KGS GROUP
CONSULTING ENGINEERS

Manitoba Infrastructure

RED RIVER FLOODWAY LONG-TERM MONITORING PROGRAM
2017 PROGRAM A – ANNUAL REPORT
DELIVERABLE D4

FINAL – REV 0

KGS Group 16-0300-002
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File No: 16-0300-002

Manitoba Infrastructure
2nd Floor - 280 Broadway
Winnipeg, Manitoba
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ATTENTION: Mr. Paul Graveline
Project Manager

RE: Red River Floodway Long-Term Monitoring Program
2017 Program A – Annual Report, Final Rev 0

Dear Mr. Graveline:

KGS Group is pleased to provide two (2) paper copies and electronic copies on DVD of the 2017 Program A – Annual Report, which is part of the Red River Floodway Long-Term Monitoring Program. This report summarizes activities for 2017.

We appreciate the opportunity to provide on-going services to Manitoba Infrastructure.

Sincerely,

J. Bert Smith, P.Eng.
Principal

MFH/ama
Enclosure

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1.0 INTRODUCTION

1.1 ENVIRONMENT ACT LICENCE REQUIREMENTS

This 2017 Program A Annual Report is submitted in response to the requirements for annual monitoring in accordance with Clause 27 and Clause 30 of Environmental Licence No. 2691 dated July 8, 2005 and described in the Manitoba Floodway Authority memorandum HM72 Rev 1 Post-construction and Long-term Monitoring Program, issued April 2013. Revisions to the Long-term Monitoring Program were given in HM99, the 2013 to 2014 Post-construction Monitoring Program Comprehensive Annual Report February 2015. Background information and historic data that are not included in this report can be found in the annual groundwater Monitoring Data Analysis Reports 2005 through 2016. There was no monitoring program in 2012.

1.2 SCOPE OF WORK

The objectives of the project are to carry out long-term monitoring, testing and reporting on groundwater conditions within and adjacent to the Red River Floodway (Floodway) in accordance with the Provincial commitment to flood protection and as required under the Red River Floodway's Operating License (Environment Act License No. 2691). The current work program, overseen through Manitoba Infrastructure (MI) includes a monitoring period from spring 2016 through fall 2018, outlined in KGS Group proposal 15-000-1555. The Three Year Project Scope of Work includes the following annual activities:

- Spring and Summer Flood Monitoring Program A (or B if required);
- Inspection of Treated Groundwater Springs;
- Annual Well Disinfection, Inspection/Maintenance/Repair Programs and Channel Inspections;
- Reporting.

Previous deliverables for the current MI work program included:

- Deliverable D1 Red River Floodway Long-Term Monitoring Program 2017 Program A-Annual Report Deliverable D1.

- Deliverable D2 Red River Floodway Long-Term Monitoring Program 2016 Annual Inspection and Maintenance Report- Deliverable D2.
- Deliverable D3 Red River Floodway Long-Term Monitoring Program Deliverable D3-2017 Program A-Task 14 Notification Report 01.

This report (Deliverable D4) contains reporting for Program A Annual Report (Task 1) which also includes the inspection of treated groundwater springs and the annual well disinfection. In 2017 MI approved a scope change for the spring inspections and channel bottom survey to be conducted by boat in the Low Flow Channel at the same time. The 2017 Annual Inspection and Maintenance Report (Task 2) was submitted as Deliverable D5. Tables and Figures are labelled using the deliverable numbers to create unique products. For example, Appendix D4-A indicates Appendix A of the Deliverable D4 report.

In 2017, the Red River Floodway was operated from March 31, 2017 to April 21, 2017. Based on projected and then actual flows the requirements for Long-term Monitoring Program A (Task 1) (as outlined in proposal 15-000-1555) were initiated in Spring 2017. This included sampling of 5 instrumented monitoring wells for inorganic parameters and bacteria three times: pre-melt, at the peak flow of the Red River Floodway; and post-flood (several weeks after peak flow in the Red River Floodway) along with sampling of 7 additional core monitoring wells, once during the peak flow of the Red River Floodway. Sampling of surface water was conducted weekly during Floodway operation at two locations (PTH 59N Bridge and PTH 44 Bridge) during the peak flow in the Red River and an additional sample was taken after the Floodway operation to help interpret the post-melt groundwater data.

In addition to the Spring Flood Monitoring Program A (Task 1) in 2017, KGS Group conducted an inspection of treated groundwater springs and an annual well disinfection program as described in this report. The 2017 Annual Inspection and Maintenance Report (Deliverable D5) has been submitted separately and also includes a discussion of the channel bottom inspection, which was conducted at the same time as the springs inspection.

The Red River flow began entering the Floodway channel naturally, prior to control structure operation on March 30, 2017. The Floodway control structure was operated from March 31, 2017 to April 21, 2017, with the peak flow occurring on April 6, 2017 as discussed in Section 3.0.

The detailed 2017 program was as follows:

- Pre-melt monitoring was conducted on March 2 to 3, 2017 before the rise in the Red River.
- Spring Floodway operation peak flow monitoring was conducted on April 5 to 7, 2017.
- Weekly surface water monitoring at locations near the PTH 44 Bridge and PTH 59N Bridge was conducted from April 5 to April 26 and Post-flood surface water monitoring was conducted on May 11, 2017.
- Resampling of bacteria was conducted in the 5 instrumented monitoring wells on April 20, 2017.
- Post- Flood Groundwater Monitoring was conducted on May 11, 2017.
- Annual Groundwater Springs Inspection and Channel Bottom inspection was conducted on September 5 to 6, 2017.
- Annual Well Disinfection Program was conducted on November 29 to 30, 2017.

The 2017 program represents the third year of the Long-term Monitoring Program, and the second year falling under Manitoba Infrastructure direction. The 2017 Long-term monitoring program used monitoring wells designated in the monitoring program for Program A Task 1 as shown on Figure D4-1.

1.3 AQUIFER CHARACTERIZATION

The carbonate aquifer found along the Floodway Channel is part of a regional groundwater flow system from eastern Manitoba. The confined carbonate bedrock aquifer has natural variations in water quality, with the conductivity ranging from moderate to high (1,000 to 2,000 µS/cm). Conductivity is a measure of dissolved solids, such as calcium, magnesium, chloride, sodium and sulphate. Near the Floodway Inlet, local mixing with saline groundwater found west of the Red River, results in higher conductivity groundwater (greater than 3,000 µS/cm) with increased chloride and sodium.

Lower conductivity values are found in the bedrock aquifer where it is influenced by the Birds Hill surficial granular aquifer, from CPR Keewatin Bridge to Church Road. The Birds Hill sand and gravel surficial aquifer is a local unconfined aquifer near PTH 59N Bridge. The bedrock

aquifer beneath and surrounding the Birds Hill deposit has lower groundwater conductivity due to the freshwater recharge through the sand and gravel.

Natural variations in groundwater quality by location and with the seasons must be considered when the baseline and ongoing water quality results are evaluated during construction activities and Floodway operation events. One way to detect whether there is surface water intrusion into the groundwater aquifer is to monitor an indicator parameter such as conductivity which, along with other major ions, can be used to evaluate this contrast. In the vicinity of the Bird's Hill sand and gravel surficial aquifer, recharge from precipitation results in groundwater with lower conductivity (500 µS/cm to 1,000 µS/cm) than is found in other areas of the carbonate aquifer.

The intrusion of surface water into the groundwater is most readily detected when there is a contrast between the chemistry of the samples. Most groundwater conductivity values were found to be greater than surface water conductivity values measured during annual spring Floodway operation. Red River conductivity values are historically lowest during spring Floodway operation events, such as in the spring of 2005, 2006, 2007, 2009, 2010, 2011, 2013 and 2014. In this situation, groundwater conductivity would be expected to decrease, if surface water intruded.

During summer Floodway operation in 2005, summer Floodway use in 2007, and summer Floodway operation in 2010 and 2011, conductivity values of surface water from the Red River diverted in the Floodway were slightly higher than in the spring, and higher than the natural groundwater conductivity levels in some areas near the CPR Keewatin Bridge, PTH 59N Bridge and Church Road. These areas have naturally low groundwater conductivity in the bedrock aquifer. Floodway Channel surface water conductivity was also higher during the summer precipitation events in June 2008, than during the spring melt, with no Floodway operation in April 2008. An increase in groundwater conductivity might occur in summer, if surface water intrudes into the groundwater at this time.

In the spring 2015 flood, one time sampling in the Floodway Channel during the spring melt on April 6, 2015 (no Floodway flow or Floodway operation) showed that the conductivity of the local surface water in the Floodway Channel was low in April, and increased in May as the surface

water input decreased and the groundwater base flow became a greater percentage of the flow system.

In the spring of 2016, the conductivity during the spring melt on March 28 to 30, 2016 (no Floodway flow or Floodway operation) showed a low conductivity for the local surface water in the Floodway channel. An increase was seen in June 2016 as the percentage of groundwater base flow increased.

2.0 METHODOLOGY

2.1 SURFACE WATER

Surface water samples in 2017 were taken in the Floodway Channel at the PTH 44 and PTH 59 Bridges. Grab samples were collected from the channel. Samples were taken directly into sample bottles attached to an extension pole. KGS Group recorded field parameters (dissolved oxygen, specific conductivity, temperature and pH) using the YSI Pro meter. Results for the field parameters are shown in Table D4-1. Laboratory analysis data are shown in Table D4-2 and Table D4-3. Original laboratory reports are given in Appendix E. Laboratory results are given in mg/L unless indicated otherwise.

2.2 WELL PUMPING METHOD MODIFICATIONS

In 2017, monitoring wells were purged using a combination of small diameter submersible pumps (either dedicated to the well or portable) and dedicated inertial pumps (Waterra tubing with foot valves). Three of the monitoring wells (K13-12321, K09-12316 and K09-12012) now contain dedicated submersible pumps, while monitoring wells K11-12014 and K11-12015 now contain dedicated Waterra tubing.

After the well disinfection program in November 2017, as approved by MI, all dedicated well pumps were removed for inside storage at KGS Group over the winter, to protect against long-term precipitation of carbonate groundwater within the pump during submergence over the winter months, prior to the next spring pre-melt event.

2.3 GROUNDWATER

Monitoring well groundwater samples were taken from 5 of 12 monitoring wells on March 2 to 3, 2017. Subsequently all 12 monitoring wells were sampled on April 4 to 7, 2017 and these 5 of 12 monitoring wells were sampled again on May 11, 2017. All monitoring wells were located within the Floodway Right-of-Way. One of the monitoring wells sampled is a water supply well for Inlet Control Structure (G05OC006). Water samples are taken from an inside tap, however the water is not used for drinking. Well locations are shown on Figure D4-1. Monitoring wells are

not used for drinking water supply. Supplementary groundwater sampling event was also conducted at 5 of the 12 monitoring wells on April 20 for bacteria, as follow up to the prior March and April 2017 sampling events.

In order to ensure groundwater samples were representative of the natural formation water, the monitoring wells were purged a minimum of three (3) well volumes, or until groundwater parameters (conductivity and temperature) stabilized. Field measurements were taken at the start of purging and at set intervals of 5 to 10 minutes. Stable groundwater parameters were achieved at all sample locations within 20 minutes.

Field measurements for pH, conductivity and dissolved oxygen were taken during each sampling period. Groundwater samples were stored in a cooler chest at 4°C for transport to the laboratory. The samples were analyzed at ALS Laboratory in Winnipeg, Manitoba. Metal samples were filtered and acidified in the laboratory, since iron and manganese were not analyzed.

Results for the field parameters are shown in Table D4-1. Laboratory analysis data are shown in Table D4-2 and Table D4-3. Original laboratory reports are given in Appendix D4-E. Laboratory results are given in mg/L, unless otherwise noted.

2.4 TRANSDUCER GROUNDWATER LEVEL AND QUALITY PROGRAM

Continuous measurements of groundwater elevation and temperature were collected from the previous October 2016 download, to November 2017 in the 5 instrumented monitoring wells. Transducers were installed at depth so that the tips were in the open bedrock or screened zone. Transducers and pumps installed in these monitoring wells are owned by MI. Transducer results are shown in Appendix D4-B. Historical transducer data, reported in the most recent previous Red River Floodway 2015 Long-term Monitoring Program Report (HM101) is compiled in Appendix D4-C. Transducer monitoring in spring 7A1 (Kildare) is discussed in Section 6.0.

2.5 WELL DISINFECTION PROGRAM

The methodology employed for the well disinfection program included the following for each location:

- Recorded water level measurement from the top of the PVC well casing;
- Temporarily removed the dedicated transducer;
- For monitoring wells with dedicated submersible pumps, the pumps were removed, labelled and placed in a dedicated bags for winter storage at KGS Group;
- Added a calculated amount of household bleach to the well to raise the chlorine level in the well water to 200 ppm;
- Operated a temporary submersible well and pumped the well until discharge water had a chlorine odour (approximately 10 minutes);
- Removed the temporary inertial pump from the well;
- Closed and locked each well.

2.6 QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)

Standardized sampling procedures and protocols were used during the sampling event to ensure representative samples were collected in a controlled manner so that scientifically defendable comparisons can be made.

Chain of Custody – KGS Group ensured all Chain-of-Custody procedures were properly undertaken and holding times were not exceeded.

Sample Collection – Samples were collected directly from the dedicated pump outlet, which is sealed in the well. Disposable latex gloves were worn when handling each piece of equipment and groundwater sample, using a new pair for each sample collection. Samples were collected in clean containers (supplied by the lab) and stored at the appropriate temperature using the proper preservatives. Any equipment replacement in the five instrumented monitoring wells was disinfected prior to installation.

Laboratory Qualification – ALS Environmental of Winnipeg, Manitoba, is a Canadian Association for Laboratory Accreditation Inc. (CALA) accredited analytical testing laboratory. Criteria and guidelines used for assessment of analytical data were clearly established with the laboratory to ensure the appropriate detection limits were used.

Duplicate Samples – Duplicate groundwater samples were submitted at a frequency of 10% for the total samples submitted to assess the quality of the laboratory analysis. The field duplicates were labelled such that the laboratory did not know the samples were duplicates. Laboratory standards and duplicates are run regularly by ALS and are on file.

Field Equipment – Field equipment such as field chemistry meters and transducers (if they include conductivity) are calibrated prior to use or installation.

3.0 SURFACE WATER RESULTS AND ASSESSMENT

3.1 2017 SPRING OPERATION

The 2017 and previous Floodway operation flows are summarized in Appendix Table D4-A-1. During the 2017 spring flood event, the Red River water began to flow naturally into the Floodway Channel on March 30, 2017 with a flow of 63 cms (2,225 cfs). The Floodway gates were in operation for 22 days from March 31, 2017 to April 21, 2017. The Red River crested on April 6, 2017 at the Floodway Inlet with a flow of 635 cms (22,421 cfs) diverted into the Floodway Channel.

3.2 2017 MONITORING LOCATIONS AND DATA

Surface water monitoring locations in 2017 were as follows:

- Floodway Channel at PTH 59N Bridge.
- Floodway Channel at PTH 44 Bridge.

Surface water quality data is shown in Table D4-1 for field data and Table D4-2 for laboratory data.

3.3 2017 CHANNEL WATER ELEVATION

Records for the Water Survey of Canada gauge in the channel near the Floodway Inlet (St. Norbert 05OC017) are given in Appendix D4-A-2, showing the 2017 peak of the spring Floodway operation elevation and the discharge. A comparison of peak flows and durations for flood events is presented in Appendix Table D4-A-1. The 2017 spring Floodway operation was similar to the 2005 summer flood discharge (635 cms vs. 657 cms), but had a shorter 22 day duration, compared with the 46 day duration in 2005. Peak flows and elevations vary along the channel and are also measured at the TransCanada Highway. Since many of the monitoring wells were not constructed in 2005, water quality comparisons are given in relation to the next largest Floodway operations - the 2013 spring and 2014 summer events.

Real time data for elevation, temperature and water quality available on-line from the USGS (United States Geological Survey) for the Red River at Grand Forks is presented in Appendix D4-A-3 This data is used as a general comparison since the Floodway Long-term monitoring program does not conduct monitoring in the Red River. The profile shows the spring peak, which resulted in Floodway operation, in Manitoba.

3.4 2017 TEMPERATURE

Based on historical data collected, the cold temperature of the Red River at the beginning of the spring melt is generally useful as an indicator of surface water infiltration when the river or overland surface water runoff temperature is a few degrees above freezing and the groundwater temperature is higher. As the spring melt advances over time, water from the spring melt starts to warm, increasing in temperature as the peak passes. Historically, a decrease in temperature has been observed in groundwater with the initial onset of spring melt.

Temperatures were first measured at approximately 5.1°C and 6.2°C in the Floodway Channel on April 5, 2017; five days after Floodway operation started as shown on Table D4-1. Temperatures from grab samples increased to 7.3 and 7.7°C on April 19 and decreased with colder weather to 3.6 to 3.8°C on April 26, 2017. The May 11, 2017 samples had temperatures of 12.7 and 14.8 °C and were taken after Floodway operation, representing groundwater baseflow combined with surface flow from local sources.

The continuous data from the Red River at Grand Forks (Appendix D4-A-3, page 3 of 10) also shows rising temperatures from 0°C to approximately 6°C from March 30 to April 3 as the flood peaked. The flood stage elevation peaked in Grand Forks on March 30, 2017. In the Floodway, surface water temperatures were slightly below, or similar to measured groundwater temperatures during the earliest sampling on April 5, 2017. Temperature shifts in groundwater during Floodway operation have been seen only in a few areas, all where downward gradients between the surface water and the groundwater would be present with even low flows in the Floodway. Temperature becomes a useful tracer again in the later part of the flood as surface water values become significantly higher than the groundwater.

3.5 2017 BACTERIOLOGICAL QUALITY

Bacteria results in the Floodway Channel surface water during the spring 2017 flood are shown in Table D4-2. Total coliform at PTH 59N Bridge ranged from 2430 MPN / 100 mL at the start of the Floodway operation and dropped to 34 MPN / 100 mL at the end, with a higher value of 308 MPN / 100 mL on April 26, 2017 after Floodway operation ended increasing to 1050 on May 11, 2017. The *E. coli* at PTH 59N Bridge ranged from <1 to 9 MPN / 100 mL during the spring Floodway operation, which was notably less than in 2016 (630 to 1440 MPN / 100 mL) when there was no Floodway operation. *E. coli* increased to 6 MPN/100 mL on April 26, 2018 and further increased to 78 MPN/100 mL on May 11, 2018.

Total coliform at PTH 44 Bridge were similar to the PTH 59N Bridge ranging from 2090 MPN / 100 mL at the start of the Floodway operation and dropping to 236 MPN / 100 mL at the end, with a higher value of 548 MPN / 100 mL on April 26, 2017 after Floodway operation ended, decreasing to 411 MPN/100 mL on May 11, 2017. The *E. coli* at the PTH 44 Bridge ranged from 4 to 8 MPN / 100 mL during the spring Floodway operation, increasing to 30 MPN/100 ML post flood, which was notably less than in 2016 (139 to 1210 MPN / 100 mL) when there was no Floodway operation. *E. coli* decreased to 6 MPN/100 mL on May 11, 2017. This is consistent with observations that the spring Floodway operation event tends to dilute bacteria concentrations in the channel due to the large volume of fresh snowmelt.

3.6 2017 NITRATE PLUS NITRITE (AS NITROGEN) AND OTHER NUTRIENTS

Nitrate plus nitrite (as N) concentration at the PTH 59N Bridge was at a maximum of 0.95 mg/l at the peak of the Floodway operation with decreased concentrations during each successive week of the flood, until April 19, 2017 where the value was 0.522 mg/L (Table D4-2). The CCME criteria for nitrate plus nitrite (as N) in drinking water is 10 mg/L; however, background groundwater concentrations are generally below 0.1 mg/L in many areas of the Floodway. Post flood sampling on April 26, 2017 showed nitrate plus nitrite (as N) at 0.02 mg/L, and May 11, 2017 sampling showed nitrate plus nitrite (as N) at <0.0051 mg/L.

Nitrate plus nitrite (as N) concentrations at the PTH 44 Bridge were at a maximum of 0.94 mg/l at the peak of the flood and decreased during each successive week of the flood, until April 19,

2017 where the value was 0.597 mg/L. Post flood sampling at PTH 44 on April 26, 2017 and May 11, 2017 showed nitrate plus nitrite (as N) at 0.06 mg/L and 0.01 mg/L respectively.

At the PTH 59N Bridge total ammonia, values were highest near the peak of the Floodway operation at 0.134 mg/L on April 5, 2017 (Table D4-2). At PTH 44 Bridge ammonia values were highest near the beginning of sampling at 0.137 mg/L on April 5, 2017. At PTH59N and PTH44 bridges values decreased to 0.048 mg/L on April 12, and were <0.01 mg/L in post melt sampling.

None of the unionized ammonia concentrations calculated exceeded the CCME FWAL guideline of 0.019 mg/L.

Total Kjeldhal Nitrogen (TKN) decreased from 1.19 mg/L to 0.66 mg/L through the Floodway operation at the PTH 59N Bridge and decreased from 1.19 to 0.85 mg/L through the flood at PTH 44 Bridge (Table D4-2). There are no CCME guidelines for TKN.

Total phosphorous values at the PTH 59N Bridge were highest on April 5, 2017 at the beginning of the Floodway operation, at values of approximately 0.51 mg/L (Table D4-2). Lower values of 0.34 to 0.18 mg/L were found during the later sampling. At PTH 44, total phosphorus values were also highest on April 5, 2017 at the beginning of the flood, at values of approximately 0.52 mg/L. Lower values of 0.33 to 0.22 mg/L were found during the later sampling. Post flood sampling at the PTH59 and PTH 44 Bridges had lower total phosphorous values of 0.077 to 0.065 mg/L. There are no CCME guidelines for total phosphorous.

Total suspended solids (TSS) were higher towards the beginning of sampling, with values of 172 to 173 mg/L on April 5, 2017; 62 to 124 on April 12, 2017 and <20 to 52 mg/L on April 19, 2017 and 18 to 26 mg/L on April 26, 2017 at PTH 59N Bridge and PTH 44 Bridge respectively (Table D4-2). Post flood sampling at PTH 59N and PTH 44 bridges showed a low TSS of 9 mg/L typical of the groundwater input to the channel. CCME guidelines for TSS relate to exposure events not baseflow, and so are not applicable.

3.7 2017 CONDUCTIVITY AND MAJOR IONS

Conductivity increased throughout the sampling from a low of 403 to 394 µS/cm on April 5, 2017 to 696 and 694 µS/cm on April 19, 2017 at PTH 59N and PTH 44 Bridge respectively. This increase reflects the increase in total dissolved solids, hardness (as $CaCO_3$), alkalinity, sodium, chloride and sulphate.

3.8 2017 DISSOLVED OXYGEN

Changes in dissolved oxygen during the flood were not pronounced in the surface water due to the short duration of the Floodway operation and the colder water temperature coincident with the early peak. Dissolved oxygen ranged from 9 to 15 mg/L in the surface water sampled. The dissolved oxygen in the groundwater was compared to the surface water to try to detect any areas of surface water infiltration (Table D4-1). However, a correlation between higher dissolved oxygen and changes in groundwater water quality was not established. However, a correlation between higher dissolved oxygen readings and changes in groundwater water quality was not established.

3.9 RELATIONSHIP AMONG PARAMETERS

Conductivity and major ions increased as the nitrate plus nitrite (as N) and the bacteria decreased during the 2017 Floodway operation period as in previous years. Overall, the surface water quality parameter results highlighted above reflect the influence of the spring Floodway operation in early April and the return to post–flood conditions characterized by an increased contribution of groundwater baseflow.

4.0 GROUNDWATER RESULTS

Groundwater quality results from monitoring wells measured in 2017 are discussed below. Results for samples collected during the peak of the floodway operation are compared to samples collected post-flood. In general, lower concentrations of parameters observed during the spring Floodway operation period versus the post-flood period would reflect possible surface water influence on groundwater within the monitoring wells sampled. As flow in the Floodway decreases and ends parameter concentrations in the Floodway tend to increase, reflecting a return to greater groundwater baseflow at these locations from the surrounding aquifer.

4.1 FLOODWAY OUTLET AND PTH 44

At the Floodway Outlet, monitoring wells located 65 m (K09-12316), and 350 m (K13-12321) north of the expanded channel within the Right-of-Way, showed some evidence of surface water intrusion from the Floodway in 2017 at various levels. Hydrographs showed a rise in groundwater elevation during the spring. At well K09-12316 the increase was comparable to the 2013 spring Floodway operation and 2014 summer flood, with little change in temperature (Appendix D4-B-1 and D4-C -Figure HM66-3), while at K13-12321 the increase was approximately 0.5 m higher than the summer 2014 flood (Appendix D4-B-5 and D4-C -Figure HM66-45).

Well K09-12316, closest to the channel, showed a decrease in conductivity from 893 µS/cm in March pre-melt sampling to 804 mg/L at the peak of the Floodway flow in the channel as shown on Table D4-3. The well close to Rockhaven Road (K13-12321) also showed a decrease in conductivity from 1780 µS/cm in March pre-melt sampling to 1030 mg/L at the peak of the Floodway flow in the channel. The decrease in conductivity reflects the decrease in alkalinity, hardness, chloride, and potassium in both monitoring wells and the decrease in sulphate and sodium in the Rockhaven Road well. Sulphate and sodium increase slightly in K09-12316 at the Floodway Outlet. A decrease in nitrate plus nitrite (as nitrogen) is also seen in this period, as background baseline groundwater has elevated nitrate plus nitrite (as nitrogen) in the pre-melt period. The greater water quality changes in the Rockhaven Road well, which is further from the Floodway, point to local recharge north of the Floodway, or influence of the Red River as an additional source of the water quality change seen in this well.

Total coliform were not detected at Rockhaven Road (K13-12321), or the Floodway outlet (K09-12316), during the March pre-melt sampling, but were detected at both locations at 2 MPN/100 mL during the spring Floodway operation, with no detection after the flood. The fact that the total coliform increased during the flood, with a decrease after, is indicative of surface water intrusion during the flood to both monitoring wells. *E. coli* bacteria was not detected during the March spring melt period, but it was detected at K09-12316 during the flood; however, *E. coli* was not detected in the duplicate sample, so the analysis cannot be relied on. *E. coli* was not detected in the May post-melt event. Dissolved oxygen concentrations did not correlate with water quality changes.

4.2 HAY ROAD TO DUNNING ROAD

At the bedrock well within the Right-of-Way at Church Road (K09-12012) the change in conductivity was comparable to the 2013 spring Floodway operation and 2014 summer flood, with little change in temperature (Appendix D4-B-2 and D4-C - Figure HM66-13). Parameter concentrations decreased during the spring Floodway operation indicating potential surface water intrusion. Nitrate plus nitrite (as N) remained below detection. Total coliform were found at 1 MPN/100 ML during the flood but were not detected in post flood sampling. *E. coli* bacteria were below detection (<1 MPN/100 mL) at this location on all dates sampled. Dissolved oxygen values were low (at or below 1 mg/L) on all dates (Table D4-1).

At the PTH 44 Bridge (U09-13571), parameter concentrations decreased during the spring Floodway operation compared with historic pre-melt measurements indicating potential surface water intrusion. Nitrate plus nitrite (as N) was elevated in the pre-melt sample and decreased during the spring Floodway operation. The dissolved oxygen value was low (below 1 mg/L).

At Hay Road (K11-12018) and Ludwick Road (K09-12011) there were no noticeable changes in parameter concentrations during the spring Floodway operation compared with the historic spring melt.

At Dunning Road (K11-12017), parameter concentrations decreased during the spring Floodway operation compared with historic pre-melt measurements indicating potential surface

water intrusion. No change was seen in nitrate plus nitrite (as N) values. The dissolved oxygen value was low (at or below 0.5 mg/L).

4.3 PTH 59N BRIDGE AREA

Near Bray Road, north of the PTH 59N Bridge, well K11-12016 did not show a change in water quality parameters between the historic pre-melt concentrations and the spring Floodway operation.

At the bedrock well located upstream of the PTH 59N bridge, and 250 m west of the expanded channel at the west Right-of-Way boundary (K11-12014) the increase in groundwater elevation was comparable to the 2013 spring Floodway operation and 2014 summer flood, with a decrease in temperature of less than 1º C (Appendix D4-B-3 and D4-C - Figure HM66-37). Parameter concentrations decreased during the spring Floodway operation from pre-melt concentrations. Nitrate plus nitrite as nitrogen increased during the flood, indicating potential surface water intrusion. Dissolved oxygen was above 2 mg/L in pre-melt and flood monitoring, likely due to the use of the Waterra tubing.

At the bedrock well located upstream of the PTH 59N bridge and 60 m west of the west channel slope within the Right-of-Way (K11-12015) the increase in groundwater elevation was comparable to the 2013 spring Floodway operation, with little decrease in temperature (Appendix D4-B-4 and D4-C - Figure HM66-38). Parameter concentrations decreased during the spring Floodway operation from pre-melt concentrations. Nitrate plus nitrite as nitrogen increased during the flood, indicating potential surface water intrusion. Dissolved oxygen was above 2 mg/L in pre-melt and flood monitoring, likely due to the use of the Waterra tubing.

Total coliform bacteria were not detected at either K11-12014 or K11-12015 during the March pre-melt, but were present in both monitoring wells during the spring Floodway operation (17 MPN and 12 MPN respectively) decreasing to 3 MPN during the latter part of the flood (April 20, 2017) and returning to below detection after the flood in May. *E. coli* bacteria was not detected in pre-melt monitoring in either well, but was detected at 1 MPN and 2 MPN respectively during the flood, with counts below detection in May 2017.

Near McGregor Farm Road at K13-12322 parameter concentrations decreased during the spring Floodway operation from pre-melt concentrations indicating potential surface water intrusion. Nitrate plus nitrite as nitrogen did not show a change. Dissolved oxygen was low, below 0.5 mg/L.

4.4 KEEWATIN BRIDGE AND AREA TO THE SOUTH

There is no monitoring from the Keewatin Bridge south to the inlet structure for Program A. These wells are monitored only in Program B.

At the inlet control structure (GO50C006) parameter concentrations decreased during the spring Floodway operation from pre-melt concentrations indicating potential surface water intrusion. Nitrate plus nitrite as nitrogen did not show a change. Dissolved oxygen was low at 0.5 mg/L.

5.0 GROUNDWATER RESULTS AND ASSESSMENT

5.1 CONDUCTIVITY CHANGES

Conductivity changes are being used as an indicator of surface water influence on groundwater quality, as conductivity is a parameter that is readily measured. Conductivity changes reflect the changes in major ions contributing to the dissolved solids.

If surface water intrudes into the aquifer, the mixing would result in changes observed in groundwater conductivity. Groundwater conductivity decreases with the addition of surface waters in most areas. Changes are most readily observed in areas where groundwater is more mineralized and thus has higher conductivity than surface water, which is typically the case during the spring. Conversely, increases in groundwater conductivity would be seen in areas where baseline groundwater conductivity is less than that of surface waters.

In addition to the Floodway, potential surface water infiltration sources in the area include ponds and open sand and gravel quarries, creeks, and the Red River (primarily near the Floodway Outlet).

The magnitude of the water quality change is described by a range in the percentage change in conductivity as follows: Type A (>50% change); Type B (25 to 50% change); Type C (10 to 25% change); Type D (5 to 10% change). Tables D4-4 and D4-5 show the 2017 water quality assessment based on changes in conductivity. For instrumented wells (Table D4-4), pre-melt samples (March) were compared with samples taken at the peak of the Floodway operation (April 5 to 6, 2017). For the remaining 7 non-instrumented monitoring wells (Table D4-5), spring Floodway operation samples were compared with recent historical pre-melt samples. The monitoring wells selected for sampling for the Long-Term monitoring program were in areas with higher potential for surface water intrusion due to hydrogeologic conditions, or locations near other surface water sources (such as the Floodway Outlet).

In 2017, 5 monitoring wells (with installed transducers) were sampled in three events for water chemistry and bacteria (pre-melt, peak of Floodway operation, post melt). From the pre-melt period to the Floodway operation and post-melt period in 2017, a change in groundwater quality

was seen in 5 of the 5 monitoring wells (100%) sampled. All of these monitoring wells are within the Floodway Right-of-Way.

Changes found from the pre-melt to the Floodway operation period were classified as follows:

- Type A (>50% change) for 1 well (20% of the total) located inside of the Right-of-Way at the Outlet at Rockhaven Road (K09-12321).
- Type B (25 to 50% change) for 2 monitoring wells (40% of the total) located inside of the Right-of-Way at the PTH 59N Bridge west side (K11-12015) and at the PTH 59N Bridge west side at west Right-of-Way (K11-12014).
- Type C (10 to 25% change) for 2 monitoring wells (40% of the total) located inside of the Right-of-Way at the Outlet (K09-12316) and Church Road (K09-12012).

For the remaining 7 core monitoring wells, which only required measurement during the spring Floodway operation period, 4 of the 7 monitoring wells (57%) showed an observable change as follows:

- Type B (25 to 50% change) for 1 well (14%) located inside of the Right-of-Way at the Floodway Inlet (G050C006).
- Type C (10 to 25% change) for 3 monitoring wells (43% of the total) located inside of the Right-of-Way at the Outlet - the PTH44 bridge (U09-13571), Dunning Road (K11-12017), and just south of the PTH59N Bridge at McGregor Farm Road (K13-12322).

5.2 BACTERIA

In 2017, total coliform bacteria were identified at all five of the monitoring well locations tested (K13-12321, K09-12316, K09-12012, K11-12014 and K11-12015), with levels decreasing toward the end of the Floodway operation period and in the post-flood monitoring, suggesting influence of surface water intrusion followed by an increase in groundwater baseflow in the post-flood sampling. *E. coli* were detected at three locations (K11-12014, K11-12015 and K09-12316) during the spring Floodway operation on April 6, 2017. Total coliform bacteria and *E. coli* were not detected at the Floodway Inlet Control Structure domestic well (washrooms) which is not used for potable water.

Notification to Manitoba Infrastructure

As required by the Long-Term monitoring program (HM72) and the terms of reference for the 2016 to 2018 monitoring program, Manitoba Infrastructure was notified within 24 hours of receipt of positive bacteria results (April 14 for results received on April 13, and April 18 for results received on April 17, 2017). A notification report (Deliverable D3-01) was sent on April 20, 2017 recommending follow up bacteria sampling, which was approved by MI.

Follow-up bacteria sampling was conducted on April 20, 2017 and showed that *E. coli* were below detection in all monitoring wells and that total coliform had decreased, but was present in three monitoring wells K11-12014, K11-12015 and K09-12316. A follow-up notification report (Deliverable D3-02) was issued on July 13, 2017 with the April 20, 2017 data. The report indicated that all monitoring wells had shown previous concentrations of either *E. coli* or total coliform in the past at comparable or higher levels, therefore the response to the 2017 flood event did not indicate a deviation from water quality norms, and no further follow-up up action was required.

A “change in conditions” which would require reporting to Manitoba Sustainable Development Water Stewardship Division was not found based on the following:

- *E. coli* had been detected previously at monitoring wells K11-12014, K11-12015 and K09-12316.
- Based on a review of the other water quality parameters tested, changes in conditions in the monitoring wells were within the range of changes found in floods of similar magnitude and duration (spring 2013 and summer 2014 flood).

5.3 NITRATE PLUS NITRITE AS (NITROGEN)

Nitrate plus nitrite (as N) concentrations were below the Canadian Drinking Water Quality Guidelines (CDWQG) of 10 mg/L at all monitoring wells tested. Seven (7) of the 12 sample locations had concentrations below detection (<0.0051 to <0.051 mg/L) in 2017, either for spring Floodway operation sampling only, or spring Floodway operation, pre-melt and post-flood events.

Higher concentrations of nitrate plus nitrite (as N) were observed during the spring Floodway operation than the pre-melt or post-flood (May) for K11-12014 and K11-12015, suggesting influence from surface water intrusion, as background nitrate/nitrite concentrations in groundwater in this area are generally low.

In contrast, one sample within the Right-of-Way at Rockhaven Road (K13-12321) and one sample at the Floodway outlet (K09-12316) showed decreases in nitrate plus nitrite (as N) during the spring Floodway operation compared with both pre-melt and post-flood values, which have higher background values. The reduction in observed values demonstrates the potential influence of surface water with lower nitrate plus nitrite (as N) values relative to background.

5.4 RELATIONSHIP BETWEEN PARAMETERS

Lower conductivity values observed during the April 2017 spring Floodway operation generally correlated with the highest total coliform counts observed. Total coliform counts decreased in the later part of the Floodway operation and post-flood (May 2017). The three monitoring wells with *E. coli* bacteria also had higher levels of total coliform bacteria and had inorganic parameter changes indicative of surface water intrusion. Bacteria were sampled in areas where water quality changes were expected; therefore the locations do not represent a random sample.

