should be included in your plan:

- ☐ Purpose and location of the project (with a map).
- ☐ A detailed description of activities on the site for all project phases, as applicable.
- ☐ Relevant meteorological data:
  - o Most recent Canadian Climate Normal data, as applicable.
  - o Historical Precipitation events (rainfall and snow).
  - o Historical temperature and trends.
  - o Evaporation and evapotranspiration, or any information for estimation of evaporation and evapotranspiration, as applicable.
  - o Climate change data, or climate change projections for the life of the project.
  - o Storm surge data, if the site is subject to potential storm surge impacts.
- ☐ Relevant hydrometric information:
  - o Streamflow data (e.g., discharge, water levels) from hydrometric stations.
  - o In-field measurements of streamflow, as applicable.
  - o Tidal water level, if the site is subject to coastal environment effects.
- ☐ Existing surface water network in and near the project site, such as:
  - o Watercourses (e.g., rivers, lakes).
  - o Wetlands.
  - o Water infrastructure (e.g., stormwater systems and drainage ditches, reservoirs, culverts, bridges, berms).

- ☐ Watershed delineation to understand how water naturally flows across the site, and where the site discharges to, by collecting and using information like:
    - o Topographic and geographic information such as 1:50000 topography maps.
    - o Aerial photography.
    - o GIS data.
    - o LiDAR.
    - o Land cover uses and vegetation.
    - o Site slopes.
- ☐ Land uses and soil data. Consider collecting information from, but not limited to:
    - o Soil Survey Reports for Nova Scotia.
    - o Global Soil Datasets.
- ☐ Flood risk and history (e.g., historical flood events, flood zones, flood mapping).

3.2. Define the Scope of Your Plan

The purpose of this section is to determine the scope of your surface water management plan to prevent adverse effects on the environment. Consider the regulatory requirements, project needs and establish management goals. Your plan should consider:

- o Applicable environmental regulations.
- o Applicable water quality guidelines and criteria for your project.
- o Flood risk mitigation.
- o Achieving water quality compliance criteria.
- o Sustainable water uses and conservation.
- o Climate change adaptation.
- o Erosion and sediment control.

It is good practice to consult with potential stakeholders early (e.g., regulatory agencies, local authorities and communities) to help set the goals of your surface water management.

3.3. Conduct a Hydrological Assessment

The purpose of a hydrological assessment is to analyze potential changes to the local hydrological cycle and water quality because of the project. A hydrological assessment can help quantify the potential impacts on surface water movement (e.g., runoff and streamflow on and near the site), as well as on surface water quality on site and in nearby water resources.

A hydrological assessment can help to inform surface water management systems and measures required to achieve the goals of the plan. It typically includes surface water quantity and quality assessments.

3.3.1. Assess Impacts on Surface Water Quantity

Surface water quantity assessment evaluates the input, movement, storage and output of surface water on a project site. It is essential for developing surface water management plans and designing surface water management systems and measures.

A water balance assessment (or model) is commonly used to complete surface water quantity assessments. A water balance quantifies inputs, outputs, and changes in water storage within a project site.

3.3.2. Assess Impacts on Surface Water Quality

Surface water quality assessments evaluate changes in the physical, chemical, and biological characteristics of water into and leaving the project site. The assessment helps predict the impact on water quality in nearby water resources.

Surface water quality monitoring is the most common method to collect information for surface water quality assessment. Modern hydrological models can account for both surface water quantity and quality changes due to project activities, and can integrate surface water, groundwater, climate, land uses, and human activities for more comprehensive and thorough assessment.

3.3.3. Address Key Considerations

Regardless of the method you use for hydrological assessment, the information provided in your surface water management plan should be sufficient to allow another person with similar background and experience to replicate the assessment and results. Additionally, the assessment or model should be updated regularly as new data becomes available.

