LAKE MANITOBA
LAKE ST. MARTIN

OUTLET CHANNELS PROJECT

MANITOBA TRANSPORTATION AND INFRASTRUCTURE

Surface Water Management Plan

June 30, 2022

Manitoba
Transportation and Infrastructure

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DISCLAIMER

This document was developed to support the Environmental Management Program (EMP) for the Lake Manitoba and Lake St. Martin Outlet Channels Project (the Project). It has been prepared by Manitoba Transportation and Infrastructure as a way to share information and facilitate discussions with Indigenous rights-holders, stakeholders and the public. It has been prepared using existing environmental and engineering information and professional judgement, as well as information from previous and ongoing public and Indigenous engagement and consultation. The contents of this document are based on conditions and information existing at the time the document was prepared and do not take into account any subsequent changes. The information, data, recommendations, and conclusions in this report are subject to change as the information has been presented as draft. This draft plan should be read as a whole, in consideration of the entire EMP, and sections or parts should not be read out of context.

Revisions to draft plans have been informed by and will be based on information received from the engagement and consultation process, the Environmental Assessment process, Project planning activities, and on conditions of provincial and federal environmental regulatory approvals received for the Project. As these will be living documents, any changes to the plans that occur after Project approvals are received will be shared with regulators, Indigenous rights-holders and stakeholders prior to implementation of the change. Either a revision number or subsequent amendment would be added to the specific environmental management plan to communicate the revision or change.

PREFACE

The Lake Manitoba and Lake St. Martin Permanent Outlet Channels Project (the Project) is proposed as a permanent flood control mitigation for Lake Manitoba and Lake St. Martin to alleviate flooding in the Lake St. Martin region of Manitoba. It will involve the construction and operation of two new diversion channels: the Lake Manitoba Outlet Channel (LMOC) will connect Lake Manitoba to Lake St. Martin and the Lake St. Martin Outlet Channel (LSMOC) will connect Lake St. Martin to Lake Winnipeg. Associated with these outlet channels are the development of bridges, control structures with power connections, a new realignment of Provincial Road (PR) 239, and other ancillary infrastructure.

Manitoba Transportation and Infrastructure is the proponent for the proposed Project. After receipt of the required regulatory approvals, Manitoba Transportation and Infrastructure will develop, manage and operate the Project. This Surface Water Management Plan (SWMP) is one component of the overall Environmental Management Program (EMP) framework, which describes the environmental management processes that will be followed during the construction and operation phases of the Project. The intent of the EMP is to facilitate the timely and effective implementation of the environmental protection measures committed to in the Project Environmental Impact Statement (EIS), the requirements and conditions of the provincial licence issued under *The Environment Act*, the federal Decision Statement issued under the *Canadian Environmental Act 2012*, and other approvals received for the Project. This includes the verification that environmental commitments are implemented, monitored, evaluated for effectiveness, and adjustments made if/as required. It includes a commitment that information is reported back in a timely manner for adjustment, if required.

A key component for the success of the EMP is environmental monitoring, such that environmental management measures are inspected and modified for compliance with environmental and regulatory requirements, including those set out in provincial and federal approvals received for the Project. As indicated, monitoring results will be reviewed and used to verify predicted environmental assessment conclusions and effectiveness of mitigation measures. If unanticipated effects occur, or if mitigation measures are inadequate, adaptive management measures and subsequent monitoring will be applied as described further in individual environmental management and monitoring plans.

Monitoring results and application of adaptive management measures will inform follow-up reporting to regulators and any required revisions to environmental management plans. Manitoba Transportation and Infrastructure has initiated discussions with rights-holders and the Rural Municipality (RM) of Grahamdale in the Project area on the establishment of an Environmental Advisory Committee (EAC). The EAC would be a platform for sharing monitoring results and discussing issues of concern. In addition, Manitoba Transportation and Infrastructure anticipates that the EAC will coordinate Indigenous Environmental Monitors and communications during the construction period and will be working with rights-holders and stakeholders on its structure and purpose.

Manitoba Transportation and Infrastructure remains committed to consultation and ongoing engagement with Indigenous rights-holders and stakeholders that are potentially impacted by the Project. Detailed EMP review discussions were incorporated into Indigenous group-specific consultation work plans. Engagement opportunities included virtual open house events, sharing draft environmental management and monitoring

plans, sharing plan-specific questionnaires, and meetings to discuss related questions and recommendations. The intent has been to offer multiple avenues to share information about the Project so that rights-holders and stakeholders would be informed and could provide meaningful input into Project planning. The original draft EMP plans and questionnaires that were posted on the Project website for public review and comment are being replaced by the second draft of each plan as it becomes available. Feedback and recommendations received were used to update the current version of the draft plans, which are posted to the Project website at: https://www.gov.mb.ca/mit/wms/lmblsmoutlets/environmental/index.html.

Figure A displays a summary of the EMP process. The EMP provides the overarching framework for the Project Construction Environmental Management Program (CEMP) and the Operation Environmental Management Program (OEMP). These will be updated prior to Project construction and operation, respectively, and will consider applicable conditions of *The Environmental Act* provincial licence, *Canadian Environmental Assessment Act 2012* federal Decision Statement conditions and other approvals, any other pertinent findings through the design and regulatory review processes, and key relevant outcomes of the ongoing Indigenous consultation and public engagement processes. Until such time, these plans will remain in draft form.

The purpose of the CEMP and OEMP is to guide how environmental issues will be addressed during construction and operation, respectively, and how adverse effects of activities will be mitigated. The CEMP is supported by several specific or targeted management plans that will guide Manitoba Transportation and Infrastructure's development of the Project's contract documents and subsequently, the Contractor(s) activities, in an environmentally responsible manner and to meet regulatory compliance in constructing the Project. The OEMP will include some of the same targeted plans developed to manage issues during construction, but prior to construction completion, they would be revised and adapted to suit the specific needs during the operation phase.

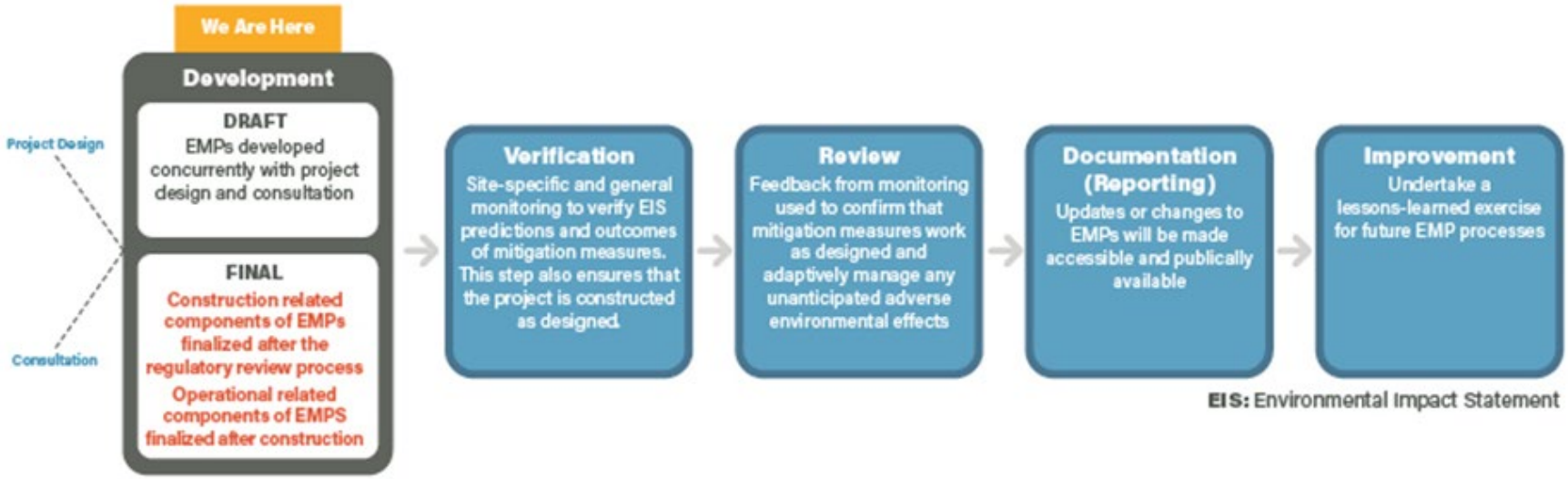

Figure A: EMP Process

LIST OF ACRONYMS AND GLOSSARY OF TERMS

Acronyms

AEMP	Aquatic Effects Monitoring Plan
CCME	Canadian Council of Ministers of the Environment
CEMP	Construction Environmental Management Program
CSP	corrugated steel pipes
DFO	Fisheries and Oceans Canada
DO	Dissolved Oxygen
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Program
ft	feet
EOC	Emergency Outlet Channel
GCS	Gradient Control Structure
GWMP	Groundwater Management Plan
IMP	Ice Management Plan
km	kilometre
LAA	Local Assessment Area
LMOC	Lake Manitoba Outlet Channel
LSMOC	Lake St. Martin Outlet Channel
m	metre
mm	millimetre
m/s	metres per second
m^3/s	cubic metres per second
mg/L	milligrams per litre
MWQSOG	Manitoba Water Quality Standards, Objectives and Guidelines
NTU	Nephelometric Turbidity Unit
OEMP	Operation Environmental Management Program

O&M	Operation and Maintenance
PAL	Protection of Freshwater Aquatic Life
PDA	Project Development Area
PR	Provincial Road
the Project	Lake Manitoba and Lake St. Martin Permanent Outlet Channels Project
PTH	Provincial Trunk Highway
QA	quality assurance
QC	quality control
RM	Rural Municipality
ROW	right-of-way
RVMP	Revegetation Management Plan
SMP	Sediment Management Plan
SWMP	Surface Water Management Plan
TSS	Total Suspended Sediment
WetMP	Wetland Monitoring Plan
WCS	Water Control Structure

Glossary of Terms

Aquatic life: Organisms temporarily or permanently living or found in water.

Aquatic vegetation: Submerged, floating-leaved and floating plants that only grow on or beneath the water surface. Submerged plants may be rooted in soils or free-floating.

Aquifer: A body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant or economic quantities of groundwater to wells and springs.

Aquitard: A confining bed and/or formation composed of rock or sediment that retards but does not prevent the flow of water to or from an adjacent aquifer. It does not readily yield water to wells or springs, but stores groundwater.

Artesian: A body of rock or sediment containing groundwater that is under greater than hydrostatic pressure: that is a confined aquifer. When an artesian aquifer is penetrated by a well, the water level will rise above the top of the aquifer; a flowing artesian well is when the water level will rise above ground surface.

Baseline: Initial environmental conditions, prior to construction or anthropogenic actions.

Bedrock: The solid rock that lies beneath the soil and other loose material on the Earth's surface.

Carbonate aquifer: See Aquifer; see Carbonates. Refers to an aquifer comprised of a carbonate bedrock.

Carbonates: A rock made up primarily of carbonate minerals (minerals containing the CO3 anionic structure). Examples: limestone, dolostone, and marble (metamorphosed limestone or dolomite) are the most commonly encountered carbonate rocks.

Cofferdam: An enclosure, usually only partially obstructing a river, from which water is pumped to expose the bottom to permit construction.

Confined aquifer: An aquifer that is bounded above and below by formations of distinctly lower permeability than that of the aquifer itself. An aquifer containing confined ground water. See artesian.

Contract Administrator: refers to the individuals, entities or groups delegated by Manitoba Transportation and Infrastructure to provide professional Engineering and Consulting Services for the Permanent Outlet Channels Project. This includes oversight of construction and maintenance contracts and operations; review of contractor submittals, plans and proposals for compliance with Project commitments and restrictions and making recommendation for acceptance or rejection of such plans by the Owner; and monitoring, inspecting, documenting and enforcing compliance with contractual and regulatory requirements.

Contractor: refers to the individuals, entities or groups contracted by Manitoba Transportation and Infrastructure to undertake specific Project construction, operation or maintenance activities, and includes all subcontractors and affiliates.

Depressurization: Action of decreasing hydrostatic pressure. Active depressurization involves the use of pumps. Passive depressurization does not involve the use of pump, but rather uses a relation between hydrostatic pressure elevation and topographic elevation.

Detailed Design: The project phase where structural engineering design principles and applicable design codes are utilized to produce a structural design complete with Drawings and tender documents in sufficient detail to construct the specific structure/rehabilitation identified as the preferred alternative from the preliminary design phase. While detailed design is primarily structural in nature, it may also include the development of the hydraulic, hydrotechnical, geotechnical, environmental and traffic control aspects of the project to support the structural design of the bridge or structure.

Dewatering: Removal or draining groundwater or surface water from a riverbed, construction site, caisson, or mine shaft, by pumping or evaporation.

Discharge: Rate of outflow; volume of water flowing down a river, from a lake outlet, or man-made structure.

Dissolved oxygen: Oxygen molecules (O_2) dissolved in water.

Electrical Conductivity: A measure of the ability of a solution to conduct electrical flow; units are microSiemens per centimetre.

Environmental Monitor: refers to the individuals, groups or designated representatives engaged by Manitoba Transportation and Infrastructure to monitor, inspect, and document compliance with contractual and regulatory requirements associated with the construction activities and associated works for the Project. The monitor may also be an active member (or representative) of the Project's Environmental Advisory Committee.

Groundwater: Water that occurs beneath the land surface and fills the pore spaces of soil or rock below saturated zone.

Hydraulic profile: The graphical representation of the water level through the channel based on the water level of the receiving water, control points, and the head loss.

Hydrocarbon: A group of chemicals made up of carbon, hydrogen, and oxygen, including gasoline and oil.

Inspector: refers to the individuals or designated representatives delegated by Manitoba Transportation and Infrastructure to monitor, inspect, document, and enforce compliance with contractual and regulatory requirements associated with the construction and/or maintenance activities and associated works for the Project.

Invert (channel): The stream bed or floor within a structure or channel.

Piezometric pressure: A measurement at a discrete location expressing the potentiometric surface which is an imaginary surface representing the pressure of groundwater in an aquifer that is defined by the level to which water will rise in a well.

Pool: A deep, slow-moving area of a stream; an artificially confined body of water above a dam or weir.

Preliminary Design: An engineering process undertaken at the pre-structural design phase. For structures, preliminary design includes some or all of the following: collection of survey information, preliminary foundation report (including soils investigation), hydrological analysis, hydraulic analysis and design, hydrogeological investigation, historical ice thickness and ice levels, condition assessment, geometric design, traffic forecasting, hazard protection, site location, environmental determinations, consideration of traffic accommodation, identification of constructability issues and possible construction staging, development of

alternatives for advancement to structural design, life cycle cost analysis of alternatives, evaluation and selection of the preferred replacement structure/rehabilitation work. This phase in the design process typically supports the pre-construction engagement and consultation process with the public and Indigenous groups, as well as the environmental submissions that satisfy environmental and/or regulatory requirements.

Recharge: Water added to an aquifer or the process of adding water to an aquifer.

Rights-holders: include First Nations, Metis Communities and other Indigenous communities who hold Aboriginal or Treaty rights that are protected under Section 35 of the Constitution Act 1982. Commonly, these include hunting, trapping, fishing or gathering rights.

Rip-rap: A lightweight stone covering used to protect soil or surface bedrock from erosion by water or the elements.

Runoff: Surface water that flows overland and into streams, wetlands or waterbodies, or into drainage systems.

Shoreline morphology: The outward appearance (shape, structure, color, pattern, size) of the narrow strip of land in immediate contact with the sea, lake or river.

Suspended sediment: Particulate matter that is held in the water column due to movement of the water.

The Owner: refers to Manitoba Transportation and Infrastructure or a designated representative delegated by Manitoba Transportation and Infrastructure with overall responsibility for, and oversight of, Project design, construction and operation.

