Table of Contents

LIST OF TABLES

LIST OF MAPS

Abbreviations and Acronyms

EIS	environmental impact statement
ISO	International Organization for Standardization
LMOC	Lake Manitoba outlet channel
LSMOC	Lake St. Martin outlet channel
masl	meters above sea level
PDA	project development area

QUESTION IAAC-26

EIS Guideline Reference: 7.1.4 Groundwater and Surface Water

EIS Reference: 6.4.2 Existing Conditions with Groundwater

Context and Rationale

The EIS guidelines require baseline information on groundwater quality to support understanding of the potential changes from the Project to water quality and associated effects to the environment.

The EIS provides information on groundwater quality from sampling programs completed between Fall 2016 and Spring 2018 in the Lake Manitoba Outlet Channel Project Development Area. The EIS does not provide the locations of groundwater monitoring wells used to establish baseline data. Therefore, it is unclear where the sampling sites are located in relation to the Project components and whether they provide an accurate representation of relevant baseline groundwater quality. No groundwater quality data was collected along the LSMOC section. This information is required to review project residual effects.

In the EIS, Table 6.4-7 only provides the maximum and minimum results; no summary statistics or information on number of samples is provided. The range of values alone does not provide enough information to adequately determine the baseline groundwater quality conditions and additional summary statistics are required.

This information is required to understand whether baseline groundwater quality is accurately characterized for the Project Area. Accurate baseline data in necessary to assess the potential effects of the Project on groundwater quality.

Information Requests

a) Provide groundwater quality baseline date for the LSMOC assessment areas or provide rationale or justification why the groundwater sampling program has not been conducted along the LSMOC.

b) For both LMOC and LSMOC assessment areas:

   i. Clearly indicate the methodology used to include historical groundwater quality data in the baseline groundwater quality dataset.

   ii. Provide raw baseline groundwater quality data, including sample depth.

   iii. Provide summary statistics for groundwater quality, which should include, at a minimum: mean, standard deviation, 95th percentiles, minimum, maximum, and number of samples.

   iv. Provide a map depicting the locations of monitoring stations that have been included in the baseline groundwater quality dataset.

Question IAAC-26

v. Identify the potential gaps in groundwater quality baseline data and indicate how data gaps will be addressed. Discuss implications of data gaps for conclusions drawn, uncertainty, and additional follow up and monitoring that would be implemented to address uncertainty in a precautionary manner.

Response IAAC-26

a) No baseline groundwater quality results were available within the Lake St. Martin Outlet Channel (LSMOC) project development area (PDA) prior to the environmental impact statement (EIS) filing in August 2019. Groundwater quality data are currently being collected within the LSMOC PDA as part of the Preliminary Design field investigation phase of the Project. In 2019 and 2020, groundwater quality monitoring was conducted in the LSMOC PDA by KGS Group (KGS) as part of the Preliminary Design field study phase of the Project. The technical reporting process from these investigations is in progress; as such, these data are not yet ready to assist preparation of a monitoring plan for the LSMOC. This information will be used in developing the plan when fully available.

   For the purposes of the assessment, the groundwater quality within the LSMOC PDA was considered to be similar to that observed within the Lake Manitoba outlet channel (LMOC) PDA. They both have similar regional geology and have the same main source of recharge as shown in Volume 2, Figure 6.4B-3 Regional Groundwater Flow of the EIS. The groundwater quality is assumed to be similar to the LMOC non-saline conditions and suitable for domestic consumption as shown in Volume 2, Table 6.4-7 Historical Groundwater Quality Data in the EIS. There is no development in the area of the LSMOC that would potentially alter the conditions. A groundwater management plan will be developed to ensure groundwater is monitored and protected during preconstruction, construction and operation of the LSMOC.

b) See responses for LMOC and LSMOC assessment areas below.