The following should be included in your hydrological assessment and outlined in your surface water management plan:

- ☐ Details of the method (or model) used, including rationale for selecting the method (or model).
- ☐ Assumptions made to facilitate the method (or model), including associated references and justifications.
- ☐ Components studied (e.g., precipitation, runoff, infiltration, evapotranspiration, groundwater, water quality parameters).
- ☐ Details on input, as required to run the selected method (or model):
    - o Include data collected during the site overview.
    - o Include references and details to estimate parameters used as input (e.g., Thornthwaite Equation to estimate potential evapotranspiration).
- ☐ Proposed time frame of assessment (e.g., monthly intervals at a minimum), and
    - o Ensure the period for assessment covers the project lifespan, or any long-term period following project closure, when needed.
- ☐ Studied scenarios (e.g., rainfall events and site conditions):
    - o Consider scenarios that are appropriate for the phases and life span of the project (e.g., 1-year, 2-year, 5- year, 10-year, 100-year events).
    - o Consider climate change's impact on rainfall magnitude, in association with the project life span.
    - o Study different phases of work, and site conditions (e.g., pre-development, different phases during development, post-development).

- ☐ Evaluation of drainage capacity of existing surface water management systems and measures to determine if upgrades are necessary:
  - o Identify potential site drainage limitations and flood risks based on the predicted water flow.
  - o Use different rainfall events considered above to assess the performance of the existing surface water management systems and measures.
  - o Identify areas prone to flooding on site that require additional management.
- ☐ Description of potential changes to water quantity, and quality as applicable, for affected water resources. Include results and conclusions drawn based on the assessment:
  - o The estimated amount of surface runoff and associated site water movement patterns for different rainfall events and site conditions.
  - o Map all locations of site discharge, if applicable.
  - o Potential site drainage limitations and flood risks.
  - o Potential adverse effects on local water resources and environment, nearby infrastructure, and surrounding communities.
- ☐ Validation and analysis of uncertainties and associated risks and risk mitigation.
  - o Validate assessment results with in-field water quantity monitoring data, when applicable[1].

Hydrological assessments (or water balance assessment) should consider the duration of the project, and conditions following project closure, as applicable. The methods should be selected by the qualified professional leading the work and supported by detailed assumptions, references and justification. As well, inputs for the hydrological assessment should be appropriately referenced and justified with considerations for uncertainty in the assumptions made.

[1] When a hydrological model is used, a sensitivity analysis can help determine how inputs, parameters, or assumptions affect the model's outputs to identify and address the uncertainties and associated risks. This will help understand the robustness and reliability of the hydrological model in predicting hydrological changes (e.g., change in site runoff and flow in watercourses). Such an analysis is important when in-field monitoring data or information is not sufficient to support a thorough validation.

3.4. Plan and Design Surface Water Management Measures

The purpose of this section is to document the design and details of surface water management systems and measures for the site.

3.4.1. Select and Design Surface Water Management Systems and Measures

The result of a hydrological assessment informs the selection and design of surface water management systems and measures for the project. The following information should be included:

- ☐ Location and design details (purpose, design calculations, drawings, specifications), as applicable, for:
  - o At-source control measures (e.g., swales, detention basins or ponds) to maximize runoff retention at the source and promote natural infiltration.
  - o Drainage systems (e.g., drains, ditches) to collect, convey and manage runoff to prevent erosion and flooding.
  - o Conveyance systems that direct clean water offsite.
  - o Catch basins and sumps to collect and filter debris before it enters any other drainage system(s).
  - o Storage and attenuation systems and measures (e.g., ponds) to temporarily store excess runoff to reduce peak flow.
  - o Outfalls that release water offsite or to the environment (e.g., watercourses, wetland).
  - o Water quality control systems or water treatment systems when required.
- ☐ A description of how climate change impacts over the lifespan of the project were considered in the design and sizing of control measures.

Surface Water Management Systems are integrated systems designed to collect, store and convey surface water for intended purposes (e.g., environmental protection, water resources management). They are usually employed for large, and complex projects.

Surface Water Management Measures are specific actions or strategies to manage surface water (e.g. retention ponds). They can be part of a surface water management system.

