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Abbreviations and Acronyms

AEMP	Aquatic Effects Monitoring Program
DMP	Debris Management Plan
EIS	environmental impact statement
EMP	Environmental Management Program
EOC	emergency outlet channel
ESCP	Erosion and Sediment Control Plan
LMOC	Lake Manitoba outlet channel
LSMOC	Lake St. Martin outlet channel
SMP	Sediment Management Plan
TSS	total suspended solids

QUESTION IAAC-44

EIS Guideline Reference: 7.2.2 Changes to groundwater, surface water, and fluvial morphology; 7.3.1 Fish and Fish Habitat

EIS Reference: 7.2.4.2 Permanent Alteration or Destruction of Fish Habitat

Context and Rationale

Section 7.2.2 of the EIS guidelines requests that the proponent describe changes to water quality and quantity and sediment quality and quantity during all phases of the Project.

Section 7.2.4.2 of the EIS states that the amount of sediment mobilized from the channels and deposited in Birch Bay and Sturgeon Bay is expected to decrease over time as the amount of fine, erodible substrates diminishes with each successive use of the channels.

However, sediment erosion and deposition will never completely stop when the channels are in use and spikes in suspended and deposited sediment are expected whenever a high flood event occurs, and the channels are conveying water at maximum capacity. The EIS does not characterize sediment erosion and deposition throughout all phases of the Project.

The information available in the EIS is insufficient to make a determination of significance of impacts to fish and fish habitat and assess habitat suitability under different flow scenarios.

Information Requests

a) Using sediment transportation models, identify the potential range of sediment deposits in Birch Bay and Sturgeon Bay through all phases of the Project, including under the operational flow conditions. If sediment transport modelling is not conducted, present estimates for the range of sediment deposits including a rationale and a discussion of areas of uncertainty.

b) Update the assessment effects to fish and fish habitat informed by the range of sediment deposits in Birch Bay and Sturgeon Bay identified in a). Identify mitigation measures and assess significance of residual effects. Discuss associated monitoring and follow up.

Response IAAC-44a. Sediment Transport Studies

As described in IAAC 12, under current conditions flood events have a substantial effect on erosion and sedimentation processes, which will be mitigated by the Project. The analysis of potential changes in sediment transport in the Project area due to the Project construction, operation and maintenance benefitted from the presence of the emergency outlet channel (EOC), which has been present for nine years and used to manage flooding. As it is in close proximity to the Project and was used for similar purpose of flood mitigation, it serves as a good proxy, and studies of the effects of constructing and operating the EOC have provided valuable insights into predicting Project effects. For sediments, this

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includes using the data set generated by sediment transport studies that were conducted in the Project area for the EOC from 2011 to 2015 (KGS Group 2016a). These studies were conducted before, during and after operation of the EOC, and could be considered as a worst-case scenario, as the EOC was not vegetated or protected against erosion, and terminated in a bog, with water discharging through Buffalo Creek. As such, the sediment transport studies included a period of very high flows in the Project area and provided information on the relationship between sediment transport and changes in flows and lake levels during extreme flood events, including the 2011 and 2014 flood events. As indicated, it is important to note that during flood events water quality is dominated by natural conditions beyond the control or influence of the Project (see response to IAAC 12).

The sediment transport studies included the collection of hydrometric data, sampling for total suspended solid (TSS) concentrations, bedload analysis, topographic surveys and bathymetric surveys. These studies were used in conjunction with numerical hydraulic models to identify the potential effects of the operation of the EOC on the erosion and sediment deposition processes in the watershed (KGS Group 2016a). The sediment transport studies conducted for the EOC from 2011 to 2015 showed that sediment is transported from the upper Dauphin River into Sturgeon Bay. The velocities in Dauphin River moved suspended materials several hundred metres into Sturgeon Bay, with limited local deposition of sediments along the Dauphin River shoreline or in back eddies (KGS Group 2016a). The suspended solids were examined for grain size distribution and were found to consist mainly of clays and silts. The studies found that smaller particles of sediment, up to about sand size, could be transported in suspension to Sturgeon Bay, while larger cobble sized substrates could be transported by bed load, and gravel sized substrates could be eroded in the river (KGS Group 2016a).

Sediment deposition in Sturgeon Bay was found to vary among open-water and ice-covered periods (KGS Group 2016a). Sediment deposition under ice cover was more evenly distributed and in smaller volumes than during the open-water season (KGS Group 2016a). During open-water, wind and currents caused re-suspension of sediment particles, such that the deposition was still distributed across the sampling area, but was in higher volumes (KGS Group 2016a). There was no relationship found between sedimentation rates and trap distances from the mouth of Dauphin River (KGS Group 2016a). The studies noted that these results were in agreement with information provided in the “State of Lake Winnipeg 1999 to 2007” report, which reported higher sedimentation rates in the fall than in the spring and summer, and that wind was a more significant factor in suspended sediment dynamics than inputs from rivers that discharge into the lake (Environment Canada and Manitoba Water Stewardship 2011). The EOC studies were conducted during periods of very high flows, and as such, provide a time series from 2011 to 2015 of how sediment erosion and transport processes are affected or not affected by high flows in the lakes and rivers within the Project area. The KGS report contains additional information on the sediment transport field studies, data analyses and 2D modeling (KGS Group 2016a).

The Project design will incorporate several features to specifically address potential erosion and sediment transport that could occur due to construction, operation or maintenance activities. The outlet channels will be designed to be non-erodible for a range of operating conditions (i.e., designed to prevent significant movement of the bed material). The Conceptual Design of the channels included examination of the channel configurations (e.g., gradient and cross-sectional geometry of the channel) required to provide flows while minimizing erosion and sediment transport. The features needed to further

understand and minimize erosion and sediment transport are being examined and developed as the Preliminary Design and Detailed Design advances. Additional studies include examination of the maximum permissible shear stresses of *in-situ* material found at the Project site to determine the design shear stress for the channels and development of other erosion design criteria for the Project. To address potential erosion and sediment transport at the channel inlet and outlet areas, rock-filled jetties are included as part of the design of the inlet and outlet areas to reduce changes in shoreline geomorphology and help prevent erosion.