Changes in nitrate plus nitrite (as N) correlated with changes in Floodway water quality at 80% (4) of 5 core monitoring wells with dedicated transducers sampled within the Right-of-Way (K13-12321 at Rockhaven Road, K09-12316 at the Floodway Outlet, and K11-12014 / K11-12015 at the PTH59N Bridge), and 14% (1) of 7 remaining core monitoring wells (U09-13571). Overall, higher nitrate plus nitrite (as N) concentrations were observed during the spring Floodway operation compared with pre-melt and post flood samples for the area near the PTH 59N Bridge. Where groundwater is locally affected by elevated nitrate plus nitrite (as N) near Rockhaven Road, the Floodway outlet and PTH44 Bridge (U09-13571), a decrease in concentrations with the spring Floodway operation was observed, as expected. Nitrate plus nitrite (as N) concentrations in all monitoring wells tested were well below the Canadian Drinking Water Quality Guideline of 10 mg/L nitrate plus nitrite (as N).

Many of the monitoring wells are located on the shoulder of the Floodway Channel, or in the spoil pile, and would be expected to experience any water quality changes more quickly than domestic wells located further away, beyond the Floodway Right-of Way. Domestic wells (with the exception of the Floodway Inlet well) are not monitored in the Long-term monitoring program. Travel times from the Floodway surface water to the monitoring wells vary, depending on Floodway Channel water elevations, piezometric water elevations, the surface water/groundwater interconnection pathway which depends on clay and till thickness, and the hydraulic conductivity of the bedrock, which ranges from highly fractured to massive.

In general, groundwater gradients will be greater and travel rates will be faster closer to the Floodway. Gradients will decrease and travel times will lengthen further from the Floodway, or in years where there is no Floodway operation, drier conditions, or limited channel flow.

5.5 SUMMARY ASSESSMENT OF CHANGES

The 2017 monitoring event flood represented a year with a moderate Floodway operation. Of the years 2005 to 2017 when Floodway Monitoring has taken place, the 2017 Floodway operation was the 4th largest spring Floodway operation of 9 years of spring Floodway operation (Table D4-A-1). Groundwater quality changes observed from monitoring wells located within the Floodway Right-of-Way in 2017 were similar to years of similar flow (2013 spring, 2005 spring, 2010 spring and 2005 summer) with the same or greater duration of Floodway operation.

The detection of bacteria and magnitude of bacteria counts were comparable to historic values and correlated with changes in inorganic water quality parameters in the monitoring wells, indicative of surface water intrusion.

The 2017 bacteria results indicate that bacteria is detected in some monitoring wells in sensitive areas during spring Floodway operation. Detection of *E. coli* continues to be infrequent, not sustained, and at levels at, or just above the detection limit when found.

All monitoring wells which showed groundwater quality changes in 2017 also showed changes in previous floods. Inorganic groundwater quality parameters seen in monitoring wells in 2017 did not exceed the Canadian Water Quality Guidelines for Drinking Water.

In 2017, total coliform bacteria were identified at five of the six sample locations tested, with levels decreasing toward the end of the Floodway operation period and in the post-flood monitoring, suggesting influence of surface water intrusion and return to an increased contribution of groundwater discharge in the channel after Floodway operation ends (post-flood). *E. coli* was detected at three locations during the peak of the spring Floodway operation, but was not present in resampling toward the end of Floodway operation or after operation (post-flood), consistent with previous years.

As required in the monitoring plan, procedures were implemented to notify Manitoba Infrastructure (e-mail and notification reports) when bacteria were detected in monitoring wells. Notification to Manitoba Water Stewardship Water Quality was not required as water quality changes within the monitoring wells were within those observed historically for floods of similar duration and magnitude.

6.0 SPRING TREATMENT AREAS

The Spring Treatment Program mitigates surface water infiltration in the bedrock aquifer. This is accomplished by providing sand filtration of any migrating fines, by decreasing the amount of flow into the springs at the filter locations for a given flood, by reducing the potential for expansion of spring areas through piping, and by improving the bacterial quality of any infiltrating water. The constructed fine sand filters have a much lower hydraulic conductivity than an open bedrock fracture; therefore, the initial flow rate from the surface water into the aquifer is decreased. As the low permeability silt fraction builds up above the sand filter layer during surface water discharge into the aquifer, the infiltration rate is reduced further. The fine sand also meets criteria for slow sand filters designed to reduce bacteria passage through the filter. After the Floodway operation, when the flow direction reverses to groundwater discharge, the sand filter protects against upward piping of the foundation material (silt, sand) which otherwise could have increased the size of a fracture/hole. In addition, during the upward flow process, silt fraction buildup and bacteria will be flushed out of the sand filter.

Sealing the groundwater discharge areas completely is not desirable, as a pressure build-up and uncontrolled discharge in another area would likely develop. The treatments provide pressure relief, but in a controlled fashion, and with a flow rate lower than was present before treatment.

Previous sampling in 2009 through 2011 (HM99, 2013 to 2014 Post Construction Monitoring Report) showed that total coliform and *E. coli* bacteria are generally present and at higher levels above the filter. The filter has been effectively reducing total coliform concentrations. *E. coli* has not been detected beneath the filter. Soon after the Floodway drains, surface water infiltration is flushed out quickly from the system as shown by a return to groundwater quality and an absence of bacteria. A return to groundwater quality (as shown by conductivity) was seen towards the end of the Floodway operation period as shown by the transducer data in 2009, 2011 and 2013, with more limited change seen in 2014 Appendix D4-B-6.

In 2016, monitoring of spring locations with a transducer was not included in the program. In 2015 one spring discharge location was monitored with a transducer during the spring melt when there was no Floodway operation. The results from 2015 (Appendix D4-C Figure HM66-

43) showed no infiltration and no drop in conductivity or temperature during the spring melt. The water level during the spring melt monitoring in 2015 was at the top of the Low Flow Channel. Monitoring in prior years showed that higher channel flows typical of Floodway operation will temporarily reverse the discharge groundwater gradient allowing surface water to recharge with a flow direction from the channel to the bedrock beneath the spring. There is a return to groundwater quality beneath the spring as the Floodway begins to drain and groundwater is again discharged into the channel. Since there was no Red River flow into the channel in 2015, these conditions did not occur and would not have occurred in 2016, which was also a year with no Floodway operation. The total flow and water depth in the channel was insufficient to reverse the gradient during the spring melt in 2015 and would have been similar in 2016.

The transducer was installed in 2017 to monitoring the 2017 spring Floodway operation. The plot of the transducer data is included in Appendix D4-B on Figure D4-B-6 spring 7A1 (Kildare). The plot shows a steep rise in groundwater elevation coincident with Floodway operation with a steep drop in groundwater temperature to nearly 1º C in the initial days of the operation as surface water intruded beneath the spring filter. The transducer installed in 2017 was not equipped to measure conductivity.

A summer inspection of 23 spring locations was conducted in August 2017 as summarized in Appendix D4-D including description (Appendix D4-D-1, Table D4-D-1) and field documentation sketches and photos (Appendix D4-D-2). A plan view of these locations is included in Deliverable D5 Long-Term Monitoring Program 2017 Annual Inspection and Maintenance Report Additional photos and video (Appendix D4-D-3) are provided on a separate DVD included with this report. This work documents conditions in the Long-term monitoring period and can be compared with surveys completed in 2013 through 2015 (HM99 2013 to 2014 Post Construction Monitoring Report) and 2016 (Deliverable D1).

The constructed filters were found to be in good condition and were working as designed. Flow appeared to be coming up through the filter and discharging through the granular layer overlying the sand filter bed. No settlement or heaving of the filters was observed. No required repairs were identified.

The discharge trenches were constructed as shallow excavated trenches that were filled with riprap to grade or slightly above grade. As in previous years, it was observed that at 11 of the treated spring sites, the rip rap within the discharge trenches was infilling with sediment and spring discharge was finding alternate flow paths to the Low Flow Channel (Appendix D4-D-1, Table D4-D-1). This resulted in overland flow toward the Low Flow Channel or flow into low areas near the filter, creating wet and soft areas. No significant erosion channels were observed at any of these locations. The discharge trenches were constructed as ditches in a few locations (5A1 and 7A1). This method appeared to be more effective in directing discharge flows along the design discharge flow path, versus other trenches. Modifying the 11 identified discharge trenches to create more pronounced ditches would improve control of flow towards the Low Flow Channel.

Both high level and low level sampling pipes were found to be in good condition, with no damage observed, with the exception of the low level pipe at 5A1, in which the steel cover was missing.

In 2016 and 2017, additional eroded discharge areas were observed in a small area along the discharge trench at 9B2. Construction of a graded sand filter would minimize potential for direct groundwater and surface water flow interconnections to develop at this location.

Five discharge locations were identified between Hay Road and the CEMR Bridge. One location had been observed previously in 2016. Two of the locations are near a Beaver Dam in the Low Flow Channel and may represent surface water. Source areas were found at two of the 5 locations. Flow rates were low and in most cases diffuse as they entered the Low Flow Channel.

Additional discharge areas AD17-1 through AD17-5 should be re-inspected in 2018 including field conductivity and temperature and source identification. Additional discharge locations AD17-1, AD17-2 and AD17-5 are adjacent to the channel; therefore, remediation may not be practical. Discharge areas AD17-3 and AD 17-4 should be assessed for potential remediation.

Remediation Items

- Modifying the 11 identified discharge trenches to create more pronounced ditches should be considered to improve control of flow towards the low flow channel.

- The cover for the low level pipe at 5A1 should be replaced in 2018.
- Construction of a graded sand filter at additional discharge areas at 9B2 should be considered.
- Additional discharge areas AD17-1 through AD17-5 should be re-inspected in 2018 including field conductivity and temperature and source identification.
- Discharge areas AD17-3 and AD 17-4 should be assessed for potential remediation.

7.0 WELL DISINFECTION

The purpose of the well disinfection program is to prepare instrumented monitoring wells that are used for bacteria analysis for the pre-melt (typically March) and flood (typically March/April) monitoring programs. The program in 2017 was conducted in the Fall, as several months are required between disinfection and sampling. Disinfection was completed at the five core monitoring wells with dedicated transducers, which are used for bacteria analysis.

On November 29 and 30, 2017 and KGS Group personnel disinfected 5 monitoring wells (K11-12316, K09-12012, K13-12321, K11-12014 and K11-12015) along the Red River Floodway at PTH 59N Bridge, Church Road, Rockhaven Road and at the Floodway Outlet following the procedure outlined in Section 2.5.

Any dedicated submersible pumps were removed from the monitoring wells at the time of disinfection for winter storage at KGS Group.

8.0 LONG-TERM MONITORING

The current work program, overseen by Manitoba Infrastructure includes a monitoring period from Spring 2016 through Fall 2018. The Three Year Project Scope of Work should be continued for 2018, to include the following annual activities:

- Spring and Summer Flood Monitoring Program A (or B if required);
- Inspection of Treated Groundwater Springs and Channel Inspections by boat;
- Annual Well Disinfection, Inspection/Maintenance/Repair Programs
- Reporting.

9.0 STATEMENT OF LIMITATIONS AND CONDITIONS

9.1 THIRD PARTY USE OF REPORT

This report has been prepared for Manitoba Infrastructure to whom this report has been addressed and any use a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. KGS Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions undertaken based on this report.

9.2 GEO-ENVIRONMENTAL STATEMENT OF LIMITATIONS

KGS Group prepared the geo-environmental conclusions and recommendations for this report in a professional manner using the degree of skill and care exercised for similar projects under similar conditions by reputable and competent environmental consultants. The information contained in this report is based on the information that was made available to KGS Group during the investigation and upon the services described, which were performed within the time and budgetary requirements of the Manitoba Infrastructure. As the report is based on the available information, some of its conclusions could be different if the information upon which it is based is determined to be false, inaccurate or contradicted by additional information. KGS Group makes no representation concerning the legal significance of its findings or the value of the property investigated.

TABLES

TABLE D4-1
2016 & 2017 MONITORING WELL AND SURFACE WATER FIELD PARAMETERS

Location	Well No.	Date	E.C. (µS/cm)	Temp. (°C)	pH (Units)	DO (mg/L)	Comments
Ground Water Samples							
Rockhaven Rd.	K13-12321	28-Mar-16	950	6.70	7.07	4.37	(1), (2), (3)
		21-Apr-16	1,100	6.80	7.25	3.13	-
		2-Jun-16	1,741	7.50	7.02	5.04	-
		2-Mar-17	-	6.8	6.97	4.77	-
		20-Apr-17	1032	7	6.99	6.02	(8)
		11-May-17	1508	6.9	7.04	6.04	
Outlet Structure	K09-12316	28-Mar-16	752	7.00	7.21	3.68	(1), (2), (3)
		21-Apr-16	823	6.90	7.43	1.96	-
		2-Jun-16	851	7.00	7.15	2.50	-
		3-Mar-17	-	6.9	7.1	2.76	
		5-Apr-17	600.4	7	7.16	1.75	(1)
		20-Apr-17	688.4	7	7.31	3.84	
		11-May-17	881	6.9	7.2	2.99	
PTH 44 Bridge	U09-13571	28-Mar-16	909	7.70	7.18	1.04	(5)
		5-Apr-17	705.7	7.8	7.11	0.92	(6)
Hay Rd.	K11-12018	28-Mar-16	1,103	6.10	7.36	0.99	(5)
		5-Apr-17	866	6.3	6.88	0.49	(6)
Church Rd.	K09-12012	29-Mar-16	1,036	6.20	7.39	0.18	(1), (2), (3)
		21-Apr-16	1,249	6.20	7.35	0.02	-
		2-Jun-16	1,005	6.40	7.23	0.15	-
		2-Mar-17	-	6.2	7.17	0.43	
		5-Apr-17	769.4	6.5	7.15	0.49	(1)
		7-Apr-17	704.1	6.3	7.15	0.72	
		20-Apr-17	947	6.2	7.26	1.13	
		11-May-17	1128	6.2	7.23	0.95	
Ludwick Rd.	K09-12011	29-Mar-16	441	6.80	7.41	1.52	(5)
		6-Apr-17	349.6	6.9	7.29	0.52	(6)
Dunning Rd.	K11-12017	29-Mar-16	1,037	6.10	7.25	0.19	(5)
		6-Apr-17	737.6	6.3	7.22	0.51	(6)
Bray Rd.	K11-12016	29-Mar-16	952	6.30	6.70	0.17	(5)
		6-Apr-17	766.9	6.3	7.19	0.4	(6)
PTH59N Bridge	K11-12014	30-Mar-16	557	7.30	7.51	0.90	(1), (2), (5)
		21-Apr-16	606	7.40	7.51	1.14	(4)
		2-Jun-16	688	7.90	7.32	4.71	-
		3-Mar-17	-	6.4	7.2	3.72	
		6-Apr-17	397.2	7.6	7.47	2.61	(8)
		20-Apr-17	595.7	7.5	7.3	1.49	
		11-May-17	681.1	7.8	7.24	0.78	
	K11-12015	30-Mar-16	521	7.20	7.70	1.12	(1), (2), (5)
		21-Apr-16	565	7.20	7.76	0.99	(3)
		2-Jun-16	583	7.40	7.44	1.49	-
		2-Mar-17	-	7.2	7.39	0.45	
		6-Apr-17	370.1	7.3	7.51	3.84	(1)
		20-Apr-17	580.6	7.3	7.44	1.43	
		11-May-17	659.5	7.3	7.39	0.89	
McGregor Farm Rd.	K13-12322	30-Mar-16	737	6.20	7.56	0.09	(5)
		6-Apr-17	605.4	6.6	7.3	0.57	(6)
Inlet Control Structure	G050C006	30-Mar-16	2,340	9.90	8.02	1.07	-
		7-Apr-17	1709	14.1	7.72	0.53	(7)

TABLE D4-1
2016 & 2017 MONITORING WELL AND SURFACE WATER FIELD PARAMETERS

Location	Well No.	Date	E.C. (µS/cm)	Temp. (°C)	pH (Units)	DO (mg/L)	Comments
Surface Water Samples							
PTH 44 Bridge	PTH 44	28-Mar-16	415	9.30	7.77	13.80	-
		2-Jun-16	553	14.40	7.61	8.37	-
		5-Apr-17	305.1	5.1	7.95	11.57	-
		12-Apr-17	591	7.5	6.64	10.25	-
		19-Apr-17	709	7.7	7.09	10.03	-
		26-Apr-17	919	3.6	6.82	14.82	-
		11-May-17	743	12.7	6.94	10.08	-
PTH59N Bridge	PTH 59N	30-Mar-16	608	6.30	7.36	8.11	-
		2-Jun-16	767	17.60	7.81	9.38	-
		5-Apr-17	312.8	6.2	7.8	9.32	-
		12-Apr-17	607.1	7.7	6.66	9.42	-
		19-Apr-17	800	7.3	6.64	9.06	-
		26-Apr-17	737.5	3.8	7.61	15.21	-
		11-May-17	657	14.8	7.93	9.29	-

Notes:

"-" = No Data

E.C. = Electrical Conductivity
D.O. = Dissolved Oxygen

1. Well contains dedicated transducers.
2. Original Dedicated Well Pump Failed
3. New Dedicated Well Pump Installed
4. New Dedicated Waterra Tubing and Foot Valve
5. Sampled with Portable Pump.
6. Purged and sampled with tornado pump.
7. Washroom tap, not used for drinking.
8. Purged and sampled with Waterra pump.
9. Conductivity results for March 3, 2017 anomalous due to meter/calibration. See laboratory conductivity results Tables D-4-2 and D-4-3.

TABLE D4-2
2016 & 2017 GENERAL SURFACE WATER QUALITY DATA FLOODWAY CHANNEL

Sample Location [1]	Location	Duplicate	Date	Parameter [2]																											
				Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Sulphate - Soluble	Ammonia (NH_3) [3]	Un-ionized Ammonia (Calculated by KGS Group)[3a]	Nitrate+ Nitrite-N	Nitrate-N	Nitrite-N	Calcium	Magnesium	Potassium	Sodium	Total Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	Anion Sum	Cation Sum	Cation - Anion Balance	Ion Balance (%)	Total Coliform MPN/100mL	E.coli MPN/100mL
CCME [4]																															
Freshwater Aquatic Life				[5]	6.5-9.0	-	-	-	-	-	-	120 [6a]/640 [6b]	-	-	0.019	-	$3^{[7a]}$/ $124^{[7b]}$	0.06	-	-	-	-	[8]	-	[9]	-	-	-	-	-	-	-
RRF at PTH 59 N																															
Event - Spring Flood Monitoring																															
PTH 59	RRF at PTH 59 N Spring Hill Ski		30-Mar-16	21	8.13	549	193	236	<0.60	<0.34	231	45.6	39.1	0.072	0.000227	0.414	0.405	0.0093	50.2	25.7	6.63	28.7	0.196	314	9	0.75	6	6.04	0.4	101	2790	630
			2-Jun-16	17	8.24	718	210	256	<0.60	<0.34	352	46.2	93.2	0.014	0.000293	4.68	4.620	0.0606	64.4	46.4	6.53	30.4	0.285	434	15	1.87	7.77	8.52	4.6	110	26100	1440
			5-Apr-17	163	7.86	403	135	165	<0.60	<0.34	195	12.8	55.9	0.134	0.001150	0.945	0.896	0.0490	44.0	20.6	9.19	15.5	0.505	239	172	1.19	4.3	4.81	5.6	112	2430	3
			12-Apr-17	112	7.96	534	163	199	<0.60	<0.34	239	19.3	99	0.048	0.000034	0.885	0.863	0.022	54.7	24.9	8.26	22.6	0.336	327	62	1.19	5.9	6.0	0.4	101	1550	9
			19-Apr-17	26	8.03	696	198	241	<0.60	<0.34	298	45.3	123	-	-	0.522	0.517	0.0056	63.6	33.7	7.26	43.4	0.176	437	<20	0.66	7.8	8.0	1.2	102	34	<1
Event - Post Flood Monitoring																															
PTH 59	RRF at PTH 59 N Spring Hill Ski		26-Apr-17	22.3	8.38	649	285	336	6	<0.34	350	24.3	63	-	-	0.0233	0.0221	0.0011	71.5	41.7	4.15	20.7	0.092	396	18	<0.20	7.7	8.0	1.9	104	308	6
			11-May-17	12	8.45	634	283	328	8.4	<0.34	340	21.7	51.9	<0.010	-	<0.0051	<0.0050	<0.0010	74	37.8	3.65	20.7	0.077	387	9	0.75	7.5	7.8	2	104	1050	78
		SW100	11-May-17	11.6	8.45	632	283	328	8.52	<0.34	345	21.7	59.2	<0.010	-	<0.0051	<0.0050	<0.0010	75.2	38.1	3.77	21	0.077	389	10	0.78	7.5	7.9	2.6	105	1200	73
RRF at PTH 44																															
Event - Spring Flood Monitoring																															
PTH 44	NW side of PTH 44 bridge		28-Mar-16	42.5	7.96	407	175	213	<0.60	<0.34	198	13.5	26.2	0.054	0.000553	1.28	1.25	0.0263	45.3	20.7	7.82	9.41	0.356	233	24.0	0.79	4.51	4.58	0.8	102	$980^{[10]}$	$139^{[10]}$
			2-Jun-16	10.0	8.03	665	227	277	<0.60	<0.34	329	38.4	81.0	<0.010	-	0.727	0.704	0.0234	62.8	41.7	4.84	27.8	0.108	396	13.0	1.32	7.36	7.9	3.5	107	41100	1210
			5-Apr-17	171	7.84	394	134	164	<0.60	<0.34	195	12.5	54.0	0.137	0.001516	0.943	0.890	0.0521	44.3	20.4	9.13	15.1	0.520	236	173	1.19	4.23	4.79	6.2	113	2090	8
		SW100	5-Apr-17	172	7.83	398	135	164	<0.60	<0.34	194	12.4	54.1	0.145	0.001604	0.943	0.892	0.0513	43.8	20.6	9.51	15.1	0.519	236	176	1.22	4.23	4.79	6.2	113	1450	4
			12-Apr-17	107	7.97	524	160	195	<0.60	<0.34	228	18.6	95.8	0.048	0.000032	0.893	0.87	0.0226	53.6	22.8	7.85	21.3	0.329	316	124	1.1	5.78	5.68	-0.8	98.3	1300	6
			19-Apr-17	54	8.53	644	205	230	9.96	<0.34	309	27.4	124	-	-	0.597	0.586	0.0109	69.3	33	7.61	36.4	0.219	423	52	0.85	7.5	7.95	2.9	106	236	4
Event - Post Flood Monitoring																															
PTH 44	NW side of PTH 44 bridge		26-Apr-17	24	8.33	704	283	337	3.96	<0.34	362	38.1	71.9	-	-	0.0552	0.0536	0.0016	73.2	43.6	4.69	29.3	0.1	431	26	0.56	8.23	8.64	2.4	105	548	30
			11-May-17	9.3	8.34	679	293	349	4.44	<0.34	357	23.5	65.9	<0.010	-	0.0116	0.0116	<0.0010	76.3	40.3	3.95	22.1	0.065	408	9	0.65	7.9	8.19	1.8	104	411	12

Notes:
"-" = No Data
E.C. = Electrical Conductivity
T.D.S. = Total Dissolved Solids
"*" = Detection Limit Adjusted For Sample Matrix Effects
T.K.N. = Total Kjeldahl Nitrogen
T.S.S. = Total Suspended Solids

1. See Figure D4-1 for sample locations.
2. All values are expressed in milligrams per litre (mg/L) unless indicated otherwise.
3. Guideline for un-ionized ammonia is 0.019 mg/L, which is equivalent to 16 µg ammonia-N /L (=19*14.0067 / 17.35052, rounded to two significant figures).
Guideline for total ammonia is temperature and pH dependent; See below table.

	pH							
Temp (^{0}C)	6	**6.5**	**7**	**7.5**	**8**	**8.5**	**9**	**10**
0	231	73	23.1	7.32	2.33	0.749	0.25	0.042
5	153	48.3	15.3	4.84	1.54	0.502	0.172	0.034
10	102	32.4	10.3	3.26	1.04	0.343	0.121	0.029
15	69.7	22	6.98	2.22	0.715	0.239	0.089	0.026
20	48	15.2	4.82	1.54	0.499	0.171	0.067	0.024
25	33.5	10.6	3.37	1.08	0.354	0.125	0.053	0.022
30	23.7	7.5	2.39	0.767	0.256	0.094	0.043	0.021

3a) Un-ionized ammonia calculation uses pH and temperature values from field data, as well as the following equations:
pKa = 0.09018+2729.92/T where T = Temperature in degree Kelvins
$f = 1/(10^{(pKa - pH)} + 1)$
Un-ionized Ammonia = f x (Ammonia)
4. CCME - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines, 1999. Updated February 6, 2014.
Chapter 4 - Canadian Water Quality Guidelines for the Protection of Aquatic Life
5. Turbidity Guidelines Narrative (see fact sheet for complete details):
Clear Flow:
Maximum increase of 8 NTUs from background levels for a short-term exposure (e.g. 24 hr period).
Maximum average increase of 2 NTUs from background levels for a longer exposure (e.g. 30 d period).
High Flow or Turbid Waters:
Maximum increase of 8 NTUs from background levels at any one time when background levels are between 8 and 80 NTUs.
Should not increase more than 10% of background levels when background is >80 NTUs.
6. Chloride toxicity to freshwater organisms was evaluated using tests with both $CaCl_2$ and NaCl salts.
a. Long-term exposure - May not be protective of certain species of endangered and special concern freshwater mussels.
Refer to fact sheet for more explanation
b. Short-term exposure - derived with severe-effect data (such as lethality) and are not intended to protect all components of aquatic ecosystem structure and function but rather to protect most species against lethality during severe but transient events.
Refer to fact sheet for more information.

BOLD - Exceedance of CCME Criteria

7. All nitrate concentrations presented here will be for the ion only (i.e. as mg NO_3-/L). Conversion factors for some of the commonly reported units in the literature are provided in the Factsheet.
For protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrophication.
For freshwater - Derived from toxicity tests utilizing $NaNO_3$.
For marine - Derived from toxicity tests utilizing $NaNO_3$ and KNO_3.
a. Long term concentration - Derived with mostly no- and some low-effect data and are intended to protect against negative effects to aquatic ecosystem structure and function during indefinite exposures (e.g. abide by the guiding principle as per CCME 2007).
b. Short term concentration - Derived with severe-effects data (such as lethality) and are not intended to protect all components of aquatic ecosystem structure and function but rather to protect most species against lethality during severe but transient events (e.g. inappropriate application or disposal of the substance of concern).
8. If trigger ranges for total phosphorous are exceeded, the potential exists for an environmental impact. If trigger range is not exceeded, but TP is more than 50% above baseline values, the potential exists for an environmental impact.

Trigger ranges (µg/L):	ultra-oligotrophic	<4	meso-eutrophic	20-35
	oligotrophic	4-10	eutrophic	35-100
	mesotrophic	10-20	hyper-eutrophic	>100

9. Suspended Sediments Guidelines (see fact sheet for complete details):
Clear Flow:
Maximum increase of 25 mg/L from background levels for any short-term exposure (e.g.. 24 hr period).
Maximum average increase of 5 mg/L from background levels for longer term exposures (e.g.. Inputs lasting between 24 hrs and 30 days).
High Flow:
Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L.
Should not increase more than 10% of background levels when background is >250 mg/L.
10. Bacteria sample taken on March 29, 2016

Floodway Operation Summary

Year	*Status*	*Peak flow in Red River*	*Start of floodway operation*	*Peak flow in floodway*	*End flow in floodway*
2016	No floodway operation	March 18, 2016	-	-	-
2017	Floodway operation	-	March 31, 2017	April 16, 2017	April 21, 2017

TABLE D4-3
2016 & 2017 GENERAL GROUNDWATER QUALITY DATA

Location	Well ID	Duplicate	Event	Date	Parameter [1]																							Comments
					Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride	Sulphate	Nitrate & Nitrite as N	Nitrate as N	Nitrite as N	Calcium	Magnesium	Potassium	Sodium	T.D.S. (calc.)	Total Cation	Total Anion	Cation-Anion Balance (%) [3,4]	Ion Balance	Total Coliform (MPN/100 mL) [5]	E.coli (MPN/100 mL) [6]	
				EQL	*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.07*	*9*	*9*	*0.005-0.01*			*0.05*	*0.01*	*0.05*	*0.02*	*5*	-	-	-	-	*0*	*0*	
				HC-CDWQ [2]																								
				Drinking Water	0.3/ 1.0/ 0.1 [7]	7.0 - 10.5 (AO)	-	-	-	-	-	80-100 [8] (AO)	250 (AO)	500 (AO)	-	10 [9]	1 [9]	-	-	-	200 (AO)	500 (AO)	-	-	-	-	0 per 100 mL	0 per 100 mL	-
Rockhaven Rd.	K13-12321	-	River Peak	28-Mar-2016	3.11	7.39	974	408	498	<0.60	<0.34	497	44.6	79.2	2.33	2.33	<0.0010	74.2	75.9	4.88	27.3	561	11.3	11.2	0.1	100	11	<1	-
		-	Re-sample	21-Apr-2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	<1	-
		-	Post-melt	2-Jun-2016	0.41	7.30	1710	506	617	<0.60	<0.34	882	243	93.7	3.25	3.25	<0.0020	113	146	6.55	69.8	990	20.9	19.1	4.3	109	<1	<1	-
		-	Pre-melt	2-Mar-2017	0.30	7.17	1780	576	703	<0.60	<0.34	938	236	87.2	4.48	4.48	<0.0050	122	154	6.32	67.8	1020	21.9	20.3	3.7	108	<1	<1	-
		-	Flood Peak	5-Apr-2017	0.33	7.57	1030	445	542	<0.60	<0.34	552	40.4	75.6	2.89	2.89	<0.0020	78.2	86.6	4.89	27.6	580	12.4	11.8	2.3	105	2	<1	-
		-	Re-sample	20-Apr-2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	<1	-
		-	Post Flood	11-May-2017	16	7.3	1440	542	661	<0.60	<0.34	792	141	86.9	3.31	3.31	<0.0050	105	129	6.13	42.9	836	17.9	16.9	2.9	106	<1	<1	
Outlet Structure	K09-12316	-	River Peak	28-Mar-2016	0.27	7.51	775	312	381	<0.60	<0.34	372	30.6	75.6	1.56	1.56	<0.0010	62.8	52.3	4.33	24.5	444	8.61	8.79	-1	98	22	<1	-
		-	Re-sample	21-Apr-2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	2	-
		-	Post-melt	2-Jun-2016	0.17	7.63	853	359	438	<0.60	<0.34	482	30.6	64.1	1.57	1.57	<0.0010	74.8	71.7	4.47	21.6	490	10.7	9.49	5.9	113	1	<1	-
		-	Pre-melt	3-Mar-2017	<0.10	7.32	893	432	527	<0.60	<0.34	523	29.5	59.0	1.8	1.80	<0.0010	77.8	79.8	4.60	21.3	539	11.5	10.8	3	106	<1	<1	-
		MW100		3-Mar-2017	0.11	7.32	900	430	524	<0.60	<0.34	521	29.5	58.8	1.81	1.81	<0.0010	77.8	79.3	4.49	21.2	537	11.4	10.8	3	106	<1	<1	-
		-	Flood Peak	5-Apr-2017	0.28	7.72	804	323	393	<0.60	<0.34	398	34.5	73.2	0.832	0.832	<0.0020	64.3	57.6	4.42	28.8	456	9.32	9	1.7	104	2	1	-
		MW-100		5-Apr-2017	0.19	7.61	802	324	395	<0.60	<0.34	406	34.7	73.0	0.838	0.836	0.0021	64.3	59.6	4.53	29.9	460	9.53	9.03	2.7	106	1	<1	-
		-	Re-sample	20-Apr-2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	<1	-
		-	Post Flood	11-May-2017	0.25	7.5	844	381	465	<0.60	<0.34	452	28.5	63.4	1.49	1.48	0.008	74.2	64.8	4.46	21.7	486	10.1	9.85	1.2	102	<1	<1	-
PTH 44 Bridge	U09-13571	-	River Peak	28-Mar-2016	0.14	7.43	940	347	423	<0.60	<0.34	427	58.2	95.4	1.64	1.64	<0.0010	69.3	61.7	4.89	38.1	543	10.3	10.7	-1.7	96.6	-	-	-
		-	Flood Peak	5-Apr-2017	0.50	7.44	952	353	431	<0.60	<0.34	466	46.9	105	1.03	1.03	<0.0020	71.9	69.5	5.01	41.5	552	11.2	10.6	2.7	106	-	-	-
Hay Rd.	K11-12018	-	River Peak	28-Mar-2016	8.20	7.23	1130	593	723	<0.60	<0.34	636	2.29	102	<0.0051	<0.0050	<0.0010	92.4	98.5	5.19	27.8	683	14.1	14	0.1	100	-	-	-
		-	Flood Peak	5-Apr-2017	2.88	7.19	1180	608	741	<0.60	<0.34	657	1.8	107	<0.010	<0.010	<0.0020	87.7	106	5.31	31.0	704	14.6	14.4	0.6	101	-	-	-
Church Rd.	K09-12012	-	River Peak	29-Mar-2016	73.3	7.44	1060	350	427	<0.60	<0.34	531	23.0	237	<0.0051	<0.0050	<0.0010	94.9	71.3	4.50	45.2	686	12.7	12.6	0.4	101	<1	<1	-
		-	Re-sample	21-Apr-2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	<1	-
		-	Post-melt	2-Jun-2016	12.8	7.56	1020	311	379	<0.60	<0.34	530	21.0	238	<0.0051	<0.0050	<0.0010	86.3	76.5	4.50	46.8	660	12.8	11.8	4.1	108	<1	<1	-
		-	Pre-melt	2-Mar-2017	226	7.36	1140	392	478	<0.60	<0.34	609	23.5	277	<0.010	<0.010	<0.0020	98.4	88.1	4.81	52.4	779	14.6	14.3	1	102	<1	<1	-
		-	Flood Peak	7-Apr-2017	16.5	7.55	934	324	395	<0.60	<0.34	430	23.6	180	<0.010	<0.010	<0.0020	71.0	61.3	3.83	40.7	575	10.5	10.9	-2	96	1	<1	-
		-	Re-sample	20-Apr-2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	<1	-
		-	Post Flood	11-May-2017	0.5	7.47	1090	387	473	<0.60	<0.34	589	19.2	242	<0.010	<0.010	<0.0020	97.9	83.7	4.85	47.9	728	14	13.3	2.4	105	<1	<1	-
Ludwick Rd.	K09-12011	-	River Peak	29-Mar-2016	0.82	8.02	454	235	286	<0.60	<0.34	230	7.98	15.4	<0.0051	<0.0050	<0.0010	47.4	27.1	2.62	9.54	251	5.08	5.23	-1.5	97	-	-	-
		MW100		29-Mar-2016	0.77	8.08	459	227	277	<0.60	<0.34	229	7.99	15.4	<0.0051	<0.0050	<0.0010	47.7	26.8	2.70	9.51	246	5.07	5.09	-0.2	99.7	-	-	-
		-	Flood Peak	6-Apr-2017	1.13	7.73	463	241	294	<0.60	<0.34	239	7.12	14.9	<0.0051	<0.0050	0.0014	48.1	28.7	2.67	8.67	255	5.21	5.33	-1.2	97.7	-	-	-
Dunning Rd.	K11-12017	-	River Peak	29-Mar-2016	3.62	7.83	1080	265	324	<0.60	<0.34	520	21.9	305	<0.0051	<0.0050	<0.0010	95.3	68.4	3.93	48.0	702	12.6	12.3	1.2	102	-	-	-
		-	Flood Peak	6-Apr-2017	2.55	7.56	970	262	320	<0.60	<0.34	476	20.0	255	<0.0051	<0.0050	<0.0010	82.6	65.5	3.86	45.0	630	11.6	11.1	2	104	-	-	-
Bray Rd.	K11-12016	-	River Peak	29-Mar-2016	0.11	7.75	990	299	364	<0.60	<0.34	500	16.1	236	<0.0051	<0.0050	<0.0010	94.4	64.1	4.49	33.8	629	11.6	11.3	1	102	-	-	-
		-	Flood Peak	6-Apr-2017	0.33	7.50	1010	300	366	<0.60	<0.34	522	14.6	254	<0.0051	<0.0050	<0.0010	92.7	70.5	4.45	37.5	654	12.2	11.7	2	104	-	-	-
PTH59N Bridge	K11-12014	-	River Peak	30-Mar-2016	<0.10	7.63	573	247	301	<0.60	<0.34	299	13.6	57.6	0.252	0.252	<0.0010	59.9	36.3	3.82	6.53	327	6.36	6.53	-1.4	97.3	9	<1	-
		MW-101		30-Mar-2016	<0.10	7.67	575	249	304	<0.60	<0.34	309	13.6	57.7	0.249	0.249	<0.0010	63.2	36.6	3.85	6.57	332	6.55	6.58	-0.3	99.5	12	<1	-
		-	Re-sample	21-Apr-2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	1	-
		-	Post-melt	2-Jun-2016	0.49	7.60	625	256	312	<0.60	<0.34	363	16.1	60.9	0.211	0.211	<0.0010	72.4	44.3	4.25	7.40	360	7.69	6.85	5.8	112	10	<1	-
		-	Pre-melt	3-Mar-2017	0.71	7.39	687	320	391	<0.60	<0.34	397	12.6	67.6	0.159	0.159	<0.0010	80.3	47.7	4.44	7.14	413	8.36	8.18	1.1	102	<1	<1	-
		-	Flood Peak	6-Apr-2017	2.35	7.73	531	208	254	<0.60	<0.34	269	11.7	64.7	0.372	0.372	<0.0010	52.7	33.4	4.35	9.19	301	5.89	5.87	0.2	100	17	1	-
		-	Re-sample	20-Apr-2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	<1	-
		-	Post Flood	11-May-2017	1.50	7.52	672	303	370	<0.60	<0.34	379	12.3	65.4	0.314	0.314	<0.0010	75.6	46.3	4.48	7.98	394	8.04	7.79	1.6	103	<1	<1	-
		K11-100		11-May-2017	1.60	7.48	678	302	368	<0.60	<0.34	385	12.2	65.9	0.321	0.321	<0.0010	76.8	47	4.58	8.11	396	8.17	7.77	2.5	105	<1	<1	-
	K11-12015	-	River Peak	30-Mar-2016	0.32	7.78	532	222	270	<0.60	<0.34	269	16.7	50.5	0.207	0.207	<0.0010	54.2	32.4	3.89	6.72	298	5.76	5.96	-1.7	96.7	9	1	-
		-	Re-sample	21-Apr-2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	<1	-
		MW-100		21-Apr-2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	<1	-
		-	Post-melt	2-Jun-2016	0.93	7.72	596	236	288	<0.60	<0.34	337	16.9	64.6	0.076	0.0733	0.0027	66.2	41.7	4.22	7.36	343	7.16	6.55	4.5	109	5	<1	-
		-	Pre-melt	2-Mar-2017	0.22	7.64	614	267	326	<0.60	<0.34	349	14.6	58.3	0.0486	0.0486	<0.0010	68.8	43.0	4.16	6.43	355	7.36	6.97	2.7	106	<1	<1	-
		-	Flood Peak	6-Apr-2017	1.44	7.79	489	191	233	<0.60	<0.34	249	12.6	55.4	0.474	0.474	<0.0010	49.3	30.5	3.96	9.14	276	5.47	5.36	1	102	12	2	-
		-	Re-sample	20-Apr-2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	<1	-
		-	Post Flood	11-May-2017	0.21	7.68	615	248	302	<0.60	<0.34	331	14.9	78.9	0.143	0.128	0.0153	63.9	41.7	4.44	8.94	361	7.12	7.02	0.7	101	<1	<1	-
McGregor Farm Rd.	K13-12322	-	River Peak	30-Mar-2016	0.84	7.60	741	247	302	<0.60	<0.34	356	16.1	148	<0.0051	<0.0050	<0.0010	61.9	48.8	3.36	23.3	450	8.2	8.48	-1.7	96.7	-	-	-
		-	Flood Peak	6-Apr-2017	0.75	7.62	796	264	322	<0.60	<0.34	400	16.1	162	<0.0051	<0.0050	<0.0010	68.5	55.7	3.79	27.8	492	9.31	9.1	1.1	102	-	-	-
Inlet Control Structure	G050C006	-	River Peak	30-Mar-2016	38.4	7.84	2340	206	252	<0.60	<0.34	477	539	295	<0.051	<0.050	<0.010	95.5	57.9	12.8	325	1450	24	25.5	-3	94.1	1	0	-
		-	Flood Peak	7-Apr-2017	37.0	7.75	2240	233	285	<0.60	<0.34	467	422	282	<0.051	<0.050	<0.010	89.2	59.4	12.3	304	1310	22.9	22.4	1	102	0	0	-