Till: An unstratified, unconsolidated mass of boulders, pebbles, sand and mud deposited by the movement or melting of a glacier.

Turbidity: A measure of the relative clarity of water.

Water table: The upper surface of the zone of saturation in an unconfined aquifer.

Waterbody: Standing and flowing surface waters (such as a creeks, rivers, lakes, and wetlands with open water), including seasonally and ephemerally occurring surface waters.

Part 1: Introduction

1.0 PURPOSE AND SCOPE

The Surface Water Management Plan (SWMP) is a component of the overall Environmental Management Program (EMP) for the Lake Manitoba and Lake St. Martin Permanent Outlet Channel Project (the Project). The Project will involve the construction and operation of the Lake Manitoba Outlet Channel (LMOC), the Lake St. Martin Outlet Channel (LSMOC) and associated components such as bridges, water control structures (WCS) with power connections, a new realignment of Provincial Road (PR) 239, and other ancillary infrastructure, as described in the EMP Framework. The construction methodology for the LMOC and LSMOC is described in the Construction Environmental Management Program (CEMP).

The purpose of the SWMP is to describe the measures to be used to mitigate or avoid impacts to local surface water during construction and operation of the LMOC and the LSMOC. These include methods to manage local runoff (both inside and outside of construction areas), and the associated potential transport and deposition of sediments beyond construction areas and into off-site receiving water bodies. The SWMP also identifies preliminary monitoring requirements to confirm mitigations are effective and the process for identifying and implementing adaptive measures if measures are not effective. This document does not cover methods used by the province for managing surface water at a larger regional / drainage basin level, nor how operation of the LMOC and LSMOC will function within the provincial flood management system. Operation of the project will occur in accordance with the Project Operating Guidelines.

The SWMP supports the requirements described in Section 2.5 of the Project Environmental Requirements (PERs) regarding Working Near Water. Section 2.5 defines this as any and all activities occurring below the ordinary high-water mark of a waterbody, and that apply to work in or near fish-bearing and non-fish bearing waterbodies, dewatering, temporary diversions, temporary crossings and access pads, stream crossings (bridges and culverts), blasting near a waterbody, debris and sedimentation removal, and water quality monitoring.

The SWMP is intended to be a living document that will be refined over the life of the Project and will be updated as detailed design advances and various aspects are implemented, incorporating lessons learned and applicable engagement feedback provided via regulators, stakeholders and/or rights-holders.

Different surface water management strategies are required for the LMOC and the LSMOC as these distinct components of the Project are located in substantially different hydrologic settings. The LMOC, for example, is located in a well-developed agricultural area with an established drainage network, whereas the LSMOC is located in an undeveloped wetland and forested area. Furthermore, the strategies for handling local surface water drainage differ between the two channels as their specific designs impact on how surface water can be managed. Given these overarching site-specific differences, the SWMP is organized into three parts:

- Part 1 contains general information that is common to both the LMOC and LSMOC.

- Part 2 contains information that is specific to the LMOC.
- Part 3 contains information that is specific to the LSMOC.

A number of other environmental management and monitoring plans are being developed for the Project that deal with aspects of water management, including a Groundwater Management Plan (GWMP), Aquatic Effects Monitoring Plan (AEMP), a Sediment Management Plan (SMP), an Ice Management Plan (IMP) and a Wetland Monitoring Plan (WetMP). The SWMP and other related environmental management and monitoring plans may be updated during/following detailed design based on input from engagement processes and environmental approvals, permits and licenses. Regional and operational surface water monitoring is included in the AEMP.

2.0 OBJECTIVES

The SWMP has been developed to address the following objectives:

- Describe measures to manage local surface water during and after construction of the LMOC and LSMOC, and the associated potential for erosion, transport and deposition of sediments and pollutants beyond construction areas and into off-site receiving water bodies.
- Summarize monitoring plans for surface water quality and quantity in the vicinity of the LMOC and LSMOC to verify that the measures implemented meet requirements and identify additional contingency measures to be considered for implementation in the event of emergency conditions or undesirable circumstances.

3.0 MANAGEMENT CRITERIA

3.1 General Considerations

The management criteria used for the development of the SWMP are based on experience with other similar large-scale projects and will be updated, as required, considering Project risks, costs, and input from on going engagement and consultation and the environmental regulatory review processes. As indicated, Section 2.5 of the PERs discusses requirements for Working Near Water. Managing activities near water requires adherence to criteria that dictate what is acceptable and when actions are required. This includes a combination of design measures, monitoring, and water quality criteria.

3.2 Water Quality Criteria

Water quality management controls during Project construction will be designed by the Contractor, in accordance with contract requirements and with approval from Manitoba Transportation and Infrastructure or the Contract Administrator, to allow discharge into waterbodies using various methods of containment, treatment and discharge. The actions will be guided by a combination of the results of visual inspections and testing, where appropriate as determined by the Inspector, and meeting appropriate Manitoba Water Quality Standards, Objectives and Guidelines (MWQSOG) objectives and Canadian Council of Ministers of the Environment (CCME) and Federal Environmental Quality Guidelines for the protection of aquatic life in waterbodies. In combination with observable changes in surface water (e.g., oil sheens, sediment plumes), these guidelines form the basis of the adaptive management and follow-up measures described in Sections 7.0 and 11.0 of this document and the relevant adaptive management sections of the other EMPs.

3.3 Design Criteria

3.3.1 Lake Manitoba Outlet Channel

For the construction phase, the water management controls related to the SWMP for the LMOC will be designed, constructed, and maintained to manage precipitation and surface run-off. Additionally, to prevent soil erosion and discharge of sediment-bearing water runoff, erosion and sediment control measures will be designed, installed and maintained until construction is completed and/or vegetation has been established on disturbed areas. These measures are further described in the SMP.

For the operation phase, the permanent works related to the management of local surface water runoff for the LMOC will be designed as follows:

- The design discharge for the outside drain will be based on the 1 in 10-year runoff event from the contributing area west of the channel alignment. This event was selected to be in line with current provincial drainage standards typically applied in rural settings.

- Average velocities within the outside drain to be less than 1.0 metres per second (m/s) during the design runoff event, with appropriate erosion protection measures used in areas where hydraulic conditions exceed this criterion.
- The design of drainage crossing structures (i.e., culverts) will comply with Manitoba Transportation and Infrastructure Water Control & Structures' Structures Design Manual.

Since surface water in the vicinity of the LMOC is not being used for drinking, drinking water quality standards do not apply. Should a runoff event or series of runoff events be experienced that exceeds the design criteria, then the impacts will be evaluated, and contingency measures as described in Section 7.3 implemented, if required.

3.3.2 Lake St. Martin Outlet Channel

For the construction phase, the water management controls related to the SWMP for the LSMOC will be designed, constructed and maintained to manage precipitation, surface run-off. Additionally, to prevent soil erosion and discharge of sediment-bearing water runoff, erosion and sediment control measures will be designed, installed and maintained until construction is completed and/or vegetation has been established on disturbed areas. These measures are further described in the SMP.

For the operation phase, the permanent works related to the management of local surface water runoff for the LSMOC will be designed as follows:

- The outside drain will be designed to maintain shear stress in the channel below the adopted erosion threshold value of 6 Pascals for clay and clay till during the 1 in 10-year runoff event. It will also convey flows up to the 1 in 10-year runoff event without causing inundation of adjacent land. Select portions of the outside drain that are incised in mineral soil through high topographic areas will be maintained in a similar manner as other provincial drains across Manitoba. Other portions of the drain that cut through peat will have minimal maintenance. The hydraulic roughness of the drain will change over time from growth of vegetation in the unmaintained areas. At those locations, this will result in higher water levels in the drain. Under this condition, the design allows for some inundation of adjacent land during the 1:10 year runoff event without damaging LSMOC infrastructure.
- Rockfill Gradient Control Structures within the outside drain are designed to incur minimal damage at the 1 in 25-year event and accommodate the 1 in 200-year event without significant risk of complete failure (i.e., washout of structure).
- Flow from the outside drain will either discharge directly into Lake Winnipeg, or into the LSMOC through a drainage control structure (i.e., culverts) at the downstream end.

Since surface and ground water in vicinity of the LSMOC is not being used for drinking, drinking water quality standards do not apply. Should a runoff event or series of runoff events be experienced that exceeds the design criteria, then the impacts will be evaluated, and contingency measures as described in Section 11.3 implemented, if required.

Part 2: Lake Manitoba Outlet Channel

4.0 SOURCES OF WATER

4.1 Surface Water

Surface water includes the runoff contribution from snowmelt and rainfall within the LMOC area (i.e., the excavated area) as well as any additional runoff from outside of the LMOC area that naturally or artificially drains towards the LMOC.

Existing drainage in the region around the LMOC generally flows towards the lower lying area between Watchorn Bay on Lake Manitoba and Birch Bay on Lake St. Martin. This low-lying area includes Watchorn Creek, draining south to Lake Manitoba, with Reed Lake, Clear Lake, Water Lake, Goodison Lake and Birch Creek draining north to Lake St. Martin. The proposed LMOC will be located immediately to the west of this low-lying area and will block existing drainage paths originating from the west.

Figure 1 shows the overall catchment area for the watershed, along with the delineation of the nine western sub-basins that will be blocked by the LMOC. The drainage areas for these sub-basins are listed in Table 1. The total existing drainage area for Birch Creek is approximately 295 square kilometres (km^2) and for Watchorn Creek is approximately 93 km^2.

Table 1: Characteristics of Sub-Basins Blocked by the LMOC

Sub Basin Name	Drainage Area (km^2)
W150 - West	2.7
W840 - West	20.8
W840A - West	5.1
W610-West	17.8
W550 - West	3.5
W530-West	19.5
W510 - West	1.1
W490 - West	10.6
W490A - West	0.4

The blockage of surface water runoff by the LMOC will reduce the drainage area of Birch Creek and Watchorn Creek by approximately 27% and 3%, respectively.

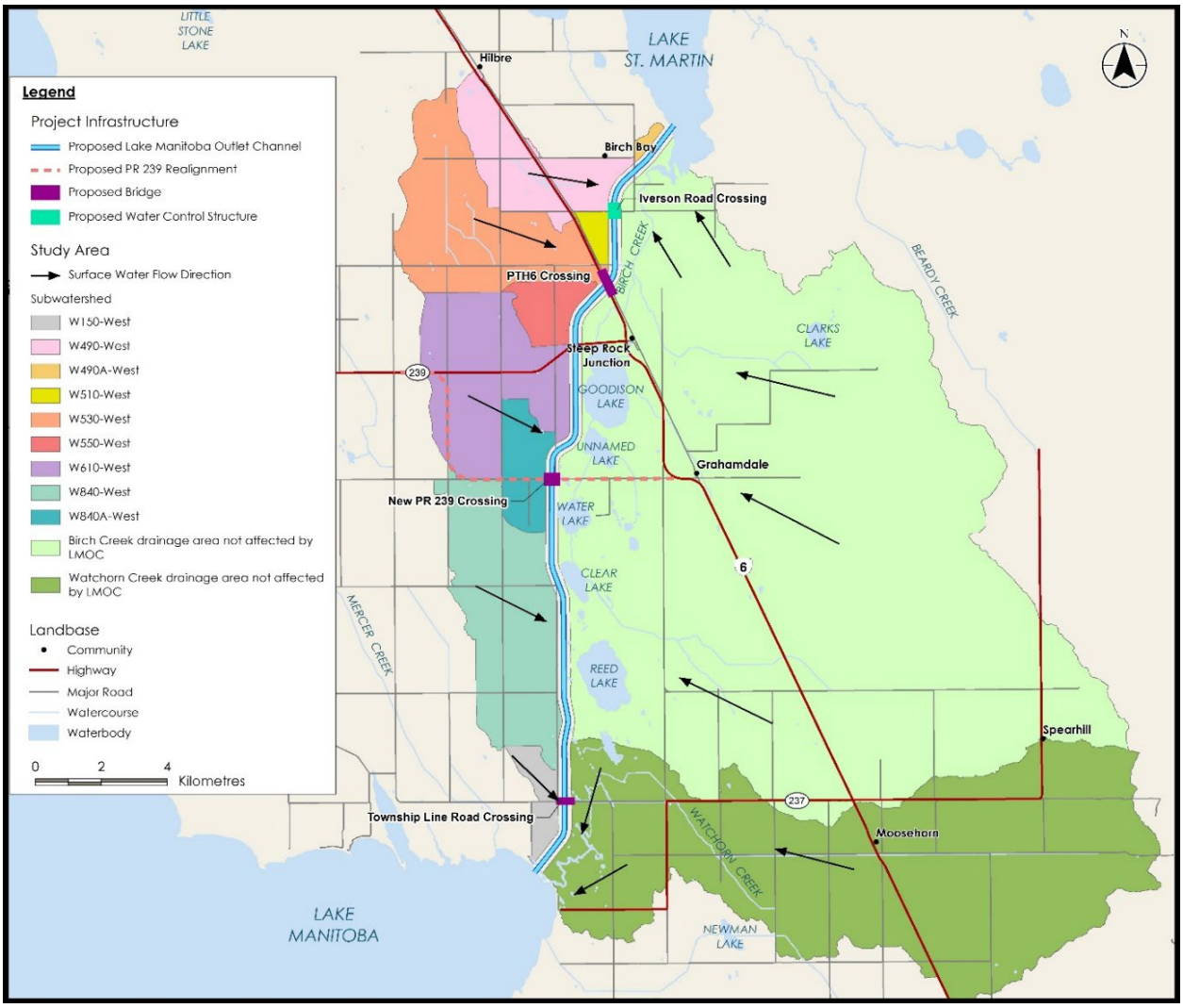

Figure 1: Surface Water Catchment Areas in Vicinity of the LMOC

4.2 Groundwater

The bedrock aquifers in the study area are composed of the Paleozoic rock sequence commonly referred to in Manitoba as the "Carbonate Aquifer System" and is considered to be the principal aquifer in the region. The primarily used aquifer in the LMOC region (referred to as the Upper Carbonate Aquifer) resides approximately in the highly fractured upper 30 metres (m) of bedrock. In areas where the bedrock aquifer pressures are elevated relative to the thickness of the confining till aquitard units, particularly during channel excavation and unloading of the confining aquitard units, there is a risk of basal heave/hydraulic fracturing of the till.

During construction, active depressurization (pumping from wells) will be undertaken to lower the pressure head in the bedrock aquifer in the vicinity of the channel alignment. Depressurization wells will be placed at select locations along the LMOC construction perimeter with each well releasing groundwater from the confined aquifer to the surface, thereby reducing aquifer pressure.

During operation, passive depressurization along the channel will take place via depressurization wells and reverse drains. Depressurization wells will passively release groundwater into the LMOC, while reverse drains will involve excavating to the bedrock and infilling with coarse material. The coarse material will act as a cover and provide the higher hydraulic conductivity required to allow water to flow upward from the bedrock aquifer into the LMOC. More information on groundwater and groundwater management is available in the GWMP.

4.3 Processed Water

Processed water consists of any water considered to be a direct product of the construction activities only and, as such, may require the implementation of mitigation measures, such as settling ponds and/or chemical remedies to meet regulatory requirements. Potential sources of processed water for the LMOC will be defined during detailed design and may include, but are not limited to:

- Dewatering of excavation areas.
- Accidental spills and releases.
- Leachate from rock stockpiles and structures containing rock exposed to surface waters and/or drainage.
- Control and treatment of sewage water from any construction camps that may be established.
- Blasting (if required).

5.0 SURFACE WATER MANAGEMENT

The management measures to control and mitigate environmental effects are described in the following sections, and as indicated, are developed to support the requirements in the PERs.