<u>LMOC</u>

i. The baseline water quality dataset for the LMOC PDA comprises results from groundwater sampling conducted by KGS between Fall 2016 and Spring 2018. The methodology used to include this historical groundwater quality data in the baseline groundwater quality dataset involved literature review of technical reports produced by KGS (2017a, 2017b, 2018). These historical datasets best represent the baseline groundwater quality in the LMOC PDA since they were collected for this Project, are specific to the LMOC PDA, have clearly defined sampling collection methods, and have had samples analyzed by a laboratory with International Organization for Standardization (ISO) accreditation.

ii. Baseline groundwater quality data in the LMOC PDA was collected by KGS between Fall 2016 and Spring 2018 (KGS 2017a, 2017b, 2018). Raw baseline groundwater quality data are presented in tabular format in the aforementioned KGS monitoring reports; these include Tables D6-18 to D6-21 in Appendix C (KGS 2017a), Tables D2-2 to D2-4 (KGS 2017b), and Tables D3-2 to D3-4 (KGS 2018). Laboratory results are also provided in all monitoring reports mentioned above.

Question IAAC-26

The specific sample depths are not provided in the KGS groundwater water quality reports (2017a, 2017b, 2018) directly. The screened depth is the sample depth for a well. These wells were screened at the bottom of the well and are in the bedrock aquifer. These were obtained from the specific drilling logs (KGS 2017a, 2018) and are listed in Table IAAC-26-1.

According to groundwater sampling methods described by KGS, samples from test hole wells were collected after the well volume was purged a minimum of three well volumes or until groundwater parameters measured in the field stabilized; samples at pump test wells were collected at the beginning and end of each pump test (KGS 2017a).

Table IAAC-26-1 Groundwater Well Depths (KGS 2017a, 2018)

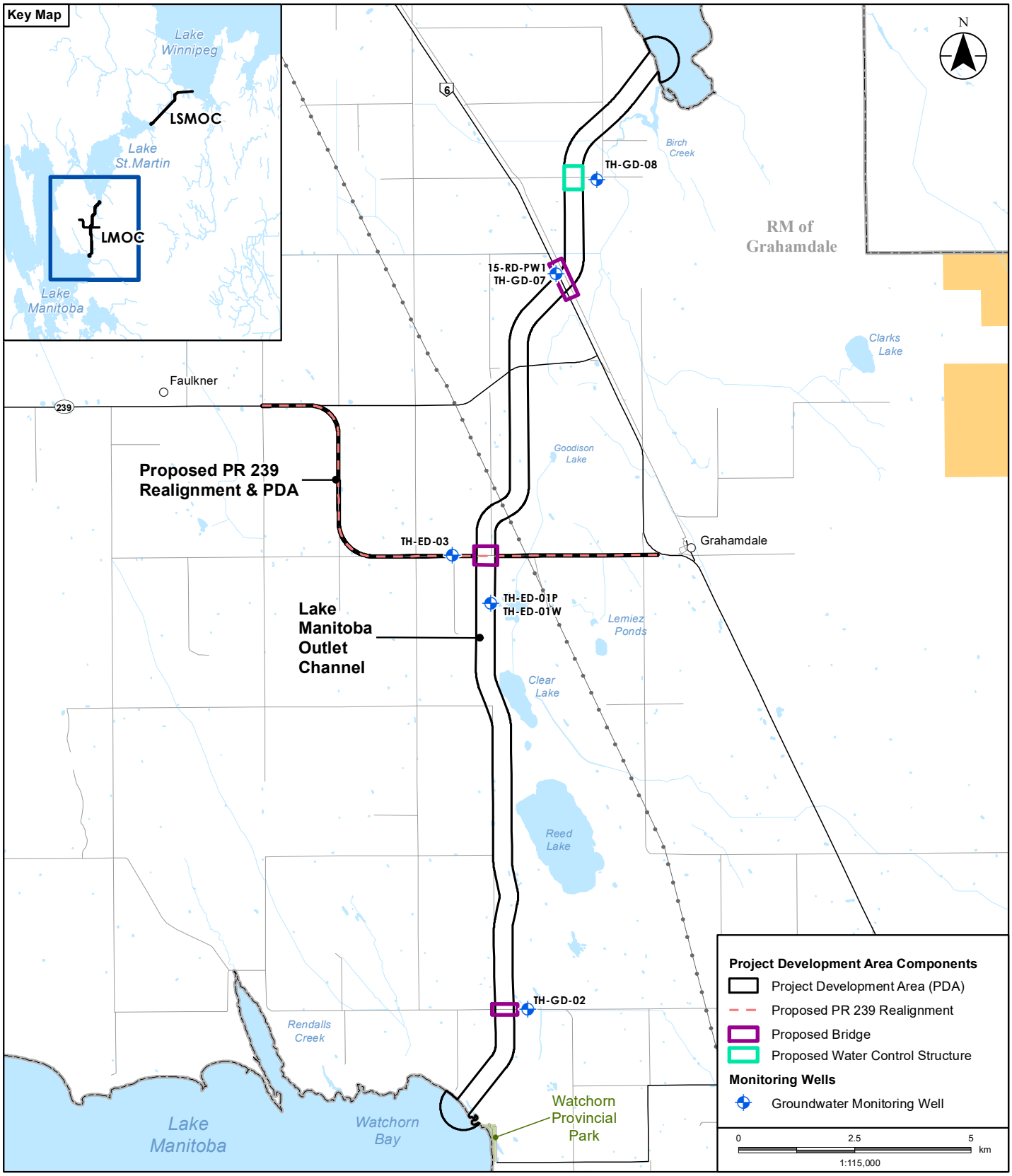
Well ID	Well Screen Depth (m)[ɣ]	Well Depth Elevation (masl)
15-RD-PW1[†]	17.7-18.6	232.69
TH-ED-01W*	25.6	217.78
TH-ED-01P*	25.9-27.4	221.99
TH-ED-03*	11.9-13.4	237.89
TH-GD-02*	20.6-22.8	225.86
TH-GD-07*	17.8-19.4	232.69
TH-GD-08*	15.5-17.1	229.43