TABLE D4-3
2016 & 2017 GENERAL GROUNDWATER QUALITY DATA

Notes:

EQL = Estimated Quantitation Limit = The lowest level of the parameter that can be quantified with confidence

E.C. = Electrical Conductivity

T.D.S. = Total Dissolved Solids

"-" = No Data

1. All values are expressed in milligrams per litre (mg/L) unless indicated otherwise.
2. Health Canada - Canadian Drinking Water Quality Guidelines (HC-CDWQ). Federal-Provincial-Territorial Committee on Drinking Water, February 2017.
   MAC - Maximum Acceptable Concentration
   AO - Aesthetic Objectives
3. Cation Anion balance = $\frac{\text{sum of meq of Cations - sum of meq of Anions}}{\text{sum of meq of Cations + sum of meq Anions}} \times 100 = \%$
4. Cation-anion balances greater than the absolute 10% are highlighted for reference only.
5. Total coliforms should be monitored in the distribution system because they are used to indicate changes in water quality.
   a) Water leaving a treatment plant: Total coliforms should be measured in conjunction with other indicators to assess water quality; the presence of total coliforms indicates a serious breach in treatment.
   b) Distribution and storage systems: Detecting total coliforms can indicate regrowth of the bacteria in biofilms or intrusion of untreated water.
   c) Non-disinfected groundwater: The presence of total coliforms may indicate that the system is vulnerable to contamination, or it may be a sign of bacterial regrowth.
6. E. Coli is used as an indicator of the microbiological safety of drinking water. E. Coli monitoring should be used in conjunction with other indicators as part of a multi-barrier approach to producing acceptable quality drinking water.
7. Waterworks systems that use a surface water source or a groundwater source under the direct influence of surface water should filter the source water to meet the following health-based turbidity limits, as defined for specific treatment technologies.
   Where possible, filtration systems should be designed and operated to reduceturbidity levels as low as possible, with a treated water turbidity target of less than 0.1 NTU at all times. Where this is not achievable, the treated water turbidity levels from individual filters:
   a) For chemically assisted filtration, shall be less than or equal to 0.3 NTU in at least 95% of the measurements made, or at least 95% of the time each calendar month,
   and shall not exceed 1.0 NTU at any time.
   b) For slow sand or diatomaceous earth filtration, shall be less than or equal to 1.0 NTU in at least 95% of the measurements made, or at least 95% of the time each
   calendar month, and shall not exceed 3.0 NTU at any time.
   c) For membrane filtration, shall be less than or equal to 0.1 NTU in at least 99% of the measurements made, or at least 99% of the time each calendar month, and shall
   not exceed 0.3 NTU at any time. If membrane filtration is the sole treatment technology employed, some form of virus inactivation* should follow the filtration process.
8. Public acceptance of hardness varies considerably. Generally, hardness levels between 80 and 100 mg/L (as CaCO3) provide acceptable balance between corrosion and incrustation; Where water is softened by sodium ion exchange, it is recommended that a separate, unsoftened supply be retained for culinary and drinking purposes.
9. Systems using chloramine disinfection or that have naturally occurring ammonia should monitor the level of nitrate/nitrite in the distribution system. Homeowners with a well should test the concentration of nitrate/nitrite in their water supply.

- Exceedance of HC-CDWQ Drinking Water Criteria

TABLE D4-4
2017 WATER QUALITY ASSESSMENT - INSTRUMENTED WELLS

WELL ID	YEAR	PROGRAM	CONDUCTIVITY							NITRATE			E. COLI	
			PRE-MELT CONDUCTIVITY (March 2-3, 2017)	SPRING FLOOD CONDUCTIVITY (April 5 to 6, 2017)	% CHANGE [3]	CHANGE IS GREATER THAN 5%[2]	MAGNITUDE OF WATER QUALITY CHANGE [1]	WELL HAS PRE-MELT GROUNDWATER CONDUCTIVITY VALUES SIMILAR TO THE FLOODWAY CHANNEL SURFACE WATER DURING THE FLOOD	CONDUCTIVITY VALUES FOR GROUNDWATER DO NOT CHANGE ASSOCIATED WITH THE SPRING MELT EVENT	PRE-MELT NITRATE PLUS NITRITE (as N) (March 2-3, 2017)	SPRING FLOOD NITRATE PLUS NITRITE (as N) (April 5-6, 2017)	% CHANGE [3]	E.COLI DETECTED IN A DISINFECTED WELL IN PRE-MELT SAMPLING	E. COLI DETECTED IN A DISINFECTED WELL IN SPRING FLOOD PEAK SAMPLING
K13-12321	2017	Program A	1780	1030	73	Yes	A	No	No	4.48	2.89	55	No	No
K09-12316	2017	Program A	893	804	11	Yes	C	No	No	1.8	0.83	117	No	Yes[4]
K09-12012	2017	Program A	1140	934	22	Yes	C	No	No	<0.01	<0.01	0	No	No
K11-12014	2017	Program A	687	531	29	Yes	B	No	No	0.159	0.372	-57	No	Yes[5]
K11-12015	2017	Program A	614	489	26	Yes	B	No	No	0.0486	0.474	-90	No	Yes[5]

Notes:
1. Magnitude of water quality change: Type A (>50% change), Type B (25% to 50% change). Type C (10% to 25% change), Type D (5% to 10%) change
2. Changes of ≤ 5% are considered to be within the accuracy of the analysis and are considered "no change" for purposes of this analysis.
3. Negative % change values indicate higher concentrations for flood peak vs pre-melt sampling.
4. E.coli was not detected in duplicate sample.
5. E.coli was not detected in follow up sampling on April 20, 2017.

- Water quality change >5% detected.

TABLE D4-5
2017 WATER QUALITY ASSESSMENT - NON-INSTRUMENTED WELLS

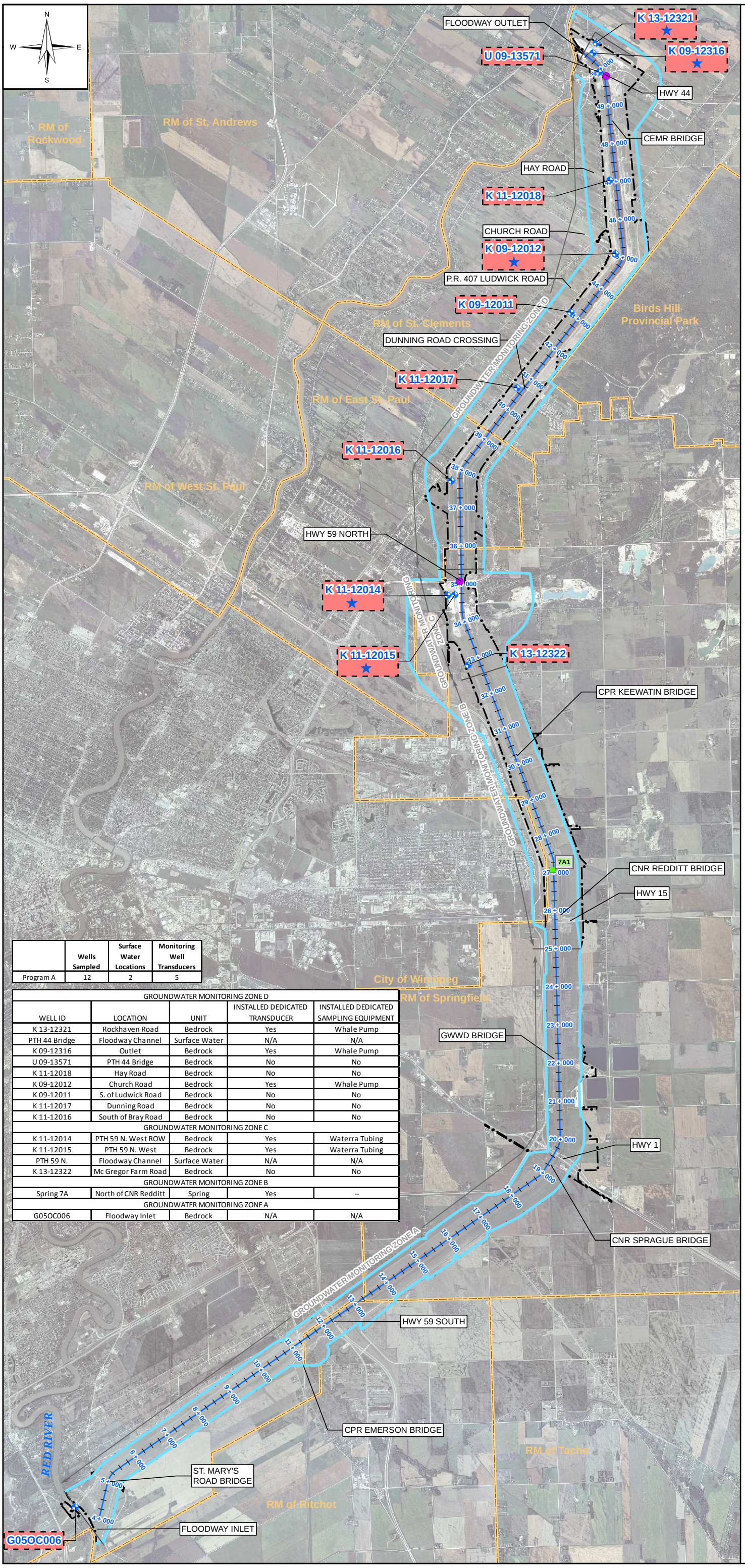
WELL ID	PROGRAM	CONDUCTIVITY							NITRATE		
		PRE-MELT CONDUCTIVITY PREVIOUS YEAR (2011, 2013 or 2014)	SPRING FLOOD CONDUCTIVITY (April 5-6, 2017)	% CHANGE [3]	CHANGE IS GREATER THAN 5%[2]	MAGNITUDE OF WATER QUALITY CHANGE [1]	WELL HAS PRE-MELT GROUNDWATER CONDUCTIVITY VALUES SIMILAR TO THE FLOODWAY CHANNEL SURFACE WATER DURING THE FLOOD	CONDUCTIVITY VALUES FOR GROUNDWATER DO NOT CHANGE ASSOCIATED WITH THE SPRING MELT EVENT	PRE-MELT NITRATE PREVIOUS YEAR (2013 or 2014)	SPRING FLOOD NITRATE PLUS NITRITE (as N) (April 5-6, 2017)	% CHANGE [3]
U09-13571	Program A	1170	952	23	Yes	C	No	No	1.42	1.03	38
K11-12018	Program A	1090	1180	-8	Negative change	-	No	Yes	<0.0050	<0.01	0
K09-12011	Program A	465	463	0	No	-	Yes	Yes	<0.0051	<0.0051	0
K11-12017	Program A	1080	970	11	Yes	C	No	No	<0.0051	<0.0051	0
K11-12016	Program A	1050	1010	4	No	-	No	Yes	<0.0050	<0.0051	0
K13-12322	Program A	880	796	11	Yes	C	No	No	0.0116	<0.0051	127 [5]
G050C006	Program A	2890	2240	29	Yes	B	No	No	<0.35	<0.051	0

Notes:
1. Magnitude of water quality change: Type A (50% change), Type B (25 to 50% change). Type C (10% to 25% change), Type D (5 to 10%) change
2. Changes of ≤ 5% are considered to be within the accuracy of the analysis and are considered "no change" for purposes of this analysis.
3. Negative % change values indicate higher concentrations for flood peak vs pre-melt sampling.
4. Pre-melt value for previous years may not be representative of 2017; therefore, percent change may not be valid.
5. Change may not be valid due to low detection limits.

- Water quality change > 5% detected.

FIGURES

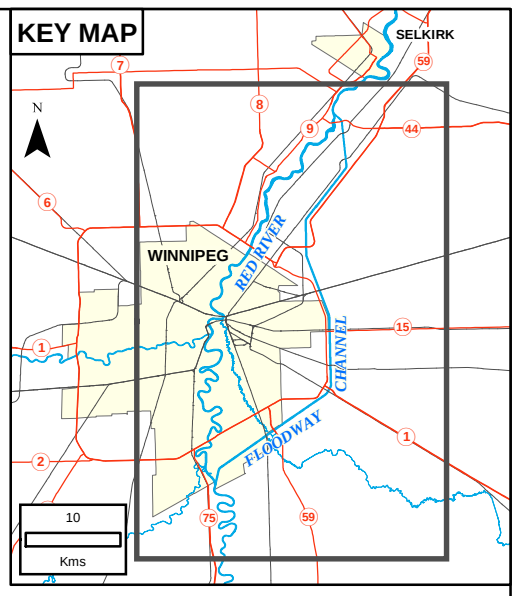
P:\Projects\2016\16-0300-002\Dwg\GIS\MXDs\Deliverable_D4\Rev0\16-0300-002_FigD4-1_Rev0.mxd



	Wells Sampled	Surface Water Locations	Monitoring Well Transducers
Program A	12	2	5

GROUNDWATER MONITORING ZONE D				
WELL ID	LOCATION	UNIT	INSTALLED DEDICATED TRANSDUCER	INSTALLED DEDICATED SAMPLING EQUIPMENT
K 13-12321	Rockhaven Road	Bedrock	Yes	Whale Pump
PTH 44 Bridge	Floodway Channel	Surface Water	N/A	N/A
K 09-12316	Outlet	Bedrock	Yes	Whale Pump
U 09-13571	PTH 44 Bridge	Bedrock	No	No
K 11-12018	Hay Road	Bedrock	No	No
K 09-12012	Church Road	Bedrock	Yes	Whale Pump
K 09-12011	S. of Ludwick Road	Bedrock	No	No
K 11-12017	Dunning Road	Bedrock	No	No
K 11-12016	South of Bray Road	Bedrock	No	No
GROUNDWATER MONITORING ZONE C				
K 11-12014	PTH 59 N. West ROW	Bedrock	Yes	Waterra Tubing
K 11-12015	PTH 59 N. West	Bedrock	Yes	Waterra Tubing
PTH 59 N.	Floodway Channel	Surface Water	N/A	N/A
K 13-12322	Mc Gregor Farm Road	Bedrock	No	No
GROUNDWATER MONITORING ZONE B				
Spring 7A	North of CNR Redditt	Spring	Yes	--
GROUNDWATER MONITORING ZONE A				
G05OC006	Floodway Inlet	Bedrock	N/A	N/A

KEY MAP



Legend

- Spring Treatment Site
- Monitoring Wells
- K11-12015 — Core Monitoring Well Location
- Instrumented Monitoring Well Location (5 Wells)
- Surface Water Sampling Location
- Proposed Groundwater Monitoring Boundary
- 4 + 000 — Floodway Channel Station
- Floodway Right of Way Limits
- RM Boundary

NOTES:
1. Instrumented monitoring well locations includes well disinfection, dedicated pumps and transducers, and analysis of dissolved oxygen and bacteria.
2. Imagery from the Manitoba Land Initiative website, and dated 2008-2010.

1 0 1 2 3
Kilometers

SCALE: 1:100,000 METRIC 11"x17"

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14.
Elevations are in metres above sea level (MSL).

NO.	YY/MM/DD	DESCRIPTION	ISSUED BY	CHECK BY
0	18/03/01	ISSUED WITH FINAL REPORT	MPS	BAT

REVISIONS / ISSUE

KGS GROUP CONSULTING ENGINEERS

Manitoba Infrastructure

RED RIVER FLOODWAY LONG TERM MONITORING PROGRAM – 2017 PROGRAM A MONITORING REPORT

PROGRAM A MONITORING WELL LOCATIONS

MARCH 2018 | FIG D4-1 | REV: 0

APPENDIX D4-A

FLOODWAY OPERATION AND RED RIVER WATER QUALITY

APPENDIX D4-A-1

TABLE D4-A-1 SUMMARY OF OBSERVED FLOW IN THE FLOODWAY DURING SPRING AND SUMMERY OPERATION

TABLE D4-A-1
SUMMARY OF OBSERVED FLOW IN FLOODWAY DURING SPRING AND SUMMER OPERATION

Year	Spring Operation					Summer Operation					Comments
	Peak Flow (cms)	Date of Peak Flow	Start of Operation	End of Operation	No. of Days of Operation	Peak Flow (cms)	Date of Peak Flow	Start of Operation	End of Operation	No. of Days of Operation	
1969	626	May 3	April 14	May 18	35	-	-	-	-	-	
1970	646	May 1	April 17	May 21	35	-	-	-	-	-	
1971	257	April 14	April 11	April 21	11	-	-	-	-	-	
1972	33.4	April 18	April 14	April 21	8	-	-	-	-	-	
1973	-	-	-	-	-	-	-	-	-	-	
1974	1040	April 24 & 25	April 17	May 17	31	-	-	-	-	-	
			May 21	May 30	10						
1975	267	May 7 & 8	April 30	May 19	20	-	-	-	-	-	
1976	292	April 11	April 7	April 18	12	-	-	-	-	-	
1977	-	-	-	-	-	-	-	-	-	-	
1978	513	April 16	April 9	May 3	25	-	-	-	-	-	
1979	1190	May 9	April 19	May 29	41	-	-	-	-	-	
1980	-	-	-	-	-	-	-	-	-	-	
1981	-	-	-	-	-	-	-	-	-	-	
1982	17.8	April 18	April 15	April 21	7	-	-	-	-	-	
1983	26.4	April 11	April 9	April 13	5	-	-	-	-	-	
1984	-	-	-	-	-	-	-	-	-	-	
1985	-	-	-	-	-	-	-	-	-	-	
1986	278	April 3	April 1	April 14	14	-	-	-	-	-	
			May 6	May 11	6						
1987	507	April 10	April 5	April 18	14	-	-	-	-	-	
1988	-	-	-	-	-	-	-	-	-	-	
1989	136	April 24	April 21	May 1	11	-	-	-	-	-	
1990	-	-	-	-	-	-	-	-	-	-	
1991	-	-	-	-	-	-	-	-	-	-	
1992	101	April 8	April 7	April 12	6	-	-	-	-	-	
1993	-	-	-	-	-	-	-	-	-	-	
1994	-	-	-	-	-	-	-	-	-	-	
1995	387	March 29	March 22	April 25	35	-	-	-	-	-	
1996	1100	April 30 & May 1 & 2	April 18	June 9	53	-	-	-	-	-	
1997	1880	May 3 & 4	April 19	June 2	45	-	-	-	-	-	
1998	191	April 1	March 30	April 6	8	-	-	-	-	-	
1999	445	April 16	April 3	May 1	29	-	-	-	-	-	
2000	-	-	-	-	-	-	-	-	-	-	
2001	598	April 28	April 5	May 20	46	-	-	-	-	-	
2002	-	-	-	-	-	159	July 6	June 13	June 25	13	
								July 4	July 10	7	
								July 17	July 26	10	
2003	-	-	-	-	-	-	-	-	-	-	
2004	446	April 5	March 31	April 21	22	294	June 12	June 10	June 30	21	
2005	433	April 8	April 2	April 22	21	657	July 4	June 9	July 24	46	
								July 31	August 3	5	
2006	941	April 15	April 5	May 7	33	-	-	-	-	-	
2007	119	April 12	April 3	April 16	14	23	June 29	June 28	July 2	5	Summer Flood was with no operation
2008	-	-	-	-	-	-	-	-	-	-	
2009	1208	April 21	April 8	May 24	47	-	-	-	-	-	
2010	450	April 6	March 28	April 22	25	345	June 4	May 30	June 16	18	
2011	1019	May 4	April 9	June 2	55	64	July 10	July 7	July 15	8	
2012	-	-	-	-	-	-	-	-	-	-	-
2013	444	May 4	April 29	June 7	41	-	-	-	-	-	
2014	142	April 21	41748	41756	9.0	68.0	July 5	June 30	July 13	14.0	Spring Flood was with no operation
2015	-	-	-	-	-	-	-	-	-	-	
2016	-	-	-	-	-	-	-	-	-	-	
2017	635	April 6	March 31	April 21	22	-	-	-	-	-	

Data is based on recorded flows from the Water Survey of Canada Gauge 05OC017 except for the 2006 data which is based on the Province of Manitoba's Daily Flood Forecast Reports

APPENDIX D4-A-2

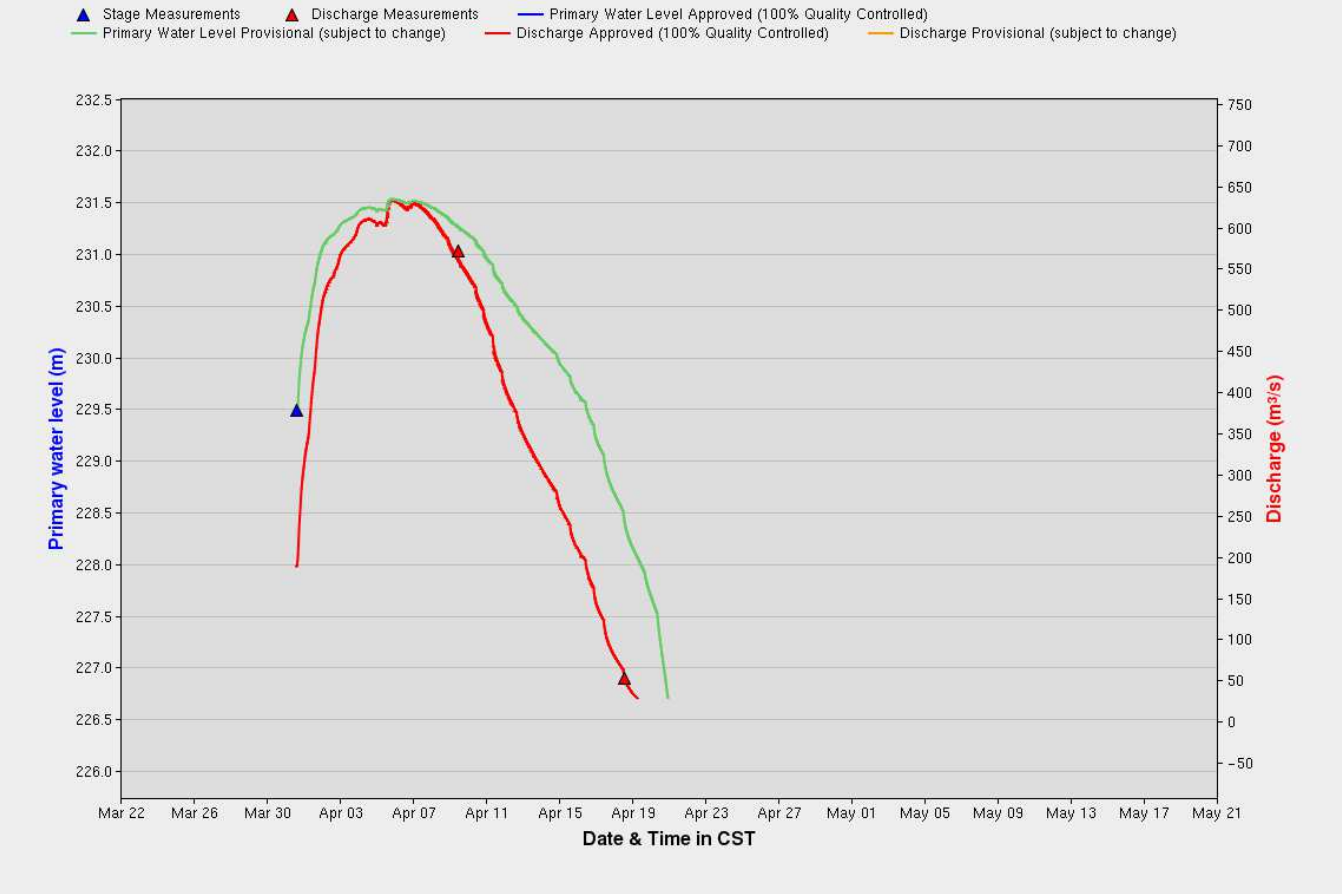
RED RIVER AT TRANSCANADA HIGHWAY
REAL-TIME DATA ENVIRONMENT CANADA

Government of Canada | Gouvernement du Canada

Real-Time Hydrometric Data Graph for RED RIVER FLOODWAY NEAR ST. NORBERT (05OC017) [MB]

Station Notice

This station is used to record high water events only. Data will be reported once the elevation reaches approximately 226.700m.



Timeliness of the real-time data

Station Information

Active or discontinued:	Active
Province / Territory:	Manitoba
Latitude:	49° 45' 24" N

Longitude:	97° 07' 17" W
Gross drainage area:	120000 km²
Effective drainage area:	N/A
Record length:	49 Years
Period of record:	1969 - 2017
Regulation type:	Regulated
Regulation length:	N/A
Real-time data available:	Yes
Sediment data available:	Yes
Type of water body:	River
RHBN:	No
EC Regional Office:	WINNIPEG
Data contributed by:	N/A
Datum of published data:	GEODETIC SURVEY OF CANADA DATUM (LOCAL 1929 ADJ.)

Data Collection History

This table contains information pertaining to the historical changes of defined elements in the operation of a station.

Period of operation	Type	Operation schedule	Gauge type
1969 - 2001	Flow	Seasonal	Recorder
2002 - 2017	Flow & Level	Seasonal	Recorder

Date modified:
2017-07-13

Government of Canada | Gouvernement du Canada

Home → Environment and natural resources → Water level and flow → Real-Time Data → Hydrometric Data Search

Real-Time Hydrometric Data for RED RIVER FLOODWAY NEAR ST. NORBERT (05OC017) [MB]

Station Notice

This station is used to record high water events only. Data will be reported once the elevation reaches approximately 226.700m.

Filter items

Showing 301 to 320 of 4,581 entries | Show 20 entries

This table provides real-time data in tabular format.

Date (CST)	Primary water level (m)	Discharge (m^3/s)
2017-04-06 01:00:00	231.527	632
2017-04-06 01:05:00	231.525	632
2017-04-06 01:10:00	231.526	632
2017-04-06 01:15:00	231.532	633
2017-04-06 01:20:00	231.527	632
2017-04-06 01:25:00	231.528	632
2017-04-06 01:30:00	231.527	632
2017-04-06 01:35:00	231.528	632
2017-04-06 01:40:00	231.529	633
2017-04-06 01:45:00	231.523	631
2017-04-06 01:50:00	231.524	631
2017-04-06 01:55:00	231.532	634
2017-04-06 02:00:00	231.524	631
2017-04-06 02:05:00	231.525	631
2017-04-06 02:10:00	231.532	633

Date (CST)	Primary water level (m)	Discharge (m^3/s)
2017-04-06 02:15:00	231.524	631
2017-04-06 02:20:00	231.527	632
2017-04-06 02:25:00	231.528	632
2017-04-06 02:30:00	231.524	631
2017-04-06 02:35:00	231.528	632

Previous 1 … 15 16 17 … 230 Next

Measured discharge

Filter items

Date	Discharge
2017-04-09 10:44:00	572
2017-04-18 13:01:00	53.8

Timeliness of the real-time data

Station Information

Active or discontinued:	Active
Province / Territory:	Manitoba
Latitude:	49° 45' 24" N
Longitude:	97° 07' 17" W
Gross drainage area:	120000 km^2
Effective drainage area:	N/A
Record length:	49 Years
Period of record:	1969 - 2017
Regulation type:	Regulated
Regulation length:	N/A
Real-time data available:	Yes
Sediment data available:	Yes
Type of water body:	River
RHBN:	No
EC Regional Office:	WINNIPEG
Data contributed by:	N/A

Datum of published data: GEODETIC SURVEY OF CANADA DATUM (LOCAL 1929 ADJ.)

Data Collection History

This table contains information pertaining to the historical changes of defined elements in the operation of a station.

Period of operation	Type	Operation schedule	Gauge type
1969 - 2001	Flow	Seasonal	Recorder
2002 - 2017	Flow & Level	Seasonal	Recorder

Date modified:
2017-07-13

APPENDIX D4-A-3

RED RIVER AT GRAND FORKS, REAL-TIME WATER QUALITY DATA-USGS

National Water Information System: Web Interface

Click to hideNews Bulletins

Please see news on new formats
- Full News

USGS 05082500 RED RIVER OF THE NORTH AT GRAND FORKS, ND

PROVISIONAL DATA SUBJECT TO REVISION

Available data for this site Time-series: Current/Historical Observations | GO

Click to hidestation-specific text

Water Quality data provided in cooperation with the North Dakota Department of Health, the cities of Grand Forks and East Grand Forks, and the Minnesota Pollution Control Agency.

Gage height and discharge data provided in cooperation with the following:

USGS Feral Priority Streamgage (fomerly NSIP)

Station 050082500 Gage Height History Write-up

- **Flood-tracking chart**
- **Streamflow duration hydrograph**
- **Current stage-discharge rating**
- **Water-quality Estimates**

Webcam near Sorlie Bridge

Image is updated daily. Click to view older photos.

Temperature is displayed in kelvin (K). Time is displayed in GMT.

This station managed by the Grand Forks Field Office.