5.1 Construction Phase (Temporary Measures)

Temporary measures will be required during construction to manage surface water to improve constructability, control the potential for erosion and manage sediments. The specific measures will depend on construction staging and sequencing until the permanent works are completed. Construction methods for temporary drainage works will consider the erosion and sediment control measures described in the SMP.

No untreated wastewaters will be released to the environment from Project construction sites, including construction camps and staging areas. Wastewater will be treated by acceptable industry methods before being released.

5.1.1 Channel Works

Channel works include construction activities related to the LMOC, excluding the inlet and outlet works, WCS and road bridges. The primary method of managing surface water during construction of the channel works will be via a permanent outside drain, which will be constructed in advance of the channel excavation. The outside drain will be located along the west side of the LMOC to intercept the watershed runoff originating from the west (which will include drainage from a portion of the realigned and upgraded section of PR 239) and prevent it from flowing into the construction zone. The outside drain will also be used to convey water from local construction dewatering and groundwater depressurization works along the LMOC. The drain will be sloped from a highpoint to be established where realigned PR 239 will cross the drain. Water in the outside drain north of this location will drain to Lake St. Martin, while water south of this location will drain to Lake Manitoba, as shown on Figure 2. Permanent culvert crossings will be constructed where the outside drain crosses Township Line Road, Provincial Trunk Highway (PTH) 6 and Iverson Road, while temporary culverts will be installed where it crosses existing PR 239, as well as other construction detours as required. The design of the permanent outside drain is described further in Section 5.2.1.

Surface water naturally flows away from the east side of the LMOC toward the existing wetlands and creeks. Accordingly, no outside drain will be required on that side of the channel. Management of surface water flows and groundwater seepage within the channel excavation will be the responsibility of the Contractor. Pumping will be required for construction of the channel works to manage surface water runoff within the excavation and to facilitate aquifer depressurization requirements.

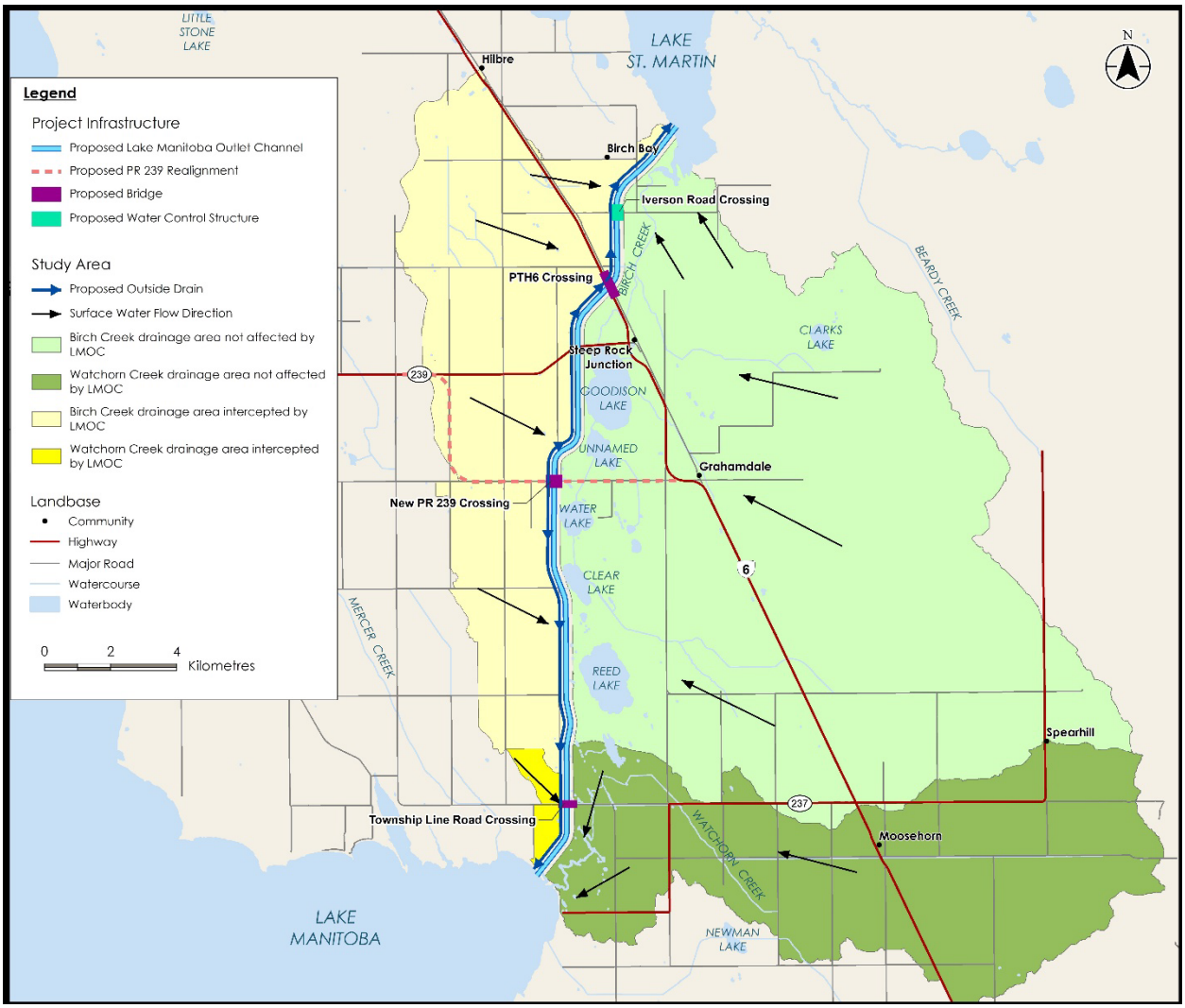

Figure 2: LMOC Outside Drain Arrangement

Water from within the work area will be treated, as required, to comply with the water quality criteria outlined in Section 3.1. Settling ponds will be constructed, as deemed necessary, prior to discharge into the outside drain and/or the waterbodies east of the LMOC, or at alternate locations that may be approved by Manitoba Transportation and Infrastructure during construction. As described in Section 5.2, the primary method to prevent or minimize the potential for erosion will be through the establishment of permanent vegetation. Until vegetation is established, temporary erosion and sediment control measures will be employed during construction, as described in the SMP.

5.1.2 Inlet Works

The inlet works, will consist of excavating the lake bottom within an approximately 140 m long by 215 m wide area of Lake Manitoba (Watchorn Bay). This excavation is expected to take place "in-the-wet" with the construction area isolated by a double turbidity curtain (i.e., two separate turbidity curtains) to prevent or minimize the migration of disturbed sediments into the lake during construction. A fish salvage program will be required within the isolated area which will be developed and conducted in accordance with Section 2.5.5 of the PERs.

Installation and removal of the double turbidity curtain, as well as the excavation work itself, will comply with Fisheries and Oceans Canada (DFO)'s Restricted Activity Timing Windows (https://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/mb-eng.html), and will be completed in accordance with the conditions outlined in the DFO Authorization. Removal of the curtain would occur once monitored water quality parameters on both sides of the curtain are similar and meet the criteria outlined in Section 3.1.

Specific methods of construction within the area will be determined by the Contractor, in accordance with contract document and with approval from Manitoba Transportation and Infrastructure or the Contract Administrator. Alternate construction methods may be proposed, such as isolating the area with a cofferdam that would be constructed behind a turbidity curtain. In this case, any water that must be pumped outside of the work area would be discharged into settling ponds, if necessary, prior to release into Lake Manitoba.

5.1.3 Outlet Works

The outlet works will consist of excavating the lake bottom within an approximately 140 m long by 115 m wide area of Lake St. Martin (Birch Bay). Construction activities and measures to manage surface water during construction will be similar to the inlet works, as described in Section 5.1.2.

5.1.4 Water Control Structure

As is also the case for the channel works, pumping will be required for construction of the water control structure (WCS) to manage surface water runoff within the excavation and to facilitate aquifer depressurization requirements. The WCS work area will be isolated from the rest of the channel construction work areas to reduce the amount of pumping required and to prevent additional surface water runoff from entering the construction area. Other potential sources of water include various types of processed water, as described in Section 4.3. Management of surface water flows and groundwater seepage within the excavation will be the responsibility of the Contractor.

Water from within the work area will be treated, as required, to comply with the water quality criteria outlined in Section 3.1. Settling ponds will be constructed adjacent to the work area, as deemed necessary, prior to discharge into the outside drain and/or the waterbodies east of the LMOC, or at alternate locations that may be approved by Manitoba Transportation and Infrastructure during construction.

5.1.5 Road Bridges

As is also the case for the channel works, pumping will be required for construction of the bridges to manage surface water runoff within the excavation and to facilitate aquifer depressurization requirements. The bridge work areas will be isolated from rest of the channel construction work areas to reduce the amount of pumping required and to prevent additional surface water runoff from entering the construction area. Other potential sources of water include various types of processed water, as described in Section 4.3. Management of surface water flows and groundwater seepage within the excavation will be the responsibility of the Contractor.

Water from within the work area will be treated, as required, to comply with the water quality criteria outlined in Section 3.1. Settling ponds will be constructed adjacent to the work area, as deemed necessary, prior to discharge into the outside drain and/or the waterbodies east of the LMOC, or at alternate locations that may be approved by Manitoba Transportation and Infrastructure during construction.

5.1.6 PR 239 Realignment

Management of surface water flows associated with the PR 239 realignment will be the responsibility of the Contractor. It is anticipated that existing ditches along the PR 239 realignment route will be used for the conveyance of surface water runoff during its construction with appropriate erosion and sediment control measures in place.

5.1.7 Sediment Management

A separate SMP for the control of erosion and sediment has been prepared for the Project. The SMP identifies temporary and permanent measures that will be incorporated during construction until vegetation has been established on disturbed areas to prevent or minimize the potential for erosion and to mitigate the transport and deposition of sediments beyond construction areas and into off-site receiving water bodies. These measures will be developed to meet requirements outlined in the provincial environmental license and federal decision statement conditions.

5.2 Operation Phase (Permanent Measures)

Once construction is complete, surface water from outside of the Project area (i.e., west of the channel) will continue to be managed with the permanent outside drain used to facilitate management of runoff during construction, as described in Section 5.2.1. Surface water runoff within the right-of-way (ROW) of the LMOC will either discharge into the LMOC or away from the channel.

Temporary erosion and sediment control measures will be maintained until vegetation has fully established, and it is confirmed that the water quality criteria outlined in Section 3.1 can be maintained in the long term. Refer to the SMP and Revegetation Management Plan (RVMP) for further details.

Construction of the LMOC will result in a reduction to the catchment area of Birch Creek and Watchorn Creek, as described in Section 4.1. Plans to address the potential effects to these waterbodies are discussed in the Aquatic Offsetting Plan. Construction of a small, gated control structure through the east dike of the LMOC at Rafkillsen Road is under consideration that could be used to augment flows in the lower Birch Creek with water from the channel, and thus reduce the flow reduction in this portion of Birch Creek due to the reduction in the drainage area caused by presence of the LMOC. Additional details on this proposed structure are described in Section 5.2.2.

5.2.1 Outside Drain

The outside drain that will be initially constructed to facilitate management of runoff during construction, as described in Section 5.1.1, will be utilized as part of the permanent drainage works for the LMOC to collect surface water runoff arriving from the west and convey it into Lake Manitoba and Lake St. Martin, as shown previously on Figure 2. On the east side, surface water naturally flows away from the LMOC toward the existing wetlands and creeks. Accordingly, no outside drain will be required on that side of the channel.

The preliminary hydraulic design of the outside drain was based on a trapezoidal channel shape with 4H:1V side slopes and sized for the 1 in 10-year runoff event. The drain base width varies between 4 m and 25 m. The outside drain invert and longitudinal slopes were set to follow the existing ground elevation profile to reduce excavation depths, while also keeping the design water surface profile at or below the existing prairie level, as well as the inverts of the existing lateral drains that will discharge into it, so as to not result in backwater effects during the 1 in 10-year runoff event with Lake Manitoba and the south basin of Lake St. Martin at the upper end of their normal operating ranges (i.e., el. 247.65 m [812.5 feet (ft)] and el. 243.84 m [800.0 ft], respectively). No diking is required along the west side of the outside drain to accommodate the passage of the 1 in 10-year runoff event.

Figure 3 and Figure 4 show the hydraulic profile for the south and north reach of the outside drain for the 1 in 10-year runoff event, respectively.

The outside drain is designed to be non-eroding during passage of the 1 in 10-year runoff event by keeping average velocities below 1.0 m/s. Higher velocities are expected in the steeper portions of the north reach near Iverson Road and where the outside drain connects to Lake St. Martin. Permanent gradient control structures are anticipated to be required in these areas to accommodate the higher velocities and control erosion. The configuration of these gradient control structures will be determined during detailed design.

Permanent culvert crossings will be required under Township Line Road, PTH 6 and Iverson Road, which will be designed to Manitoba Transportation and Infrastructure Water Control & Structures design requirements. It is presently anticipated that 3–1800-millimetre (mm) diameter corrugated steel pipes (CSP) (i.e. culverts) with be required at Township Line Road, while 2-1500 mm diameter CSPs will be required at Iverson Road. The crossing at PTH 6 is anticipated to consist of a single 2400 mm x 2400 mm cast-in-place concrete box culvert. All culverts will be embedded into the bed of the outside drain by 300 mm.