3.4.2. Consider Additional Mitigations to Potential Adverse Effects

While surface water management measures like drainage ditches or retention ponds can reduce runoff from heavy rainfall, they may not be able to prevent erosion and control sedimentation alone, especially at sites with large amounts of exposed soils, steep slopes, or loose soils. In such cases, erosion and sediment control (ESC) measures such as vegetation, soil cover, erosion mats, silt fence, or others may be needed. More information can be found in the "Guide to Developing Erosion and Sediment Control Plans", as amended from time to time.

Changes to local hydrology due to project activities may impact nearby water resources and sensitive habitats (e.g., wetlands, lakes, rivers, groundwater). It is important to identify the predicted impacts to inform what, if any, additional approvals may be required (e.g. approvals for wetland alterations, watercourse alterations, water withdrawals and storage of water).

Consult with the Department to determine if any additional approvals (e.g., water-course or wetland alteration approvals) are required if the project may directly or indirectly affect nearby water resources.

3.5. Develop a Monitoring Program

A monitoring program tracks indicators that assess how effectively the plan meets the set goals. The monitoring program should:

- Assess the performance of surface water management systems and measures.
- Identify maintenance or repair requirements for surface water management systems and measures. Determine if the site requires additional measures or modifications due to repeated failures.
- Support maintenance planning for water quality control systems.
- Monitor site conditions during the project work for potential environmental risks and develop mitigation measures accordingly.
- Document site conditions throughout the project or post-project when necessary. Ensure the plan is implemented as designed.

- Provide information to support communication between the project team and regulatory agencies for effective surface water management and environmental protection.
- Support long-term monitoring, when required. Collect and provide information to plan for ongoing monitoring and adjustments to maintain surface water management system effectiveness after project closure.

As part of your surface water management plan, the following details about your monitoring plan should be included:

- ☐ Monitoring locations, including site discharge points or water resources on and near project site
- ☐ Monitoring method(s), such as visual inspections, water quantity and quality sampling, or a combination of both.
- ☐ Specific details for selected monitoring indicators or parameters.
- ☐ Monitoring method (e.g., site visits, continuous monitoring using in-situ/online devices, etc.) and criteria for assessing results[2].
- ☐ Monitoring frequency, specifying intervals such as daily, weekly, or during and after storm events.
- ☐ Approach for data analysis to assess performance. Consider statistical and analytical tools to analyze collected data.
- ☐ Record management, explaining how monitoring results will be documented and how records will be maintained for the duration of the project.

[2] Monitoring can include both water quantity and quality monitoring. Depending on the need of the project and surface water management, either or both water quantity and quality monitoring may be required to assist assessing the effectiveness of a surface water management plan and systems and measures. This monitoring can be included as part of an overall monitoring plan for a metal mine site.

Adaptive Management based on Monitoring

Monitoring can provide the basis for optimizing the surface water management plan and associated systems and measures to reduce costs while still achieving set goals to prevent adverse effects on the environment, infrastructure, and surrounding communities. Monitoring also provides records to demonstrate due diligence in compliance and environmental protection.

Documentation

Good documentation supports ongoing risk assessment in surface water management and ensures effective implementation. It also demonstrates due diligence in environmental protection and compliance with regulatory requirements. Maintain thorough records of actions to prevent and mitigate adverse environmental effects from your project. Documentation can be paper-based, electronic, or a combination of both. Regardless of the format, surface water management documentation typically includes:

- Completed inspection and monitoring reports.
- Notes and records on maintenance and repairs to surface water management systems and measures.
- Communication notifications and reports.
- Incident assessment and reports.
- Revisions to plans and additional measures. Date-stamped photographs with explanatory notes, and videos (with descriptions).
- Field notes and sketches to capture details that may be difficult to photograph.

3.6. Create a Contingency Plan

Emergencies or unforeseen events can occur on any site. A good contingency plan ensures a rapid and effective response with minimal disruption. In addition to the situations outlined in the Contingency Planning Guidelines, you may consider including contingencies associated with surface water management. Appendix C includes some common issues and best practices in a contingency plan for surface water management.