Available Parameters	Available Period
☐ All 7 Available Parameters for this site	
☑ 00010 Temperature, water	2007-10-01 2017-04-03
☑ 00060 Discharge	2007-10-01 2017-04-03
☑ 00065 Gage height [Bubbler]	2007-10-01 2017-04-03
☑ 00095 Specific cond at 25C	2007-10-01 2017-04-03
☑ 00300 Dissolved oxygen	2007-10-01 2017-04-03
☑ 00400 pH	2007-10-01 2017-04-03
☑ 63680 Turbidity, Form Neph	2007-10-01 2017-04-03

Output format

◉ Graph
○ Graph w/ stats
○ Graph w/o stats

○ Graph w/ (up to 3) parms
○ Table
○ Tab-separated

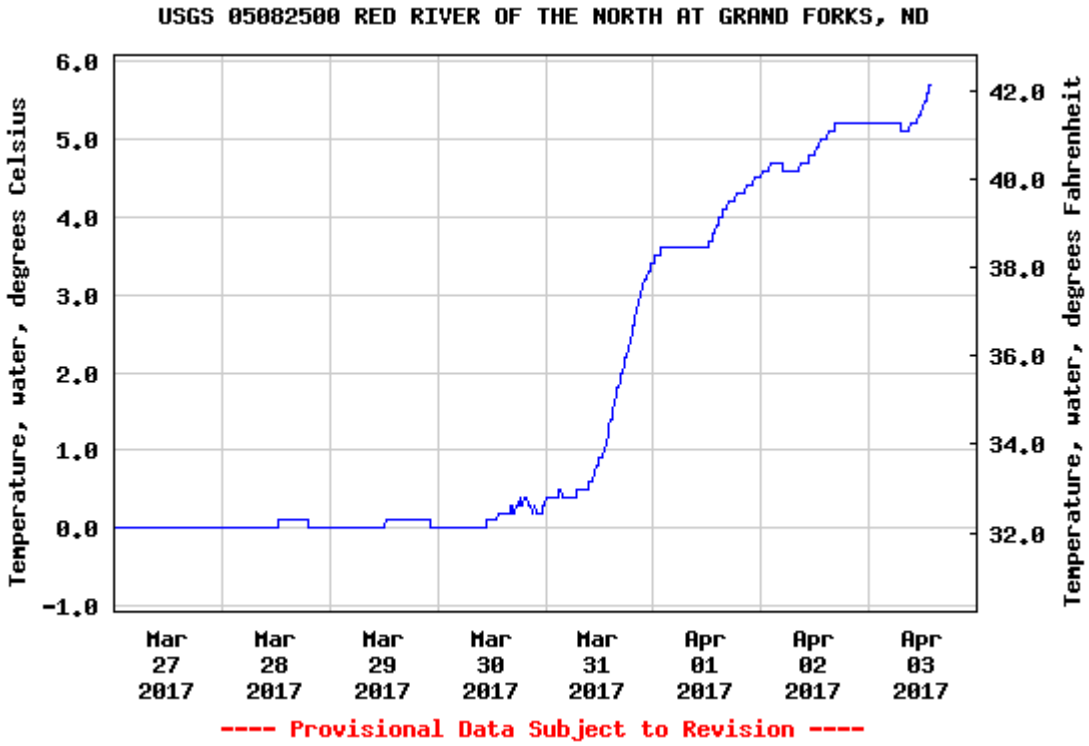
Days (7) [Summary of all available data for this site](#) GO
[Instantaneous-data availability statement](#)

-- or --

Begin date
2017-03-27

End date
2017-04-03

Temperature, water, degrees Celsius
Most recent instantaneous value: 5.7 04-03-2017 13:45 CDT



Add up to 2 more sites and replot for "Temperature, water, degrees Celsius"

[?](#)
Add site numbers
[Note](#)

Enter up to 2 site numbers separated by a comma. A site number consists of 8 to 15 digits

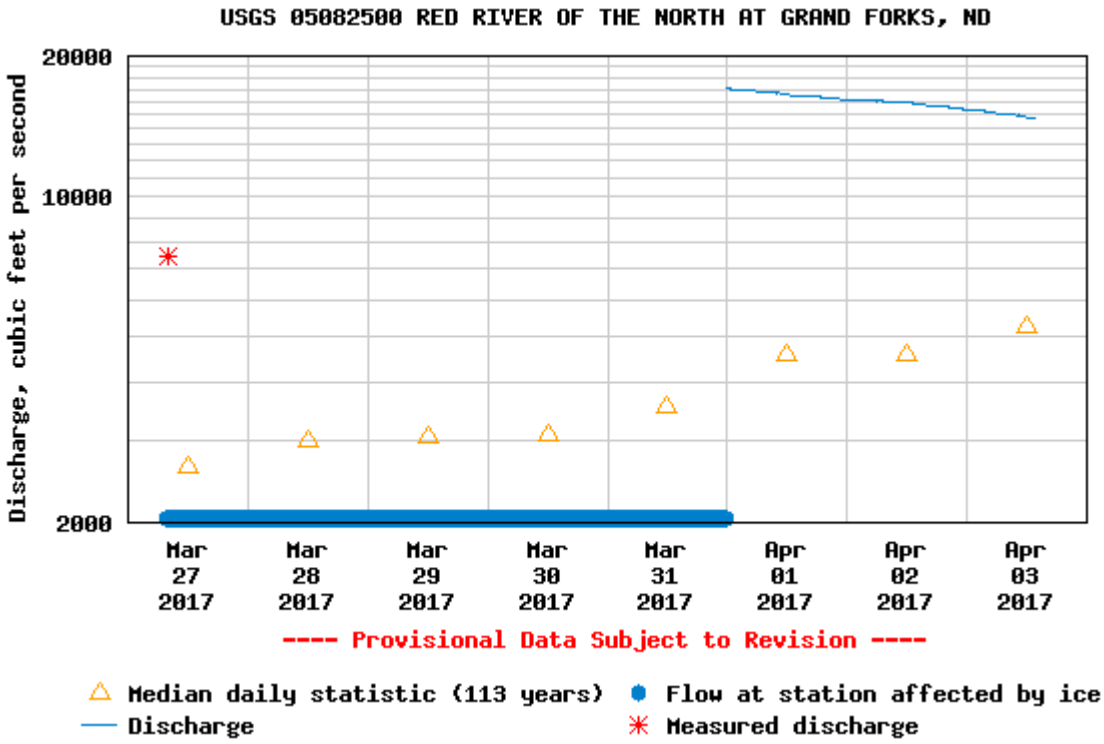
GO

Create [presentation-quality](#) / [stand-alone](#) graph. Subscribe to
[?](#)

WaterAlert

Share this graph |

Discharge, cubic feet per second
Most recent instantaneous value: 14800 04-03-2017 13:45 CDT



Add up to 2 more sites and replot for "Discharge, cubic feet per second"

?
Add site numbers
Note

Enter up to 2 site numbers separated by a comma. A site number consists of 8 to 15 digits

GO

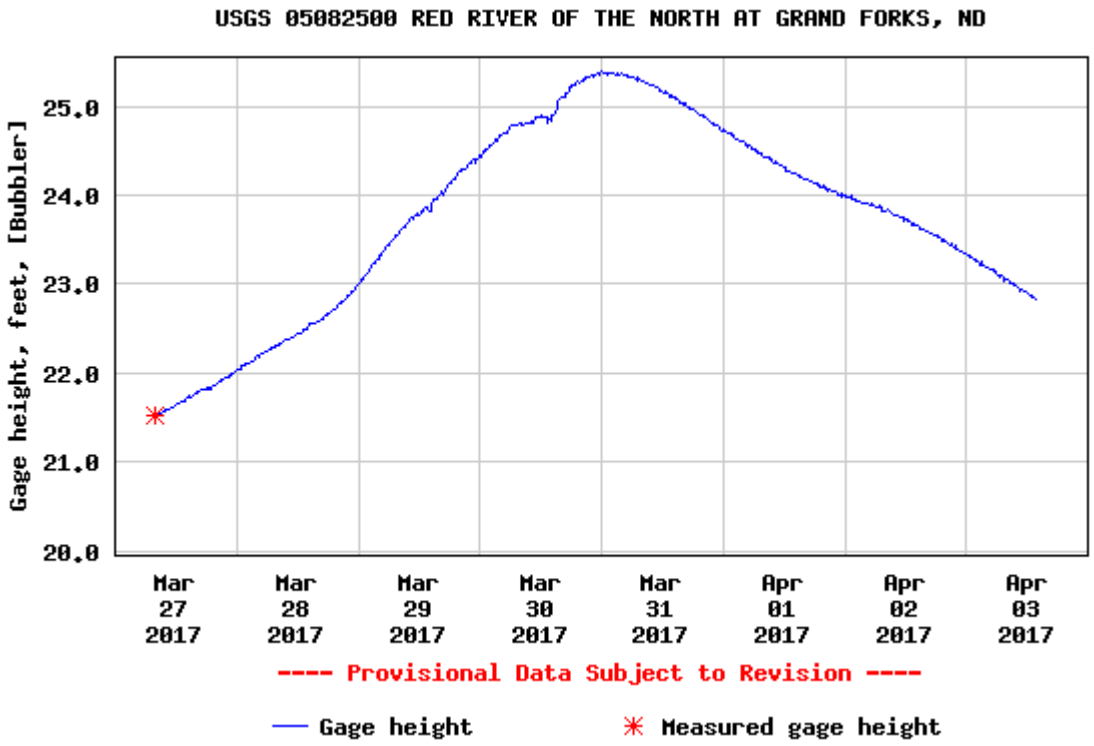
Create presentation-quality / stand-alone graph. Subscribe to
?
WaterAlert

Share this graph |

Daily discharge, cubic feet per second -- statistics for Apr 3 based on 113 years of record more

Min (1937)	25th percen-tile	Median	Mean	75th percen-tile	Most Recent Instantaneous Value Apr 3	Max (2009)
207	2480	5270	9860	11500	14800	73800

Gage height, feet, [Bubbler]
Most recent instantaneous value: 22.84 04-03-2017 13:45 CDT



Add up to 2 more sites and replot for "Gage height, feet, [Bubbler]"

?
Add site numbers
Note

Enter up to 2 site numbers separated by a comma. A site number consists of 8 to 15 digits

GO

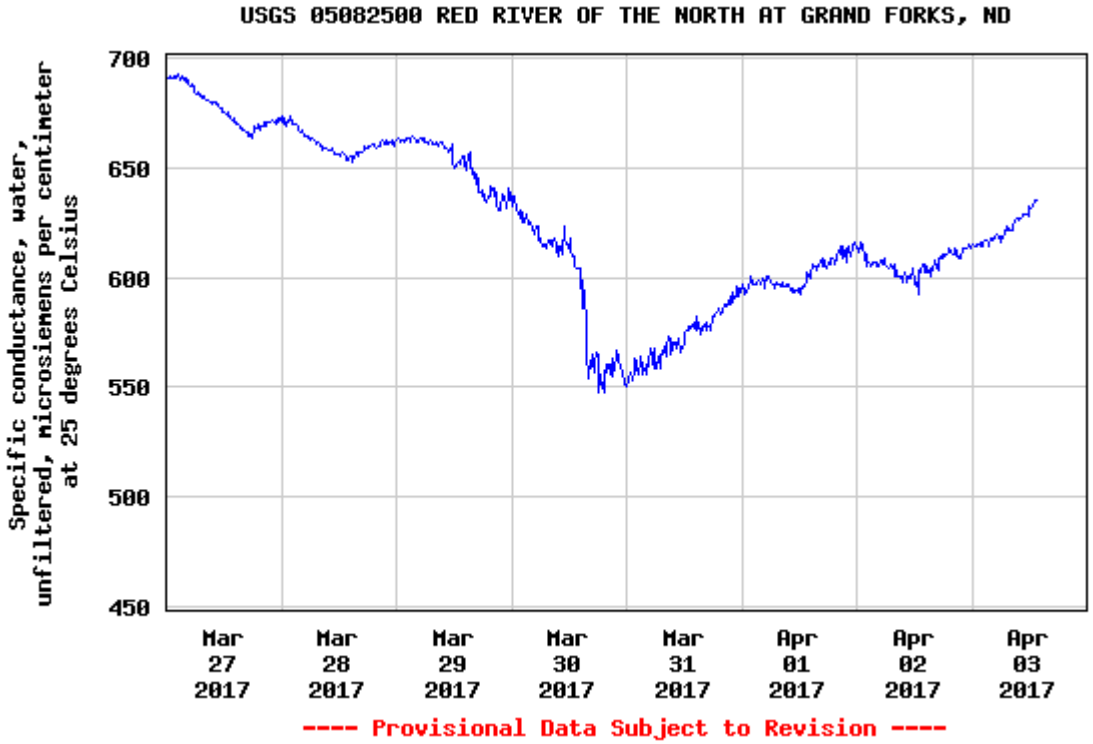
Create presentation-quality / stand-alone graph. Subscribe to ?

WaterAlert

Share this graph |

Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius

Most recent instantaneous value: 635 04-03-2017 13:45 CDT



Add up to 2 more sites and replot for "Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius"

?

Add site numbers

Note

Enter up to 2 site numbers separated by a comma. A site number consists of 8 to 15 digits

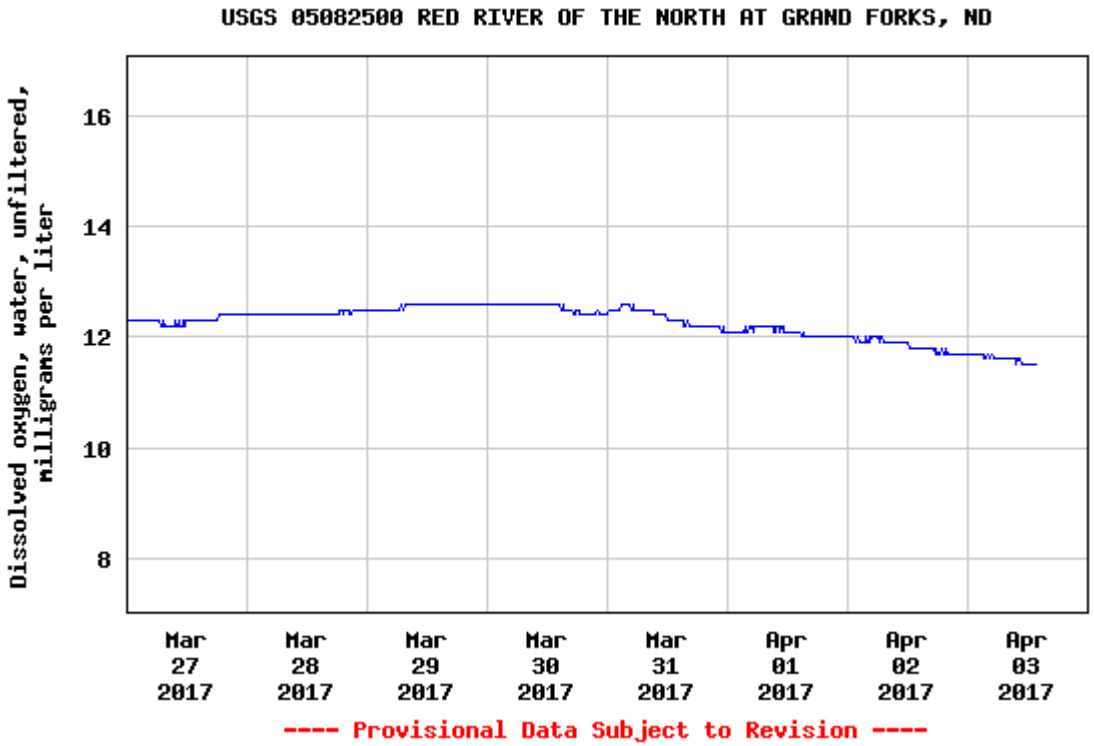
GO

Create presentation-quality / stand-alone graph. Subscribe to ?

WaterAlert

Share this graph |

Dissolved oxygen, water, unfiltered, milligrams per liter
Most recent instantaneous value: 11.5 04-03-2017 13:45 CDT



Add up to 2 more sites and replot for "Dissolved oxygen, water, unfiltered, milligrams per liter"

?
Add site numbers
Note

Enter up to 2 site numbers separated by a comma. A site number consists of 8 to 15 digits

GO

Create presentation-quality / stand-alone graph. Subscribe to
?

WaterAlert

Share this graph |

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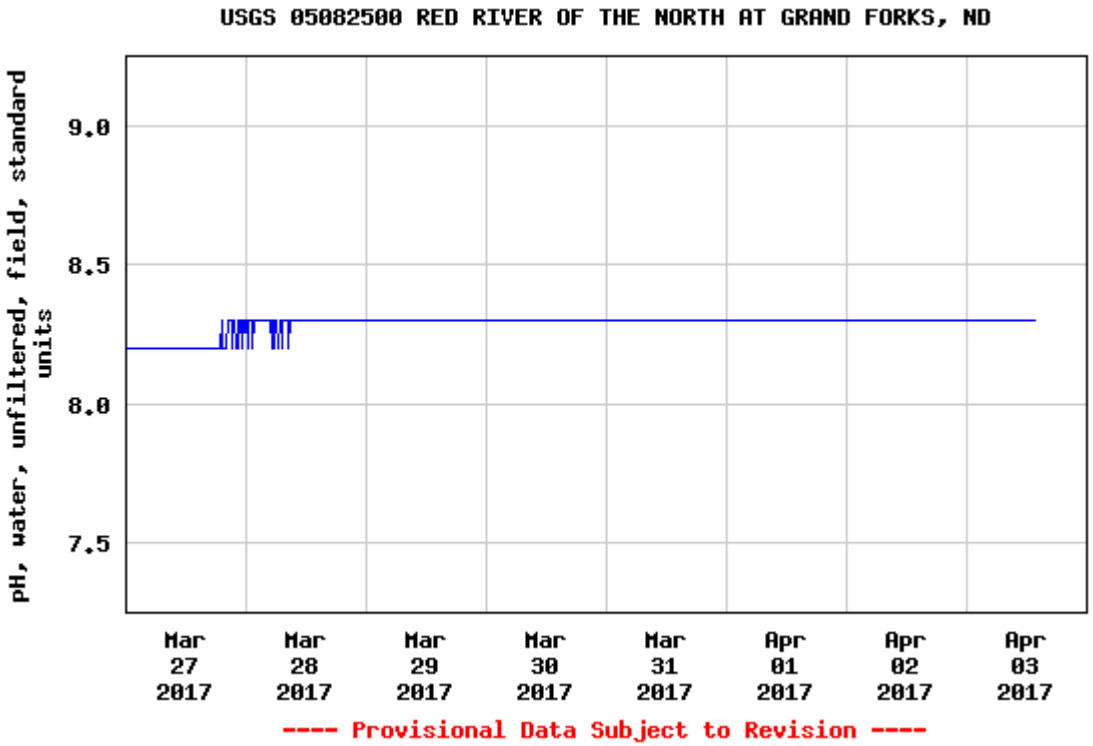
pH, water, unfiltered, field, standard units
Most recent instantaneous value: 8.3 04-03-2017 13:45 CDT



Add up to 2 more sites and replot for "pH, water, unfiltered, field, standard units"

?
Add site numbers
Note

Enter up to 2 site numbers separated by a comma. A site number consists of 8 to 15 digits

GO

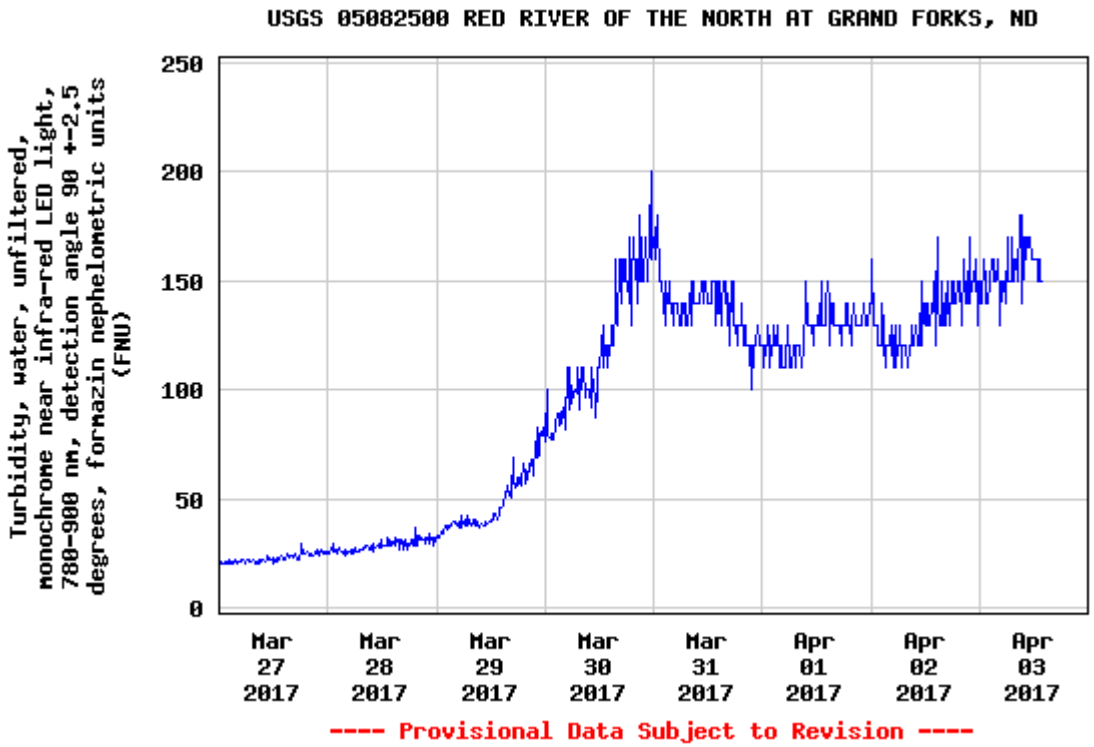
Create presentation-quality / stand-alone graph. Subscribe to
?

WaterAlert

Share this graph |

Turbidity, water, unfiltered, monochrome near infra-red LED light, 780-900 nm, detection angle 90 +-2.5 degrees, formazin nephelometric units (FNU)

Most recent instantaneous value: 150 04-03-2017 13:45 CDT



Add up to 2 more sites and replot for "Turbidity, water, unfiltered, monochrome near infra-red LED light, 780-900 nm, detection angle 90 +-2.5 degrees, formazin nephelometric units (FNU)"

?

Add site numbers

Note

Enter up to 2 site numbers separated by a comma. A site number consists of 8 to 15 digits

GO

Create presentation-quality / stand-alone graph. Subscribe to ? WaterAlert

Share this graph |

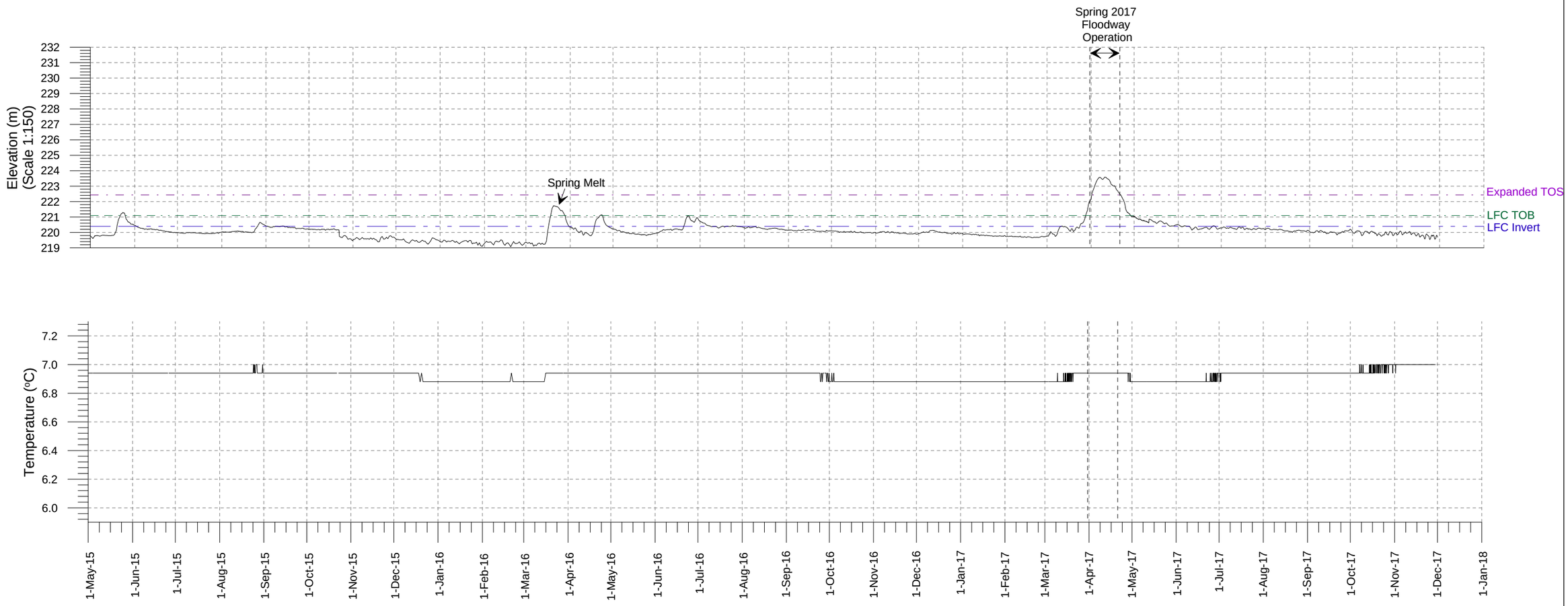
Questions about sites/data?
Feedback on this web site
Automated retrievals
Help
Data Tips
Explanation of terms
Subscribe for system changes
News

Title: USGS Current Conditions for the Nation
URL: https://waterdata.usgs.gov/nwis/uv?

Page Contact Information: North Dakota Water Data Support Team
Page Last Modified: 2017-04-03 15:54:43 EDT
1.13 0.81 caww01

APPENDIX D4-B

2016 TO 2018 TRANSDUCER PROGRAM



Notes:
TOS - Toe of Slope
LFC - Low Flow Channel
TOB - Top of Bank

1. See Appendix D4-C Figure HM66-13 Rev. 5 for historical data.

Groundwater
Transducer Data - K09-12316

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	18/03/01	ISSUED WITH FINAL REPORT	PJL	MFH

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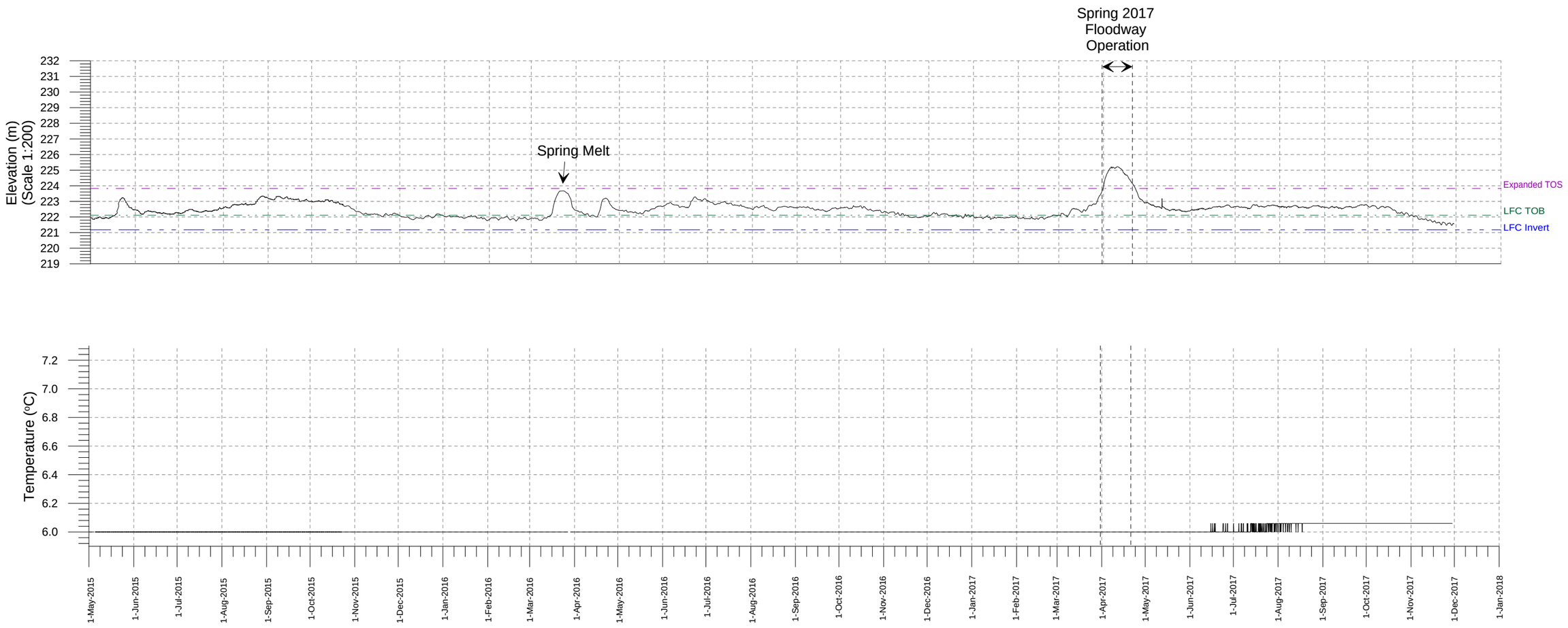
Manitoba Infrastructure

RED RIVER FLOODWAY
LONG TERM MONITORING PROGRAM
PROGRAM A ANNUAL REPORT

WATER ELEVATION AND
TEMPERATURE READINGS AT
K09-12316 (Floodway Outlet)

MARCH 2018 | APPENDIX D4-B-1 | REV: 0

P:\Projects\2016\16-0300-002\Design\Env\Grapher & Transducer Data\16-0300-002_Grapher Files\K09-12316 (9616)\K09-12316_(9616)_Hydrograph_16-0300-002.grf



Notes:
TOS - Toe of Slope
LFC - Low Flow Channel
TOB - Top of Bank

1. See Appendix D4-C Figure HM66-13 Rev.5 for historical data.

Groundwater
Transducer Data - K09-12012

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	18/03/01	ISSUED WITH FINAL REPORT	PJL	MFH

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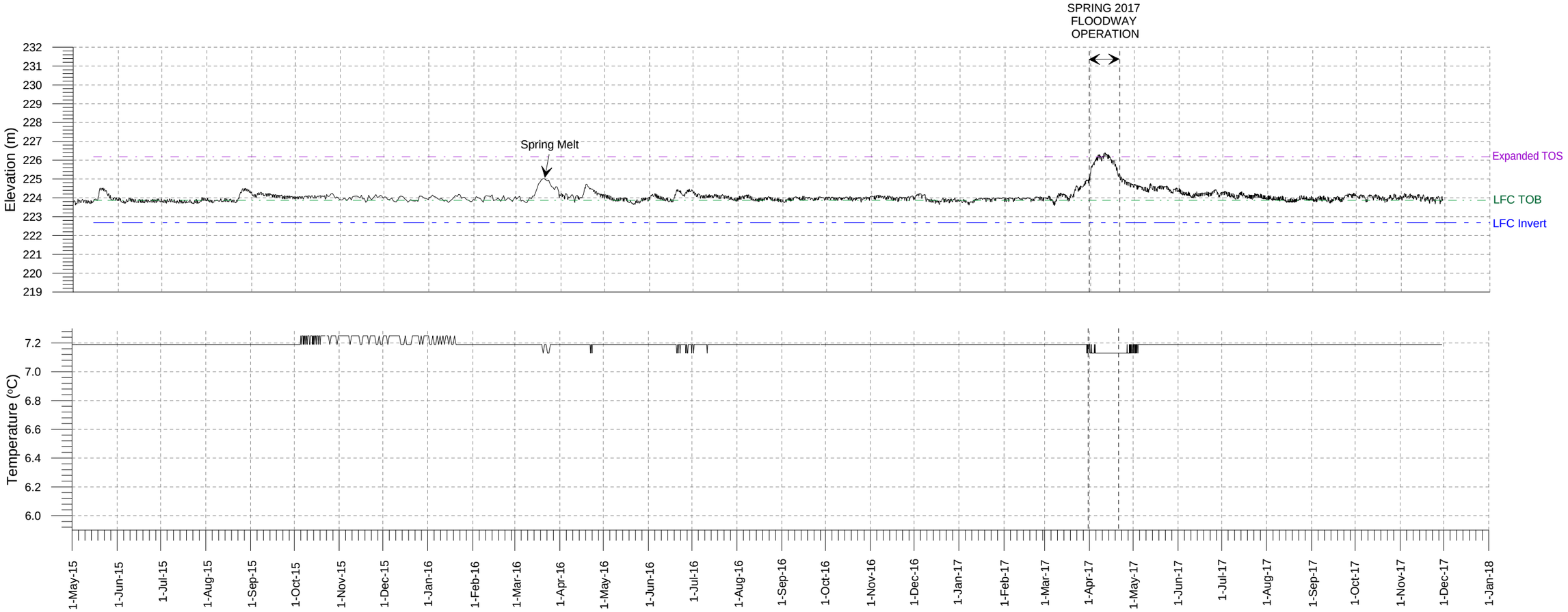
RED RIVER FLOODWAY
LONG TERM MONITORING PROGRAM
PROGRAM A ANNUAL REPORT

WATER ELEVATION AND
TEMPERATURE READINGS AT
K09-12012 (Church Rd.)

MARCH 2018 | APPENDIX D4-B-2 | REV: 0

P:\Projects\2016\16-0300-002\Design\Env\Grapher & Transducer Data\16-0300-002_Grapher Files\K09-12012\K09-12012_.grf



Note

TOS - Toe of Slope
LFC - Low Flow Channel
TOB - Top of Bank

1. See Appendix D4-C Figure HM66-37 Rev.6 for historical data.

Groundwater
——— Transducer Data - K11-12014

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
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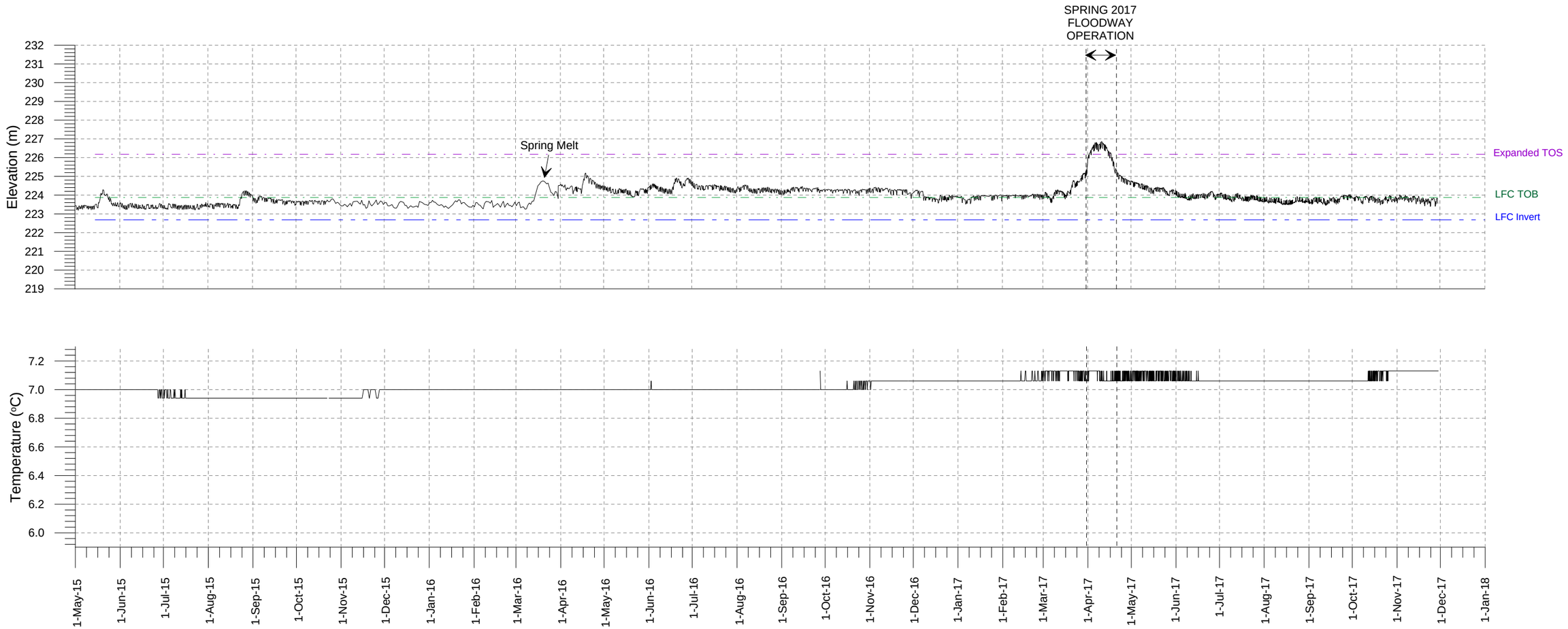
RED RIVER FLOODWAY
LONG TERM MONITORING PROGRAM
PROGRAM A ANNUAL REPORT

WATER ELEVATION AND
TEMPERATURE READINGS AT
K11-12014 (PTH 59N West Side)

MARCH 2018 | APPENDIX D4-B-3 | REV: 0

P:\Projects\2016\16-0300-002\Design\Env\Grapher & Transducer Data\16-0300-002_Grapher Files\K11-12014\K11_12014.grf



Note

TOS - Toe of Slope
LFC - Low Flow Channel
TOB - Top of Bank

1. See Appendix D4-C Figure HM66-38 - Rev. 6 for historical data.

Groundwater
Transducer data - K11-12015

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	18/03/01	ISSUED WITH FINAL REPORT	PJL	MFH

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Manitoba Infrastructure

RED RIVER FLOODWAY
LONG TERM MONITORING PROGRAM
PROGRAM A ANNUAL REPORT

WATER ELEVATION AND
TEMPERATURE READINGS AT
K11-12015 (PTH 59N WEST)

MARCH 2018 | APPENDIX D4-B-4 | REV: 0

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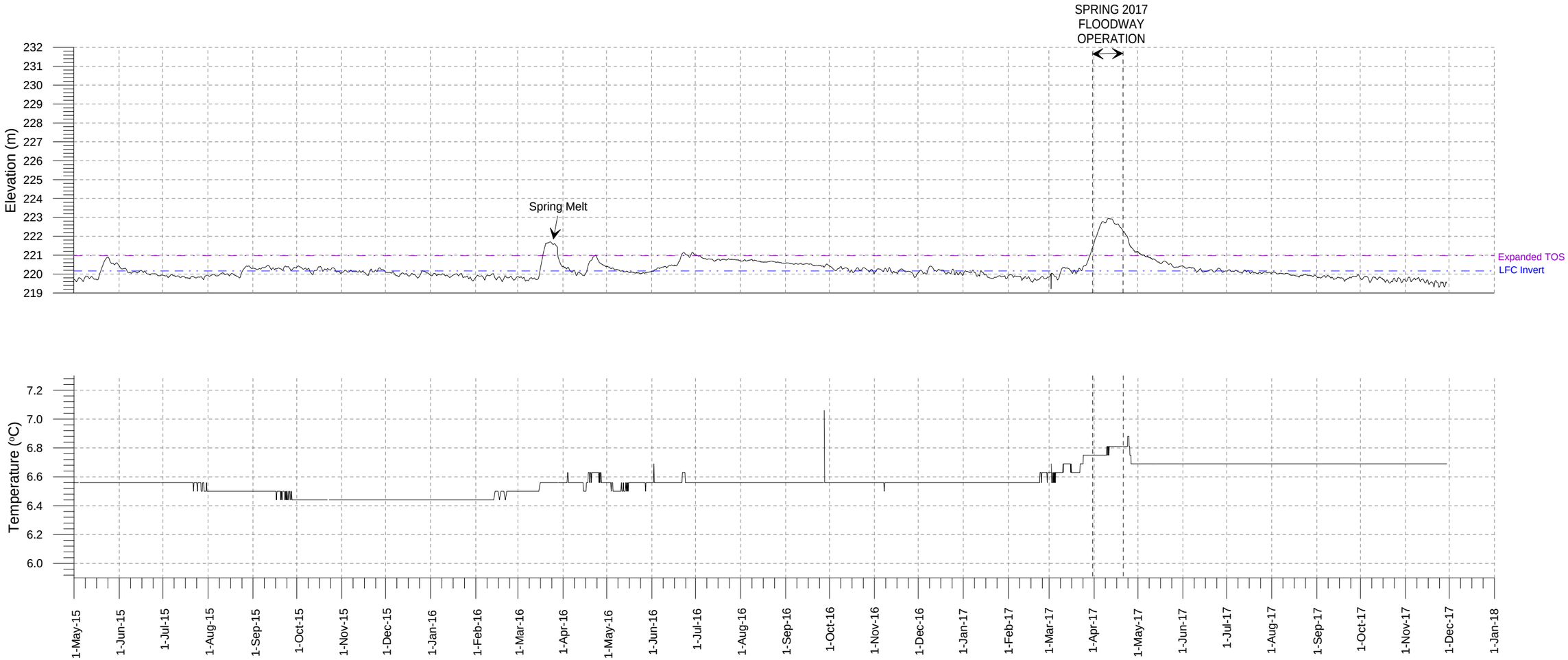

Note

TOS - Toe of Slope
TOB - Top of Bank

1. See Appendix D4-C Figure HM66-45 - Rev. 2 for historical data.

Groundwater
Transducer Data - K13-12321

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	18/03/01	ISSUED WITH FINAL REPORT	PJL	MFH

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Manitoba Infrastructure

RED RIVER FLOODWAY
LONG TERM MONITORING PROGRAM
PROGRAM A ANNUAL REPORT

WATER ELEVATION AND
TEMPERATURE READINGS AT
K13-12321 (Rockhaven Rd.)