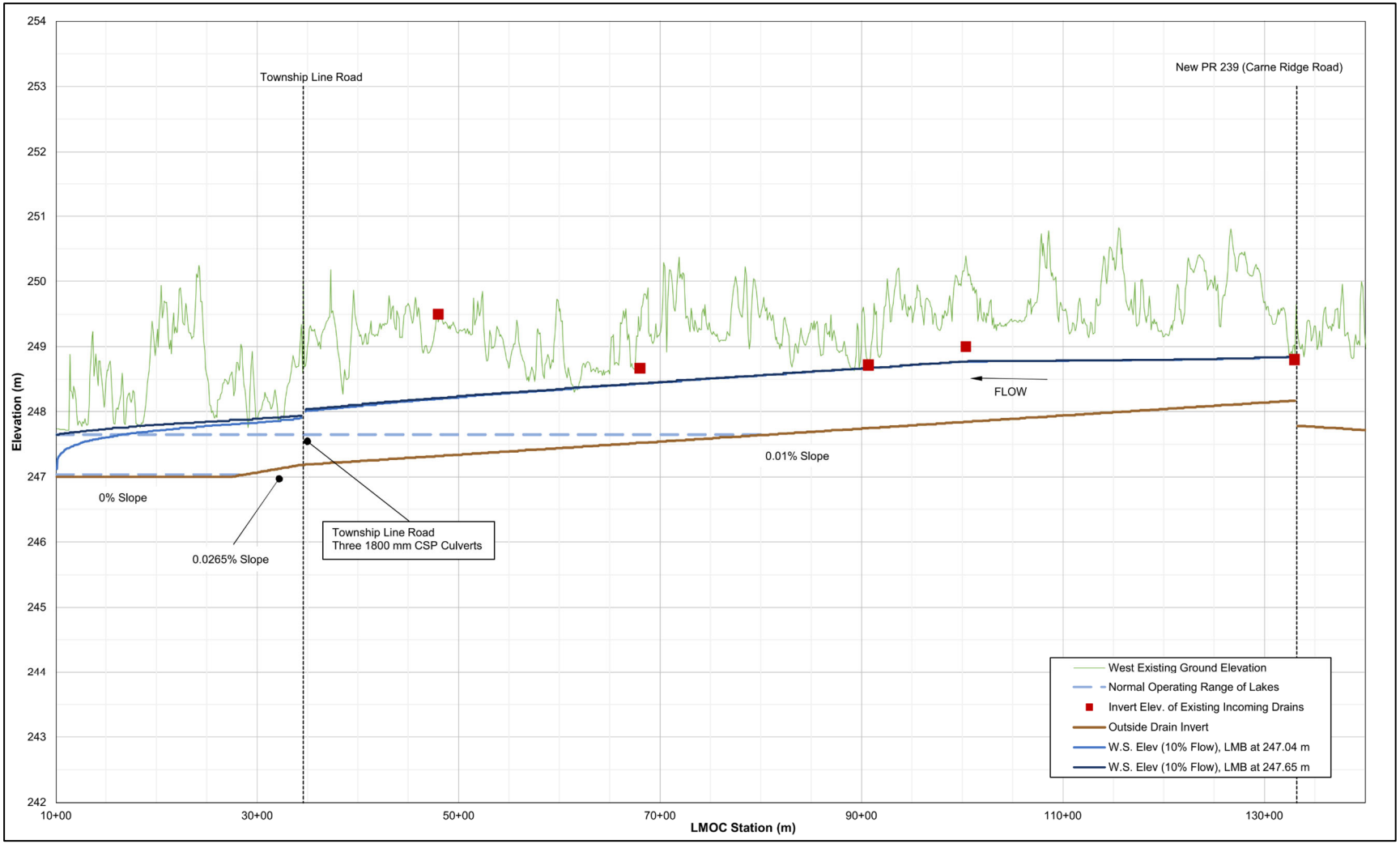

Figure 3: LMOC Outside Drain Profile – South Reach

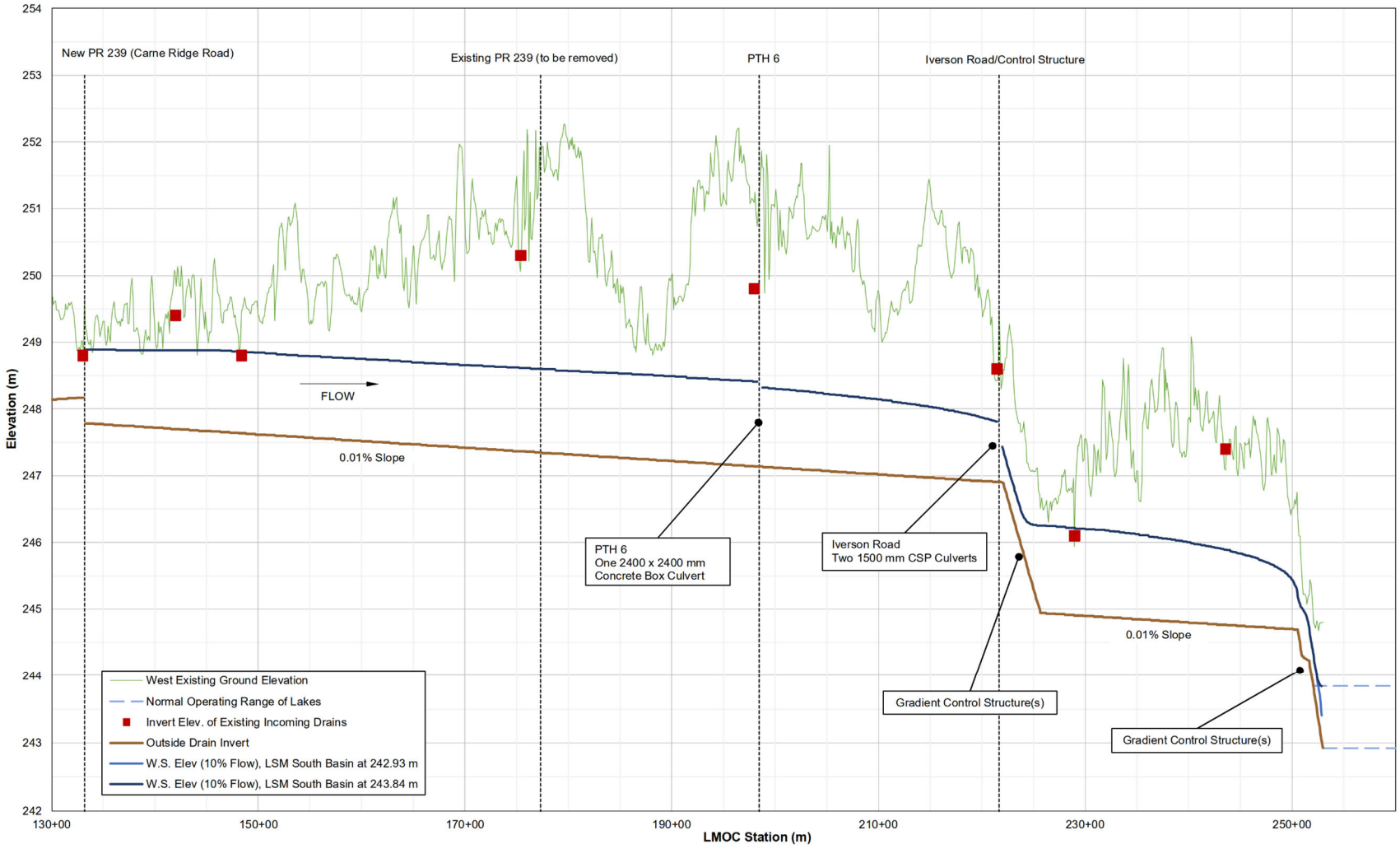

Figure 4: LMOC Outside Drain Profile – North Reach

Consideration is being given to incorporating passive wetland treatment in order to mitigate potential effects of agricultural runoff that may enter the outside drain. Such wetlands could be located immediately downstream of agricultural operations in order to facilitate filtering of runoff prior to it leaving those sites. In addition, natural vegetation will grow in the shallow water depths within a portion of the outside drain near where it discharges into Lake Manitoba which will provide some additional filtering of runoff. Water quality monitoring, in the outside drain and near the discharge point to the lake will be undertaken to assess if additional measures are needed.

5.2.2 Augmentation of Birch Creek Flows

Consideration is being given to constructing a small, gated control structure where the undeveloped Rafkillsen Road Government Road Allowance intersects the LMOC, which is located between PTH 6 and the proposed WCS at Iverson Road. The purpose of the proposed structure (which is referred to as the Birch Creek Flow Augmentation Structure) would be to allow for the controlled release of LMOC water into the lower Birch Creek in order to restore flow that will be lost due to the reduction in the drainage area caused by the construction of the LMOC.

The proposed structure would be comprised of a gated conduit with concrete headwalls built through the east channel bank. The conduit would be approximately 1 m in diameter and would accommodate conveyance of a flow rate of up to 0.5 cubic metres per second (m^3/s) by gravity into an approximately 490 m long discharge channel that would be constructed along the undeveloped Rafkillsen Road Government Road Allowance and tied-into Birch Creek. Riprap protection would be installed at the downstream end of the conduit to control erosion and assist in dissipating the energy of the released flow.

The Birch Creek Flow Augmentation Structure would only be operated during open-water periods when the LMOC WCS gates are closed, and thus would be designed to accommodate water levels in the LMOC that reflect the normal operation range of Lake Manitoba (i.e., el. 247.04 m to 247.65 m [810.5 ft to 812.5 ft]). The structure's gate would be utilized to control the amount of flow released and the timing of the releases to coincide with critical fish spawning periods in Birch Creek.

5.2.3 Conditions in the LMOC

Expected flow sources into the LMOC include discharge from Lake Manitoba (when the WCS gates are open) and runoff originating from within the LMOC ROW. Water will be present throughout the LMOC when the WCS gates are closed. Under this condition, the water level in the channel upstream of the WCS will be equal to the water level on Lake Manitoba, and on the downstream side of the WCS it will be equal to the water level on Lake St. Martin.

When the WCS gates are initially opened, the water level in the LMOC will drop approximately 2.8 m immediately upstream of the WCS and will increase in the upstream direction such that it is equal to the level of Lake Manitoba at the inlet. Immediately downstream of the WCS, the water level in the LMOC will rise by approximately 0.6 m and will decrease in the downstream direction such that it is equal to the level of the south basin of Lake St. Martin at the outlet. Water levels along the channel will then rise and fall in response to the levels of Lake Manitoba and Lake St. Martin.

The mode of operation of the LMOC is such that some revegetated portions of the channel side slopes (above the channel armouring) will experience alternating periods of submergence (wet) and exposure (dry). This could lead to zones where vegetation may not survive or grow well, thus making these portions of the slopes potentially susceptible to erosion. Measures to mitigate this risk are discussed in the RVMP and the SMP.

5.2.4 Revegetation Plan

Maintaining and establishing a vegetation cover along the LMOC is fundamental to minimizing the erosion potential, during both its construction and operation. The revegetation approach will be dynamic and flexible in terms of its implementation under potentially challenging hydrological conditions and is described further in the RVMP.

6.0 MONITORING

6.1 Baseline Monitoring

Figure 5 identifies baseline surface water quality monitoring locations. Baseline water quality data have been collected between 2016 and 2021 for waterbodies in the vicinity of the LMOC. Baseline data will form the basis of comparison to monitor for changes in surface water quality in waterbodies in the vicinity of the LMOC during construction and for two years post-construction. Additional data collected since 2021 will be added to the data compilation prior to construction. Sites for baseline monitoring in the vicinity of the LMOC were selected to represent the variety of waterbodies that may be impacted by construction of the LMOC. In addition, as described in the WetMP, baseline wetland surface water quality monitoring is planned in the vicinity of LMOC prior to construction.

Figure 5: LMOC Baseline Surface Water Quality Monitoring Locations

6.2 Construction Phase Monitoring

6.2.1 Overview

Surface water will be monitored during construction to identify changes that may result from construction activities along the LMOC and to assess the effectiveness of proposed mitigations and the SMP. If the water quality criteria identified in Section 3.1 are exceeded and attributed to the Project, then additional mitigation measures would be considered, as described in Section 7.0. Where monitoring results show impacts that are not attributed to the Project, information will be provided to Manitoba Environment, Climate, and Parks.

LMOC construction-phase surface water monitoring will be conducted for the duration of the construction phase. The frequency and location of sample stations included in the program will change as the construction staging advances. Determination of frequency and location of samples will also be based on:

- environmental considerations described in the Project EIS
- proximity and potential for change to local fish-bearing receiving waters as a result of the works
- monitoring plans being developed for the Project as part of other management plans (such as the AEMP, the GWMP and Wetland Management Plan)
- input from engagement processes and regulatory input.

Monitoring plans are provided in the sub-sections that follow related to:

- discharges from construction areas
- surface water quantity and quality in lakes and streams in the vicinity of the LMOC
- sediment monitoring for in-lake excavation and commissioning activities
- cattle operation runoff.

6.2.2 Discharge from Construction Areas

Effects on surface water quality from the construction of the Project were predicted in the environmental assessment (EA) process. The Project may affect surface water quality via introduction of sediment to waterbodies, discharge of groundwater to surface water, and accidental spills and leaks during Project construction.

Water quality criteria outlined in Section 3.2 for the protection of aquatic life will be met where water is discharged from the Project construction area to waterbodies (see EPP mapbooks for delineation of such areas within the Project Development Area [PDA]). An Environmental Monitor on site will implement a monitoring program for turbidity, total suspended sediment (TSS), dissolved oxygen (DO), and other relevant parameters at discharge points at an appropriate frequency to confirm compliance.

Sediment in Discharges

Sediment monitoring of construction site discharges will include general observations during routine surveillance activities (i.e., areas of exposed soil and/or sediment plumes) and monitoring of turbidity using hand-held sampling devices. The objective of monitoring TSS and turbidity during construction activities is to confirm that sediment mitigation measures and erosion and sediment controls are effective and that

discharges from the Project construction area are managed appropriately before release to waterbodies. The monitoring results will be used to inform adaptive management of construction activities to reduce construction related increases in suspended sediment concentrations. This monitoring plan will be modified as needed in the field to complement the construction activities as they are developing; however, general guidelines for sediment monitoring of construction site discharge are as follows:

- Consider site-specific waterbody characteristics, including receiving waterbody size and width, water depth, water velocity and flow (i.e., laminar flow vs. turbulent flow). Monitoring transects may be established where background and downstream water samples may be collected in a manner that captures changes in suspended sediment concentrations near the construction site. Where a visual plume is observed, a sample will be taken from the middle of the plume and as close to the source as safely possible. Water samples will be at 50% water depth where water is less than 1 m deep. Where waterbodies are greater than 1 m deep, samples will be taken at 20% and 80% of water depth at each transect sample point and results averaged.
- When sediment introduction to the waterbodies is likely, turbidity sampling will be completed at appropriate intervals. If turbidity levels remain constant and low, the sample frequency may be reduced, or halted altogether, as directed by the Inspector.
- Daily turbidity monitoring records will be kept and maintained during construction and will be available on site. Upon completion of construction activities, a final construction monitoring report with all sampling and testing data will be produced.

Other Parameters in Discharges

Where water discharged from the Project construction area may exceed CCME-Protection of Freshwater Aquatic Life (PAL) guidelines and MWQSOG-PAL objectives as outlined in Section 3.1, an Inspector or Environmental Monitor will sample such water prior to discharge to a waterbody for appropriate parameters (DO, temperature, conductivity, and pH) which may be altered by groundwater discharge.

Spills and Leaks

An Inspector or Environmental Monitor will visually inspect discharges from the Project construction area for indications of spills and leaks, such as sheen and foam. In the event of a release during Project construction, contractors will follow their own spill response plans, which will have been reviewed and approved by Manitoba Transportation and Infrastructure as part of their contract submittals. The PERs describe measures to address accidents and spills, including reporting, cleanup, compliance training, inspection, and enforcement.

6.2.3 Surface Water in Local Waterbodies

Surface water monitoring during construction will include collection of surface water quality samples and water level measurements within the vicinity of the LMOC. Water levels are anticipated to be monitored at selected locations in small lakes along Birch Creek using staff gauges and/or continuous level recorders, to be determined during the detailed design phase. This monitoring will be incorporated in the SWMP at detailed design, as required, in consideration of other EMP requirements.

Proposed surface water quality monitoring sites will include previously established baseline sites in the vicinity of the LMOC (see Section 6.1). Monitoring locations may be adjusted as designs are advanced and additional engagement input is received from regulators, rights-holders, and public stakeholders. They will also be positioned to address any relevant regulatory approvals conditions. Proposed water quality parameters to be monitored for are listed in Table 2 including routine chemistry, total and dissolved nutrients, carbon, total and dissolved metals (including mercury), bacteria, hydrocarbons, and pesticides. Monthly open-water sampling at these monitoring sites is planned during active construction in the vicinity of the monitoring sites. Methylmercury in fish tissue and chlorophyll *a* monitoring are included in the AEMP during Project commissioning.

All surface water quality samples will be collected following standard procedures, will be submitted to an accredited laboratory for analysis, and subject to standard quality assurance (QA)/quality control (QC) processes.