The amount of erosion, transport and deposition in an area is dependent on the type and size of materials present (e.g., clay, silt, sand, gravel, rock) and the erosive force of the water flow or water level to entrain and transport particles of different sizes. Without the Project, all high flows pass through Fairford River to Lake St. Martin and Dauphin River to Sturgeon Bay and enter Lake St. Martin and Sturgeon Bay at one location. With the Project, high flows will be split between the rivers and the constructed channels, which will reduce the amount of outflow to the existing river outlet areas within Lake St. Martin and Sturgeon Bay.

The operation of the EOC did not reduce flow volumes or lake levels in the Fairford River, Lake St. Martin or Dauphin River. Conversely, operation of the Lake Manitoba Outlet Channel (LMOC) and Lake St. Martin Outlet Channel (LSMOC) will reduce high flows in the rivers and high lake levels. This decrease in outflow in the Dauphin and Fairford rivers is expected to reduce erosion and transport of sediment to these local areas as less flow will entrain and transport less sediment in these natural channels. Sediment deposition in Lake St. Martin and Sturgeon Bay may be reduced with a reduced sediment load, but it is expected that the changes in sediment deposition due to operation of the Project may not be discernible from existing conditions, particularly in Sturgeon Bay, where the effects of wind on sedimentation rates and suspended sediment dynamics may exceed the effects of sediment inputs from river outflows. As such, the extensive sediment transport studies and sediment monitoring conducted for the EOC from 2011 to 2015 provided an analogue for the potential changes in sediment transport with and without the Project, and additional sediment transport modelling was not considered to be required.

The surface water assessment identified potential activities during construction, operation or maintenance of the Project that could result in the release and/or transport of sediment to waterways. The Project monitoring and follow-up programs are being developed concurrently with the advancement of Project design to include these aspects. The Project Environmental Management Program (EMP) summarized in Volume 1, Section 3.7 of the environmental impact statement (EIS), describes the environmental management processes that will be followed during construction, operation and maintenance, and includes an Erosion and Sediment Control Plan (ESCP), a Sediment Management Plan (SMP) and a Debris Management Plan (DMP). Additional information on the Project EMP and environmental management and monitoring plans can be found in the response to IAAC-15.

b. *Fish and Fish Habitat Assessment*

In assessing potential Projects effects to fish and fish habitat based on sediment, it is important to provide appropriate context. The Project is being implemented to mitigate flooding, an event that currently causes considerable adverse effects to the region, including increases in suspended sediment. There will be

temporary increases in sediment during construction, but construction methods will be used to prevent most sediment from reaching natural waterbodies and protection plans implemented with structured inspection and response protocols described above to address this issue. Once in place, the channels will consist of relatively non-erodible material with very low flows outside of operating during flood conditions. As indicated, studies of the EOC have provided a good basis for understanding effects and designing effective measures to avoid them.

Given the studies and context described above, the fish and fish habitat assessment does not need to be updated to consider inputs of sediment volumes into Birch and Sturgeon bays. The sediments generated from the LMOC are expected to be temporarily deposited into the Birch Bay area of Lake St. Martin. Due to the shallow nature of the lake and wave action, most of those sediments are expected to be transported downstream over time and will eventually be deposited into Sturgeon Bay. Sediments generated by the LSMOC will also be deposited into Sturgeon Bay. Due to shallow depths and wave action, most of the sediments in Sturgeon Bay will eventually be transported and settle in the deep mid main basin of Lake Winnipeg. Overall, due to the reduction in flooding, the amount of sediment transported post project is expected to be less than the amount of sediment transported without the Project in place.

The sediment inputs from the channels are not expected to have a significant negative effect on fish and fish habitat in Lake St. Martin or Sturgeon Bay. Fish inhabiting Lake Manitoba, Lake St. Martin and Lake Winnipeg are adapted to living in turbid water conditions and, therefore, can tolerate a wide range of TSS concentrations. TSS concentrations within surrounding waterbodies are not expected to exceed guidelines during construction or operation of the channels (except possibly under flood conditions and at lower concentrations than if the Project did not exist). Should increased TSS concentrations occur near point source introductions, it is expected that fish will be able to temporarily avoid these areas before appropriate mitigation or adaptive management is undertaken.

Sediments are constantly being deposited into Lake St. Martin and Sturgeon Bay and due to lake bathymetry and wave action are continually being sorted and transported. Consequently, it is expected that any short-term increases in sediment deposition in these areas will not have a long-term negative affect on fish habitat. Any short-term effects are expected to be small in magnitude and local. Long-term effects will extend to the main basin of Lake Winnipeg where the incremental effect is expected to be negligible.

The Aquatic Effects Monitoring Program (AEMP), together with the physical monitoring that will be conducted under other plans in the EMP, will contribute to confirming the predicted effects to fish resulting from sediment inputs. Monitoring of benthic production and fish reproduction will provide evidence of potential effects to fish habitat. Monitoring of fish abundance will provide evidence of potential effects to fish populations.

References

EC and MWS (Environment Canada and Manitoba Water Stewardship). 2011. State of Lake Winnipeg 1999 to 2007. Environment Canada Report.

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KGS Group. 2016a. Lake St. Martin Emergency Relief Channel Monitoring and Development of Habitat Compensation Physical Processes DRAFT / MIT-009-13_002_REV B. KGS Group 13-0431-001. March 2016.