MARCH 2018 | APPENDIX D4-B-5 | REV: 0

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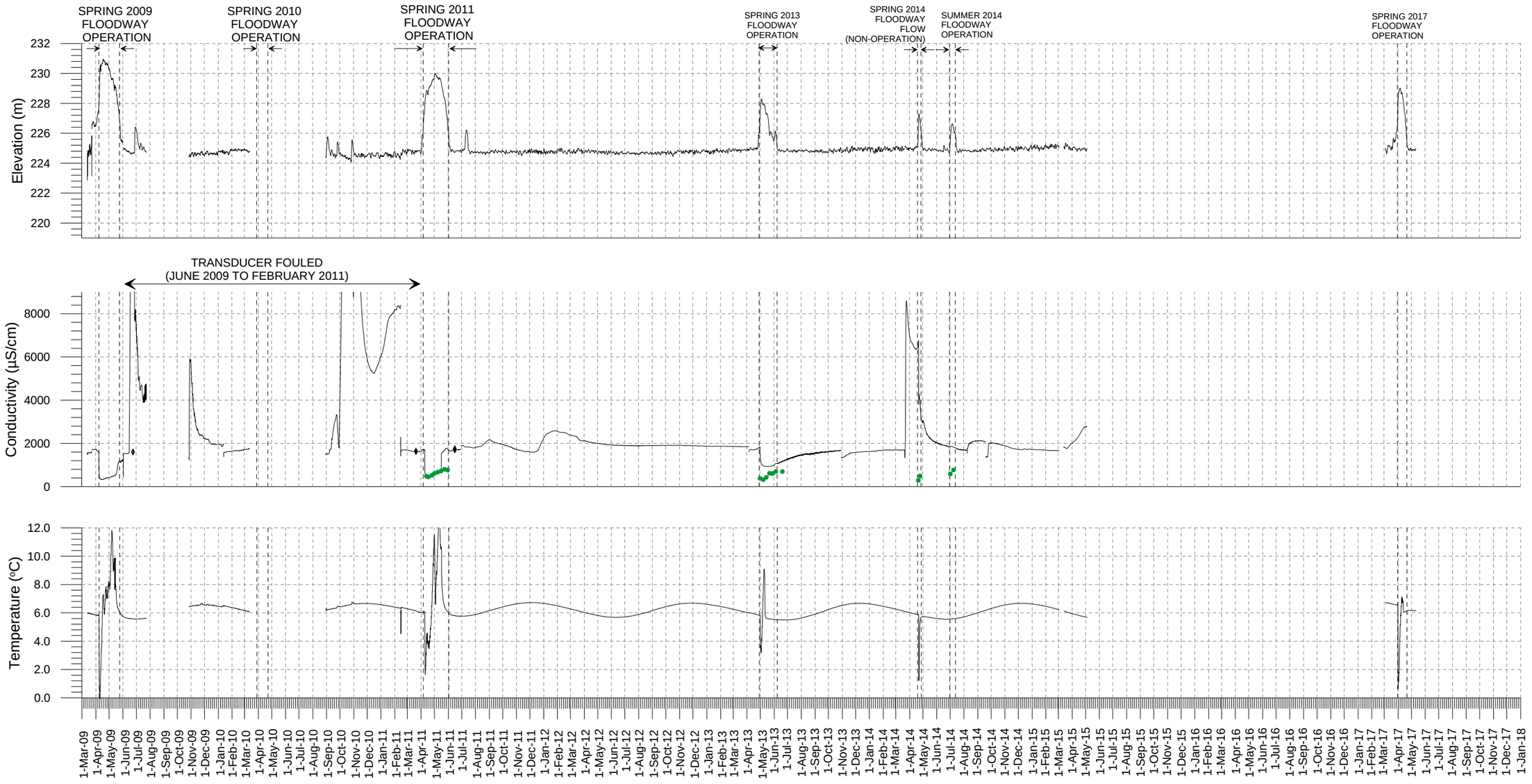

Surface Water
- Laboratory Measured Conductivity

Groundwater
- Transducer Data - 7A1 Spring
- Laboratory Measured Conductivity
- Field Measured Conductivity

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	18/03/01	ISSUED WITH FINAL REPORT	PJL	MFH

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Manitoba Infrastructure

RED RIVER FLOODWAY
LONG TERM MONITORING PROGRAM
PROGRAM A ANNUAL REPORT

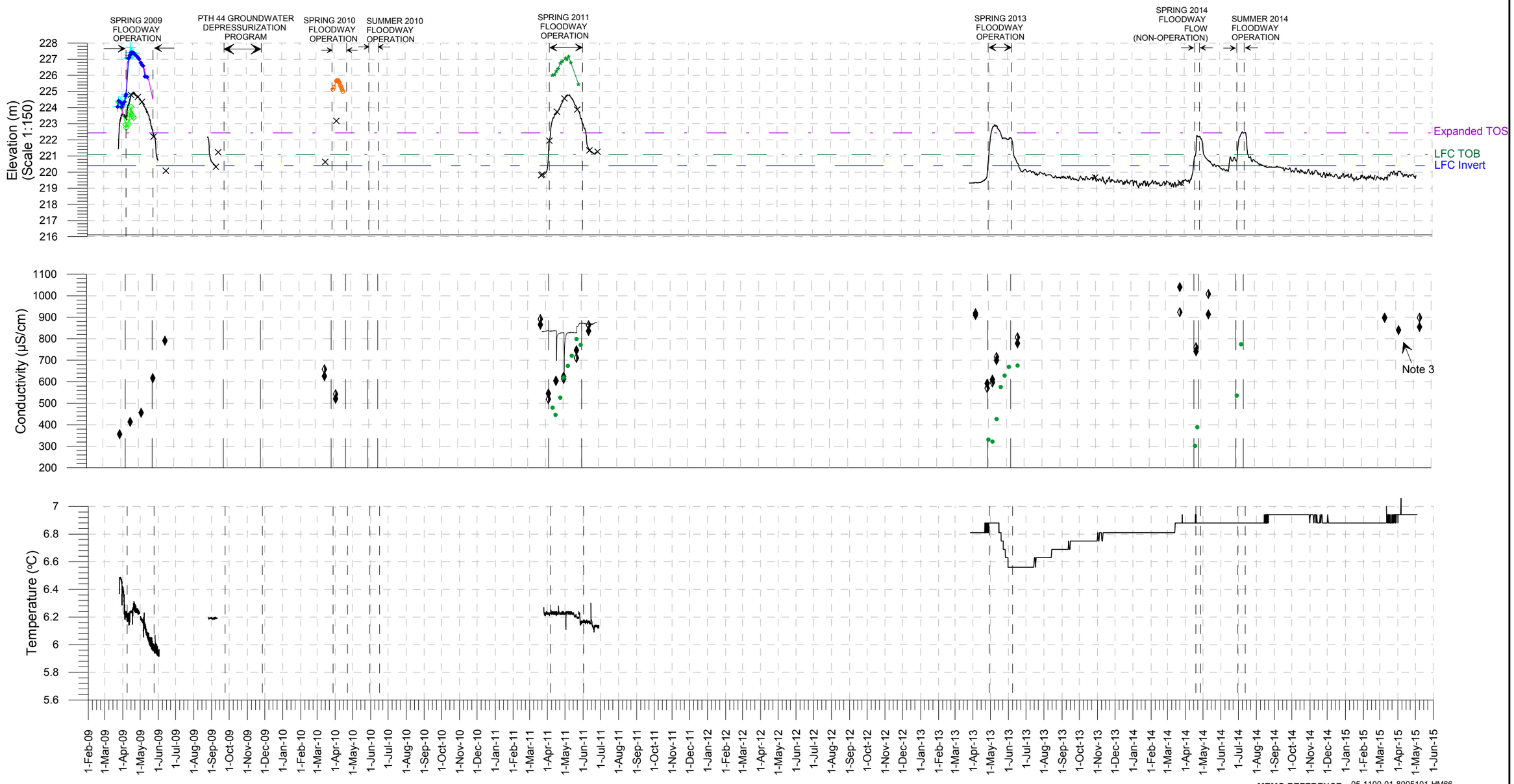
CONDUCTIVITY AND TEMPERATURE READINGS AT MFA ID 7A1 SPRING (CNR REDDITT/KILDARE AREA)

MARCH 2018 | APPENDIX D4-B-6 | REV: 0

P:\Projects\2016\16-0300-002\Design\Env\Grapher & Transducer Data\16-0300-002_Grapher Files\Spring 7A1

APPENDIX D4-C

HISTORICAL TRANSDUCER PROGRAM



Notes:
TOS - Toe of Slope
LFC - Low Flow Channel
TOB - Top of Bank
1. Modelled 2009 surface water levels are derived from measured water levels and discharge hydrographs at the floodway inlet. The water surface elevation is computed using the hydrodynamic version of the HEC RAS computer program.
2. Measured 2009 and 2010 surface water levels are from KGS Group data taken at locations along the channel. The measured location closest to each monitoring well was used.
3. Field measured conductivity suspect on April 6, 2015, therefore not included in plot.

Surface Water
- 2009 Floodway Water Level Modelled (Stn 50+500)
- 2009 Floodway Water Level Measured (Stn 50+437)
- 2010 Floodway Water Level Measured (Stns 50+424 to 50+437)
- 2011 Floodway Water Level Measured (Stns 50+426 to 50+427)
- Laboratory Measured Conductivity

Groundwater
- Transducer Data - K09-12316
- Outlet Water Level Measured
- Red River Water Level Measured
- Manual GW DTW
- Laboratory Measured Conductivity
- Field Measured Conductivity

MEMO REFERENCE: 05-1100-01-8005101-HM66

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

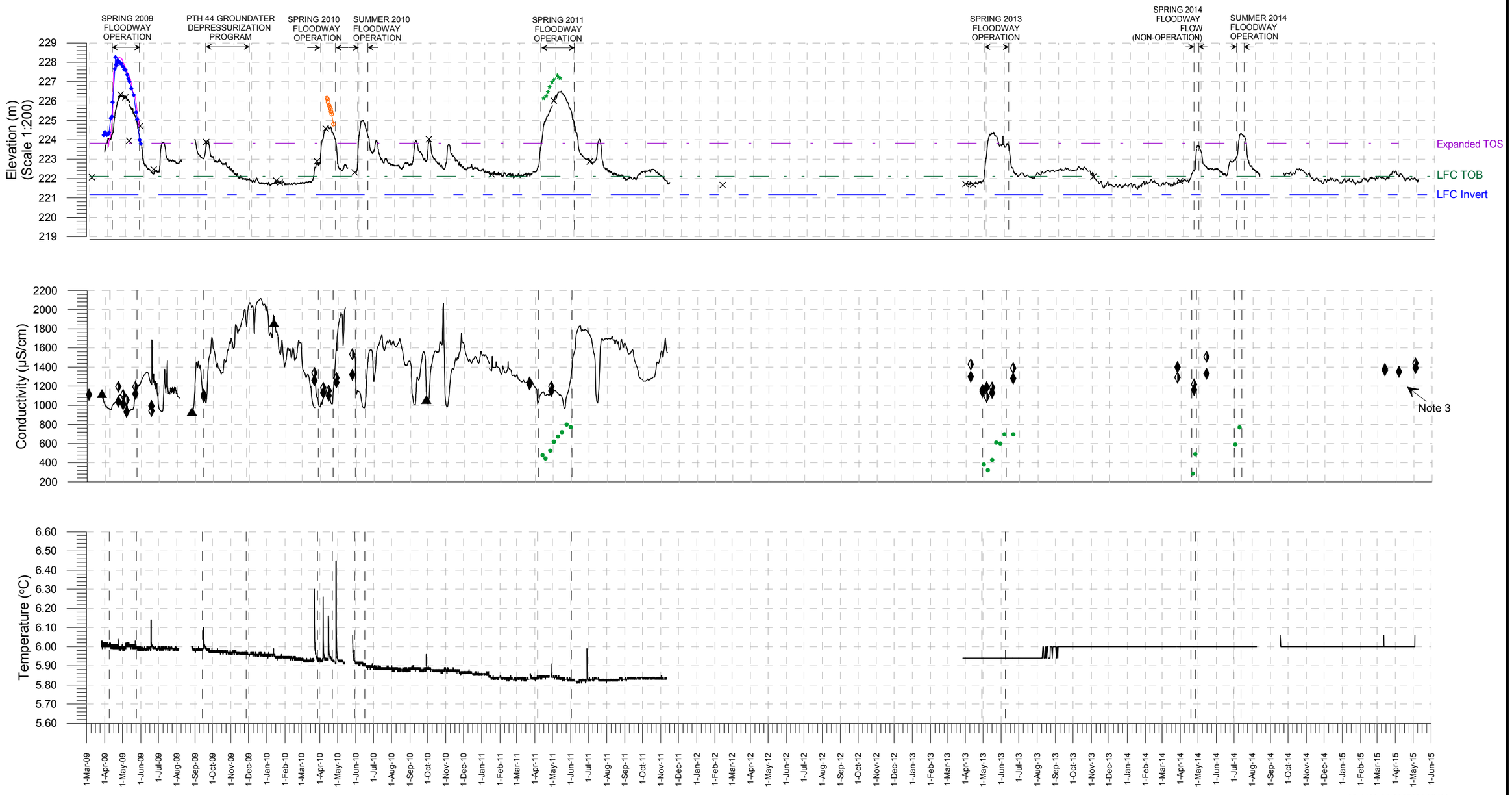
RED RIVER FLOODWAY EXPANSION

GROUNDWATER RESPONSE TO FLOODWAY WATER LEVELS

WATER ELEVATION, CONDUCTIVITY AND TEMPERATURE READINGS AT MFA ID K09-12316 (FLOODWAY OUTLET)

JUNE 2015	FIGURE HM66-3	REV 5

X:\projects\2003\03-1100-01\Structures & Systems\(.40) OutletStructure\Temp\Dewatering\Transducer_Data\12316 (9616)



Notes:
TOS - Toe of Slope
LFC - Low Flow Channel
TOB - Top of Bank
1. Modelled 2009 surface water levels are derived from measured water levels and discharge hydrographs at the floodway inlet. The water surface elevation is computed using the hydrodynamic version of the HEC RAS computer program.
2. Measured 2009 and 2010 surface water levels are from KGS Group data taken at locations along the channel. The measured location closest to each monitoring well was used.
3. Field measured conductivity suspect on April 6, 2015, therefore not included in plot.

Surface Water
- 2009 Floodway Water Level Modelled (Stn 45+000)
- 2009 Floodway Water Level Measured (Stn 47+064 (Hay Road))
- 2010 Floodway Water Level Measured (Stns 45+001 to 45+003)
- 2011 Floodway Water Level Measured (Stns 48+523 to 48+525)
- Laboratory Measured Conductivity

Groundwater
- Transducer Data - K09-12012
- × Manual Depth to Water Measurement
- ♦ Laboratory Measured Conductivity
- ◊ Field Measured Conductivity
- ▲ Field Calibrated Conductivity Date

MEMO REFERENCE: 05-1100-01-8005101-HM66

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

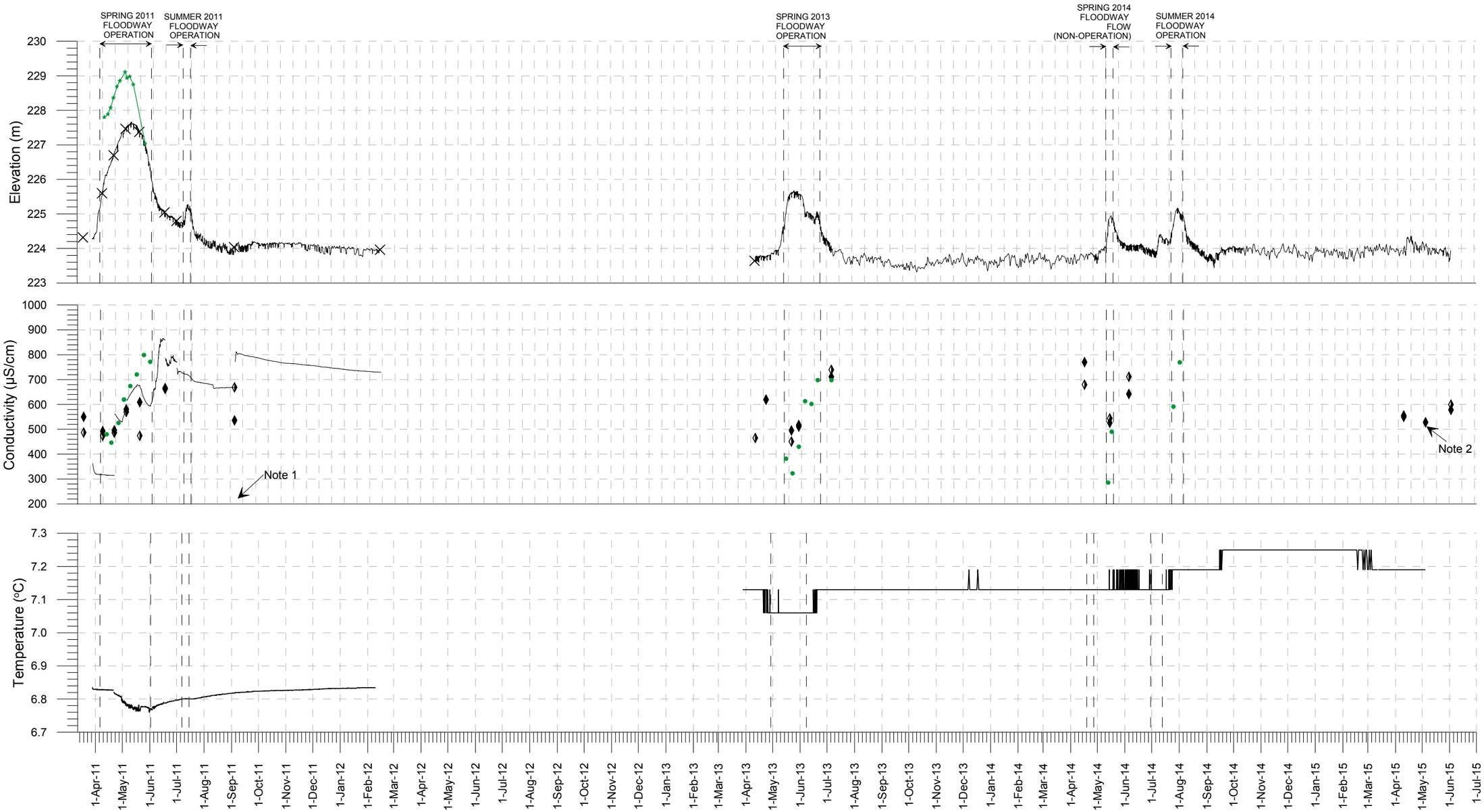
RED RIVER FLOODWAY EXPANSION

GROUNDWATER RESPONSE TO FLOODWAY WATER LEVELS

WATER ELEVATION, CONDUCTIVITY AND TEMPERATURE READINGS AT MFA ID K09-12012 (Church Road)

JUNE 2015	FIGURE HM66-13	REV 5

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.12) GW Invest\Temp\(.05) GW Piezo Levels\05-1100-01\Transducer_Data\K09-12012\K09-12012_



MEMO REFERENCE 05-1100-01-8005101-HM66

Note

1. Transducer fouled at bottom of well, relocated higher.
2. Field measured conductivity suspect on April 6, 2015 therefore not included.

Surface Water

- 2011 Floodway Water Level Measured (Stns 35+018 to 35+020)
- Laboratory Measured Conductivity

Groundwater

- Transducer Data - K11-12014
- Manual Depth to Water Measurement
- Field Measured Conductivity
- Laboratory Measured Conductivity

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

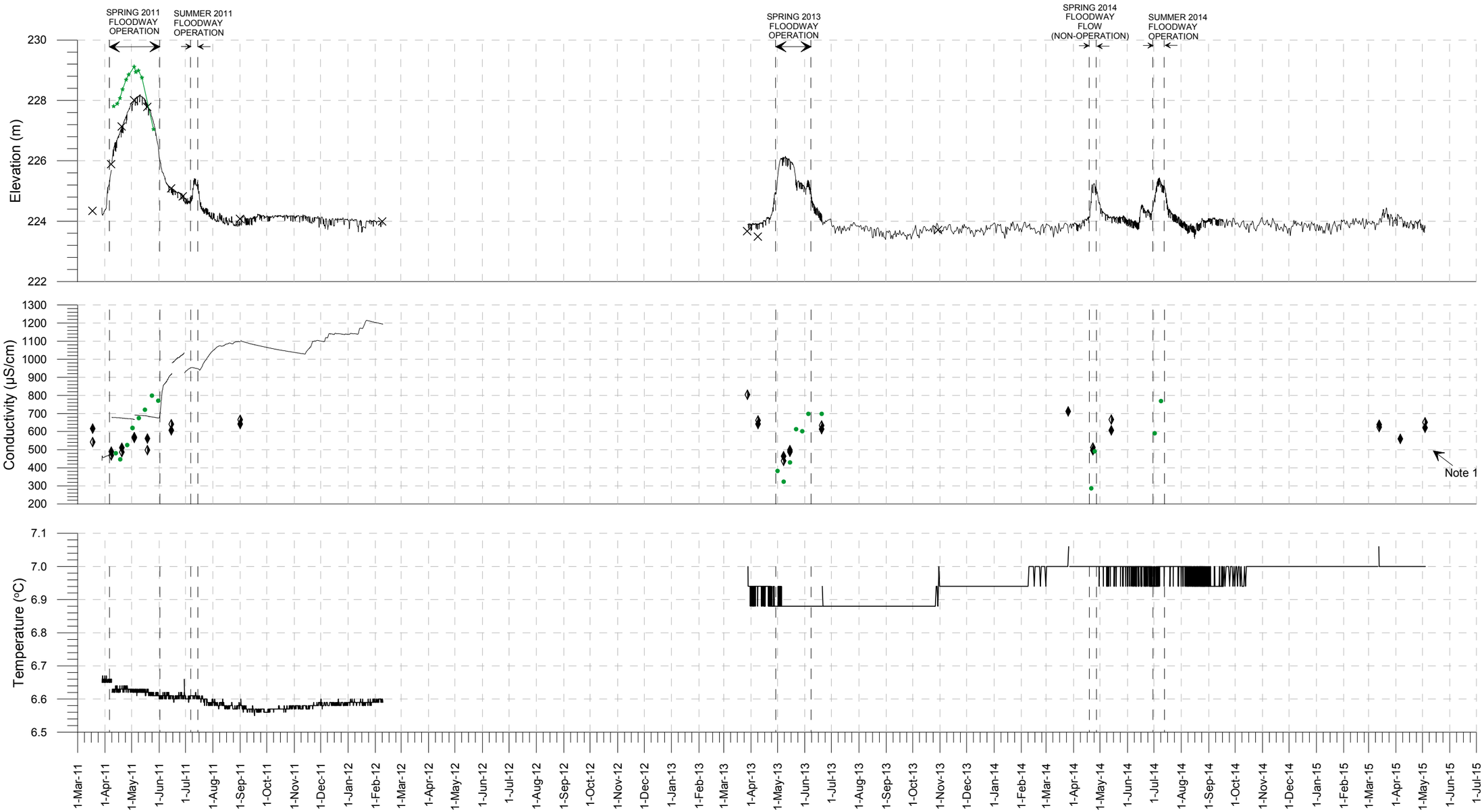
RED RIVER FLOODWAY EXPANSION

GROUNDWATER RESPONSE TO FLOODWAY WATER LEVELS

WATER ELEVATION, CONDUCTIVITY AND TEMPERATURE READINGS AT MFA ID K11-12014 (PTH59N - WEST SIDE)

JUNE 2015	FIGURE HM66-37	REV 6

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.12) GW Invest\Temp\(.05) GW Piezo Levels\05-1100-01\Transducer_Data\K11-12014



Note

1. Field measured conductivity suspect on April 6, 2015, therefore not included in plot.

Surface Water

- 2011 Floodway Water Level Measured (Stns 35+018 to 35+020)
- Laboratory Measured Conductivity

Groundwater

- Transducer data - K11-12015
- X Manual elevation
- Laboratory measured conductivity
- Field measured conductivity

MEMO REFERENCE: 05-1100-01-8005101-HM66

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

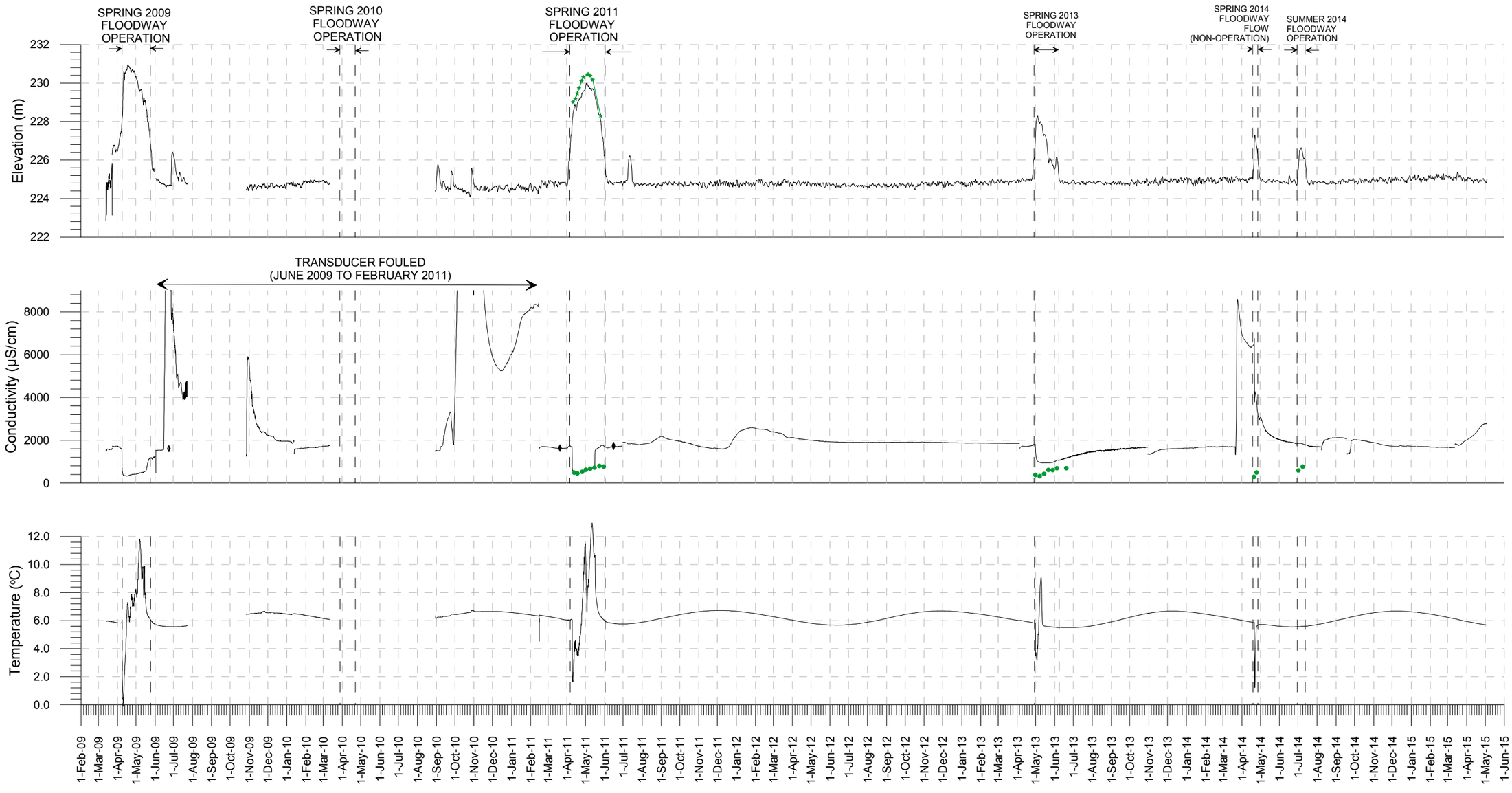
RED RIVER FLOODWAY EXPANSION

GROUNDWATER RESPONSE TO FLOODWAY WATER LEVELS

WATER ELEVATION, CONDUCTIVITY AND TEMPERATURE READINGS AT MFA ID K11-12015 (PTH 59N - WEST SIDE)

JUNE 2015	FIGURE HM66-38	REV 6

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.12) GW Invest\Temp\(.05) GW Piezo Levels\05-1100-01\Transducer_Data\K11-12015



Surface Water

- 2011 Floodway Water Level Measured (Stns 25+626 to 25+799)
- Laboratory Measured Conductivity

Groundwater

- Transducer Data - 7A1 Spring
- Laboratory Measured Conductivity
- Field Measured Conductivity

MEMO REFERENCE: 05-1100-01-8005101-HM66

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

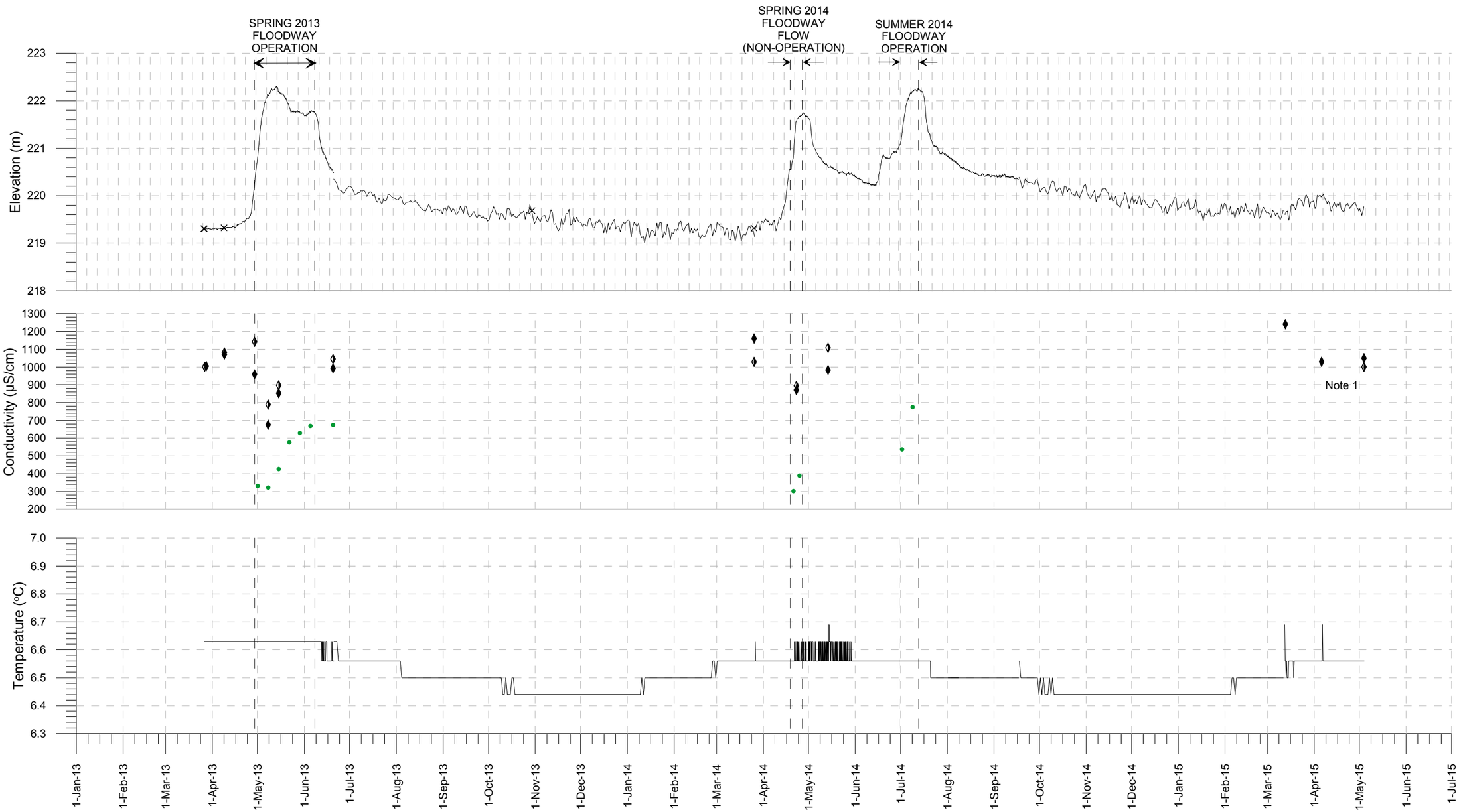
RED RIVER FLOODWAY EXPANSION

GROUNDWATER RESPONSE TO FLOODWAY WATER LEVELS

CONDUCTIVITY AND TEMPERATURE READINGS AT MFA ID 7A1 SPRING (CNR REDDITT/KILDARE AREA)

JUNE 2015	FIGURE HM66-43	REV 5

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.12) GW Invest\Temp\(.07) ChannBaseflow_GWDischarge\Spring 7A1 Transducer Data



MEMO REFERENCE 05-1100-01-8005101-HM66

Note

1. Field measured conductivity suspect on March 13 and April 6, 2015, therefore not included in plot.

Surface Water

- 2011 Floodway Water Level Measured (Stns 50+426 to 50+427)
- Laboratory Measured Conductivity

Groundwater

- Transducer Data - K13-12321
- × Manual Depth to Water Measurement
- ♦ Laboratory Measured Conductivity
- ◊ Field Measured Conductivity

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.12) GW Invest\Temp\(.05) GW Piezo Levels\05-1100-01\Transducer_Data\K13-12321

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION

GROUNDWATER RESPONSE TO FLOODWAY WATER LEVELS

WATER ELEVATION, CONDUCTIVITY AND TEMPERATURE READINGS AT MFA ID K13-12321 (ROCKHAVEN RD)

JUNE 2015	FIGURE HM66-45	REV 2

APPENDIX D4-D

2017 INSPECTION OF SPRING TREATMENT AREAS

APPENDIX D4-D-1

SUMMARY 2017 INSPECTION OF SPRING TREATMENT AREAS

APPENDIX D4-D-1
2017 INSPECTION OF SPRING TREATMENT AREAS

1.0 INTRODUCTION AND SCOPE OF WORK

Annual summer inspections of the previously treated groundwater spring discharge areas are required in the Long-term monitoring program and were conducted in September 2017 by KGS Group. At total of 23 spring areas were treated as part of the program between March 2009 and February 2011. Treatment of these sites involved the construction of pervious graded sand filters to minimize potential for direct groundwater and surface water flow interconnections to develop. The filters were designed to: restrict the exfiltration rate of groundwater discharge by using the clean lower permeability sand layer while allowing for continued piezometric pressure relief; protect against ongoing piping and development of additional flow pathways under exfiltrating conditions; and satisfy requirements to restrict infiltration of silt and pathogens (e.g. bacteria) if possible.

The purpose of the 2017 inspection program was to:

- Document the condition of treated spring areas;
- Verify that additional discharge areas have not developed at the periphery of the treated area or immediately adjacent;
- Verify that the sampling standpipe is undamaged and accessible; and
- Identify any maintenance/repairs necessary.

A summary of the inspected sites is included in Appendix Table D4-D-1. Inspection forms including sketches and select photos for each of the treated spring areas are included in Appendix D4-D-2.

Detailed maps of spring locations can be found in the 2017 Annual Inspection and Monitoring Report Deliverable D5. Spring locations are also included in the Floodway Drilling and Instrumentation Published Map File HM80 Rev 1 (November 2013) and the Compilation of Subsurface Investigations CCO-418Y-002g Rev0 included as a PDF copy in Appendix K of HM99.

Electronic files containing additional photographs and video of each site have been included on a CD only in Appendix D4-D2 of this report. This report serves as a complete documentation of baseline conditions in the Long-term monitoring period and can be compared to future conditions.