Table 2: Proposed Surface Water Quality Monitoring Parameters

Water Quality Parameters	
Field Parameters	DO; Electrical Conductivity; Oxidation Reduction Potential; pH; Temperature; Turbidity
General Chemistry	Alkalinity, Bicarbonate (as CaCO3); Alkalinity, Carbonate (as CaCO3); Alkalinity, Hydroxide (as CaCO3); Alkalinity, Total; Hardness (as CaCO3); Total Dissolved Solids; Major ions (Sulfate; Chloride; Fluoride; Sodium; Potassium)
Sediment	TSS
Microbiological Parameters	*Escherichia coli (E.Coli);* Fecal Coliforms
Nutrients/Carbon	Ammonia (as N); Nitrate (as N); Nitrite (as N); Total Kjeldahl Nitrogen; Nitrogen (Total); Phosphorus, Total; Phosphorus, Total (Dissolved); Phosphorus, Total (Particulate); Phosphate (PO4), dissolved and reactive; Dissolved Organic Carbon (DOC); Dissolved Inorganic Carbon (DIC); Total Organic Carbon (TOC); Total Inorganic Carbon (TIC)
Petroleum Hydrocarbons	Benzene; Toluene; Ethylbenzene, Xylene (BTEX); Hydrocarbons
Metals	Standard Total/Dissolved Metals Scan (including Mercury)
Pesticides	Glyphosate; Organochlorinated

6.2.4 Sediment Monitoring for In-Lake Excavation and Commissioning Activities

A detailed in-lake real-time TSS monitoring program will be implemented during construction to monitor the magnitude of spatial, and temporal changes in TSS concentrations within the vicinity of the PDA during in-lake construction (inlet and outlet works) and commissioning activities. The monitoring program design is based on the expected construction effects on the sedimentation regime in Watchorn Bay and Birch Bay, and recent experience on other construction projects in the Province of Manitoba. Details can be found in Appendix 2A of the SMP.

6.3 Operation Phase Monitoring

Collection of surface water quality samples and water level measurements at previously established baseline sites will continue following construction of the LMOC. This monitoring will initially be carried out during the first two years post-commissioning, the intent of which is to confirm the effectiveness of construction mitigations and site restoration measures. This duration may be extended depending on the monitoring results, environmental conditions present and success of revegetation.

The frequency and locations of the water quality monitoring conducted during the 2 year post-commissioning period will be based on specific environmental conditions present, success of revegetation, and adjusted, as required, based on the monitoring results. Water quality monitoring parameters are expected to be consistent with those monitored during the construction phase, as summarized in Section 6.2.

Longer-term operation monitoring (which includes consideration of the frequency of use of the LMOC) will take place beyond the 2-year post-commissioning period as outlined in the AEMP and the Operation and Maintenance (O&M) Manual.

6.4 Cattle Operation Runoff

Cattle feedlots are present in the watershed catchment area surrounding the LMOC. Runoff from these feedlot areas, which currently flows toward the waterbodies on Watchorn Creek and Birch Creek during overland flooding events, can contain nutrients such as phosphorus and nitrogen as well as bacteria indicated by fecal coliforms.

Sampling and testing of runoff will be conducted in the vicinity of cattle operations. Samples will be analysed for typical lagoon effluent and compared to water quality guidelines referenced in Section 3.1. Proposed parameters are as follows:

- Chemical Oxygen Demand (COD)
- Biochemical Oxygen Demand (BOD_5)
- Total Phosphorus (TP)
- Total Kjeldahl Nitrogen (TKN)
- Total Ammonia (NH_3-N)
- Total Nitrogen (TN)
- Nitrate/Nitrite

- Fecal coliforms
- Alkalinity
- TSS
- pH – field and lab
- DO - field
- Oxidation-Reduction Potential (ORP) – field
- Electrical Conductivity (EC) – field
- Turbidity.

Pre-construction monitoring will focus on monitoring the water quality of the runoff in the vicinity of cattle operations at discharge locations near where the point sources connect to the existing municipal drainage network. This information will be used to identify the need for specific mitigation requirements associated with each cattle operation. Management triggers and actions will be developed as the plan for management of cattle operation runoff is developed further.

Focused surface water quality monitoring in the vicinity of cattle operations will be continued during construction and post-construction phases, as needed, to confirm the effectiveness of mitigation. This may include some monitoring locations where the municipal drainage network connects to the outside drain, as well as a location within the outside drain where it discharges into Watchorn Bay.

6.5 Reporting

Annual surface water monitoring reports will be prepared throughout the construction phase and for the duration of monitoring ultimately conducted during the operation phase. The results of the cattle operation runoff water quality monitoring will be reported annually, or as needed.

7.0 ADAPTIVE MANAGEMENT AND FOLLOW-UP

7.1 General

A follow up process is a form of adaptive management to improve practices by learning about their effects and then making changes in those practices as new information is available. The *Canadian Environmental Assessment Act 2012* defines a follow up program as "a program for verifying the accuracy of the impact assessment of a designated project and determining the effectiveness of any mitigation measures." An associated Operational Policy Statement (https://www.canada.ca/content/dam/iaac-acei/documents/ops/ops-follow-up-programs-2011.pdf) indicated that "a follow-up program is used to:

- verify predictions of environmental effects identified in the EA
- determine the effectiveness of mitigation measures in order to modify or implement new measures where required
- support the implementation of adaptive management measures to address previously unanticipated adverse environmental effects
- provide information on environmental effects and mitigation that can be used to improve and/or support future EAs including cumulative environmental effects assessments, and
- support environmental management systems used to manage the environmental effects of projects."

As discussed in Section 12.4.1.2 of the Project EIS, construction activities and the changes in flows and water levels caused by the Project may have minor effects on fluvial geomorphology, sediment and debris transport in the surface water local assessment area (LAA), but primarily during and immediately after construction. Suspended sediment levels may temporarily increase at work sites during construction activities, and at outlet areas during initial operation (gates open) of the outlet channels after a period of non-operation (gates closed). As such, the purpose and objectives of follow-up activities will be to monitor and further understand the residual effects due to the Project.

As indicated, the SWMP has been developed to address the requirements of Section 2.5 of the PERs regarding Working Near Water. Although the methods and recommendations outlined in the SWMP were developed based on site-specific expectations and conditions, it is accepted that these conditions are subject to change. For example, weather conditions and climate change will inevitably drive some of the design decisions during Project construction and long-term operation. Results from ongoing data collection and monitoring programs will inform and facilitate any necessary adjustments to this plan, to the extent feasible. By employing adaptive management strategies, assumptions used in the initial design will be evaluated and management practices modified in response to the outcomes during the Project construction period and subsequent operation phase based on baseline investigations, follow-up monitoring and reporting.

Adaptive management uses the Project designs while learning from field performance to manage risk and allow the incorporation of new knowledge into subsequent steps. The foundation of this process relies on data input and implementation of sound monitoring programs. Based on the monitoring results and feedback

during construction, temporary mitigation measures described in this SWMP, as well as those included in the SMP and RVMP, will be revisited and updated, as required. For example, if the establishment of vegetation following excavation work is more difficult than expected, alternate revegetation methods may be considered, or additional temporary erosion control measures may be warranted. Adaptive management will play an important role in acknowledging and working through management challenges in the presence of uncertainty.

7.2 Follow Up Response

As described in Section 6.0, monitoring will include visual inspections and water quality monitoring. The data and analyses generated by monitoring will be used to provide information on the effectiveness of mitigation measures, aid in the validation of predicted residual effects, and provide data and results required for environmental regulatory approvals requirements. If conditions recorded appear to be exceeding criteria or management thresholds, relative to baseline conditions, then follow-up responses will be implemented as described in the sub-sections below, as well as those identified in the CEMP, PERs, SMP, RVMP and any other applicable plans under the EMP.

7.2.1 Construction

Discharges from Construction Areas

Should monitoring results indicate that the water to be discharged from construction areas do not meet the water quality objectives outlined in Section 3.2, the following tasks will be carried out:

- Environmental Monitor shall confirm the results are accurate (e.g., rule out measurement equipment malfunction).
- Environmental Monitor will discuss the exceedance with Manitoba Transportation and Infrastructure.
- Manitoba Transportation and Infrastructure shall consider undertaking additional monitoring further downstream of the discharge point (near the receiving local lakes and streams) to determine if the exceedance persists closer to those receiving waterbodies.
- Manitoba Transportation and Infrastructure or Contract Administrator will take action, which includes investigating the activity that is resulting in the exceedance and if it is still underway, implement mitigation, if necessary/possible. Mitigation may include directing the Contractor to modify work activities, such as (but not limited to):
    - temporary suspension of work activity
    - modifying the rate of discharge and/or location
    - apply mitigation measures as per the relevant plans under the EMP (such as installing additional erosion and sediment control measures as per the SMP, further aerating the discharge as per the GWMP, implementing spill/leak response as per the CEMP, etc.)
- Environmental Monitor shall record the event in the daily report.

Surface Water in Local Waterbodies

Surface water quality monitoring data in local lakes and streams in the vicinity of the LMOC will be reviewed as it is received. Should guideline exceedances attributable to Project construction activities be detected, adaptive management strategies will be implemented. Should monitoring results not meet the water quality objectives outlines in Section 3.1, then the following tasks will be carried out:

- Environmental Monitor shall confirm the results are accurate (e.g., rule out measurement equipment malfunction) and attributed to Project construction activities.
- Environmental Monitor will discuss the exceedance with Manitoba Transportation and Infrastructure.
- Manitoba Transportation and Infrastructure or Contract Administrator will take action, which includes investigating the activity that is resulting in the exceedance and if it is still underway, implement mitigation, if possible. Mitigation may include directing the Contractor to modify work activities, such as (but not limited to):
    - modifying the rate of discharge and/or location
    - apply mitigation measures as per the relevant plans under the EMP (such as installing additional erosion and sediment control measures as per the SMP, further aerating the discharge as per the GWMP, etc.)
    - temporary suspension of work activity
- Environmental Monitor shall record the event in the daily report.

Sediment Management for In-lake Excavation

Detailed adaptive response protocols will be implemented to address potential sediment effects during in-lake excavation work. The protocols are based on recent experience on other construction projects in the Province of Manitoba. Details can be found in Appendix 2A of the SMP.

Cattle Operation Runoff

Pre-construction cattle operation runoff water quality monitoring will be used to identify specific mitigation requirements associated with each cattle operation. Management triggers and actions will be developed as the plan for management of cattle operation runoff is developed further.

Focused surface water quality monitoring in the vicinity of cattle operations will be continued during construction and post-construction phases, as needed, to confirm the effectiveness of mitigation. This may include some monitoring locations where the municipal drainage network connects to the outside drain, as well as a location within the outside drain where it discharges into Watchorn Bay.

7.2.2 Commissioning

As with in-lake excavation, detailed adaptive response protocols will be implemented to address potential sediment effects during in-lake excavation work and commissioning activities. The protocols are based on recent experience on other construction projects in the Province of Manitoba. Details can be found in Appendix 2A of the SMP.

7.2.3 Operation Phase

Management triggers and adaptive management actions will be developed as per the operation phase monitoring program based on the results of the SWMP monitoring during construction.

7.3 Contingency Measures and Emergency Response

Contingency measures and emergency response will be developed for deployment in the event that aspects of this SWMP do not meet the water quality objectives or if the prescribed measures are overwhelmed during a severe runoff event greater than the design condition (or multiple successive large runoff events). Contingency planning will also be incorporated for unexpected events such as, but not limited to, an uncontrolled breach of a settling pond, or the failure of a pumping system for depressurization or dewatering. These will be developed by the Contractor in accordance with Section 1.3 of the PERs and submitted to Manitoba Transportation and Infrastructure for approval prior to start of construction.

Mitigation measures will be identified in the "base" plan that may include, for example, choosing locations of construction phase settling ponds to reduce direct surface runoff to aquatic environments. Contingency measures that would be implemented in the event of an emergency will also be identified that may include the deployment of straw rolls/wattles, erosion control blankets, rapid stabilization techniques, supplementary seeding, temporary settling ponds, etc. These will be developed as per the CEMP, PERs, SMP, RVMP and any other applicable EMPs.

In the event of an emergency, the Contractor, Manitoba Transportation and Infrastructure, and the Contract Administrator will determine which contingency and emergency control measures will be implemented. These contingency and emergency control measures would be carried out within a predetermined time period depending on the site conditions and nature of the emergency. Contingency measures will include monitoring at immediate downstream locations in the event of emergency conditions or undesirable circumstances.

During the operation phase, the channel will be resistant to large precipitation events through vegetation and armoring. Nevertheless, contingency and emergency control measures will be implemented by Manitoba Transportation and Infrastructure, depending on the site conditions and nature of the emergency, with due consideration given to the O&M manual that will be developed for the Project prior to the operation phase.

Part 3: Lake St. Martin Outlet Channel

8.0 SOURCES OF WATER

8.1 Surface Water

Surface water includes the runoff contribution from snowmelt and rainfall within the LSMOC area (i.e., excavated area) as well as any additional runoff from outside of the LSMOC area which naturally or artificially drains towards the LSMOC.

Along the LSMOC, most of the surface water flows naturally towards Buffalo Creek. Flows in Buffalo Creek were monitored between 2011 and 2015 to support aquatic monitoring of the Lake St. Martin Emergency Outlet Channel (EOC). Base flows in the creek, when the EOC was not in operation, were measured between approximately 1 m^3/s and 10 m^3/s and was estimated to range up to approximately 25 m^3/s in response to significant rainfall events.

Figure 6 shows the surface water catchment areas intercepted by the LSMOC alignment. The drainage areas for these sub-basins are summarized in Table 3.

The sub-basins listed in Table 3 drain to Buffalo Creek, with the exception of A3 which discharges directly to Lake Winnipeg. The LSMOC will reduce the total drainage area upstream of the Buffalo Creek confluence with the Dauphin River by approximately 51.5% (reduction from 31.5 km^2 to 15.3 km^2). The total sub-basin area contributing flows to the LSMOC outside drain will be 18.9 km^2 (A1, A2, and A3).

Table 3: Characteristics of Sub-Basins Intercepted by the LSMOC

Sub-Basin Name	Drainage Area (km^2)	Location Relative to LSMOC
A1	11.5	East
A2	4.7	East
A3	2.7	East
A4	6.5	West
A5	2.9	West
A6	0.9	West
A7	5.0	West

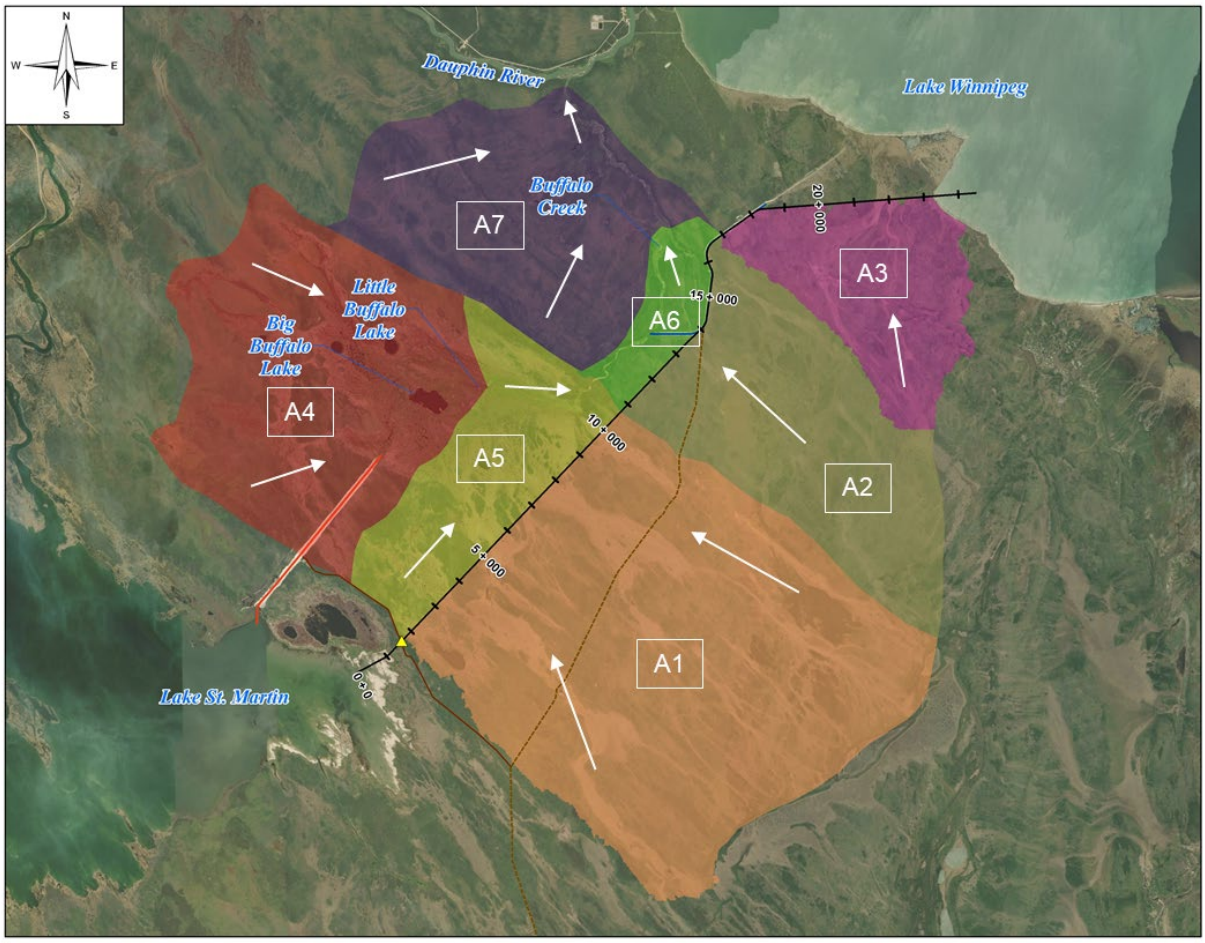

Figure 6: Surface Water Catchment Areas Intercepted by the LSMOC

8.2 Groundwater and Seepage Water

Two distinct groundwater systems are known to be present within the region of the LSMOC: within the upper saturated peat and the lower confined carbonate bedrock aquifer.