3.7. Incorporate Continuous Surface Water Management after Project Completion

Effective surface water management ensures the project site continues to meet the goals set in the surface water management plan after project completion. This section outlines your post-closure actions to ensure long-term sustainability, prevention of water-related risks, and protection of the environment and public safety.
Include the following, as applicable:

- ☐ Long-term surface water management goals and maintenance of surface water management systems:
  - o Develop a long-term maintenance plan, including monitoring, inspections, and maintenance (e.g., cleaning, sediment removal, repair of infrastructure, and vegetation management).
  - o Identify personnel and associated responsibilities for maintenance.
- ☐ Flood Risk Management:
  - o Reassess flood risks in the post-closure phase to ensure surface water management systems and measures continue to mitigate flooding effectively.
  - o Assess whether modifications or improvements to flood prevention measures are necessary due to potential land use or climate changes.
  - o Ensure natural flood plain functions are maintained where possible.
- ☐ Water Quality Management:
  - o Periodically monitor water quality of site runoff and discharge, especially during and after storm events. This is particularly important for sites previously used for industrial or construction activities, where contaminants may be present.
  - o Assess whether additional water treatment measures are needed if the land use changes after project closure (e.g., from industrial to recreational or residential).
  - o Implement management systems and measures to manage water quality.
- ☐ Erosion and Sediment Control:
  - o Develop a long-term ESC plan as per the Guide to Developing Erosion and Sediment Control Plans.

4. Complete Your Plan

4.1. Share Your Plan with Staff

Once you complete your plan, ensure all staff (including those working on the site and responsible for oversight of the project) are familiar with it.

Keep a copy of the plan on site for staff reference and make it available to an Environment Inspector of the Department upon request.

4.2. Update and Revise Your Plan as Needed

An effective surface water management plan should be dynamic and adapt to changing site conditions. Anytime you update the surface water management plan, communicate the changes to staff so they are aware and can adapt their work as required.

Treat the surface water management plan as a living document; ongoing revisions will help project or site owners ensure sufficient measures remain in place to protect the environment.

Always document revisions to the plan.

Appendix A
Summary of Information for a Surface Water Management Plan

It is the responsibility and due diligence of the project owner to develop and implement a surface water management plan to prevent adverse effects on the environment. Consider the following questions when preparing your surface water management plan:

- Does the plan include sufficient information to understand the site conditions and potential adverse effects on surface water resources from the project?
- Has the project design sufficiently considered the adverse effects with feasible, realistic, and appropriate mitigations proposed?

The surface water management plan should include adequate assessment of the potential changes, interactions and alterations to water resources due to project activities, as well as selected mitigation measures with necessary design details. The information summary below can help those who need a plan. You can use the summary to guide your plan preparation, while using Section 3 of this Guide to assist you in preparing the details to include for each item.

Information in the summary below should be provided when applicable to the project

Section 1 - Project Overview and Site Conditions

- ☐ Purpose and location of the project (with a map)
- ☐ A detailed description of the project's goals and methodology
- ☐ Timelines of proposed activities, including all phases and associated components of the project, as applicable
- ☐ Applicable Meteorological data
- ☐ Applicable Hydrometric information.
- ☐ Existing surface water network in and near the project site
- ☐ Watershed delineation and supporting information
- ☐ Land uses and soil data
- ☐ Flood risk and history

NOTE: *Include the methodology used to collect the above-mentioned information. Include necessary notes in the map(s) or drawing(s) of the site that help to explain the overview and results. Provide adequate references for all information sources included in your plan (e.g., 1:50000 topography maps, Canadian Climate Normals, Soil Survey Reports, etc.).*

Section 2 - Scope of the Surface Water Management Plan

- ☐ Scope of the plan, such as
  - o Compliance with regulatory requirements
  - o Meet water quality guidelines and criteria
  - o Flood risk mitigation
  - o Sustainable water uses and conservation
  - o Climate change adaptation
  - o Erosion and sediment control