2.0 INSPECTION PROGRAM METHODOLOGY

KGS Group representatives completed the spring inspections on September 5 - 6, 2017. An aluminum boat and motor was used to access the treated spring sites with a handheld GPS used to identify the location of each of the sites. The inspection for each spring included:

- Photographs of the filter, discharge trench, low level and high level sampling pipes, flow paths, and any additional discharge areas;
- Videos of flowing springs;

- Assessment of any damage to the filter, discharge trench, or sampling pipes and the repairs required;
- Identification of any additional discharge areas in the vicinity (~500 m north and south) of the treated spring areas;
- Measurement of water levels within low level sampling pipes where possible;
- Overall assessment of how the filter is working relative to design.

Observations from the inspections were recorded on inspection forms (Appendix D1-2) and the photograph and video numbers and times were recorded to identify the treated spring area.

3.0 SUMMARY OF INSPECTION FINDINGS

3.1 CONDITION OF FILTERS

The constructed filters were found to be in good condition and were working as designed. Flow appeared to be coming up through the filter and discharging through the granular layer overlying the sand filter bed. No settlement or heaving of the filters was observed.

3.2 ADDITIONAL DISCHARGE AREAS

Some additional discharge (AD) locations outside of the filtered springs were observed as follows:

- AD17-1: Discharge location into the low flow channel (<0.1 USgpm) from the west side mid way between Church Rd. and Hay Rd. (UTM 648661, 5546623) is just 10 m downstream of a beaver dam across the low flow (UTM 648659, 5546613) and is potentially upstream water finding a new pathway around the dam as opposed to being from a spring source. This point is adjacent to the low flow channel and should be sampled for field conductivity and temperature in 2018 to confirm the discharge source.

- AD17-2: A second similar location of discharge (<0.1 USgpm) on the west side (UTM 648646, 5546742) is 129 m downstream of the beaver dam and it is possible that this also is a redirection of upstream water from the dam although this appears to be localized and no ponding is apparent at this location. Sampling for field conductivity and temperature should be conducted in 2018 to determine the source.

- AD17-3: During the 2016 springs inspection an additional discharge location (UTM 648624, 5547187) was observed on the east side of the low flow channel across from Hay Rd. This location was once again observed at UTM 648624, 5547181 and finds several fanned out pathways of individually low volume (<0.1 USgpm) discharge locations for approximately 64 m along the east side of the low flow channel. Total discharge approximately <5 USgpm. The source is apparent upstream of the discharge.

- AD17-4: On the west side, across the low flow channel from the previous discharge location there is also a section of discharge locations into the channel (<0.1 USgpm) that extend for approximately 88 m from a ponding location at UTM 648593, 5547218 to UTM 648587, 5547306.

- AD17-5: Low volume (<1 USgpm) discharge was observed mid-way between Hay Rd. and CEMR bridge on the east shore with no apparent ponding or source at UTM 648528, 5548099.

3.3 CONDITION OF DISCHARGE TRENCHES

The discharge trenches were constructed as shallow excavated trenches that were filled with riprap to grade or slightly above grade. It was observed that at 11 of the 23 treated spring sites, the rip rap within the discharge trenches was infilling with sediment and spring discharge was finding alternate flow paths to the Low Flow Channel. This resulted in overland flow toward the Low Flow Channel or flow into low areas near the filter, creating wet and soft areas. No significant erosion channels were observed at any of these locations.

The discharge trenches at the 5A1 and 7A1 locations were constructed as ditches (see photos in inspection reports) which appeared to be more effective in directing discharge flows along the design discharge flow path.

3.4 CONDITION OF SAMPLING PIPES

The two high level sampling pipes, at 11A2 and 18A1, were both found to be in good condition with no damage observed.

The 10 low level sampling pipes were generally found to be in good condition. At one location, 5A1, a 30 inch steel cover was missing from the protective casing.

4.0 REPAIRS REQUIRED

4.1 FILTERS

No repairs of the filters are required. The filters appear to be operating as designed.

4.2 ADDITIONAL DISCHARGE AREAS

In 2016 and 2017 additional eroded discharge areas were observed in a small area along the discharge trench at 9B2. Construction of a graded sand filter would minimize potential for direct groundwater and surface water flow interconnections to develop at this location.

Additional discharge areas AD17-1 through AD17-5 should be re-inspected in 2018 including field conductivity and temperature and source identification. Additional discharge locations AD17-1, AD17-2 and AD17-5 are adjacent to the channel; therefore remediation may not be practical. Discharge areas AD17-3 and AD 17-4 should be assessed for potential remediation.

4.3 DISCHARGE TRENCHES

The discharge trenches that were constructed with riprap to grade or above grade generally appeared to infill with sediment, resulting in spring flows finding alternate flow paths to the Low Flow Channel. Excavating out the existing discharge channel to create a ditch, similar to 5A1 and 7A1, would likely direct flow along the design discharge trench. Alternatively, constructing a new ditch, with riprap armouring, along the existing overland discharge path would also be

effective in limiting any erosion concerns with overland flow. The discharge trenches that require some repair include:

- 5A1 – widening of the existing discharge ditch;
- 7C1 – excavating out discharge trench to create ditch, constructing new discharge ditch;
- 8B1 – excavating out discharge trench to create ditch;
- 8B2 – excavating out discharge trench to create ditch;
- 8C1 – excavating out discharge trench to create ditch;
- 9B1 – constructing new discharge ditch;
- 9B2 – excavating out discharge trench to create ditch;
- 10A1 – excavating out discharge trench to create ditch;
- 11A1 – constructing new discharge ditch;
- 18A1 – excavating out discharge trench to create ditch, constructing new discharge ditch;
- 21A1 – excavating out discharge trench to create ditch.

4.4 SAMPLING PIPES

The low level sampling pipes that require some repair include:

- 5A1 – replacing a missing 30 inch steel cover for vertical corrugated steel pipe casing;

TABLE D4-D1
2017 SUMMER INSPECTION OF SPRING TREATMENT AREAS

Site No.	Channel Side	Approximate Channel Station	Low Level Sampling Pipe Installed	High Level Sampling Pipe Installed	Northing	Easting	Flow Observed Summer 2017	Condition of Filter	Additional Discharge Areas in Vicinity of Filter	Constructed Discharge Trench Operating as Designed	Low Level Sampling Pipe Repairs Required
Spring Area Treatment Sites											
2A1	West	21+000	Yes	No	5523219	647097	Yes	Good	No	Yes	No
5A1	West	26+280	Yes	No	5528520	646961	Yes	Good	No	No	Yes, missing cover
7A1	West	27+060	Yes	No	5529304	646939	Yes	Good	Yes. Very low flow discharge 10 m upstream	Yes	No
7B2	West	27+157	No	No	5529475	646951	Yes	Good	Yes. Very low flow: -7 m upstream; -14 m upstream; and -70 m downstream along LFC.	Yes	-
7C1	East	27+400	Yes	No	5529640	646969	Yes	Good	No	No	No
8B1	West	29+880	No	No	5531953	646023	Yes	Good	No	No	-
8B2	West	29+970	No	No	5532027	645993	Yes	Good	No	No	-
8C1	West	30+080	Yes	No	5532127	645959	Very Little	Good	No	No	No
9A6	East	30+400	No	No	5532480	645890	Yes	Good	No	Yes	-
9B1	West	30+840	No	No	5532846	645734	Very Little	Good	No	No	-
9B2	East	30+978	No	No	5532997	645715	No	Good	Yes	No	-
10A1	West	31+000	No	No	5533022	645665	Yes	Good	No	No	-
11A1	West	31+290	Yes	No	5533274	645559	Yes	Good	No	No	No
11A2	East	33+900	Yes	Yes	5535772	644767	No	Good	No	N/A (no flow)	No
16A2	West	42+180	No	No	5543145	647070	No	Good	No	No (Ponding)	-
17A2	East	42+769	Yes	No	5543545	647519	Yes	Good	No	Yes	No
18A1	West	42+800	Yes	Yes	5543620	647443	Yes	Good	No	No	No
18A2	West	42+900	No	No	5543718	647478	No	Good	No	N/A (no flow)	-
20A2	East	47+030	No	No	5547417	648610	Very Little	Good	No	N/A (no flow)	-
21A1	West	47+796	No	No	5548152	648465	Very Little	Good	No	No	-
21A2	East	47+796	No	No	5548170	648545	Yes	Good	No	N/A (no flow)	-
23A1	West	49+395	No	No	5549740	648290	No	Good	No	N/A (no flow)	-
23A2	East	49+450	Yes	No	5549842	648355	Yes	Good	No	N/A (no flow)	No

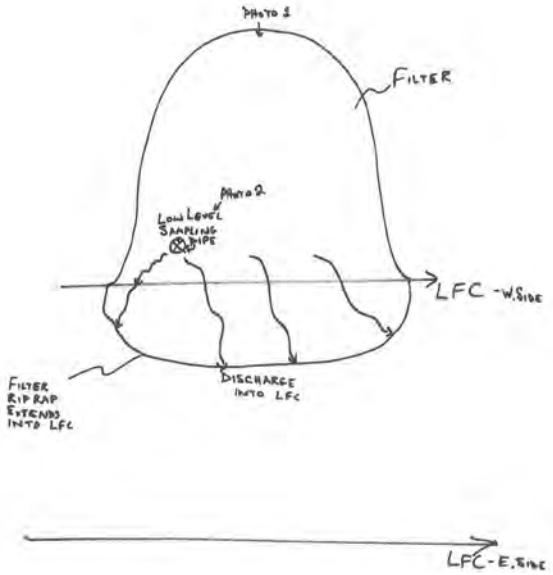
APPENDIX D4-D-2

FIELD DOCUMENTATION

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 2A1 **Date:** September 5, 2017
Site Description: West side, north of HWY1 bridge.

Site Sketch and Photo Locations:



Photos:

Photo 1: Spring treatment filter site 2A1.

Photo 2: Discharge into LFC at 2A1.

Filter Condition: Good
Repairs Required: None

Approximate Flow: 8 USgpm

Additional Discharge Areas: No

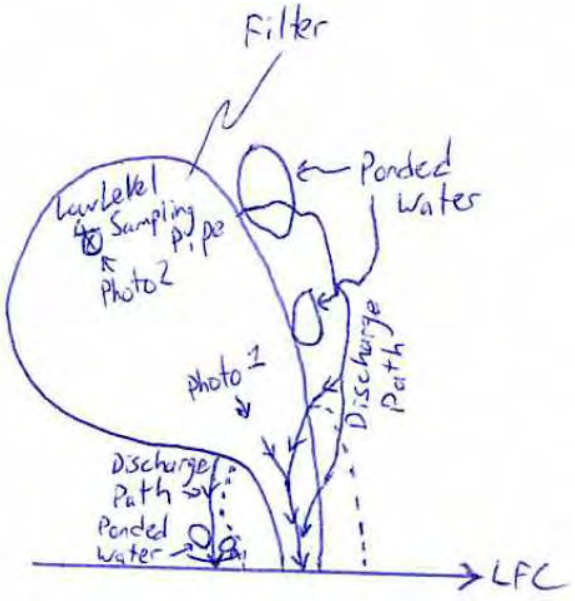
Sampling Standpipe: Yes, low level
Depth to bottom: Could not measure
Depth to water: At surface
Condition: Water above PVC, so left sealed to avoid cross contamination.
Repairs Required: None.

Other Comments: Filter appears to be working effectively.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 5A1 **Date:** September 6, 2017
Site Description: West side, north of Redditt bridge.

Site Sketch and Photo Locations:



Photos:

Photo 1: Spring treatment filter site 5A1 and constructed discharge trench.

Photo 2: Low level sampling pipe and protective steel casing at 5A1. Cover is missing.

Filter Condition: Good – water flowing along discharge channel as well as finding alternate flow paths to LFC. No significant erosion observed within overland discharge areas. Vegetation is quite grown over.
Repairs Required: Widening the discharge channel may focus flow along design discharge path and accommodate flows.

Approximate Flow: 10 USgpm

Additional Discharge Areas: No

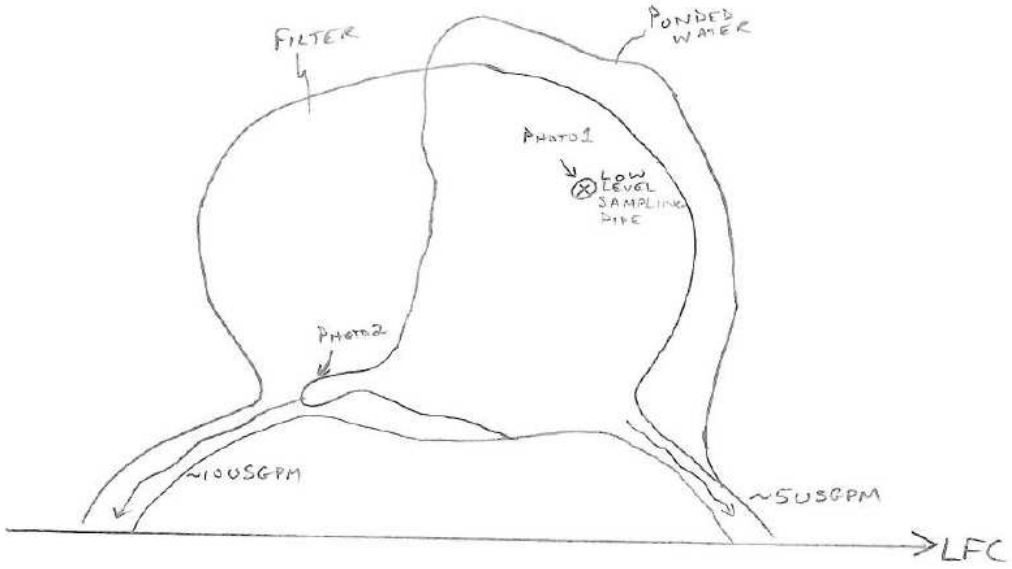
Sampling Standpipe: Yes, low level
Depth to bottom: Could not measure, 50 mm poly pipe, coiled in CMP protective casing
Depth to water: Water has filled protective steel casing
Condition: Missing a 30 inch cover
Repairs Required: Replace the 30 inch cover

Other Comments: Filter appears to be working effectively other than alternate flow paths.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 7A1 **Date:** September 5, 2017
Site Description: West side, south of 7B2.

Site Sketch and Photo Locations:



Photos:

Photo 1: Low level sampling pipe and water within protective casing.

Photo 2: Discharge ditches at 7A1 effectively direct water to LFC.

Filter Condition: Good
Repairs Required: None

Approximate Flow: 15 USgpm

Additional Discharge Areas: No

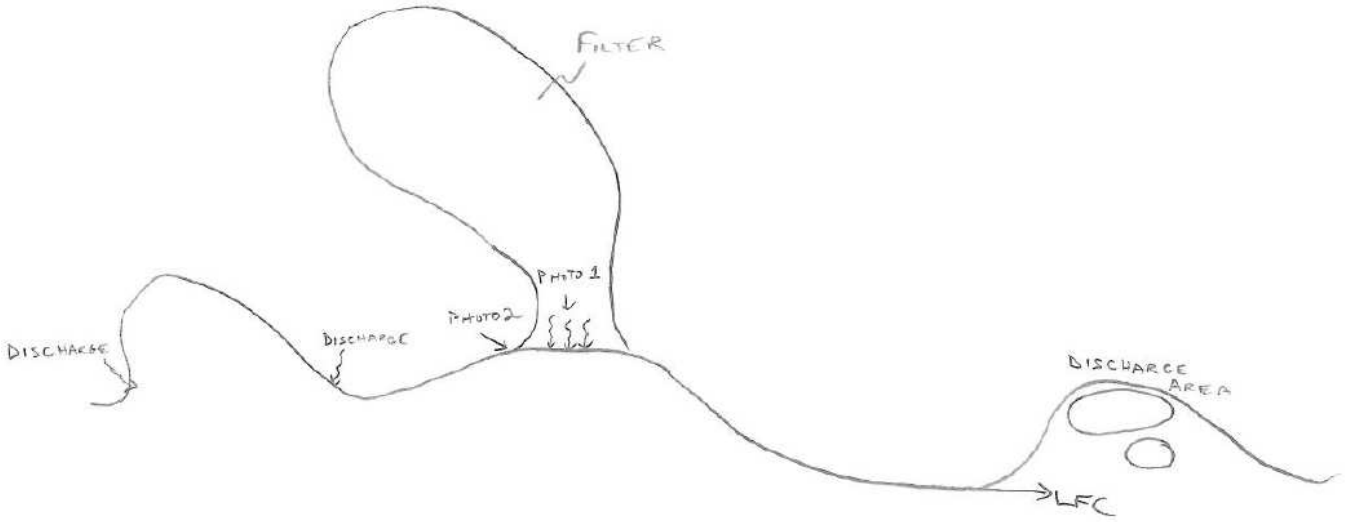
Sampling Standpipe: Yes, low level
Depth to bottom: Could not measure, 50 mm poly pipe, coiled in CMP protective casing.
Depth to water: Water has filled protective steel casing.
Condition: Good
Repairs Required: None

Other Comments: Large flow through filter, appears to be working effectively. Constructed discharge channels are formed as ditches and effectively direct discharge water to the LFC.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 7B2 **Date:** September 5, 2017
Site Description: West side, north of 7A1.

Site Sketch and Photo Locations:



Photos:

Photo 1: Spring treatment filter 7B2.

Photo 2: Filter discharge at 7B2 into LFC.

Filter Condition: Good
Repairs Required: None

Approximate Flow: 4 USgpm

Additional Discharge Areas: Two very low flow discharge areas approximately 7 m and 14 m upstream along LFC. One area of discharge approximately 70 m downstream along LFC.

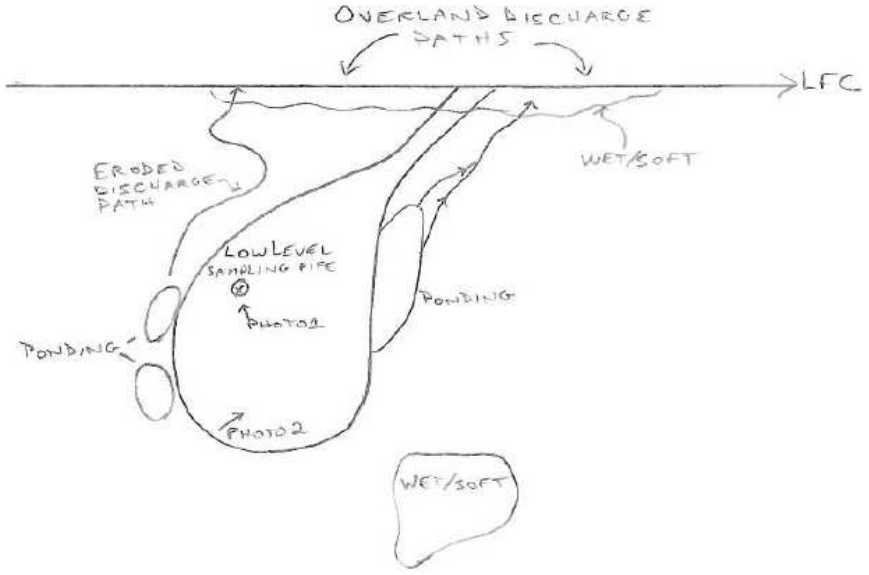
Sampling Standpipe: No

Other Comments: Filter appears to be working effectively.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 7C1 **Date:** September 5, 2017
Site Description: East side, between Redditt and Keewatin bridges.

Site Sketch and Photo Locations:



Photos:

Photo 1: Spring treatment filter site 7C1.

Photo 2: Water flowing through 7C1 filter and finding alternate flow paths to LFC or ponding in low areas.

Filter Condition: Good – water finding alternate flow paths to LFC or ponding in low areas. Constructed discharge channel appears to be clogged with sediment. Eroded path on south side of filter.

Repairs Required: Excavating rip rap from discharge channel and creating a swale may focus flow along design discharge path.

Approximate Flow: 4 USgpm

Additional Discharge Areas: No

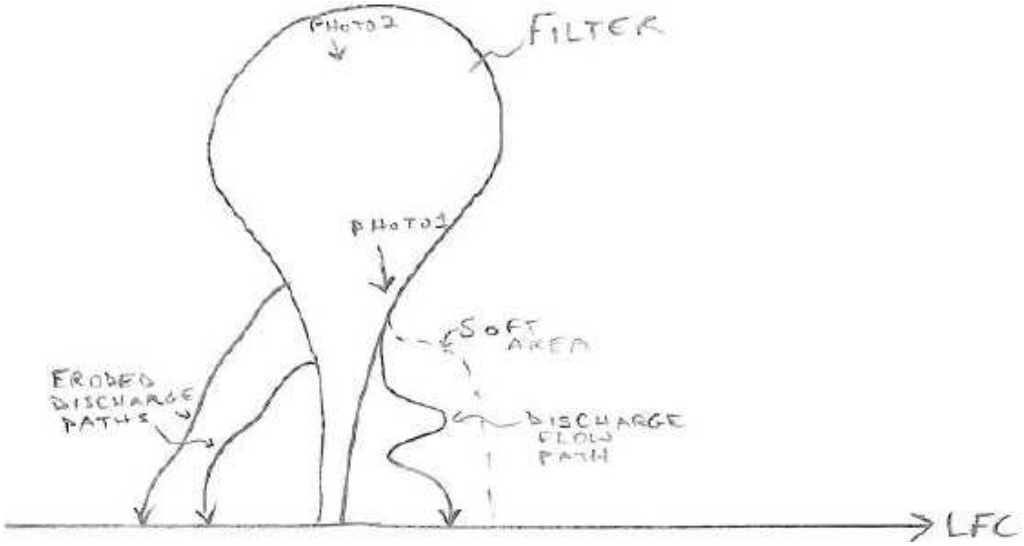
Sampling Standpipe: Yes, low level
Depth to bottom: Did not measure in order to avoid cross contamination. 2.41 m previously.
Depth to water: 0 m (at top of pipe). Artesian when opened.
Condition: Good
Repairs Required: None

Other Comments: Filter appears to be working effectively other than the discharge channel. Very soft along LFC.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 8B1 **Date:** September 5, 2017
Site Description: West side, south of Keewatin bridge.

Site Sketch and Photo Locations:



Photos:

Photo 1: Water finding alternate flow path to LFC.

Photo 2: Spring treatment filter 8B1.

Filter Condition: Good – water finding alternate flow path to LFC. Constructed discharge channel appears to be clogged with sediment. Some erosion observed on south side in 2 paths but not currently flowing
Repairs Required: Excavating rip rap from discharge channel and creating a swale may focus flow along design discharge path.

Approximate Flow: 6 USgpm

Additional Discharge Areas: No

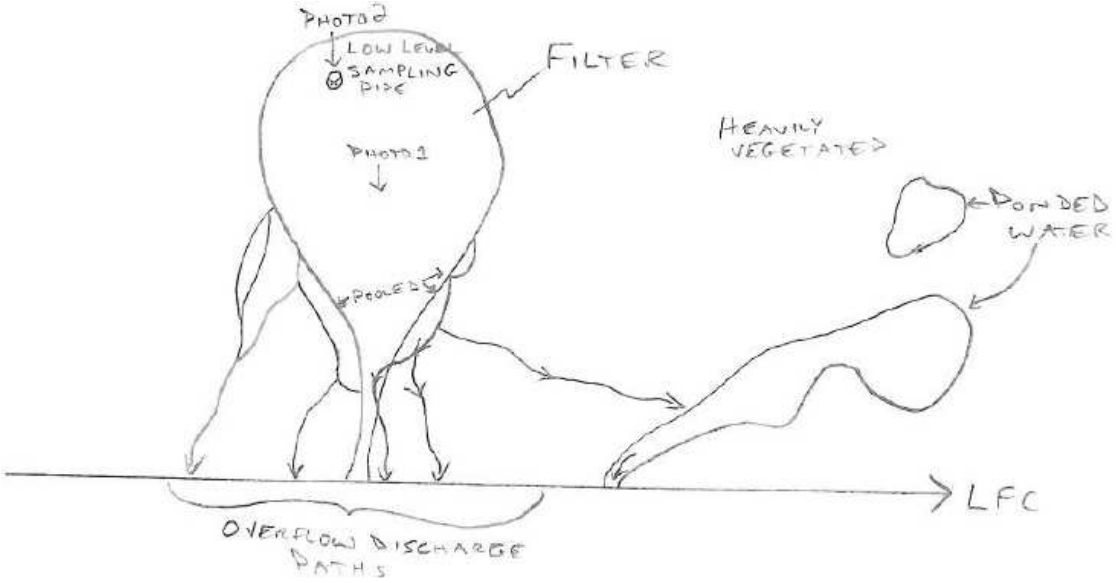
Sampling Standpipe: No

Other Comments: Filter appears to be working effectively other than the discharge channel.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 8C1 **Date:** September 5, 2017
Site Description: West side, south of Keewatin bridge, north of 8B2.

Site Sketch and Photo Locations:



Photos:

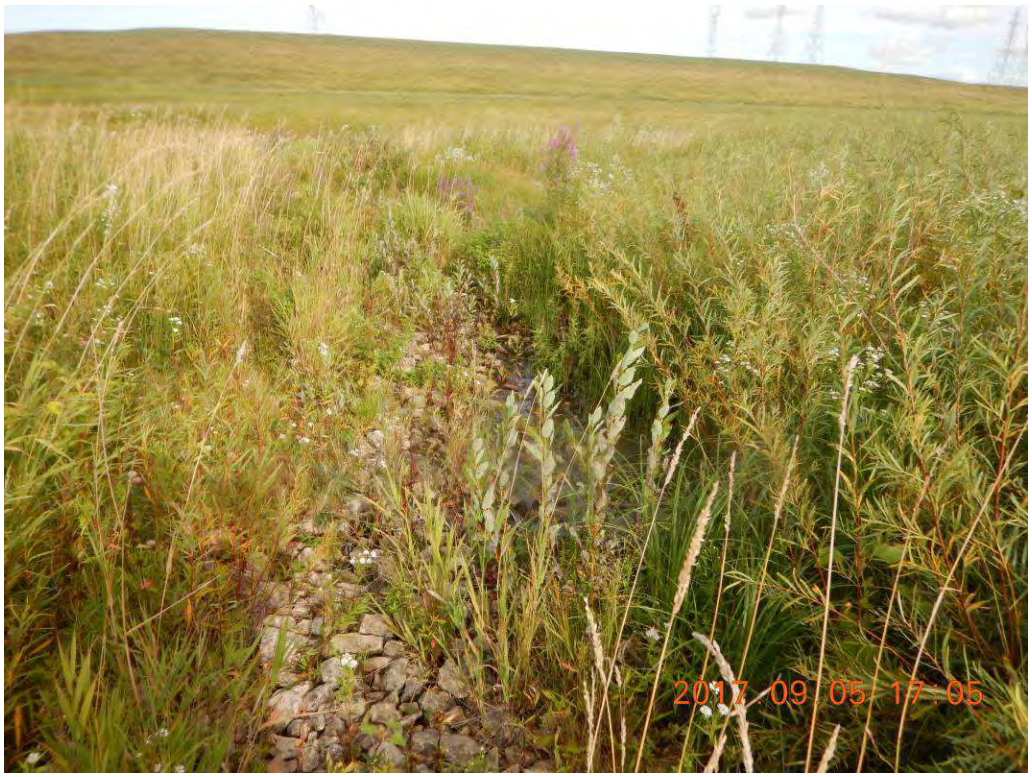


Photo 1: Spring treatment filter site 8C1 and constructed discharge trench.

Photo 2: Low level sampling pipe and protective steel casing at 8C1.

Filter Condition: Good – water finding alternate flow paths to LFC. Flow paths wet and soft, but not currently flowing. Constructed discharge channel appears to be clogged with sediment. No significant erosion observed within overland discharge areas.
Repairs Required: Excavating rip rap from discharge channel and creating a swale may focus flow along design discharge path.

Approximate Flow: >0.1USgpm

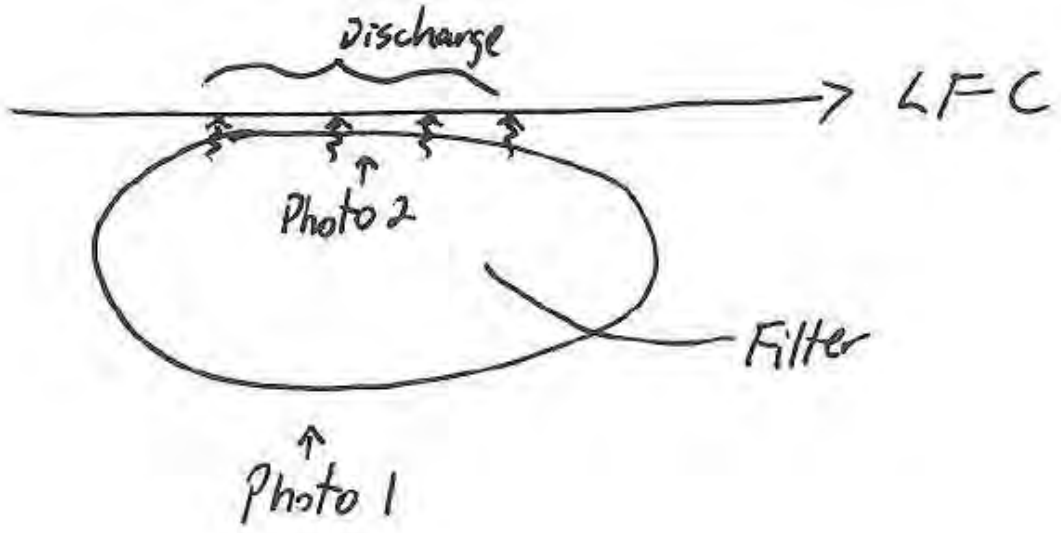
Additional Discharge Areas: No.
Sampling Standpipe: Yes, low level
Depth to bottom: 2.93 m
Depth to water: 0.20 m below steel casing.
Condition: Good
Repairs Required: None

Other Comments: Filter appears to be working effectively other than alternate flow path. Ponded area to the North of filter is discharging to LFC and appears to be sourced from the filter. PVC cap & threaded coupling was off of casing and was replaced upon inspection.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 9A6 **Date:** September 5, 2017
Site Description: East side, north of CPR Keewatin bridge.

Site Sketch and Photo Locations:



Photos:

Photo 1: Spring treatment filter 9A6.

Photo 2: Spring 9A6 discharge into Low Flow Channel.

Filter Condition: Good

Repairs Required: None

Approximate Flow: 4 USgpm

Additional Discharge Areas: No

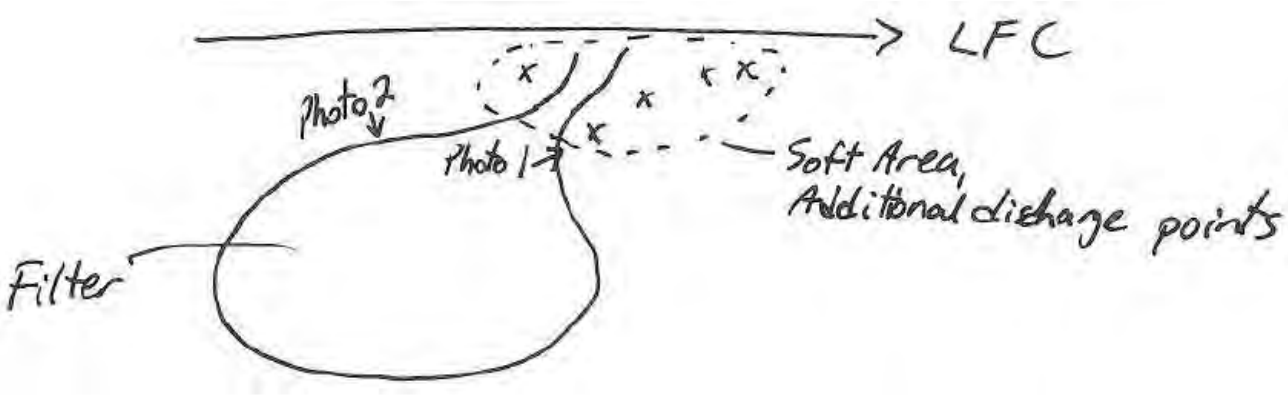
Sampling Standpipe: No

Other Comments: Flow coming through filter, appears to be working effectively.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 9B2 **Date:** September 5, 2017
Site Description: East side, north of CPR Keewatin Bridge.

Site Sketch and Photo Locations:



Photos:

Photo 1: Additional discharge points along constructed discharge trench, very soft area.

Photo 2: Spring treatment filter 9B2.

Filter Condition: Good – water finding alternate flow paths to LFC. No significant erosion observed within overland discharge area.

Repairs Required: Excavating rip rap from discharge channel and creating a swale may focus flow along design discharge path.

Approximate Flow: 0 USgpm

Additional Discharge Areas: Yes, piping observed along constructed discharge trench, very low flows. Further investigation treatment of additional discharge areas may be required.

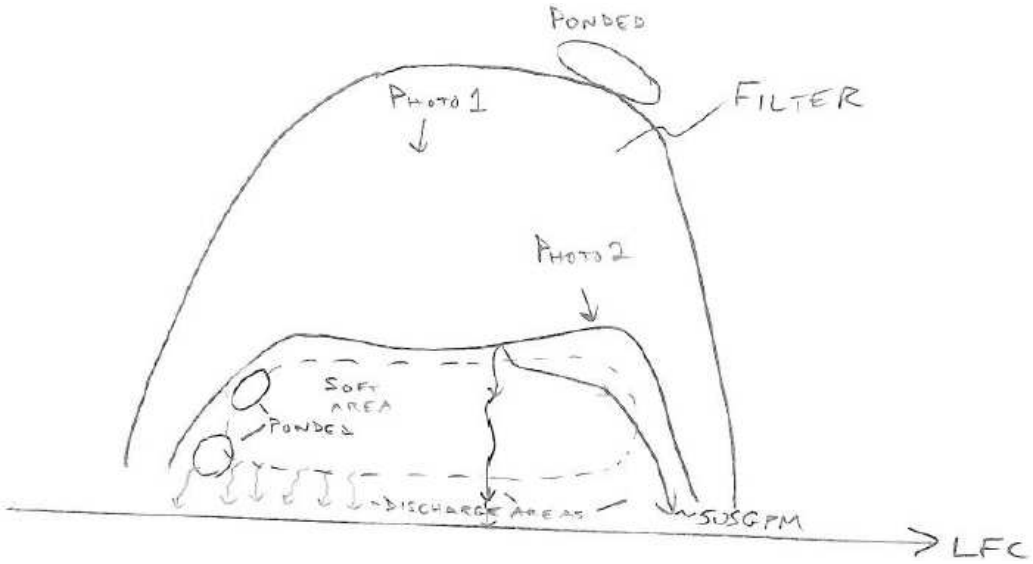
Sampling Standpipe: No

Other Comments: Wet and soft along discharge trench and near LFC.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 10A1 **Date:** September 5, 2017
Site Description: West side, north of Keewatin bridge.

Site Sketch and Photo Locations:



Photos:

Photo 1: Spring treatment filter 10A1.

Photo 2: Water flowing through 10A1 filter and finding alternate flow paths to LFC.

Filter Condition: Good – water finding alternate flow paths to LFC. Constructed discharge channels appear to be clogged with sediment. No significant erosion observed within overland discharge area.

Repairs Required: Excavating rip rap from discharge channels and creating swales may focus flow along design discharge paths.

Approximate Flow: 5 USgpm at North discharge

Additional Discharge Areas: No

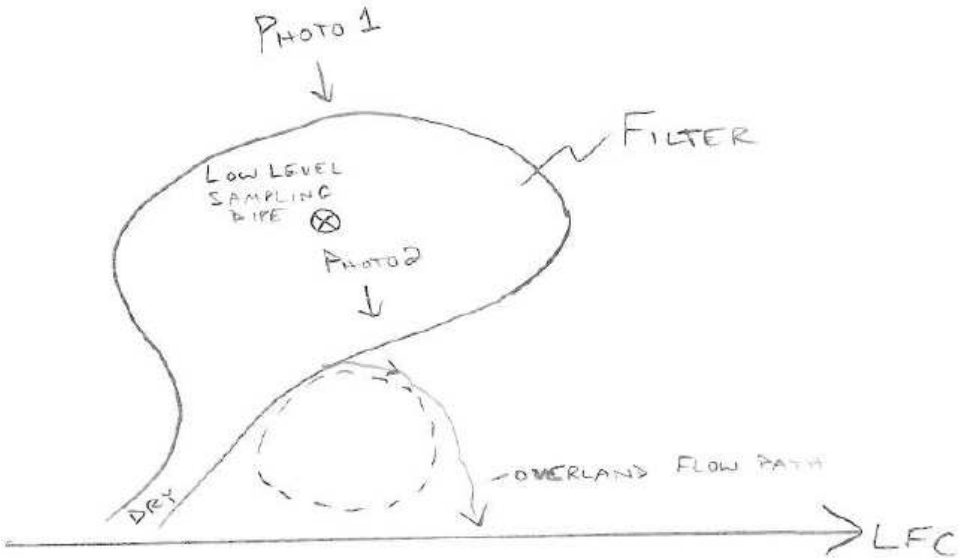
Sampling Standpipe: No

Other Comments: Filter appears to be working effectively other than the discharge channels.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 11A1 **Date:** September 5, 2017
Site Description: West side, north of Keewatin bridge.