The upper, saturated peat unit is perched above the clays (where present) and underlying till units. The peat is recharged directly from surface rainfall and snowmelt. Small-scale flow systems develop from raised bog/peat mound areas, flowing radially outward toward relatively lower-lying depressions and other associated open water areas. Construction of the LSMOC will result in temporarily localized discharge from this system into excavated areas until channel dikes are constructed. Localized discharge will also occur into the outside drain and will vary seasonally depending on the water table and surface conditions.

The lower, confined bedrock aquifer is comprised of a Paleozoic rock sequence commonly referred to in Manitoba as the "Carbonate Aquifer System". This aquifer system is isolated from the peat unit by the upper clay zone and underlying tills. In areas where the pressures are high relative to the confining till units, there is a risk of upward pressure fracturing the till, and producing some uncontrolled groundwater discharge, which is anticipated to be limited by the low permeable nature of the tightly fractured bedrock. Because these conditions cannot be avoided in the region, it was estimated for the Project that there will be a degree of groundwater discharge. In general, consideration of groundwater piezometric pressures and any associated aquifer depressurization requirements will apply to the channel excavation, the channel inlet/outlet excavations, and channel WCS foundations, including long-term WCS uplift pressure mitigation.

Seepage water may also be attributed to minor leakage downstream of a cofferdam. Quantification of groundwater and seepage volumes will be defined, as required. More information on groundwater and seepage water are available in the GWMP.

8.3 Processed Water

Processed water consists of any water considered to be a direct product of the construction activities only and, as such, may require the implementation of mitigation measures, such as settling ponds and/or chemical remedies to meet natural discharge criteria. Potential sources of processed water for the LSMOC Project will be defined during detailed design and may include, but are not limited to:

- Blasting (if required).
- Leachate from rock stockpiles and structures containing rock exposed to surface waters and/or drainage.
- Discharge of wastewaters from processing of aggregate materials and concrete batch plant, and water treatment plant filter backwash.
- Dewatering of excavation areas.
- Accidental spills and releases.
- Control and treatment of sewage water from any construction camps that may be established.

9.0 SURFACE WATER MANAGEMENT

The management measures to control and mitigate environmental effects are described in the following sections, and as indicated, are designed to support the requirements in the PERs.

9.1 Construction Phase (Temporary Measures)

Temporary measures will be required during construction to manage surface water to improve constructability, control the potential for erosion and manage sediments. The specific measures will depend on construction staging and sequencing until the permanent works are completed. Construction methods for temporary drainage works will consider the erosion and sediment control measures described in the SMP.

No untreated wastewaters will be released to the environment from Project construction sites, including construction camps and staging areas. Wastewater will be treated by acceptable industry methods before being released.

9.1.1 Channel Works

Channel works include all construction activities related to the LSMOC, excluding the inlet and outlet works and the WCS.

The primary method of managing surface water for channel works will be via a permanent outside drain, which will be constructed as part of the initial contracts. The purpose of the outside drain is to intercept surface water runoff from the east side of the Project upstream of the construction areas to minimize inflow of surface water into the construction zone. During construction, intercepted surface water will be conveyed along the drain and discharged directly into Lake Winnipeg with a temporary outlet protected with riprap.

Within the excavated channel, a pilot ditch will be constructed as part of the initial contracts to promote downstream drainage of the excavated area. Earth plugs will be maintained between contracts to prevent discharge of water from one contract to the next. As contracts are completed, the earth plugs will be removed to allow for gravity drainage away from the construction site. The existing Reach 3 plug that currently conveys water from the Reach 3 Emergency Channel towards Buffalo Creek will also be removed. Temporary outlets for the pilot ditch and the outside drain are shown on Figure 7.

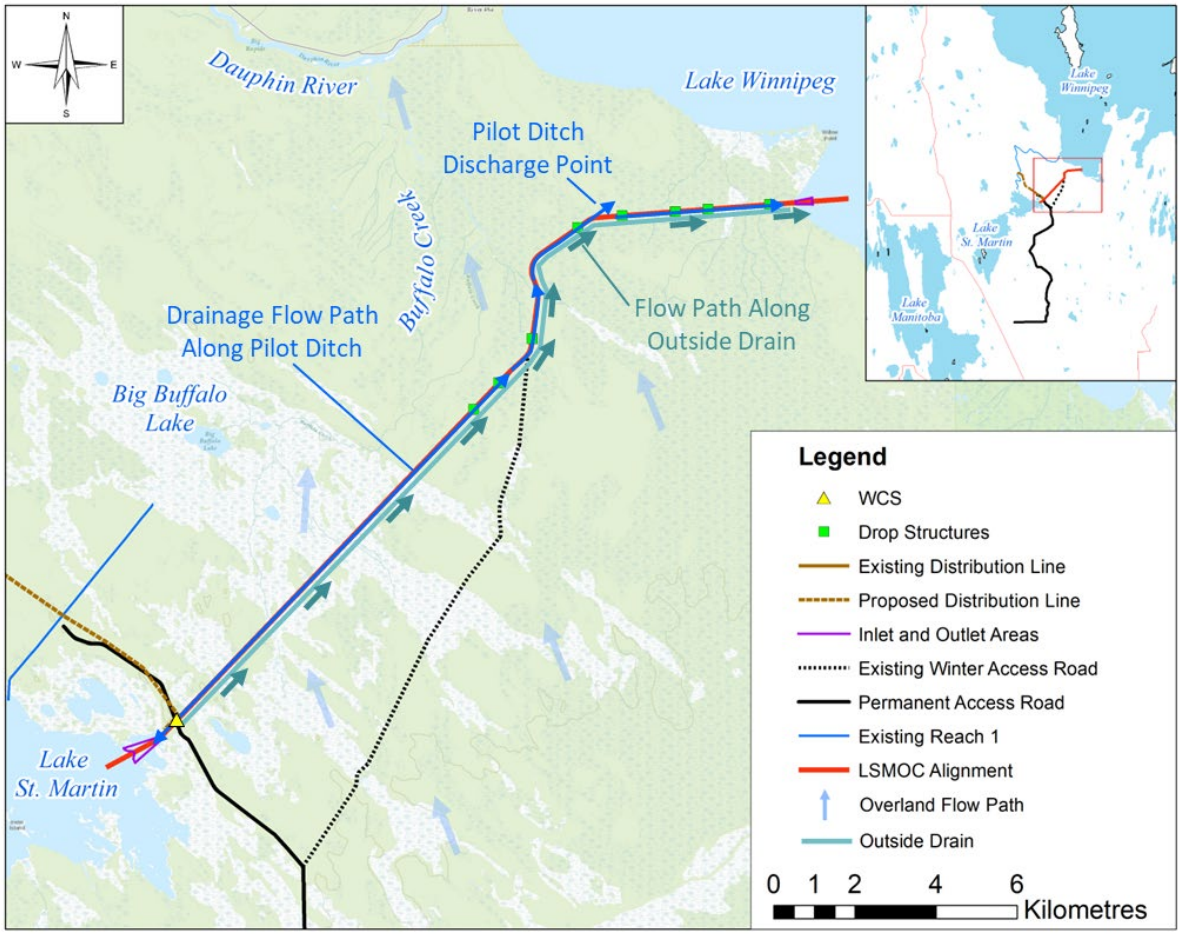

Figure 7: Temporary Drainage Plan

Surface water management within the excavated area of each individual contract will be the responsibility of the Contractor. This is anticipated to involve a combination of temporary pumping in low lying areas and gravity drainage away from the construction site. Water from within the work area will be treated, as required, to comply with the water quality criteria outlined in Section 3.1, prior to discharge into the outside drain, or towards Lake St. Martin, Lake Winnipeg or Buffalo Creek, and as approved by Manitoba Transportation and Infrastructure during construction. Water discharged offsite will be released to settling ponds, filtering systems or through dense terrestrial vegetation of sufficient distance from waterbodies or streams to reduce the potential of sediment release downstream of the construction areas. As described in Section 10.2, the primary method to prevent or minimize the potential for erosion within the LSMOC will be through the establishment of permanent vegetation. Until vegetation is established, temporary erosion and sediment control measures will be employed during construction, as described in the SMP.

Figure 7 shows the preliminary temporary drainage plan for LSMOC channel works.

9.1.2 Inlet Works

The inlet works will consist of excavating the lake bottom within an approximately 1,200 m long by 600 m wide area of Lake St. Martin. It is expected that the construction area will be surrounded with a temporary rock plug or cofferdam to allow work activities to be isolated from the lake. Riprap protection will be incorporated into the design to protect the plug/cofferdam against wave action from a wind event consistent with the criteria defined in Section 3.3. A turbidity curtain will be temporarily installed in Lake St. Martin prior to construction of the rock plug/cofferdam, or as required, to prevent or minimize the migration of disturbed sediments into the lake during construction. A fish salvage program will be required within the isolated area which will be developed and conducted in accordance with Section 2.5.5 of the PERs, and following the methods described in the AEMP.

Once construction of the LSMOC is complete, the rock plug/cofferdam will be removed in part or in whole, as required and in accordance with environmental requirements. Installation and removal of the rock plug or cofferdam will also comply with DFO's Restricted Activity Timing Windows (https://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/mb-eng.html) and will be completed in accordance with the conditions outlined in the DFO Authorization. Removal of the turbidity curtain would occur once monitored water quality parameters on both sides of the curtain are similar and meet the criteria outlined in Section 3.1.

Specific methods of construction within the isolated area will be determined by the Contractor, in accordance with contract requirements and as approved by Manitoba Transportation and Infrastructure. Excavation works may occur "in-the-wet" or within one or multiple areas that have been dewatered for construction. Any water that must be pumped outside of the work area will be discharged into dense terrestrial vegetation, settling ponds, or filtering systems, if necessary, prior to release into Lake St. Martin. Alternate construction methods will also be considered, such as isolating the area with a double turbidity curtain instead of a rock plug/cofferdam, or allowing excavation works to occur in the winter in shallow areas where the lake ice freezes all the way through to the bottom elevation. These options will be reviewed at detailed design with input from the environmental approval process.

9.1.3 Outlet Works

The outlet works will consist of excavating the lake bottom within an approximately 200 m long by 200 m wide area of Lake Winnipeg (Sturgeon Bay). Construction activities and measures to manage surface water during construction will be similar to the inlet works, as described in Section 9.1.2.

9.1.4 Water Control Structure

Dewatering activities will be required for construction of the WCS to collect surface water runoff and to address groundwater depressurization requirements, as described in the GWMP. The WCS work area will be isolated from channel construction activities to reduce the amount of pumping required and to prevent additional surface water runoff from entering the work area. Other potential sources of water include various types of processed water, as described in Section 8.3. Management of surface water flows and groundwater seepage within the excavation will be the responsibility of the Contractor.

Water from within the work area will be treated, as required, to comply with the water quality criteria outlined in Section 3.1, and discharged into dense vegetation or settling ponds, as deemed necessary, towards the outside drain or at alternate locations that may be approved by Manitoba Transportation and Infrastructure during construction.

9.1.5 Sediment Management

A separate SMP for the control of erosion and sediment has been prepared for the Project. The SMP identifies temporary and permanent measures that will be incorporated during construction until vegetation has been established on disturbed areas to prevent or minimize the potential for erosion and to mitigate the transport and deposition of sediments beyond construction areas and into off-site receiving water bodies. These measures will be developed to comply with requirements outlined in the Environmental license and federal decision statement conditions.

9.2 Operation Phase (Permanent Measures)

Once LSMOC construction is complete, surface water from outside of the Project area to the east of the channel will continue to be managed with the permanent outside drain, as described in Section 9.2.1. Surface water runoff within the ROW of the LSMOC will either discharge into the LSMOC or away from the channel, as described in Section 10.2.2.

Permanent erosion control measures, such as the drop structures, will help minimize erosion in the LSMOC. In addition, temporary erosion and sediment control measures will be maintained until vegetation has fully established on the side slopes and it is confirmed that the criteria identified in Section 3.1 can be maintained in the long term. Refer to the SMP and RVMP for further details.

Construction of the LSMOC will result in a reduction to the catchment size of the Buffalo Creek basin, as described in Section 9.1. As described in Section 9.2.2, methods to re-introduce water to the Buffalo Creek wetlands are under consideration.

9.2.1 Outside Drain

The outside drain that will be constructed to facilitate management of surface water runoff during construction, as described in Section 9.1.1, will be utilized as part of the permanent drainage works for the LSMOC. The permanent outside drain will function in the same way as it did during construction, collecting surface water runoff from the east side of the Project area and conveying it towards Lake Winnipeg. The only difference will be that the permanent outlet will be directed into the LSMOC channel through conduits under the channel dikes and spoil pile rather than discharging directly into Lake Winnipeg. On the west side of the LSMOC, surface water naturally flows away from the channel toward Buffalo Creek or Lake Winnipeg. Therefore, no outside drain is required on that side of the LSMOC.

The outside drain comprises a trapezoidal excavated channel. The drain invert was selected to minimize excavation volumes while also minimizing inundated areas at the 1:10 year design runoff event. The drain invert intersects both peat and mineral soil along its length. In areas where the drain runs through peat, the

cross section will have side slopes of 3H:1V. In areas where the drain runs through mineral soil, the side slopes will be 4H:1V. The base width of the drain varies from 4 m at the upstream end to 14 m at the downstream end, to account for the accumulation of flow in the downstream direction. The invert slope of the drain is 0.06% with the exception of two reaches that have slopes of 0.02% and 0.04% to better fit the natural topography.

Gradient Control Structures (GCS) will be constructed along the drain to limit water velocities and shear stresses to permissible levels to mitigate potential for erosion of the drain. The GCSs will be rockfill structures with raised crests and steep chutes. The chutes will be protected with riprap to prevent erosion from the high velocities in the region where the water surface elevation is lowered over a short distance. The GCSs are designed to withstand flows up to the 1:25 year event with minimal damage and flows up to the 1:200 year event without complete failure (washout of structures).