[†] Pump well
* Test hole well
[ɣ] screened opening, except TH-ED-01W, which is a bedrock opening.

iii. In the EIS, Volume 2, Table 6.4-7 provides the maximum and minimum results; Table IAAC-26-2 below expands on this information and provides summary statistics for groundwater quality including: mean, standard deviation, 5th and 95th percentiles, minimum, maximum, and number of samples.

iv. Map 26-1 depicts the locations of monitoring stations included in the baseline water quality dataset.

Baseline conditions in the LMOC aquifer are well understood and discussed in the EIS; no information gaps exist. Continued understanding of groundwater quality conditions pre-construction, during construction, and post-construction is the key next step in protecting the aquifer. This will be accomplished through ongoing pre-construction groundwater quality monitoring, and via construction and post-construction monitoring plans to be developed as part of the Preliminary Design phase of the LMOC within the groundwater management plan. The water would be expected to meet Canadian Drinking Water Guidelines (Health Canada 2017) or if those are not currently met then to maintain baseline conditions. For these samples there was very limited data on total coliforms (two samples on samples well) and they did not meet guideline. Bacteria were sampled at the pump well at the start and end of the test. The pump well was not disinfected prior to sampling; however, bacteria were sampled to detect any changes while pumping. At TH-ED-01 total coliform decreased during the pump test from 24 to



Legend

- Existing Transmission Line
- Provincial Highway (PTH/PR)
- Municipal Road
- Rural Municipality
- Wildlife Management Area
- Provincial Park

Notes

1. Coordinate System: WGS 1984 UTM Zone 14N
2. Data Sources: Governments of Manitoba and Canada, Manitoba Infrastructure, MLI 2019
3. Last Update: 5/24/2020 5:16:39 PM

Manitoba

MANITOBA INFRASTRUCTURE
Lake Manitoba & Lake St.Martin Outlet Channels Project
Environmental Impact Statement

Groundwater Monitoring Well Locations - Lake Manitoba Outlet Channel PDA

DRAFT

IR Map 26-1

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Question IAAC-26

2 MPN/100 mL while E. coli was not detected in either sample. It is expected that this groundwater is drinking water quality and does not have detectable coliform. There will be a program to sample domestic wells in the vicinity of the LMOC to during and post construction and report to the Office of Drinking Water in Manitoba.