Site Sketch and Photo Locations:



Photos:

Photo 1: Spring treatment filter site 11A1 and low level sampling pipe, covered by vegetation.

Photo 2: Water flowing through 11A1 filter and finding alternate flow path to LFC.

Filter Condition: Good – water finding alternate flow path to LFC. Constructed discharge channel appears to be clogged with sediment. No significant erosion observed within overland discharge area.

Repairs Required: Excavating rip rap from discharge channel and creating a swale may focus flow along design discharge path. Alternatively, construct a new swale along existing flow path.

Approximate Flow: 6 USgpm
Additional Discharge Areas: No

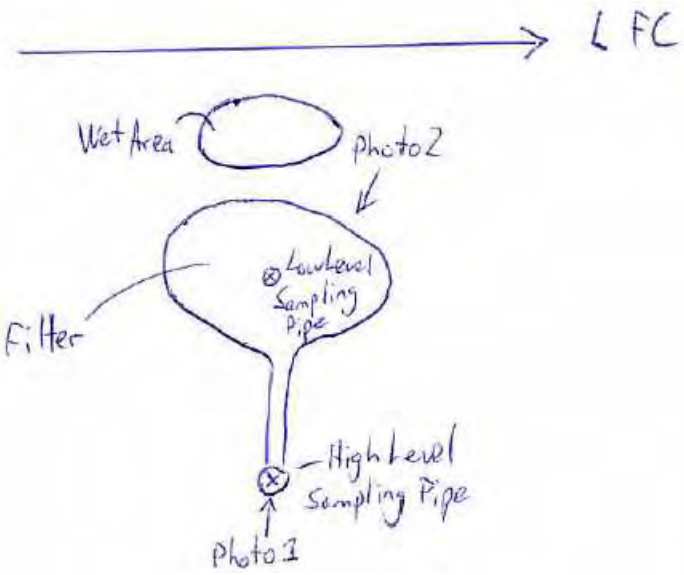
Sampling Standpipe: Yes, low level
Depth to bottom: 3.09 m (2016)
Depth to water: 0.190 m below PVC TOC
Condition: Good.
Repairs: None.

Other Comments: Filter appears to be working effectively other than alternate flow path. Water flowing over very soft soil between filter and LFC.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 11A2 **Date:** September 6, 2017
Site Description: East side of Floodway, south of PTH59N bridge.

Site Sketch and Photo Locations:



Photos:

Photo 1: High level sampling pipe and protective CMP casing.

Photo 2: Water flowing through 11A2 filter and finding alternate flow paths to LFC.

Filter Condition: Good

Repairs Required: None

Approximate Flow: 0 USgpm

Additional Discharge Areas: No

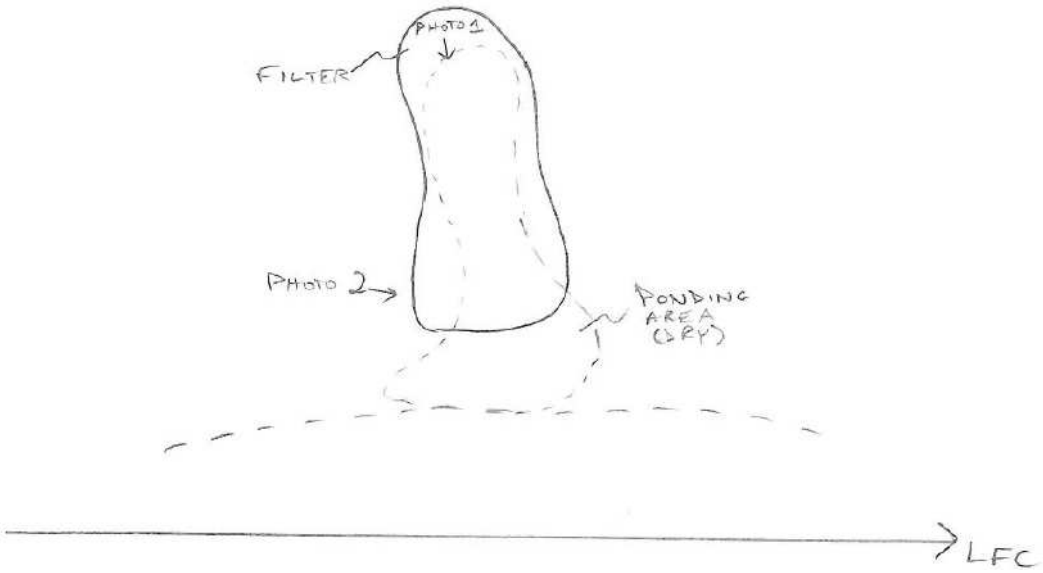
Sampling Standpipe: Yes, low level and high level
Depth to bottom: 1.93 m (low level), soft at bottom (2016).
Depth to water: 1.05m (low level)
Condition: Good
Repairs Required: None

Other Comments: There is no discharge trench constructed to Low Flow Channel. Dry around filter. Could add mono foam around PVC at opening in steel protector at high level standpipe but is a low priority.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 16A2 **Date:** September 6, 2017
Site Description: West side, north of Dunning Road.

Site Sketch and Photo Locations:



Photos:

Photo 1: Spring treatment filter 16A2.

Photo 2: Spring treatment filter 16A2.

Filter Condition: Good. No apparent discharge path to drain into LFC.

Repairs Required: None.

Approximate Flow: No Flow

Additional Discharge Areas: No

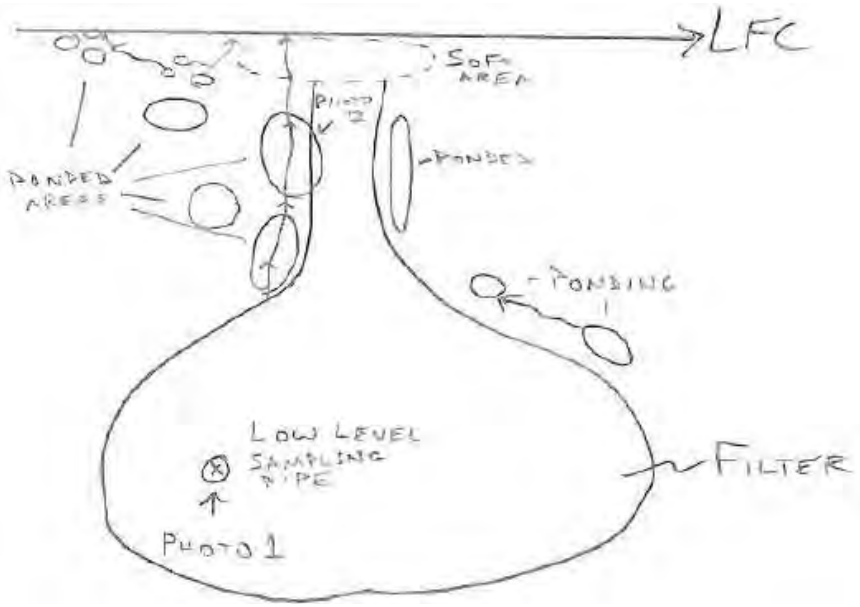
Sampling Standpipe: No

Other Comments: No flow observed. Dried ponding area exists on and around filter. Heavily vegetated.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 17A2 **Date:** September 6, 2017
Site Description: East side, north of Dunning Road

Site Sketch and Photo Locations:



Photos:

Photo 1: Spring treatment filter site 17A2 and low level sampling pipe.

Photo 2: Water ponding beside the French drain at 17A2.

Filter Condition: Good

Repairs Required: None

Approximate Flow: 2 USgpm

Additional Discharge Areas: Small discharge area along French Drain, may just be ponding water.

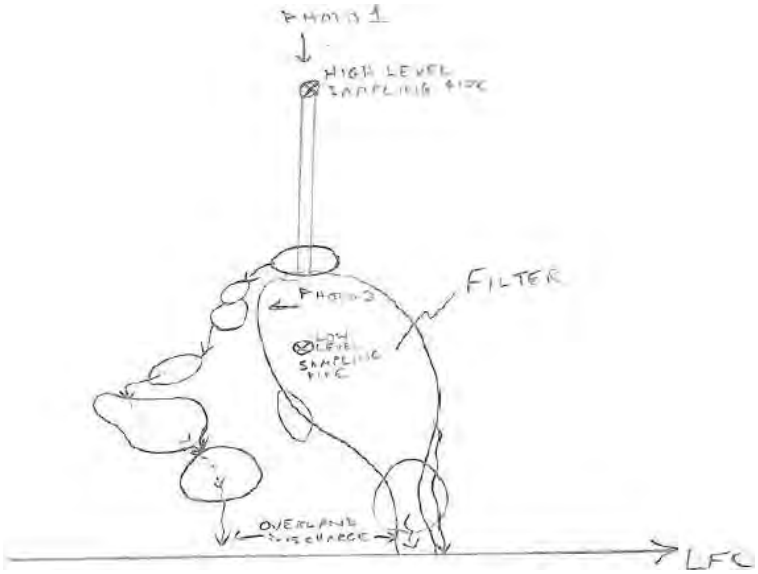
Sampling Standpipe: Yes, low level
Depth to bottom: 1.510 m (2016)
Depth to water: 0.319 m
Condition: Good
Repairs Required: None

Other Comments: Area around filter is dry; filter appears to be working well other than alternate flow path.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 18A1 **Date:** September 6, 2017
Site Description: West side, north of LFC bike/pedestrian bridge.

Site Sketch and Photo Locations:



Photos:

Photo 1: High level sampling pipe and protective CMP casing.

Photo 2: Water flowing through filter and finding alternate flow paths to LFC at 18A1.

Filter Condition: Good – water finding alternate flow paths to LFC. Constructed discharge channel appears to be clogged with sediment. No significant erosion observed within overland discharge areas.
Repairs Required: Excavating rip rap from discharge channel and creating a swale may focus flow along design discharge path.

Approximate Flow: Path to South of discharge path ~ 15 USgpm. Path adjacent to discharge path ~ 3 USgpm.

Additional Discharge Areas: No

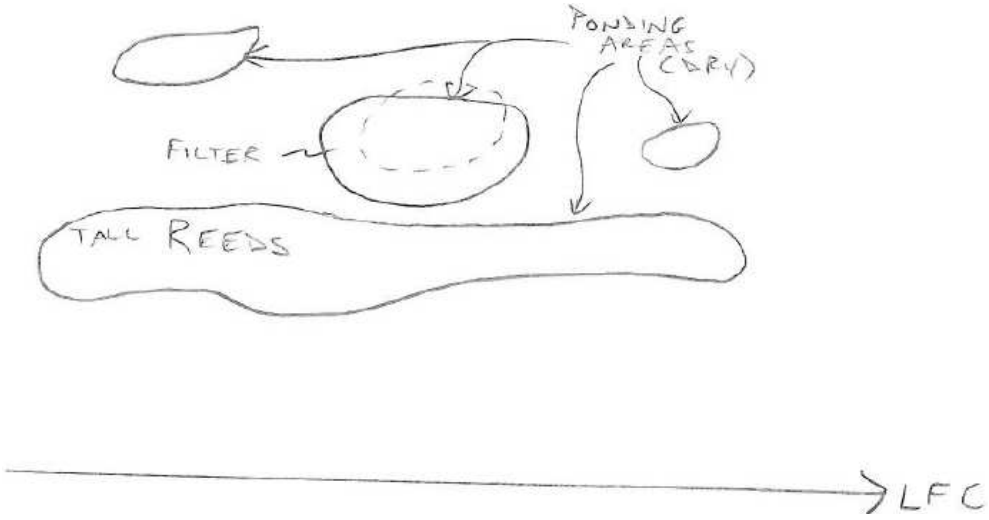
Sampling Standpipe: Yes, low level and high level.
Depth to bottom: 1.94 m (low level). Very soft at bottom.
Depth to water: 0.18 m (low level).
Condition: PVC has lifted up and is in contact with steel protective casing.
Repairs: None

Other Comments: Filter appears to be working effectively other than the discharge channel.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 18A2 **Date:** September 6, 2017
Site Description: West side, approximately 100 m north of 18A1.

Site Sketch and Photo Locations:



Photos:

Photo 1: Spring treatment filter site 18A2.

Photo 2: Dried ponding area near spring treatment filter site 18A2.

Filter Condition: Good
Repairs Required: None

Approximate Flow: No flow

Additional Discharge Areas: No

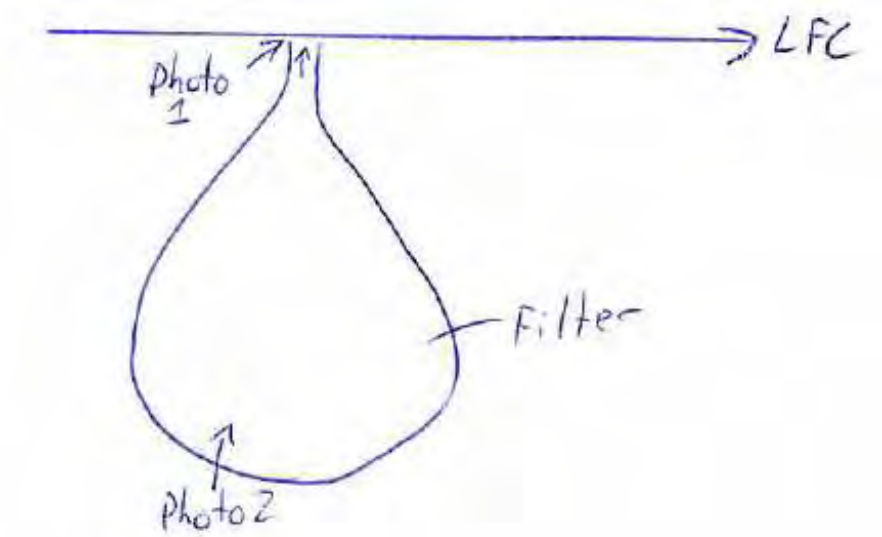
Sampling Standpipe: No

Other Comments: Dried areas with reeds from surface water ponding around filter.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 20A2 **Date:** September 6, 2017
Site Description: East side, south of 21A2

Site Sketch and Photo Locations:



Photos:

Photo 1: Tie-in of filter drain to Low Flow Channel.

Photo 2: Spring treatment filter 20A2.

Filter Condition: Good

Repairs Required: None

Approximate Flow: <0.1 USgpm

Additional Discharge Areas: No

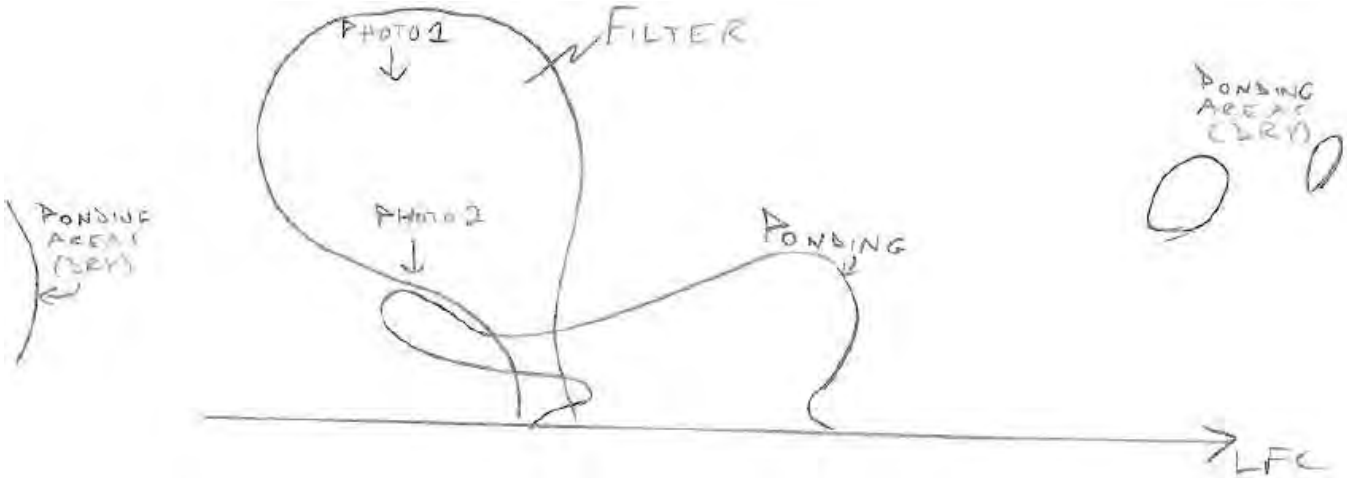
Sampling Standpipe: No

Other Comments: No flow observed, no wet or soft areas.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 21A1 **Date:** September 6, 2017
Site Description: West side, south of CEMR bridge.

Site Sketch and Photo Locations:



Photos:

Photo 1: Spring treatment filter 21A1.

Photo 2: Water flowing through 21A1 filter and finding alternate flow path to LFC.

Filter Condition: Good – water finding alternate flow path to LFC. Constructed discharge channel appears to be clogged with sediment. No significant erosion observed within overland discharge area.

Repairs Required: Excavating rip rap from discharge channel and creating a swale may focus flow along design discharge path.

Approximate Flow: <0.1 USgpm

Additional Discharge Areas: No

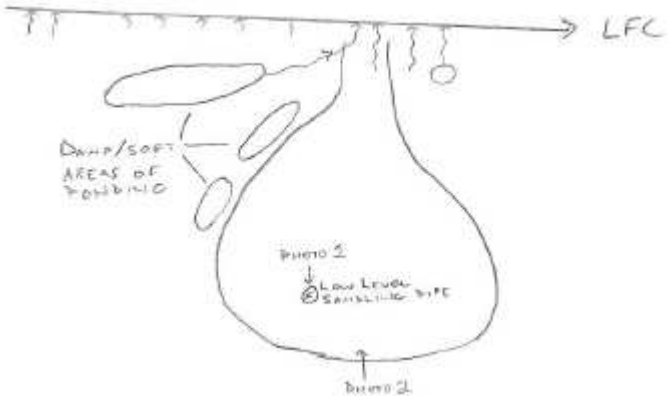
Sampling Standpipe: No

Other Comments: Filter appears to be working effectively other than the discharge channel. LFC at filter elevation / above discharge channel.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 21A2 **Date:** September 6, 2017
Site Description: East side, north of 20A2

Site Sketch and Photo Locations:



Photos:

Photo 1: Spring treatment filter 21A2.

Photo 2: Tie-in of 21A2 filter drain to Low Flow Channel.

Filter Condition: Good

Repairs Required: None

Approximate Flow: 1 USGpm

Additional Discharge Areas: No

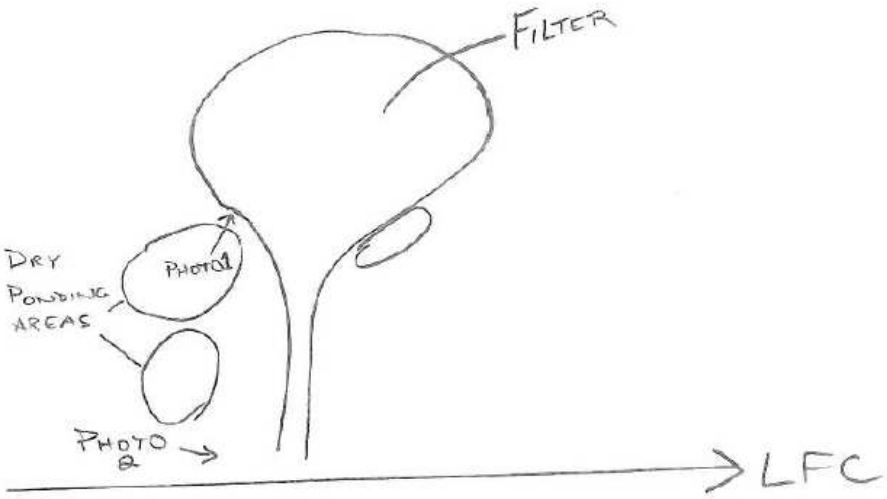
Sampling Standpipe: No

Other Comments: No flow observed, no wet or soft areas around filter.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 23A1 **Date:** September 6, 2017
Site Description: West side, south of PTH 44 bridge.

Site Sketch and Photo Locations:



Photos:

Photo 1: Spring treatment filter 23A1.

Photo 2: Tie in of discharge channel to LFC at 23A1.

Filter Condition: Good

Repairs Required: None

Approximate Flow: No Flow

Additional Discharge Areas: No

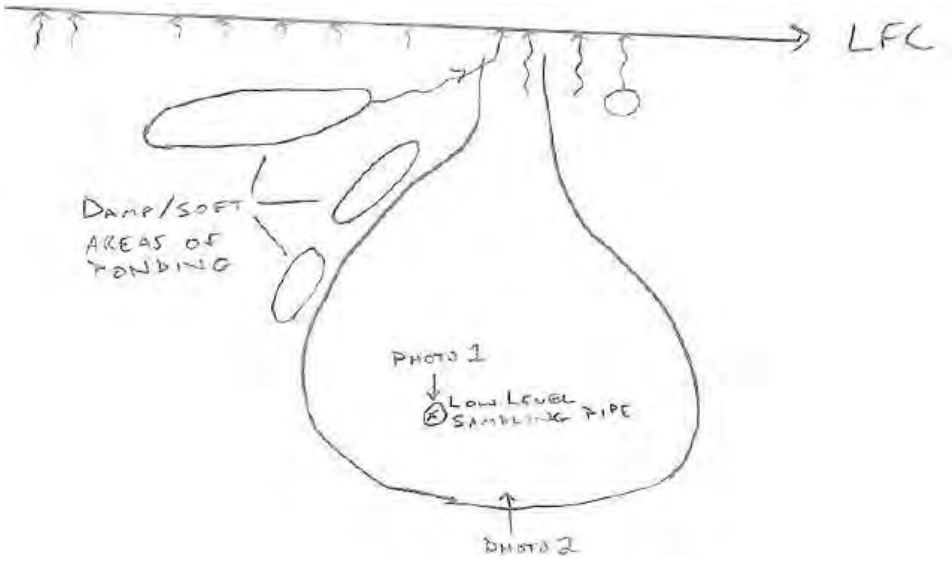
Sampling Standpipe: No

Other Comments: Rip rap is filling with sediment, hard to see filter and discharge channel. Heavy vegetation.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: 23A2 **Date:** September 6, 2017
Site Description: East side, just south of PTH 44 bridge.

Site Sketch and Photo Locations:



Photos:

Photo 1: Low level sampling pipe steel protective casing.

Photo 2: Spring treatment filter site 23A2.

Filter Condition: Good

Repairs Required: None

Approximate Flow: <0.1 USgpm

Additional Discharge Areas: No

Sampling Standpipe: Yes, low level
Depth to bottom: 1.56 m
Depth to water: 0.145 m below PVC top of casing.
Condition: Good.
Repairs: None.

Other Comments: No wet or soft areas around filter.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: AD17-1 **Date:** September 6, 2017
Site Description: West side, approximately 10 m downstream of a beaver dam crossing the low flow channel. Located mid way between Church Rd. and Hay Rd.
UTM: 14U 648661 5546623.

Site Sketch and Photo Locations:

Photos:

Photo 1: Additional discharge location facing upstream toward beaver dam.

Photo 2: Slow seepage at additional discharge location.

Approximate Flow: <0.1 USgpm

Other Comments: Additional discharge location 10 m downstream of beaver dam and is potentially diverted flow from the dam.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: AD17-2 **Date:** September 6, 2017
Site Description: West side, approximately 129 m downstream of a beaver dam that crosses the low flow channel. Located mid way between Church Rd. and Hay Rd.
UTM: 14U 648646 5546742.

Photos:

Photo 1: Additional discharge location facing west from mid channel.

Photo 2: Slow seepage at additional discharge location.

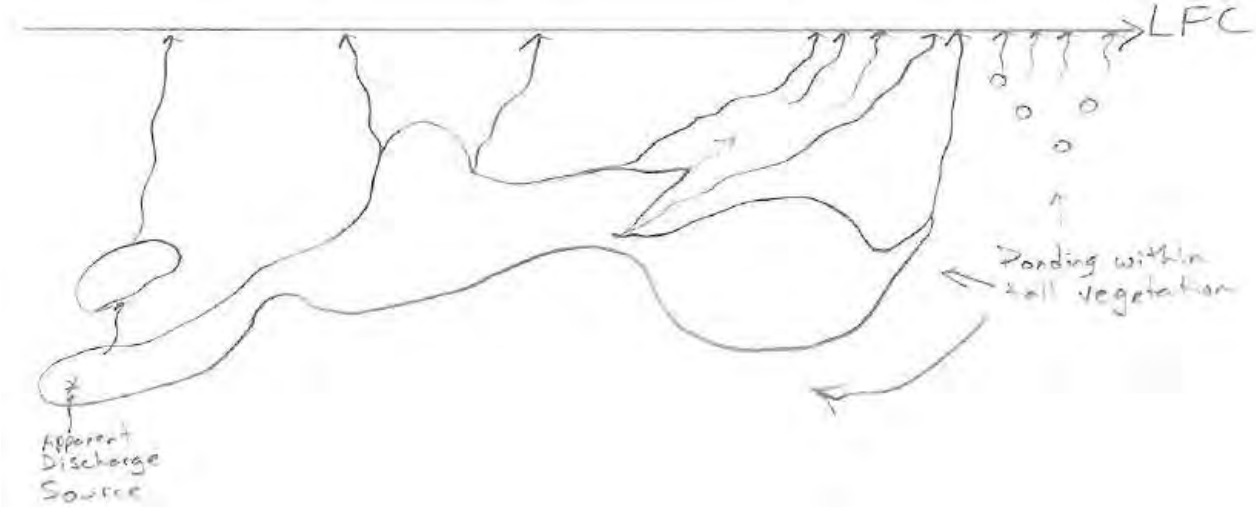
Approximate Flow: <0.1 USgpm

Other Comments: Additional discharge location 129 m downstream of beaver dam and potentially diverted flow from the dam as opposed to groundwater discharge.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: AD17-3 **Date:** September 6, 2017
Site Description: East side of channel across from Hay Rd. Across channel from AD17-4.
UTM: 14U 0648624 5547181.

Site Sketch and Photo Locations:



Photos:

Photo 1: Additional discharge location apparent source pooling.

Photo 2: Low flow seepage into channel.

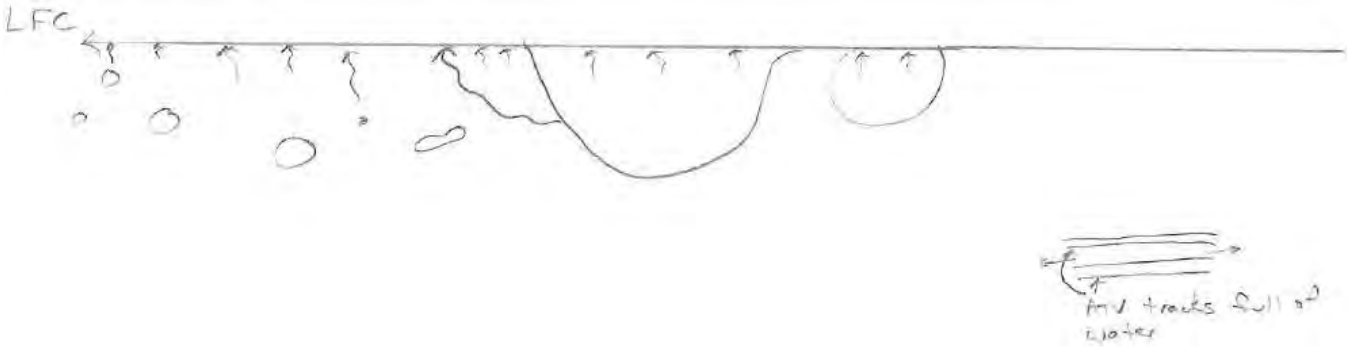
Approximate Flow: <0.1 USgpm individual streams. Approximately <5 USgpm total discharge.

Other Comments: Additional discharge location with low flow discharges into the channel spanning approximately 65 m from 14U 0648624 5547181 downstream to 14U 0648614 5547245.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: AD17-4 **Date:** September 6, 2017
Site Description: West side of channel across from Hay Rd. Across the channel from AD17-3.
UTM: 14U 0648593 5547218.

Site Sketch and Photo Locations:



Photos:

Photo 1: Additional discharge pooling and seepage.

Photo 2: Low flow seepage into channel.

Approximate Flow: <0.1 USgpm

Other Comments: Additional discharge location with low flow discharges into the channel spanning approximately 91 m from approximately 14U 0648593 5547218 downstream to 14U 0648587 5547306.

2017 Summer Inspection of Spring Treatment Areas

Treatment Site ID: AD17-5 **Date:** September 6, 2017
Site Description: West side of channel between Hay Rd. and CEMR Bridge and approximately 70 m south of Spring 21A2.
UTM: 14U 0648099 5548528.

Photos:

Photo 1: Additional discharge adjacent to low flow channel.

Photo 2: Low flow seepage into channel.

Approximate Flow: <0.1 USgpm

Other Comments: Additional discharge location with very low flow discharge adjacent to the low flow channel. No apparent ponding or source aside from channel slope.

APPENDIX D4-D-3

ADDITIONAL PHOTOGRAPHS AND VIDEO (INCLUDED ON DVD)

APPENDIX D4-E

LABORATORY REPORTS

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 07-MAR-17
PO No.: MI FLOODWAY
WO No.: L1896850
Project Ref: 16-0300-002.1000.01
Sample ID: K13-12321
Sampled By: ADS/DL
Date Collected: 02-MAR-17
Lab Sample ID: L1896850-1
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Bicarbonate (HCO3)	703		mg/L			06-MAR-17
Carbonate (CO3)	<0.60		mg/L			06-MAR-17
Hydroxide (OH)	<0.34		mg/L			06-MAR-17
Alkalinity, Total (as CaCO3)	576		mg/L			03-MAR-17
Chloride (Cl)	236		mg/L		250	03-MAR-17
Conductivity	1780		umhos/cm			03-MAR-17
Hardness (as CaCO3)	938		mg/L		500	06-MAR-17
*Nitrate (as N)	4.48		mg/L	10		03-MAR-17
*Nitrate and Nitrite as N	4.48		mg/L	10		07-MAR-17
*Nitrite (as N)	<0.0050	DLM	mg/L	1		03-MAR-17
Sulfate (SO4)	87.2		mg/L		500	03-MAR-17
TDS (Calculated)	1020		mg/L		500	06-MAR-17
*Turbidity	0.30		NTU			03-MAR-17
pH	7.17		pH units			03-MAR-17
Total Coliform and E.coli by MPN QT97						
Total Coliforms	<1		MPN/100mL	0		02-MAR-17
Escherichia Coli	<1		MPN/100mL	0		02-MAR-17
Ion Balance Calculation						
Ion Balance	108		%			07-MAR-17
Cation - Anion Balance	3.7		%			07-MAR-17
Anion Sum	20.3		me/L			07-MAR-17
Cation Sum	21.9		me/L			07-MAR-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	122		mg/L			03-MAR-17
Magnesium (Mg)-Dissolved	154		mg/L			03-MAR-17
Potassium (K)-Dissolved	6.32		mg/L			03-MAR-17
Sodium (Na)-Dissolved	67.8		mg/L		200	03-MAR-17

KGS Group Consultants (Winnipeg)
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Date: 07-MAR-17
PO No.: MI FLOODWAY
WO No.: L1896850
Project Ref: 16-0300-002.1000.01
Sample ID: K13-12321
Sampled By: ADS/DL
Date Collected: 02-MAR-17
Lab Sample ID: L1896850-1
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 07-MAR-17
PO No.: MI FLOODWAY
WO No.: L1896850
Project Ref: 16-0300-002.1000.01
Sample ID: K09-12012
Sampled By: ADS/DL
Date Collected: 02-MAR-17
Lab Sample ID: L1896850-2
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Bicarbonate (HCO3)	478		mg/L			06-MAR-17
Carbonate (CO3)	<0.60		mg/L			06-MAR-17
Hydroxide (OH)	<0.34		mg/L			06-MAR-17
Alkalinity, Total (as CaCO3)	392		mg/L			03-MAR-17
Chloride (Cl)	23.5		mg/L		250	03-MAR-17
Conductivity	1140		umhos/cm			03-MAR-17
Hardness (as CaCO3)	609		mg/L		500	06-MAR-17
*Nitrate (as N)	<0.010	DLM	mg/L	10		03-MAR-17
*Nitrate and Nitrite as N	<0.010		mg/L	10		07-MAR-17
*Nitrite (as N)	<0.0020	DLM	mg/L	1		03-MAR-17
Sulfate (SO4)	277		mg/L		500	03-MAR-17
TDS (Calculated)	779		mg/L		500	06-MAR-17
*Turbidity	226		NTU			03-MAR-17
pH	7.36		pH units			03-MAR-17
Total Coliform and E.coli by MPN QT97						
Total Coliforms	<1		MPN/100mL	0		02-MAR-17
Escherichia Coli	<1		MPN/100mL	0		02-MAR-17
Ion Balance Calculation						
Ion Balance	102		%			07-MAR-17
Cation - Anion Balance	1.0		%			07-MAR-17
Anion Sum	14.3		me/L			07-MAR-17
Cation Sum	14.6		me/L			07-MAR-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	98.4		mg/L			03-MAR-17
Magnesium (Mg)-Dissolved	88.1		mg/L			03-MAR-17
Potassium (K)-Dissolved	4.81		mg/L			03-MAR-17
Sodium (Na)-Dissolved	52.4		mg/L		200	03-MAR-17

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Date: 07-MAR-17
PO No.: MI FLOODWAY
WO No.: L1896850
Project Ref: 16-0300-002.1000.01
Sample ID: K09-12012
Sampled By: ADS/DL
Date Collected: 02-MAR-17
Lab Sample ID: L1896850-2
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 07-MAR-17
PO No.: MI FLOODWAY
WO No.: L1896850
Project Ref: 16-0300-002.1000.01
Sample ID: K11-12015
Sampled By: ADS/DL
Date Collected: 02-MAR-17
Lab Sample ID: L1896850-3
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Bicarbonate (HCO3)	326		mg/L			06-MAR-17
Carbonate (CO3)	<0.60		mg/L			06-MAR-17
Hydroxide (OH)	<0.34		mg/L			06-MAR-17
Alkalinity, Total (as CaCO3)	267		mg/L			03-MAR-17
Chloride (Cl)	14.6		mg/L		250	03-MAR-17
Conductivity	614		umhos/cm			03-MAR-17
Hardness (as CaCO3)	349		mg/L		500	06-MAR-17
*Nitrate (as N)	0.0486		mg/L	10		03-MAR-17
*Nitrate and Nitrite as N	0.0486		mg/L	10		07-MAR-17
*Nitrite (as N)	<0.0010		mg/L	1		03-MAR-17
Sulfate (SO4)	58.3		mg/L		500	03-MAR-17
TDS (Calculated)	355		mg/L		500	06-MAR-17
*Turbidity	0.22		NTU			03-MAR-17
pH	7.64		pH units			03-MAR-17
Total Coliform and E.coli by MPN QT97						
Total Coliforms	<1		MPN/100mL	0		02-MAR-17
Escherichia Coli	<1		MPN/100mL	0		02-MAR-17
Ion Balance Calculation						
Ion Balance	106		%			07-MAR-17
Cation - Anion Balance	2.7		%			07-MAR-17
Anion Sum	6.97		me/L			07-MAR-17
Cation Sum	7.36		me/L			07-MAR-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	68.8		mg/L			03-MAR-17
Magnesium (Mg)-Dissolved	43.0		mg/L			03-MAR-17
Potassium (K)-Dissolved	4.16		mg/L			03-MAR-17
Sodium (Na)-Dissolved	6.43		mg/L		200	03-MAR-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 07-MAR-17
PO No.: MI FLOODWAY
WO No.: L1896850
Project Ref: 16-0300-002.1000.01
Sample ID: K11-12015
Sampled By: ADS/DL
Date Collected: 02-MAR-17
Lab Sample ID: L1896850-3
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

Guidelines & Objectives

Sample Parameter Qualifier key listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Health Canada MAC Health Related Criteria Limits

Nitrate/Nitrite-N*	Criteria limit is 10 mg/L (1.0 mg/L if present as all Nitrite-N). High concentrations may contribute to blue baby syndrome in infants.
Lead*	A cumulative body poison, uncommon in naturally occurring hard waters.
Fluoride*	Present in fluoridated water supplies at 0.8 mg/L to reduce dental caries. Elevated levels causes fluorosis (mottling of teeth).
Total Coliforms*	Criteria is 0 CFU/100mL. Adverse health effects.
E. Coli*	Criteria is 0 CFU/100 mL. Certain E. Coli bacteria can be life threatening.