The permanent surface water drainage plan is presented in Figure 8.

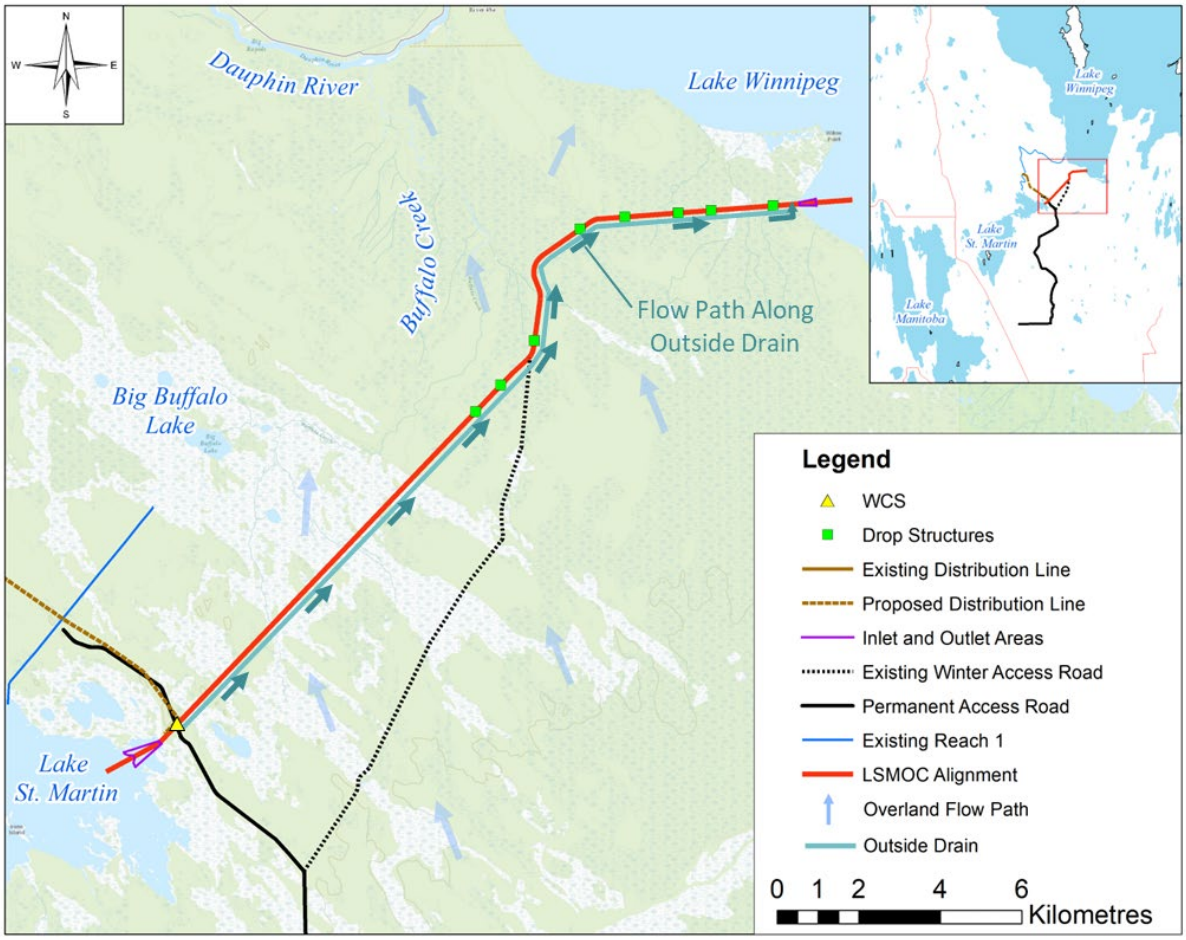

Figure 8: Permanent Surface Water Drainage Plan

Figure 9 shows the hydraulic profile for the outside drain for the 1:10 year design event. The preliminary design of the outside drain includes 15 GCSs with crest heights ranging from approximately 0.4-0.7 m.

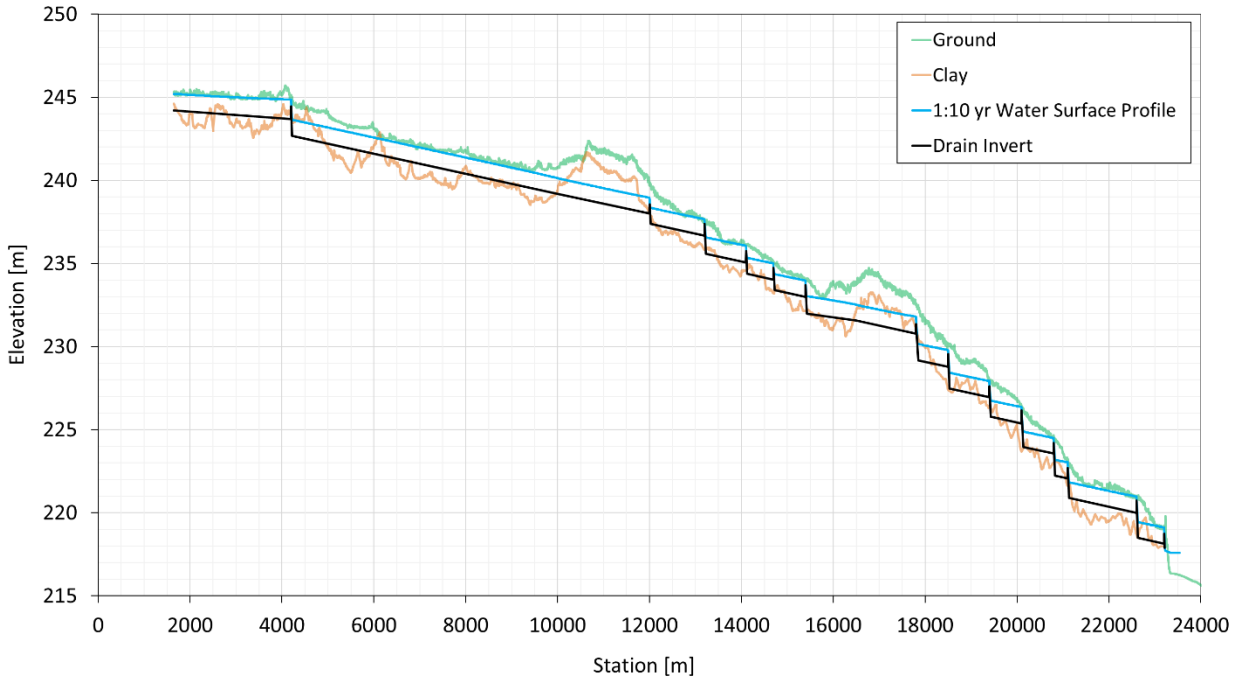

Figure 9: Profile of the Outside Drain

The hydraulic roughness of the drain will change over time, affecting its capacity and the extent of inundated areas expected during runoff events. Soon after construction, the hydraulic roughness of the drain will be relatively low. Over time, growth of vegetation will gradually increase the roughness. Specific portions of the drain that cut through high points in the topography and have inverts incised in mineral soil are expected to be maintained in a similar manner as other provincial drains across Manitoba. Minimal maintenance activities are expected in other portions of the drain that cut through peat. In those areas, it is expected that long after construction of the outside drain (i.e., when the drain has grown in with vegetation), the 1:10 year runoff event will cause some temporary ponding of low-lying areas outside of the Project ROW. The extent and duration of ponding of adjacent land increases for more extreme events. Ponded water could flow overland towards Lake Winnipeg outside of the drain. Rockfill overflow sections will be included with the design, if required, on the banks of the LSMOC to control overflow from the drain into LSMOC during these more extreme events.

9.2.2 Augmentation of Buffalo Creek Watershed Flows

Manitoba Transportation and Infrastructure has considered four options to offset for the water intercepted by the LSMOC during operation and reduce potential effects to wetland function. While discussions are ongoing with communities and regulators as a part of the engagement and consultation process, the tentatively preferred option is a controlled flow release from one or more ditches located along the west channel ROW. The ditch would collect local rainfall and snowmelt within the ROW and additional water would be added from Lake St. Martin, as required to provide required water quantities.

Water would flow via gravity through the structure or with a pump into a ditch running parallel to the LSMOC channel. Water from the ditch would be released at one or more points to distribute flow to the area of wetlands downgradient of the outlet channel. The goal is to mimic natural flows that would diffuse across the wetland landscape. The release of water will be actively managed and will be limited to occur within the spring, summer, and fall months. The flow of water to be released would be dependent on the diameter of conduit used to transport the water. For example, conduit diameters ranging between 0.5 m and 2 m would convey flows between approximately 0.1 m^3/s and 1 m^3/s when within typical Lake St. Martin north basin water levels (i.e., between 242.9 and 243.8 m).

This is Manitoba Transportation and Infrastructure's tentatively preferred option as it provides a reliable source of water with flexibility during operation to control the frequency, flow rate, timing, and volume of water released. The appropriate flow rates, infrastructure design, and confirmation of the proposed option to best compensate flow to this sub watershed will occur during detailed design.

9.2.3 Conditions in the LSMOC

When the LSMOC WCS gates are closed, sheet pile cut-off walls at the crests of the drop structures will maintain a minimum water depth of 1 m above the channel invert in the pools between the drop structures. A base flow will be provided through the WCS to maintain appropriate water quality conditions (DO levels). Other sources of water into the LSMOC will include groundwater discharge and runoff within the channel banks and along the slopes of the channel dikes.

Maintaining and establishing a vegetation cover in the LSMOC is a key component to minimizing the erosion potential during construction and over the long-term. A summary of the revegetation plan is provided in Section 10.2.3. Temporary erosion and sediment control measures will be maintained along the channel banks until vegetation has fully established.

When the LSMOC is in operation, water levels in the channel will typically increase by two to three meters for extended periods. As a result, portions of the channel side slopes will experience alternating periods of submergence (wet) and exposure (dry). Under these conditions, there will be a zone (above the channel armouring) where vegetation may not survive or grow well, thus making the slopes susceptible to erosion. Adaptive management measures to mitigate this risk have been included in the RVMP and in the SMP and involve implementing a long-term monitoring and management approach as well as installing permanent erosion control measures if deemed necessary.

9.2.4 Revegetation Plan

Maintaining and establishing a vegetation cover in the LSMOC is fundamental to minimizing the erosion potential during construction and over the long-term. The revegetation approach will be dynamic and flexible in terms of its implementation under potentially challenging hydrological conditions and is described in the RVMP.

10.0 MONITORING

10.1 Baseline Monitoring

Figure 10 identifies baseline surface water quality monitoring locations. Baseline water quality data have been collected between 2020 and 2021 for waterbodies in the vicinity of the LSMOC. In addition, data collected for the EOC in 2011-2015 have been incorporated in the baseline dataset. Baseline data will form the basis of comparison to monitor for changes in surface water quality in waterbodies in the vicinity of the LSMOC during construction and for two years post-construction. Additional data collected since 2021 will be added to the data compilation prior to construction. Sites for baseline monitoring in the vicinity of the LSMOC were selected to represent the variety of waterbodies that may be impacted by construction of the LSMOC. In addition, as described in the WetMP, baseline wetland surface water quality monitoring is planned in the vicinity of LSMOC prior to construction.

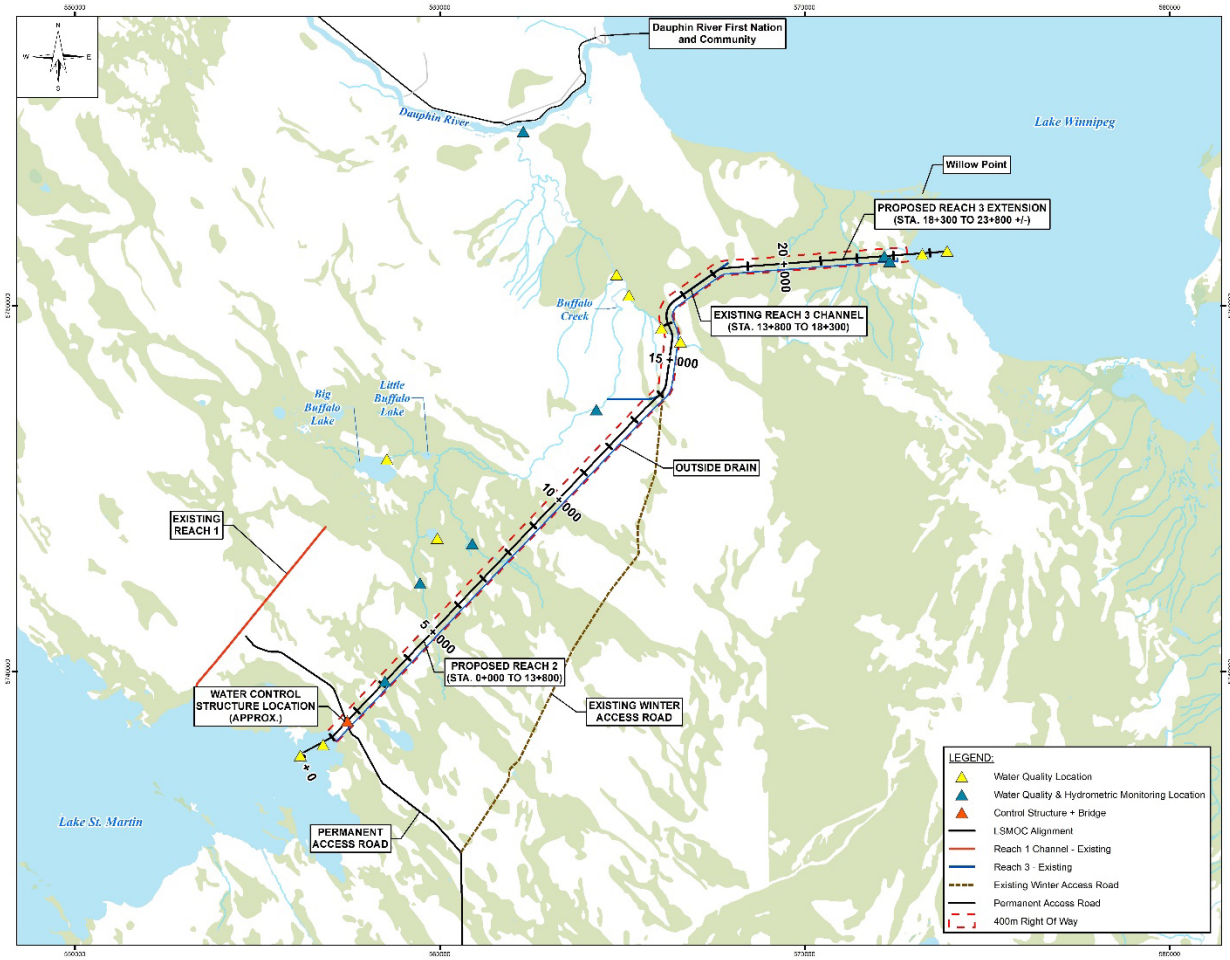

Figure 10: LSMOC Baseline Surface Water Quality Monitoring Locations

10.2 Construction Phase Monitoring

10.2.1 Overview

Surface water will be monitored during construction to identify changes that may result from construction activities along the LSMOC and to assess the effectiveness of proposed mitigations and the SMP. If the water quality criteria identified in Section 3.1 are exceeded and attributed to the Project, then additional mitigation measures would be considered. Where monitoring results show impacts that are not attributed by the Project, information will be provided to Manitoba Conservation and Climate.