Section 3 - Hydrological Assessment

- ☐ Method (or model) used for assessment
- ☐ Details of the method (or model) and rationale for selecting the method (or model)
- ☐ Assumptions made with associated references and justifications
- ☐ Components studied (e.g., precipitation, runoff, infiltration, evapotranspiration, groundwater, water quality parameters)
- ☐ Input, as required to run the selected method (or model) with references and details to estimate parameters used as input
- ☐ Time frame of assessment, as applicable
- ☐ Studied scenarios (e.g., rainfall events and site conditions)
- ☐ Evaluation of drainage capacity of existing surface water management systems and measures
- ☐ Potential changes to water quantity, and quality as applicable, for affected water resources
- ☐ Validation and analysis for uncertainties and associated risks and risk mitigation
- ☐ Potential adverse effects on local water resources, the environment, nearby infrastructure, and surrounding communities

Section 4 - Surface Water Management Systems and Measures

- ☐ Location for surface water management systems and measures
- ☐ Purpose of selected systems and measures
- ☐ Design calculations, drawings and specifications, as applicable
- ☐ Climate change impacts on the design of systems and measures, as applicable

Section 5 - Performance Monitoring

- ☐ Monitoring locations, methodology, parameters and frequency.
- ☐ Approach for data analysis to assess performance.

Section 6 - Contingency Plan

- ☐ Potential emergency or unforeseen events related to surface water management
- ☐ Actions to take

Section 7 - –Project Closure

- ☐ Long-term surface water management goals and maintenance of surface water management systems
- ☐ Flood risk management
- ☐ Water quality management
- ☐ Long-term erosion and sediment control

Appendix B
Qualified Professionals who can be involved in Surface Water Management Plan Development

PROFESSIONALS	ROLES
Water Resources Engineer or professionals with equivalent experience	Assess hydrological conditions of the project site and surrounding areas, which helps design surface water management systems and measures.
Environmental Engineer or professionals with equivalent experience	Design or support design of systems and measures to manage surface water runoff, water quality, and pollution control. They integrate hydrological data and work on sustainable solutions to ensure that water discharge meets environmental standards.
Project specific engineer or professionals	Focus on specific project design and activities (e.g., mining engineer for a mine project). Provide information on project planning, construction and operation, including any spatial design and layout, to ensure surface water management systems and measures are well integrated into the project work.
Civil Engineer	Focus on infrastructure design and associated construction and operation, including the surface water management systems (e.g., ditching and drainage systems).
Geotechnical Engineer	Analyze soil properties and how soils interact with surface water, especially regarding the stability of the ground and erosion risks and associate mitigations.
Water Quality Specialist	When needed, focus on analyzing and ensuring contaminants from project activities are controlled and treated effectively so water quality is maintained, or water quality criteria are met.

PROFESSIONALS	ROLES
Site Professional – Contaminated Site	When needed, make sure all work and documents comply with the relevant provisions of the Environment Act and Contaminated Sites Regulations. A Site Professional must be a registered Engineer or Geoscientist with at least five years relevant work experience in contaminated site work (investigation, management and remediation).
Biologist, Ecologist, or professionals with equivalent experience	Assess potential impacts on local ecosystems, including aquatic environments (e.g., fish and fish habitat) and provide recommendations for minimizing ecological damage.
	In addition, the following staff should be considered for successful implementation of the surface water management plan.
Project Manager	The project manager coordinates the implementation of the surface water management plan, ensuring that all aspects of the surface water management plan are integrated into the broader project.
Regulatory Compliance Specialist, Environmental Consultant, or person with equivalent experience	Ensure that the surface water management plan adheres to all relevant environmental, water management, and safety regulations. Coordinate and oversee environmental assessments, ensure compliance with regulatory requirements, and help integrate surface water management into broader environmental protection plan.
Environmental Health and Safety (EHS) staff	Ensures that all surface water management work complies with health and safety standards, protecting workers, local communities, and ecosystems.

Appendix C
Contingency Planning for Surface Water Management

The Nova Scotia Contingency Planning Guidelines have been developed to assist organizations in preparing a contingency plan. They outline the requirements under the Environment Act or regulations made pursuant to the Act.

The information below serves as best practices to help supplement contingency plan design to address contingencies commonly encountered in surface water management.

COMMON CONTINGENCIES RELATED TO SURFACE WATER MANAGEMENT

1. FLOOD EVENTS

Determine areas prone to flooding during heavy rainfall or storm events and snowmelt. Consider the risks of overflow or system failure.