LSMOC

i. As mentioned in Part (a), no baseline groundwater quality data are available in the LSMOC PDA and therefore the methodology to include historical groundwater quality data in the baseline groundwater quality dataset cannot be provided at this time.

ii. As mentioned in Part (a), no baseline groundwater quality data are available and therefore the raw datasets cannot be provided at this time.

iii. As mentioned in Part (a), no baseline groundwater quality data are available and therefore summary statistics cannot be provided at this time.

iv. As mentioned in Part (a), no baseline groundwater quality data are available and therefore a map depicting the locations of monitoring stations cannot be provided at this time.

The lack of baseline data is the primary gap in groundwater quality data in the LSMOC PDA. This gap will be addressed by ongoing groundwater quality sampling in the LSMOC PDA by KGS as part of the Preliminary Design phase of the Project. It is assumed that the groundwater is non-saline and could be used at some point for domestic consumption, therefore, it must be fully protected even though there are no current domestic well users. Developing an understanding of groundwater quality and water levels conditions pre-construction, during construction, and post-construction is the key step in protecting the aquifer. This will be accomplished through ongoing pre-construction groundwater quality monitoring, and via construction and post-construction monitoring plans to be developed as part of the Preliminary Design phase of the LSMOC within the groundwater management plan. The water would be expected to meet Canadian Drinking water guidelines (Health Canada 2017) or if those are not currently met then maintain baseline conditions.

References

CCME (Canadian Council of Ministers of the Environment). 1999 (Updated to 2018). Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment, Winnipeg.

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Question IAAC-26

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KGS Group Consulting Engineers. 2017b. Investigations and Preliminary Engineering for LMB Channels Options C and D Deliverable D2, Annual Monitoring Report to July 1, 2017. Final Rev 0, Prepared by KGS Group.

KGS Group Consulting Engineers. 2018. Investigations and Preliminary Engineering for Lake Manitoba Outlet Channels Options C and D Deliverable D3, Annual Monitoring Report to July 01, 2018. KGS Group Project 16-0300-006. Final - Rev 0. August 2018.

Question IAAC-26

Table IAAC-26-2 Historical Groundwater Quality Data from October 2016 to May 2018 of the LMOC PDA (KGS 2018)