LSMOC construction-phase surface water monitoring will be conducted for the duration of the construction phase. The frequency and location of sample stations included in the program will change as the construction staging advances. Determination of frequency and location of samples will also be based on:

- environmental considerations described in the Project EIS;
- proximity and potential for change to local fish bearing receiving waters as a result of the works;
- monitoring plans being developed for the Project as part of other management plans (such as the AEMP, the GWMP and Wetland Management Plan);
- input from engagement processes and regulatory input.

Monitoring plans are provided in the sub-sections that follow related to:

- discharges from construction areas
- surface water quantity and quality in lakes and streams in vicinity of the LSMOC
- sediment monitoring for in-lake excavation and commissioning activities

10.2.2 Discharge from Construction Areas

Effects on surface water quality from the construction of the Project were predicted in the EA process. The Project may affect surface water quality via introduction of sediment to waterbodies, discharge of groundwater to surface water, and accidental spills and leaks during Project construction.

Water quality criteria outlined in Section 3.2 for the protection of aquatic life will be used to manage discharges from the Project construction area to an aquatic environment (i.e., waterbodies). See the EPP mapbooks for delineation of such areas within the PDA. An Environmental Monitor on site will implement a monitoring program for turbidity, TSS, DO, and other relevant parameters at discharge points at an appropriate frequency to confirm compliance.

Sediment in Discharges

Sediment monitoring in construction site discharges will include general observations during routine surveillance activities (i.e., areas of exposed soil and/or sediment plumes) and monitoring using hand-held sampling devices.

The objective of monitoring TSS and turbidity during construction activities is to confirm that sediment mitigation measures and erosion and sediment controls are effective and that discharges from the Project

construction area are managed appropriately before release to aquatic environment (i.e., waterbodies). The monitoring results will be used to inform adaptive management of construction activities to reduce construction related increases in suspended sediment concentrations. This monitoring plan will be modified as needed in the field to complement the construction activities as they are developing; however, the general guideline for discharge monitoring is as follows:

- Consider site-specific waterbody characteristics including receiving waterbody size and width, water depth, water velocity and flow (i.e., laminar flow vs turbulent flow). Monitoring transects may be established where background and downstream water samples may be collected in a manner that captures changes in suspended sediment concentrations near the construction site. Where a visual plume is observed, a sample will be taken from the middle of the plume and as close to the source as safely possible. Water samples will be at 50% water depth where water is less than 1 m deep. Where waterbodies are greater than 1 m deep, samples will be taken at 20% and 80% of water depth at each transect sample point and results averaged.
- When sediment introduction to the aquatic environment (i.e., waterbodies) is likely, turbidity sampling will be completed at appropriate intervals. If turbidity levels remain constant and low the sample frequency may be reduced, or halted altogether, as directed by the Environmental Monitor.
- Daily turbidity monitoring records will be kept and maintained during construction and will be available on site. Upon completion of construction activities, a final construction monitoring report with all sampling and testing data will be produced by the Environmental Monitor.

Other Parameters in Discharges

Where water discharged from the Project construction area may exceed CCME-PAL guidelines and MWQSOG-PAL objectives as outlined in Section 3.1, an Inspector or Environmental Monitor will monitor such water prior to discharge for appropriate parameters (DO, temperature, conductivity, and pH), which may be altered by groundwater discharge.

Spills and Leaks

An Inspector or Environmental Monitor will visually inspect discharges from the Project construction area for indications of spills and leaks, such as sheen and foam. In the event of a release during Project construction, contractors will follow their own spill response plans, which will have been reviewed and approved by Manitoba Transportation and Infrastructure as part of their contracts. PERs have been developed that describe measures to address accidents and spills, including reporting, cleanup, compliance training, inspection, and enforcement.

10.2.3 Surface Water in Local Waterbodies

Surface water monitoring will include collection of surface water quality samples and water level measurement in the vicinity of the LSMOC. Monitoring of flows and water levels have been included to support monitoring of water quantity at select locations in the LSMOC Channel and outside drain, and in Buffalo Creek. The frequency and location of the monitoring stations included in the program will be updated as required, based on monitoring results, input from regulatory approvals and as the construction staging advances to reflect Project needs and requirements.

Proposed surface water quality monitoring sites will include previously established baseline sites in the vicinity of the LSMOC (see Section 10.2). These sites were selected to represent the variety of creeks and lakes in vicinity of the channels. Monitoring locations may be adjusted as designs are advanced and additional engagement input is received from regulators, rights-holders, and public stakeholders. They will also be positioned to address any relevant regulatory approvals conditions. Proposed water quality parameters are listed in Table 4. This comprehensive list of parameters includes routine chemistry, total and dissolved nutrients, carbon, total and dissolved metals (including mercury), bacteria, hydrocarbons, and pesticides. Presently, a monthly open-water sampling at these monitoring sites is planned during active construction in the vicinity of the monitoring sites. Results would be reviewed monthly for guideline exceedances and results would be reported quarterly. Should the guideline exceedances attributable to Project construction activities be detected, adaptive management measures will be immediately implemented. Refer to Section 11.0 for relevant adaptive management sections of the other EMPs for more details. Methylmercury in fish tissue and chlorophyll *a* are included in the AEMP.

All surface water quality samples will be collected following standard procedures, will be submitted to an accredited laboratory for analysis and subject to standard QA/ QC processes.

Table 4: Proposed Surface Water Quality Monitoring Parameters

Water Quality Parameters	
Field Parameters	DO; Electrical Conductivity; Oxidation Reduction Potential; pH; Temperature; Turbidity
General Chemistry	Alkalinity, Bicarbonate (as CaCO3); Alkalinity, Carbonate (as CaCO3); Alkalinity, Hydroxide (as CaCO3); Alkalinity, Total; Hardness (as CaCO3); Total Dissolved Solids; Major ions (Sulfate; Chloride; Fluoride; Sodium; Potassium)
Sediment	TSS
Microbiological Parameters	*Escherichia coli (E.Coli);* Fecal Coliforms
Nutrients/Carbon	Ammonia (as N); Nitrate (as N); Nitrite (as N); Total Kjeldahl Nitrogen; Nitrogen (Total); Phosphorus, Total; Phosphorus, Total (Dissolved); Phosphorus, Total (Particulate); Phosphate (PO4), dissolved and reactive; Dissolved Organic Carbon (DOC); Dissolved Inorganic Carbon (DIC); Total Organic Carbon (TOC); Total Inorganic Carbon (TIC)
Petroleum Hydrocarbons	BTEX; Hydrocarbons
Metals	Standard Total/Dissolved Metals Scan (including Mercury)
Pesticides	Glyphosate; Organochlorinated

10.2.4 Sediment Monitoring for In-Lake Excavation and Commissioning Activities

A detailed in-lake real-time TSS monitoring program will be implemented during construction to monitor the magnitude of spatial and temporal changes in TSS concentrations in the vicinity of the PDA during in-lake construction and commissioning activities. The monitoring program design is based on the expected construction effects on the sedimentation regime in the North Basin of Lake St. Martin and in Lake Winnipeg (Sturgeon Bay), and recent experience on other construction projects in the Province of Manitoba. Details can be found in Appendix 2B of the SMP.

10.3 Operation Phase Monitoring

Collection of surface water quality samples and water level measurements at previously established baseline sites will continue following construction of the Project. This monitoring will initially be carried during the first two years post-commissioning, the intent of which is to confirm the effectiveness of construction mitigations and site restoration measures. This duration may be extended depending on the monitoring results, environmental conditions present, and success of revegetation.

The frequency and locations of the water quality monitoring conducted during the 2-year post-commissioning period will be based on specific environmental conditions present, success of revegetation, and adjusted, as required, based on monitoring results. Flow and water level monitoring will also be included to support assessment of surface water quality parameters at select surface water sampling stations in the LSMOC Channel and outside drain, and in the Buffalo Creek watershed. Water quality monitoring parameters are expected to be consistent with those monitored during the construction phase, as summarized in Section 10.2.

Longer-term operation monitoring (which includes consideration of the frequency of use of the LSMOC) will take place beyond the 2-year post-commissioning period as outlined in the AEMP and the O&M Manual.

10.4 Reporting

Annual surface water monitoring reports will be prepared throughout the construction phase and for the duration of monitoring ultimately conducted during the post-commissioning phase.

11.0 ADAPTIVE MANAGEMENT AND FOLLOW-UP

11.1 General

A follow up process is a form of adaptive management to improve practices by learning about their effects and then making changes in those practices as new information is available. The *Canadian Environmental Assessment Act 2012* defines a follow up program as "a program for verifying the accuracy of the impact assessment of a designated project and determining the effectiveness of any mitigation measures." An associated Operational Policy Statement (https://www.canada.ca/content/dam/iaac-acei/documents/ops/ops-follow-up-programs-2011.pdf) indicated that "a follow-up program is used to:

- verify predictions of environmental effects identified in the EA
- determine the effectiveness of mitigation measures in order to modify or implement new measures where required
- support the implementation of adaptive management measures to address previously unanticipated adverse environmental effects
- provide information on environmental effects and mitigation that can be used to improve and/or support future EAs including cumulative environmental effects assessments, and
- support environmental management systems used to manage the environmental effects of projects."

As discussed in Section 12.4.1.2 of the Project EIS, construction activities and the changes in flows and water levels caused by the Project may have minor effects on fluvial geomorphology, sediment and debris transport in the surface water LAA, but primarily during and immediately after construction. Suspended sediment levels may temporarily increase at work sites during construction activities, and at outlet areas during initial operation (gates open) of the outlet channels after a period of non-operation (gates closed). As such, the purpose and objectives of follow-up activities will be to monitor and further understand the residual effects due to the Project.

As indicated, the SWMP has been developed to address the requirements of Section 2.5 of the PERs regarding Working Near Water. Although the methods and recommendations outlined in the SWMP were developed based on site-specific expectations and conditions, it is accepted that these conditions are subject to change. For example, weather conditions and climate change will inevitably drive some of the design decisions during implementation and long-term operation. Results from ongoing data collection and monitoring programs will inform and facilitate any necessary adjustments to this plan to the extent feasible. By employing adaptive management strategies, assumptions used in the initial design will be evaluated and management practices modified in response to the outcomes during the Project construction period and subsequent operation phase based on baseline investigations, follow-up monitoring and reporting.

Adaptive management uses the Project designs while learning from field performance to manage risk and allow the incorporation of new knowledge into subsequent steps. The foundation of this process relies on data input and implementation of sound monitoring programs. Based on the monitoring results and feedback

during construction, temporary mitigation measures described in this SWMP, as well as those included in the SMP and RVMP, should be revisited and updated, as required.

For example, if the establishment of vegetation following excavation work is more difficult than expected, alternate revegetating methods may be considered, or additional temporary erosion control measures may be warranted. Adaptive management will play an important role in acknowledging and working through management challenges in the presence of uncertainty.

11.2 Follow Up Response

As described in Section 10.0, monitoring will include visual inspections and water quality monitoring. The data and analyses generated by monitoring will be used to provide information on the effectiveness of mitigation measures, aid in the validation of predicted residual effects, and provide data and results required for environmental licensing requirements. If conditions recorded appear to be exceeding criteria or management thresholds, relative to baseline conditions, then follow-up responses will be implemented as described in the sub-sections below, as well as those identified in the CEMP, PERs, SMP, RVMP and any other applicable plans under the EMP.

11.2.1 Construction

Discharges from Construction Areas

Should monitoring results indicate that the water to be discharged from construction areas do not meet the water quality objectives outlined in Section 3.1, the following tasks will be carried out:

- Environmental Monitor shall confirm the results are accurate (e.g., rule out turbidity measurement equipment malfunction).
- Environmental Monitor will discuss the exceedance with Manitoba Transportation and Infrastructure.
- Manitoba Transportation and Infrastructure shall consider undertaking additional monitoring further downstream of the discharge point (near the receiving local lakes and streams) to determine if the exceedance persists closer to those receiving waterbodies.
- Manitoba Transportation and Infrastructure or Contract Administrator will take action, which includes investigating the activity that is resulting in the exceedance and if it is still underway, implement mitigation, if necessary/possible. Mitigation may include directing the Contractor to modify work activities, such as (but not limited to):
    - temporary suspension of work activity,
    - modifying the rate of discharge and/or location
    - apply mitigation measures as per the relevant plans under the EMP (such as installing additional erosion and sediment control measures as per the SMP, further aerating the discharge as per the GWMP, implementing spill/leak response as per the CEMP, etc.)
- Environmental Monitor shall record the event in the daily report.

Surface Water in Local Waterbodies

Surface water quality monitoring data in local lakes and streams in the vicinity of the LMOC will be reviewed, as it is received. Should guideline exceedances attributable to Project construction activities be detected, adaptive management strategies will be implemented. Should monitoring results not meet the water quality objectives outlines in Section 3.1, then the following tasks will be carried out:

- Environmental Monitor shall confirm the results are accurate (e.g., rule out measurement equipment malfunction) and attributed to Project construction activities.
- Environmental Monitor will discuss the exceedance with Manitoba Transportation and Infrastructure.
- Manitoba Transportation and Infrastructure or Contract Administrator will take action, which includes investigating the activity that is resulting in this exceedance and if it is still underway, implement mitigation, if possible. Mitigation may include directing the Contractor to modify work activities, such as (but not limited to):
  - modifying the rate of discharge and/or location
  - apply mitigation measures as per the relevant plans under the EMP (such as installing additional erosion and sediment control measures as per the SMP, further aerating the discharge as per the GWMP, etc.)
  - temporary suspension of work activity
- Environmental Monitor shall record the event in the daily report.

Sediment Management for In-lake Excavation

Detailed adaptive response protocols will be implemented to address potential sediment effects during in-lake excavation work. The protocols are based on recent experience on other construction projects in the Province of Manitoba. Details can be found in Appendix 2B of the SMP.

11.2.2 Commissioning

As with in-lake excavation, detailed adaptive response protocols will be implemented to address potential sediment effects during in-lake excavation work and commissioning activities. The protocols are based on recent experience on other construction projects in the Province of Manitoba. Details can be found in Appendix 2B of the SMP.

11.2.3 Operation Phase

Management triggers and adaptive management actions will be developed as for the post-commissioning monitoring program based on the results of the SWMP monitoring during construction.

11.3 Contingency Measures and Emergency Response

Contingency measures and emergency response will be developed for deployment in the event that aspects of this SWMP do not meet the water quality objectives or if the prescribed measures are overwhelmed during a severe runoff event greater than the design condition (or multiple successive large runoff events). Contingency planning will also be incorporated for unexpected events such as, but not limited to, an uncontrolled breach of a settling pond, or the failure of a pumping system for dewatering. These will be developed by the Contractor in accordance with Section 1.3 of the PERs and submitted to Manitoba Transportation and Infrastructure for approval prior to start of construction.

Mitigation measures will be identified in the "base" plan and may include, for example, choosing final locations of settling ponds to reduce direct surface runoff to aquatic environments, or incorporating secondary containment cells at each of the main settling ponds. Contingency measures that would be implemented in the event of an emergency will also be identified and may include, for example, the deployment of straw rolls/wattles, erosion control blankets, rapid stabilization techniques, supplementary seeding, temporary settling ponds etc. These will be developed as per the CEMP, PERs, SMP, RVMP and any other applicable EMPs.

In the event of an emergency, the Contractor, the Owner, and the Contract Administrator will determine which contingency and emergency control measures will be implemented. These contingency and emergency control measures would be carried out within a predetermined time period depending on the site conditions and nature of the emergency. Contingency measures will include monitoring at immediate downstream locations in the event of emergency conditions or undesirable circumstances.

During the operation phase, the channel will be resistant to large precipitation events through vegetation and armoring. Nevertheless, contingency and emergency control measures will be implemented by Manitoba Transportation and Infrastructure, depending on the site conditions and nature of the emergency, with due consideration given to the O&M manual that will be developed for the Project prior to the operation phase.