RESPONSE PROCEDURE:

- Develop and implement flood forecasting and early warning systems. Establish emergency flood barriers or diversion channels.
- Ensure quick mobilization of resources for flood response, including evacuation plans and communication strategies.

2. DROUGHT

Evaluate how reduced precipitation may affect water supply, runoff patterns, and impact site surface water management systems.

RESPONSE PROCEDURE:

- Implement drought contingency measures, such as alternative water sourcing strategies (e.g., groundwater, recycled water).
- Incorporate water use efficiency and conservation through reduced consumption or water-saving strategies (e.g., rainwater harvesting) and adjust project operations to adapt to dry conditions.
- Update the Surface Water Management plan to address reduced runoff. Regularly inspect and maintain surface water management systems and measures to ensure effectiveness under lower flow conditions. Increase water quality monitoring and management practices to assess the need for more water quality control measures.

3. RELEASE OF SUBSTANCE AND POLLUTION

Identify risks of potential contamination from releases or project activities such as industrial discharges, agricultural runoff, sewage overflows, or chemical spills that could degrade local water quality.

RESPONSE PROCEDURE:

- Prepare emergency response strategy for containing and cleaning up hazardous substances.
- Consider adding temporary shut-off systems to water intakes or surface water management systems with additional treatment measures.
- Coordinate with local government and environmental agencies to monitor and mitigate pollution impacts.

4. INFRASTRUCTURE FAILURE

Assess the risk of surface water management system failures, pipeline leaks, or the malfunction of water treatment facilities that may impact surface water management performance.

RESPONSE PROCEDURE:

- Maintain an up-to-date inventory of critical infrastructure and emergency maintenance protocols.
- Establish backup systems, such as backup power supplies, alternate water treatment facilities, or diversion channels, to ensure reliability in case of failure.

5. LAND USE CHANGES

Consider how developments in surrounding areas may alter watershed hydrology and change runoff, requiring adjustments to surface water management systems.

RESPONSE PROCEDURE:

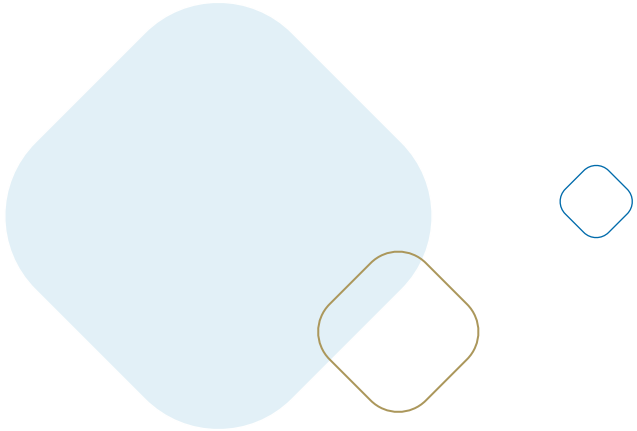
- Plan additional capacity for surface water management systems and measures.
- Plan additional surface water quality management measures when land use changes lead to increased needs for water quality management.

6. CLIMATE CHANGE

Plan for long-term shifts in rainfall and storm patterns, temperatures, and sea levels that could impact surface water management.

RESPONSE PROCEDURE:

- Develop climate adaptation strategies, including water conservation and infrastructure design considerations (e.g., increases size of detention ponds, additional capacity of ditches).
- Implement new technologies to address changing climate conditions.



Appendix D
List of Applicable Hydrological Models

This is not an exhaustive list of all hydrological models that are used for hydrological assessment. The list only provides information on some hydrological models seen in the past for the purposes of hydrological assessment. This list is for information purposes only. The Department does not endorse any of the methods listed below.