Parameter	HC-CDWQG	CCME-FAL	Statistics						
			n	Min	Max	Mean	Standard Deviation	5th Percentile	95th Percentile
pH (pH units)	6.5 - 8.5 (AO)	6.5 - 9.0	36	7.53	8.46	7.72	0.21	7.54	8.26
Hardness as $CaCO_3$ (mg/L)	-	-	36	125	420	384	79	137	406
Chloride (5) (mg/L)	≤250 (AO)	120/640	36	5.28	17.8	6.05	4.41	5.30	17.6
Fluoride (mg/L)	-	0.12	7	0.466	0.821	0.697	0.133	0.471	0.804
Sulphate (mg/L)	-	-	36	21.6	165	121	36.7	40.8	158
Nitrate (as N) (mg/L)	10 (MAC)	3/124	36	0.00250	0.211	0.00250	0.0342	0.00250	0.0154
Nitrite (as N) (mg/L)	1.0 (MAC)	0.06	36	0.0005	0.0191	0.0005	0.0034	0.0005	0.0063
Total Phosphorus (mg/L)	-		3	0.0129	0.0810	0.0250	0.0297	0.0141	0.0754
Total Dissolved Solids (mg/L)	500 (AO)	-	35	295	532	494	58.0	333	523
E. Coli (MPN/100 mL)	None Detect per 100 mL (MAC)	-	2	ND	ND	ND	NA	ND	ND
Total Coliform (MPN/100 mL)	None Detect per 100 mL (MAC)	-	2	2	24	13	11	3	23
Aluminum, Dissolved (mg/L)	0.1- 0.2 (OG)	0.005/0.1	34	0.0005	0.0189	0.0010	0.0037	0.0005	0.0092
Antimony, Dissolved (mg/L)	0.006 (MAC)	-	34	0.00005	0.00074	0.00005	0.00014	0.00005	0.00035
Arsenic, Dissolved (mg/L)	0.010 (MAC)	0.005	34	0.00005	0.00103	0.00017	0.00027	0.00005	0.00078
Barium, Dissolved (mg/L)	1.0 (MAC)	-	34	0.0136	0.0275	0.0195	0.0031	0.0139	0.0225
Boron, Dissolved (mg/L)	5.0 (MAC)	29/1.5	34	0.168	0.732	0.571	0.160	0.181	0.703
Cadmium, Dissolved (mg/L)	0.005 (MAC)	0.00009/0.001	34	0.0000025	0.0000123	0.0000050	0.0000020	0.0000025	0.0000063
Chromium, Dissolved (mg/L)	0.05 (MAC)	0.0089 (III)/0.001 (VI)	34	0.00005	0.00069	0.00005	0.00023	0.00005	0.00050
Copper, Dissolved (mg/L)	1.0 (AO)	-	34	0.00010	0.00146	0.00010	0.00029	0.00010	0.00089
Iron, Dissolved (mg/L)	0.3 (AO)	0.3	34	0.005	0.154	0.005	0.032	0.005	0.062
Lead, Dissolved (mg/L)	0.010 (MAC)	-	34	0.000025	0.000108	0.000025	0.000019	0.000025	0.000062
Manganese, Dissolved (mg/L)	0.05 (AO)	-	34	0.00413	0.103	0.0110	0.0209	0.00543	0.0598
Molybdenum, Dissolved (mg/L)	-	0.073	34	0.00017	0.0392	0.00028	0.00998	0.00018	0.0286
Nickel, Dissolved (mg/L)	-	-	34	0.00025	0.00454	0.00050	0.00093	0.00025	0.00255
Selenium, Dissolved (mg/L)	0.05 (MAC)	0.001	34	0.000025	0.00050	0.000025	0.00023	0.000025	0.00050
Silver, Dissolved (mg/L)	-	0.00025	34	0.000005	0.000050	0.000005	0.000022	0.000005	0.000050
Sodium, Dissolved (mg/L)	200 (AO)	-	36	30.3	74.1	33.6	12.0	30.4	72.8
Thallium, Dissolved (mg/L)	-	0.0008	34	0.000005	0.000050	0.000020	0.000020	0.000005	0.000050
Uranium, Dissolved (mg/L)	0.02 (MAC)	0.033/0.015	34	0.000593	0.00490	0.00119	0.00108	0.000615	0.00410
Zinc, Dissolved (mg/L)	5 (AO)	0.03	34	0.0005	0.0054	0.0010	0.0013	0.0005	0.0049

Question IAAC-26

Table IAAC-26-2 Historical Groundwater Quality Data from October 2016 to May 2018 of the LMOC PDA (KGS 2018)

Parameter	HC-CDWQG	CCME-FAL	Statistics						
			n	Min	Max	Mean	Standard Deviation	5th Percentile	95th Percentile

NOTES:
This table shows parameters with established guidelines.
Column “n” refers to number of samples.
Results are in mg/L unless otherwise specified in the parameter column.
HC-CDWQG-Drinking Water - Health Canada Canadian Drinking Water Quality guidelines. (Health Canada 2017).
MAC: maximum acceptable concentration; AO: aesthetic objective; OG: operational guidance.
CCME-FAL - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines for the protection of Freshwater Aquatic Life (CCME 1999).
Exceedance of HC-CDWQG are double underlined and exceedances of CCME-FAL are shaded.
ND- None detected
For statistical calculations, half detection limit values are used for the results of the laboratory analyses reported as less than the detection limit values.