MODEL	OPEN SOURCE /FREE	TYPICAL APPLICATIONS
SCS Curve Number	Yes	Runoff estimation
Rational Method	Yes	Runoff estimation
SWAT	Yes	Watershed-scale studies
HEC-HMS	Yes	Precipitation-runoff simulation
TOPMODEL	Yes	Topography-based runoff estimation
HBV	Yes	Stream flow simulation and flood forecasting
MIKE SHE	No	Integrated hydrological simulation
VIC	Yes	Large scale hydrology and climate impact analysis
MIKE 11	No	River flow routing
HEC-RAS	Yes	Water flow simulation in rivers and channels
WEAP	Yes	Water resource management planning
SWMM*	Yes	Urban stormwater estimation
InfoWorks ICM	No	Integrated urban drainage and river flow modeling
SRM	Yes	Snowmelt runoff simulation
SNOW-17	Yes	Snow accumulation and snow melt simulation dynamics

*There are several commercial models developed based on the SWMM, such as PCSWMM

Appendix E
List of Common Data Sources to Support Development of a Surface Water Management Plan

This list only includes some commonly used data and relevant sources to support hydrological assessments and prepare surface water management plans. This list is not an exhaustive list of data sources that may be used or required to support the development of a surface water management plan.

The information listed below includes references and website links to third-party resources. It is only for information purposes. Users of this information are encouraged to verify the information independently and consult the original sources where appropriate.

DATA SOURCE	**TYPE OF DATA**	**DATA PUBLISHER AND WEBSITE LINK** (IF APPLICABLE)
CANADIAN CLIMATE NORMALS	Average climatic conditions of a particular location. Historical precipitation, historical temperature	Environment and Climate Change Canada https://climate.weather.gc.ca/climate_normals/index_e.html
CLIMATE CHANGE DATA	Tool to access, visualize, and analyze climate data, and provides related information and tools to support adaptation planning and decision-making	ClimateData.ca https://climatedata.ca
CLIMATE CHANGE PROJECTIONS	Climate trends and projections	Environment and Climate Change Canada https://www.canada.ca/en/environment-climate-change/services/climate-change/canadian-centre-climate-services/basics/trends-projections.html
STORM SURGE	Storm surge data	Government of Canada - Open Government Portal https://open.canada.ca/data/en/dataset/de1a9911-8893-11e0-82c2-6cf049291510
TIDAL WATER	Tides, currents, and water levels	Fisheries and Oceans Canada https://www.tides.gc.ca/en Tides and water levels data archive https://tides.gc.ca/en/tides-and-water-levels-data-archive

COASTAL HAZARD MAP	General information on highwater coastal lines and projected flooding information	Government of Nova Scotia https://nsgi.novascotia.ca/chm
STREAMFLOW DATA	Water level and flow rate in watercourses	Water Survey of Canada https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey.html
GEONOVA	Watercourses and wetlands, topographic and geographic information	Government of Nova Scotia https://geonova.novascotia.ca/
PROVINCIAL LANDSCAPE VIEWER	Watercourses and wetlands, protected areas, crown lands	Government of Nova Scotia https://novascotia.ca/natr/landscape/
NOVA SCOTIA LAKE MAPPING TOOL	Watercourses and wetlands	Government of Nova Scotia https://nse.maps.arcgis.com/apps/webappviewer/index.html?id=7ded7a30bef44f848e8a4fc8672c89bd
NOVA SCOTIA TOPOGRAPHIC DATABASE – LAND COVER	Land cover information	Government of Nova Scotia https://open.canada.ca/data/dataset/1c5afbb5-0a23-3d0e-54c4-744aec42a69b
SOIL SURVEY FOR NOVA SCOTIA	Soil survey reports	Agriculture and Agri-Food Canada https://sis.agr.gc.ca/cansis/publications/surveys/ns/index.html
GLOBAL SOIL DATASETS	Nova Scotia Detailed Soil Survey information	Government of Canada - Open Government Portal https://open.canada.ca/data/en/dataset/083534ca-d5b0-46f5-b540-f3a706dbc2de
FLOOD MAPPING	Flood mapping data	Natural Resources Canada https://natural-resources.canada.ca/science-data/science-research/flood-mapping/data-related-flood-mapping
FLOOD RISK AND HISTORY	Flood risk and history information	Government of Canada - Open Government Portal https://ouvert.canada.ca/data/dataset/d3a95098-7eb3-85f4-9a2a-9c173830d562


NOVA SCOTIA