*Health Canada Canadian Drinking Water Quality Guidelines (MAC limit)

Aesthetic Objective Concentration Levels

Alkalinity	Acid neutralizing capacity. Usually a measure of carbonate and bicarbonates and calculated and reported as calcium carbonate.
Balance	Quality control parameter ratioing cations to anions
Bicarbonate	See Alkalinity. Report as the anion HCO3-1
Carbonate	See Alkalinity. Reported at the anion CO3-2
Calcium	See Hardness. Common major cation of water chemistry.
Chloride	Common major anion of water chemistry.
Conductance	Physical test measuring water salinity (dissolved ions or solids)
Hardness	Classical measure or capacity of water to precipitate soap (chiefly calcium and magnesium ions). Causes scaling tendency in water if carbonates/bicarbonates are present (if >200 mg/L). For drinking water purposes waters with results <200 mg/L are considered acceptable, results >200 mg/L are considered poor but can be tolerated. Results >500 mg/L are unacceptable.
Hydroxide	See alkalinity
Magnesium	See hardness. Common major cation of water chemistry. Elevated levels (>125 mg/L) may exert a cathartic or diuretic action.
pH	Measure of water acidity/alkalinity. Normal range is 7.0-8.5.
Potassium	Common major cation of water chemistry.
Sodium	Common major cation of water chemistry. Measure of salinity (saltiness).The aesthetic objective (not related to health) for sodium in drinking water is 200 mg/L. However, where sodium concentration of the drinking water exceeds 20 mg/L, it is recommended that any person on a sodium restricted diet consult with his/her physician or Medical Officer of Health concerning the use of that water.
Sulphate	Common major anion of water chemistry. Elevated levels may exert a cathartic or diuretic action.
Total Dissolved Solids	A measure of water salinity.
Iron	Causes staining to laundry and porcelain and astringent taste. Oxidizes to red-brown precipitate on exposure to air.
Manganese	Elevated levels may cause staining of laundry and porcelain.
Heterotrophic Plate Count	Criteria is 500 cfu/mL Measure of heterotrophic bacteria present.

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
Contact: Marci Friedman Hamm

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-WP	**Water**							
Batch R3668196								
WG2489325-4 LCS								
Alkalinity, Total (as CaCO3)			104.0		%		85-115	03-MAR-17
WG2489325-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	03-MAR-17
CL-IC-N-WP	**Water**							
Batch R3669031								
WG2488595-2 LCS								
Chloride (Cl)			101.0		%		90-110	03-MAR-17
WG2488595-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	03-MAR-17
EC-WP	**Water**							
Batch R3668196								
WG2489325-3 LCS								
Conductivity			101.4		%		90-110	03-MAR-17
WG2489325-1 MB								
Conductivity			<1.0		umhos/cm		1	03-MAR-17
MET-D-MS-WP	**Water**							
Batch R3668157								
WG2488763-2 LCS								
Calcium (Ca)-Dissolved			101.3		%		80-120	03-MAR-17
Magnesium (Mg)-Dissolved			108.0		%		80-120	03-MAR-17
Potassium (K)-Dissolved			103.0		%		80-120	03-MAR-17
Sodium (Na)-Dissolved			106.1		%		80-120	03-MAR-17
WG2488763-1 MB								
Calcium (Ca)-Dissolved			<0.20		mg/L		0.2	03-MAR-17
Magnesium (Mg)-Dissolved			<0.050		mg/L		0.05	03-MAR-17
Potassium (K)-Dissolved			<0.10		mg/L		0.1	03-MAR-17
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	03-MAR-17
NO2-L-IC-N-WP	**Water**							
Batch R3669031								
WG2488595-2 LCS								
Nitrite (as N)			99.8		%		90-110	03-MAR-17
WG2488595-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	03-MAR-17
NO3-L-IC-N-WP	**Water**							

Quality Control Report

Workorder: L1896850 Report Date: 07-MAR-17

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO3-L-IC-N-WP	**Water**							
Batch R3669031								
WG2488595-2 LCS								
Nitrate (as N)			102.1		%		90-110	03-MAR-17
WG2488595-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	03-MAR-17
PH-WP	**Water**							
Batch R3668196								
WG2489325-2 LCS								
pH			7.41		pH units		7.3-7.5	03-MAR-17
SO4-IC-N-WP	**Water**							
Batch R3669031								
WG2488595-2 LCS								
Sulfate (SO4)			101.7		%		90-110	03-MAR-17
WG2488595-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	03-MAR-17
TC,EC-QT97-WP	**Water**							
Batch R3667047								
WG2488106-2 DUP		**L1896850-1**						
Total Coliforms		<1	<1	RPD-NA	MPN/100mL	N/A	65	02-MAR-17
Escherichia Coli		<1	<1	RPD-NA	MPN/100mL	N/A	65	02-MAR-17
WG2488106-1 MB								
Total Coliforms			<1		MPN/100mL		1	02-MAR-17
Escherichia Coli			<1		MPN/100mL		1	02-MAR-17
TURBIDITY-WP	**Water**							
Batch R3668273								
WG2489372-2 LCS								
Turbidity			101.5		%		85-115	03-MAR-17
WG2489372-1 MB								
Turbidity			<0.10		NTU		0.1	03-MAR-17

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	02-MAR-17 12:40	03-MAR-17 11:43	0.25	23	hours	EHTR-FM
	2	02-MAR-17 14:30	03-MAR-17 11:43	0.25	21	hours	EHTR-FM
	3	02-MAR-17 16:00	03-MAR-17 11:43	0.25	20	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1896850 were received on 02-MAR-17 16:40.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

10- 231789

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

L1896850

Page 1 of 1

Report To		Report Format / Distribution		Service Request (Rush subject to availability - Contact ALS to confirm TAT)
Company:	KGS Group	Standard: ✓ Other (specify):		✓ Regular (St
Contact:	Marci Friedman-Hamm	Select: PDF ✓ Excel ✓ Digital Fax		Priority(2-4
Address:	865 Waverley St. -3rd floor	Email 1:	AMelvin@Kgsgroup.com, PLindell@Kgsgroup.com	Emergency
	Winnipeg, MB R3T 5P4	Email 2:	MFHamm@Kgsgroup.com	Same Day
Phone:	Fax:			

L1896850-COFC

Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information	
	Copy of Invoice with Report? (circle) Yes or No	Job #:	16-0300-002. 1000. 01
Company:		PO / AFE:	MI Floodway
Contact:		LSD:	Floodway
Address:			
Phone:	Fax:	Quote #:	Q55656
Lab Work Order # (lab use only)		ALS Contact: Judy	Sampler: ADS/OL

(Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	KGS-ROWW-0-FDWY-WP	TC, EC - QT97 - WP											Number of Containers
	K13 - 12321	02-MAR-17	12:40	GW	X	X											3
	K09 - 12012	↓	14:30	GW	X	X											3
	K11 - 12015	↓	16:00	GW	X	X											3

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

GW samples not field filtered
Metals bottles do have preservative

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: [signature]	Date: MAR 2/17	Time: 1640	Received by: [signature]	Date: 2-3-17	Time: 16:40	Temperature: 5 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION   WHITE - LABORATORY COPY   YELLOW - CLIENT COPY   GENF 18.01 Front

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 08-MAR-17
PO No.: FLOODWAY PREMELT
WO No.: L1897170
Project Ref: 16-0300-002.1000.02
Sample ID: K09-12316
Sampled By: ACM/ADS
Date Collected: 03-MAR-17
Lab Sample ID: L1897170-1
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	527		mg/L			06-MAR-17
Carbonate (CO3)	<0.60		mg/L			06-MAR-17
Hydroxide (OH)	<0.34		mg/L			06-MAR-17
*Nitrate and Nitrite as N	1.80		mg/L	10		07-MAR-17
pH						
pH	7.32		pH units			03-MAR-17
Turbidity						
*Turbidity	<0.10		NTU			03-MAR-17
TDS calculated						
TDS (Calculated)	539		mg/L		500	08-MAR-17
Sulfate in Water by IC						
Sulfate (SO4)	59.0		mg/L		500	03-MAR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0010		mg/L	1		03-MAR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	1.80		mg/L	10		03-MAR-17
Ion Balance Calculation						
Ion Balance	106		%			08-MAR-17
Cation - Anion Balance	3.0		%			08-MAR-17
Anion Sum	10.8		me/L			08-MAR-17
Cation Sum	11.5		me/L			08-MAR-17
Hardness Calculated						
Hardness (as CaCO3)	523		mg/L		500	08-MAR-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	77.8		mg/L			07-MAR-17
Magnesium (Mg)-Dissolved	79.8		mg/L			07-MAR-17
Potassium (K)-Dissolved	4.60		mg/L			07-MAR-17
Sodium (Na)-Dissolved	21.3		mg/L		200	07-MAR-17
Conductivity						
Conductivity	893		umhos/cm			03-MAR-17
Chloride in Water by IC						
Chloride (Cl)	29.5		mg/L		250	03-MAR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	432		mg/L			03-MAR-17
Total and E. coli to endpoint by QT97						

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 08-MAR-17
PO No.: FLOODWAY PREMELT
WO No.: L1897170
Project Ref: 16-0300-002.1000.02
Sample ID: K09-12316
Sampled By: ACM/ADS
Date Collected: 03-MAR-17
Lab Sample ID: L1897170-1
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total and E. coli to endpoint by QT97						
Total Coliforms	<1		MPN/100mL	0		03-MAR-17
Escherichia Coli	<1		MPN/100mL	0		03-MAR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Judy Dalmaijer
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 08-MAR-17
PO No.: FLOODWAY PREMELT
WO No.: L1897170
Project Ref: 16-0300-002.1000.02
Sample ID: K11-12014
Sampled By: ACM/ADS
Date Collected: 03-MAR-17
Lab Sample ID: L1897170-2
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	391		mg/L			06-MAR-17
Carbonate (CO3)	<0.60		mg/L			06-MAR-17
Hydroxide (OH)	<0.34		mg/L			06-MAR-17
*Nitrate and Nitrite as N	0.159		mg/L	10		07-MAR-17
pH						
pH	7.39		pH units			03-MAR-17
Turbidity						
*Turbidity	0.71		NTU			03-MAR-17
TDS calculated						
TDS (Calculated)	413		mg/L		500	08-MAR-17
Sulfate in Water by IC						
Sulfate (SO4)	67.6		mg/L		500	03-MAR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0010		mg/L	1		03-MAR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.159		mg/L	10		03-MAR-17
Ion Balance Calculation						
Ion Balance	102		%			08-MAR-17
Cation - Anion Balance	1.1		%			08-MAR-17
Anion Sum	8.18		me/L			08-MAR-17
Cation Sum	8.36		me/L			08-MAR-17
Hardness Calculated						
Hardness (as CaCO3)	397		mg/L		500	08-MAR-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	80.3		mg/L			07-MAR-17
Magnesium (Mg)-Dissolved	47.7		mg/L			07-MAR-17
Potassium (K)-Dissolved	4.44		mg/L			07-MAR-17
Sodium (Na)-Dissolved	7.14		mg/L		200	07-MAR-17
Conductivity						
Conductivity	687		umhos/cm			03-MAR-17
Chloride in Water by IC						
Chloride (Cl)	12.6		mg/L		250	03-MAR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	320		mg/L			03-MAR-17
Total and E. coli to endpoint by QT97						

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 08-MAR-17
PO No.: FLOODWAY PREMELT
WO No.: L1897170
Project Ref: 16-0300-002.1000.02
Sample ID: K11-12014
Sampled By: ACM/ADS
Date Collected: 03-MAR-17
Lab Sample ID: L1897170-2
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total and E. coli to endpoint by QT97						
Total Coliforms	<1		MPN/100mL	0		03-MAR-17
Escherichia Coli	<1		MPN/100mL	0		03-MAR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Judy Dalmaijer
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 08-MAR-17
PO No.: FLOODWAY PREMELT
WO No.: L1897170
Project Ref: 16-0300-002.1000.02
Sample ID: MW100
Sampled By: ACM/ADS
Date Collected: 03-MAR-17
Lab Sample ID: L1897170-3
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	524		mg/L			06-MAR-17
Carbonate (CO3)	<0.60		mg/L			06-MAR-17
Hydroxide (OH)	<0.34		mg/L			06-MAR-17
*Nitrate and Nitrite as N	1.81		mg/L	10		07-MAR-17
pH						
pH	7.32		pH units			03-MAR-17
Turbidity						
*Turbidity	0.11		NTU			03-MAR-17
TDS calculated						
TDS (Calculated)	537		mg/L		500	08-MAR-17
Sulfate in Water by IC						
Sulfate (SO4)	58.8		mg/L		500	03-MAR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0010		mg/L	1		03-MAR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	1.81		mg/L	10		03-MAR-17
Ion Balance Calculation						
Ion Balance	106		%			08-MAR-17
Cation - Anion Balance	3.0		%			08-MAR-17
Anion Sum	10.8		me/L			08-MAR-17
Cation Sum	11.4		me/L			08-MAR-17
Hardness Calculated						
Hardness (as CaCO3)	521		mg/L		500	08-MAR-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	77.8		mg/L			07-MAR-17
Magnesium (Mg)-Dissolved	79.3		mg/L			07-MAR-17
Potassium (K)-Dissolved	4.49		mg/L			07-MAR-17
Sodium (Na)-Dissolved	21.2		mg/L		200	07-MAR-17
Conductivity						
Conductivity	900		umhos/cm			03-MAR-17
Chloride in Water by IC						
Chloride (Cl)	29.5		mg/L		250	03-MAR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	430		mg/L			03-MAR-17
Total and E. coli to endpoint by QT97						

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 08-MAR-17
PO No.: FLOODWAY PREMELT
WO No.: L1897170
Project Ref: 16-0300-002.1000.02
Sample ID: MW100
Sampled By: ACM/ADS
Date Collected: 03-MAR-17
Lab Sample ID: L1897170-3
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total and E. coli to endpoint by QT97						
Total Coliforms	<1		MPN/100mL	0		03-MAR-17
Escherichia Coli	<1		MPN/100mL	0		03-MAR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Judy Dalmaijer
Account Manager

Guidelines & Objectives

Health Canada MAC Health Related Criteria Limits

Nitrate/Nitrite-N*	Criteria limit is 10 mg/L (1.0 mg/L if present as all Nitrite-N). High concentrations may contribute to blue baby syndrome in infants.
Lead*	A cumulative body poison, uncommon in naturally occurring hard waters.
Fluoride*	Present in fluoridated water supplies at 0.8 mg/L to reduce dental caries. Elevated levels causes fluorosis (mottling of teeth).
Total Coliforms*	Criteria is 0 CFU/100mL. Adverse health effects.
E. Coli*	Criteria is 0 CFU/100 mL. Certain E. Coli bacteria can be life threatening.

*Health Canada Canadian Drinking Water Quality Guidelines (MAC limit)

Aesthetic Objective Concentration Levels

Alkalinity	Acid neutralizing capacity. Usually a measure of carbonate and bicarbonates and calculated and reported as calcium carbonate.
Balance	Quality control parameter ratioing cations to anions
Bicarbonate	See Alkalinity. Report as the anion HCO3-1
Carbonate	See Alkalinity. Reported at the anion CO3-2
Calcium	See Hardness. Common major cation of water chemistry.
Chloride	Common major anion of water chemistry.
Conductance	Physical test measuring water salinity (dissolved ions or solids)
Hardness	Classical measure or capacity of water to precipitate soap (chiefly calcium and magnesium ions). Causes scaling tendency in water if carbonates/bicarbonates are present (if >200 mg/L). For drinking water purposes waters with results <200 mg/L are considered acceptable, results >200 mg/L are considered poor but can be tolerated. Results >500 mg/L are unacceptable.
Hydroxide	See alkalinity
Magnesium	See hardness. Common major cation of water chemistry. Elevated levels (>125 mg/L) may exert a cathartic or diuretic action.
pH	Measure of water acidity/alkalinity. Normal range is 7.0-8.5.
Potassium	Common major cation of water chemistry.
Sodium	Common major cation of water chemistry. Measure of salinity (saltiness).The aesthetic objective (not related to health) for sodium in drinking water is 200 mg/L. However, where sodium concentration of the drinking water exceeds 20 mg/L, it is recommended that any person on a sodium restricted diet consult with his/her physician or Medical Officer of Health concerning the use of that water.
Sulphate	Common major anion of water chemistry. Elevated levels may exert a cathartic or diuretic action.
Total Dissolved Solids	A measure of water salinity.
Iron	Causes staining to laundry and porcelain and astringent taste. Oxidizes to red-brown precipitate on exposure to air.
Manganese	Elevated levels may cause staining of laundry and porcelain.
Heterotrophic Plate Count	Criteria is 500 cfu/mL Measure of heterotrophic bacteria present.

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
Contact: Marci Friedman Hamm

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-WP	**Water**							
Batch R3668196								
WG2489325-9 LCS								
Alkalinity, Total (as CaCO3)			102.6		%		85-115	03-MAR-17
WG2489325-6 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	03-MAR-17
CL-IC-N-WP	**Water**							
Batch R3669031								
WG2488595-6 LCS								
Chloride (Cl)			100.7		%		90-110	03-MAR-17
WG2488595-5 MB								
Chloride (Cl)			<0.50		mg/L		0.5	03-MAR-17
EC-WP	**Water**							
Batch R3668196								
WG2489325-8 LCS								
Conductivity			101.1		%		90-110	03-MAR-17
WG2489325-6 MB								
Conductivity			<1.0		umhos/cm		1	03-MAR-17
MET-D-MS-WP	**Water**							
Batch R3669328								
WG2490118-2 LCS								
Calcium (Ca)-Dissolved			100.5		%		80-120	07-MAR-17
Magnesium (Mg)-Dissolved			106.6		%		80-120	07-MAR-17
Potassium (K)-Dissolved			104.3		%		80-120	07-MAR-17
Sodium (Na)-Dissolved			104.6		%		80-120	07-MAR-17
WG2490118-1 MB								
Calcium (Ca)-Dissolved			<0.20		mg/L		0.2	07-MAR-17
Magnesium (Mg)-Dissolved			<0.050		mg/L		0.05	07-MAR-17
Potassium (K)-Dissolved			<0.10		mg/L		0.1	07-MAR-17
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	07-MAR-17
NO2-L-IC-N-WP	**Water**							
Batch R3669031								
WG2488595-6 LCS								
Nitrite (as N)			100.0		%		90-110	03-MAR-17
WG2488595-5 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	03-MAR-17
NO3-L-IC-N-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO3-L-IC-N-WP	**Water**							
Batch R3669031								
WG2488595-6 LCS								
Nitrate (as N)			101.3		%		90-110	03-MAR-17
WG2488595-5 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	03-MAR-17
PH-WP	**Water**							
Batch R3668196								
WG2489325-7 LCS								
pH			7.41		pH units		7.3-7.5	03-MAR-17
SO4-IC-N-WP	**Water**							
Batch R3669031								
WG2488595-6 LCS								
Sulfate (SO4)			101.8		%		90-110	03-MAR-17
WG2488595-5 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	03-MAR-17
TC,EC-QT97-ENDPT-WP	**Water**							
Batch R3668315								
WG2488779-2 DUP		**L1897170-1**						
Total Coliforms		<1	<1	RPD-NA	MPN/100mL	N/A	65	03-MAR-17
Escherichia Coli		<1	<1	RPD-NA	MPN/100mL	N/A	65	03-MAR-17
WG2488779-1 MB								
Total Coliforms			<1		MPN/100mL		1	03-MAR-17
Escherichia Coli			<1		MPN/100mL		1	03-MAR-17
TURBIDITY-WP	**Water**							
Batch R3668273								
WG2489372-5 LCS								
Turbidity			102.0		%		85-115	03-MAR-17
WG2489372-4 MB								
Turbidity			<0.10		NTU		0.1	03-MAR-17

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	03-MAR-17 11:00	03-MAR-17 11:43	0.25	0.72	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1897170 were received on 03-MAR-17 14:20.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

10- 231790

L1897170-COFC

ALS Environmental — Form

Page 1 of 1

Report To		Standard: X Other (specify):	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company:	KGS Group	Select: PDF X Excel X Digital Fax	X Regular (Standard Turnaround Times - Business Days)
Contact:	Marci Friedman Hamm	Email 1: MFHamm@KGSgroup.com	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	865 Waverly Street 3rd floor Wpg MB R3T 5P4	Email 2: PLindell@KGSgroup.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone:	204-896-1209 Fax: 896-0754	AMelvin@KGSgroup.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT

Invoice To	Same as Report? (circle) Yes or No (if No, provide details)	Client / Project Information	
	Copy of Invoice with Report? (circle) Yes or No	Job #:	16-0300-002.1000.02
Company:		PO / AFE:	Floodway Pre Melt
Contact:	Accounts Payable	LSD:	Floodway Manitoba
Address:			
Phone:	Fax:	Quote #:	Q55656

Lab Work Order # (lab use only)

ALS Contact: Judy — Sampler: ACn + ADS

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	KGS-Routine-D-FDW7-WP	TC, EC-ST97-WP	Number of Containers
	K09-12316	03-Mar-17	11:00	GW	X	X	3
	K11-12014	"	12:00	GW	X	X	3
	MW 100	"	13:00	GW	X	X	3

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Not filtered Not preserved

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

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Released by: [signature]	Date: Mar 3/17	Time: 14:20	Received by: [signature]	Date: 14:20	Time: 3-3-17	Temperature: 6 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

KGS Group Consultants (Winnipeg)
ATTN: MIKE SMITH
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4

Date Received: 06-APR-17
Report Date: 17-APR-17 14:59 (MT)
Version: FINAL

Client Phone: 204-896-1209

Certificate of Analysis

Lab Work Order #: L1910112

Project P.O. #: NOT SUBMITTED
Job Reference: 16-0300-002
C of C Numbers:
Legal Site Desc:

Hua Wo
Chemistry Laboratory Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1910112-1 K09-12011							
Sampled By: ADS/RAP on 06-APR-17 @ 09:00							
Matrix: GW							
ROU1W Dissolved Floodway							
Alkalinity, Bicarbonate							
Bicarbonate (HCO3)	294		1.2	mg/L		10-APR-17	
Alkalinity, Carbonate							
Carbonate (CO3)	<0.60		0.60	mg/L		10-APR-17	
Alkalinity, Hydroxide							
Hydroxide (OH)	<0.34		0.34	mg/L		10-APR-17	
Alkalinity, Total (as CaCO3)							
Alkalinity, Total (as CaCO3)	241		1.0	mg/L		07-APR-17	R3695945
Chloride in Water by IC							
Chloride (Cl)	7.12		0.50	mg/L		07-APR-17	R3701562
Conductivity							
Conductivity	463		1.0	umhos/cm		07-APR-17	R3695945
Dissolved Metals by ICP-MS							
Calcium (Ca)-Dissolved	48.1		0.20	mg/L	07-APR-17	07-APR-17	R3696515
Magnesium (Mg)-Dissolved	28.7		0.050	mg/L	07-APR-17	07-APR-17	R3696515
Potassium (K)-Dissolved	2.67		0.10	mg/L	07-APR-17	07-APR-17	R3696515
Sodium (Na)-Dissolved	8.67		0.050	mg/L	07-APR-17	07-APR-17	R3696515
Hardness Calculated							
Hardness (as CaCO3)	239		0.54	mg/L		11-APR-17	
Ion Balance Calculation							
Ion Balance	97.7			%		17-APR-17	
Cation - Anion Balance	-1.2			%		17-APR-17	
Anion Sum	5.33			me/L		17-APR-17	
Cation Sum	5.21			me/L		17-APR-17	
Nitrate in Water by IC (Low Level)							
Nitrate (as N)	<0.0050		0.0050	mg/L		07-APR-17	R3701562
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.0051		0.0051	mg/L		17-APR-17	
Nitrite in Water by IC (Low Level)							
Nitrite (as N)	0.0014		0.0010	mg/L		07-APR-17	R3701562
Sulfate in Water by IC							
Sulfate (SO4)	14.9		0.30	mg/L		07-APR-17	R3701562
TDS calculated							
TDS (Calculated)	255		5.0	mg/L		11-APR-17	
Turbidity							
Turbidity	1.13		0.10	NTU		07-APR-17	R3696292
pH							
pH	7.73		0.10	pH units		07-APR-17	R3695945
L1910112-2 K11-12017							
Sampled By: ADS/RAP on 06-APR-17 @ 10:00							
Matrix: GW							
ROU1W Dissolved Floodway							
Alkalinity, Bicarbonate							
Bicarbonate (HCO3)	320		1.2	mg/L		10-APR-17	
Alkalinity, Carbonate							
Carbonate (CO3)	<0.60		0.60	mg/L		10-APR-17	
Alkalinity, Hydroxide							
Hydroxide (OH)	<0.34		0.34	mg/L		10-APR-17	
Alkalinity, Total (as CaCO3)							
Alkalinity, Total (as CaCO3)	262		1.0	mg/L		07-APR-17	R3695945
Chloride in Water by IC							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1910112-2 K11-12017							
Sampled By: ADS/RAP on 06-APR-17 @ 10:00							
Matrix: GW							
Chloride in Water by IC							
Chloride (Cl)	20.0		0.50	mg/L		07-APR-17	R3701562
Conductivity							
Conductivity	970		1.0	umhos/cm		07-APR-17	R3695945
Dissolved Metals by ICP-MS							
Calcium (Ca)-Dissolved	82.6		0.20	mg/L	07-APR-17	07-APR-17	R3696515
Magnesium (Mg)-Dissolved	65.5		0.050	mg/L	07-APR-17	07-APR-17	R3696515
Potassium (K)-Dissolved	3.86		0.10	mg/L	07-APR-17	07-APR-17	R3696515
Sodium (Na)-Dissolved	45.0		0.050	mg/L	07-APR-17	07-APR-17	R3696515
Hardness Calculated							
Hardness (as CaCO3)	476		0.54	mg/L		11-APR-17	
Ion Balance Calculation							
Ion Balance	104			%		17-APR-17	
Cation - Anion Balance	2.0			%		17-APR-17	
Anion Sum	11.1			me/L		17-APR-17	
Cation Sum	11.6			me/L		17-APR-17	
Nitrate in Water by IC (Low Level)							
Nitrate (as N)	<0.0050		0.0050	mg/L		07-APR-17	R3701562
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.0051		0.0051	mg/L		17-APR-17	
Nitrite in Water by IC (Low Level)							
Nitrite (as N)	<0.0010		0.0010	mg/L		07-APR-17	R3701562
Sulfate in Water by IC							
Sulfate (SO4)	255		0.30	mg/L		07-APR-17	R3701562
TDS calculated							
TDS (Calculated)	630		5.0	mg/L		11-APR-17	
Turbidity							
Turbidity	2.55		0.10	NTU		07-APR-17	R3696292
pH							
pH	7.56		0.10	pH units		07-APR-17	R3695945
L1910112-3 K11-12016							
Sampled By: ADS/RAP on 06-APR-17 @ 11:30							
Matrix: GW							
ROU1W Dissolved Floodway							
Alkalinity, Bicarbonate							
Bicarbonate (HCO3)	366		1.2	mg/L		10-APR-17	
Alkalinity, Carbonate							
Carbonate (CO3)	<0.60		0.60	mg/L		10-APR-17	
Alkalinity, Hydroxide							
Hydroxide (OH)	<0.34		0.34	mg/L		10-APR-17	
Alkalinity, Total (as CaCO3)							
Alkalinity, Total (as CaCO3)	300		1.0	mg/L		07-APR-17	R3695945
Chloride in Water by IC							
Chloride (Cl)	14.6		0.50	mg/L		07-APR-17	R3701562
Conductivity							
Conductivity	1010		1.0	umhos/cm		07-APR-17	R3695945
Dissolved Metals by ICP-MS							
Calcium (Ca)-Dissolved	92.7		0.20	mg/L	07-APR-17	07-APR-17	R3696515
Magnesium (Mg)-Dissolved	70.5		0.050	mg/L	07-APR-17	07-APR-17	R3696515
Potassium (K)-Dissolved	4.45		0.10	mg/L	07-APR-17	07-APR-17	R3696515
Sodium (Na)-Dissolved	37.5		0.050	mg/L	07-APR-17	07-APR-17	R3696515
Hardness Calculated							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1910112-3 K11-12016							
Sampled By: ADS/RAP on 06-APR-17 @ 11:30							
Matrix: GW							
Hardness Calculated							
Hardness (as CaCO3)	522		0.54	mg/L		11-APR-17	
Ion Balance Calculation							
Ion Balance	104			%		17-APR-17	
Cation - Anion Balance	2.0			%		17-APR-17	
Anion Sum	11.7			me/L		17-APR-17	
Cation Sum	12.2			me/L		17-APR-17	
Nitrate in Water by IC (Low Level)							
Nitrate (as N)	<0.0050		0.0050	mg/L		07-APR-17	R3701562
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.0051		0.0051	mg/L		17-APR-17	
Nitrite in Water by IC (Low Level)							
Nitrite (as N)	<0.0010		0.0010	mg/L		07-APR-17	R3701562
Sulfate in Water by IC							
Sulfate (SO4)	254		0.30	mg/L		07-APR-17	R3701562
TDS calculated							
TDS (Calculated)	654		5.0	mg/L		11-APR-17	
Turbidity							
Turbidity	0.33		0.10	NTU		07-APR-17	R3696292
pH							
pH	7.50		0.10	pH units		07-APR-17	R3695945
L1910112-4 K11-12014							
Sampled By: ADS/RAP on 06-APR-17 @ 12:45							
Matrix: GW							
ROU1W Dissolved Floodway							
Alkalinity, Bicarbonate							
Bicarbonate (HCO3)	254		1.2	mg/L		10-APR-17	
Alkalinity, Carbonate							
Carbonate (CO3)	<0.60		0.60	mg/L		10-APR-17	
Alkalinity, Hydroxide							
Hydroxide (OH)	<0.34		0.34	mg/L		10-APR-17	
Alkalinity, Total (as CaCO3)							
Alkalinity, Total (as CaCO3)	208		1.0	mg/L		07-APR-17	R3695945
Chloride in Water by IC							
Chloride (Cl)	11.7		0.50	mg/L		07-APR-17	R3701562
Conductivity							
Conductivity	531		1.0	umhos/cm		07-APR-17	R3695945
Dissolved Metals by ICP-MS							
Calcium (Ca)-Dissolved	52.7		0.20	mg/L	07-APR-17	07-APR-17	R3696515
Magnesium (Mg)-Dissolved	33.4		0.050	mg/L	07-APR-17	07-APR-17	R3696515
Potassium (K)-Dissolved	4.35		0.10	mg/L	07-APR-17	07-APR-17	R3696515
Sodium (Na)-Dissolved	9.19		0.050	mg/L	07-APR-17	07-APR-17	R3696515
Hardness Calculated							
Hardness (as CaCO3)	269		0.54	mg/L		11-APR-17	
Ion Balance Calculation							
Ion Balance	100			%		17-APR-17	
Cation - Anion Balance	0.2			%		17-APR-17	
Anion Sum	5.87			me/L		17-APR-17	
Cation Sum	5.89			me/L		17-APR-17	
Nitrate in Water by IC (Low Level)							
Nitrate (as N)	0.372		0.0050	mg/L		07-APR-17	R3701562
Nitrate+Nitrite							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1910112-4 K11-12014							
Sampled By: ADS/RAP on 06-APR-17 @ 12:45							
Matrix: GW							
Nitrate+Nitrite							
Nitrate and Nitrite as N	0.372		0.0051	mg/L		17-APR-17	
Nitrite in Water by IC (Low Level)							
Nitrite (as N)	<0.0010		0.0010	mg/L		07-APR-17	R3701562
Sulfate in Water by IC							
Sulfate (SO4)	64.7		0.30	mg/L		07-APR-17	R3701562
TDS calculated							
TDS (Calculated)	301		5.0	mg/L		11-APR-17	
Turbidity							
Turbidity	2.35		0.10	NTU		07-APR-17	R3696292
pH							
pH	7.73		0.10	pH units		07-APR-17	R3695945
Total Coliform and E.coli by MPN QT97							
Total Coliforms	17		1	MPN/100mL		06-APR-17	R3695036
Escherichia Coli	1		1	MPN/100mL		06-APR-17	R3695036
L1910112-5 K11-12015							
Sampled By: ADS/RAP on 06-APR-17 @ 13:45							
Matrix: GW							
ROU1W Dissolved Floodway							
Alkalinity, Bicarbonate							
Bicarbonate (HCO3)	233		1.2	mg/L		10-APR-17	
Alkalinity, Carbonate							
Carbonate (CO3)	<0.60		0.60	mg/L		10-APR-17	
Alkalinity, Hydroxide							
Hydroxide (OH)	<0.34		0.34	mg/L		10-APR-17	
Alkalinity, Total (as CaCO3)							
Alkalinity, Total (as CaCO3)	191		1.0	mg/L		07-APR-17	R3695945
Chloride in Water by IC							
Chloride (Cl)	12.6		0.50	mg/L		07-APR-17	R3701562
Conductivity							
Conductivity	489		1.0	umhos/cm		07-APR-17	R3695945
Dissolved Metals by ICP-MS							
Calcium (Ca)-Dissolved	49.3		0.20	mg/L	07-APR-17	07-APR-17	R3696515
Magnesium (Mg)-Dissolved	30.5		0.050	mg/L	07-APR-17	07-APR-17	R3696515
Potassium (K)-Dissolved	3.96		0.10	mg/L	07-APR-17	07-APR-17	R3696515
Sodium (Na)-Dissolved	9.14		0.050	mg/L	07-APR-17	07-APR-17	R3696515
Hardness Calculated							
Hardness (as CaCO3)	249		0.54	mg/L		11-APR-17	
Ion Balance Calculation							
Ion Balance	102			%		17-APR-17	
Cation - Anion Balance	1.0			%		17-APR-17	
Anion Sum	5.36			me/L		17-APR-17	
Cation Sum	5.47			me/L		17-APR-17	
Nitrate in Water by IC (Low Level)							
Nitrate (as N)	0.474		0.0050	mg/L		07-APR-17	R3701562
Nitrate+Nitrite							
Nitrate and Nitrite as N	0.474		0.0051	mg/L		17-APR-17	
Nitrite in Water by IC (Low Level)							
Nitrite (as N)	<0.0010		0.0010	mg/L		07-APR-17	R3701562
Sulfate in Water by IC							
Sulfate (SO4)	55.4		0.30	mg/L		07-APR-17	R3701562
TDS calculated							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1910112-5 K11-12015							
Sampled By: ADS/RAP on 06-APR-17 @ 13:45							
Matrix: GW							
TDS calculated							
TDS (Calculated)	276		5.0	mg/L		11-APR-17	
Turbidity							
Turbidity	1.44		0.10	NTU		07-APR-17	R3696292
pH							
pH	7.79		0.10	pH units		07-APR-17	R3695945
Total Coliform and E.coli by MPN QT97							
Total Coliforms	12		1	MPN/100mL		06-APR-17	R3695036
Escherichia Coli	2		1	MPN/100mL		06-APR-17	R3695036
L1910112-6 K13-12322							
Sampled By: ADS/RAP on 06-APR-17 @ 14:45							
Matrix: GW							
ROU1W Dissolved Floodway							
Alkalinity, Bicarbonate							
Bicarbonate (HCO3)	322		1.2	mg/L		10-APR-17	
Alkalinity, Carbonate							
Carbonate (CO3)	<0.60		0.60	mg/L		10-APR-17	
Alkalinity, Hydroxide							
Hydroxide (OH)	<0.34		0.34	mg/L		10-APR-17	
Alkalinity, Total (as CaCO3)							
Alkalinity, Total (as CaCO3)	264		1.0	mg/L		07-APR-17	R3695945
Chloride in Water by IC							
Chloride (Cl)	16.1		0.50	mg/L		07-APR-17	R3701562
Conductivity							
Conductivity	796		1.0	umhos/cm		07-APR-17	R3695945
Dissolved Metals by ICP-MS							
Calcium (Ca)-Dissolved	68.5		0.20	mg/L	07-APR-17	07-APR-17	R3696515
Magnesium (Mg)-Dissolved	55.7		0.050	mg/L	07-APR-17	07-APR-17	R3696515
Potassium (K)-Dissolved	3.79		0.10	mg/L	07-APR-17	07-APR-17	R3696515
Sodium (Na)-Dissolved	27.8		0.050	mg/L	07-APR-17	07-APR-17	R3696515
Hardness Calculated							
Hardness (as CaCO3)	400		0.54	mg/L		11-APR-17	
Ion Balance Calculation							
Ion Balance	102			%		17-APR-17	
Cation - Anion Balance	1.1			%		17-APR-17	
Anion Sum	9.10			me/L		17-APR-17	
Cation Sum	9.31			me/L		17-APR-17	
Nitrate in Water by IC (Low Level)							
Nitrate (as N)	<0.0050		0.0050	mg/L		07-APR-17	R3701562
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.0051		0.0051	mg/L		17-APR-17	
Nitrite in Water by IC (Low Level)							
Nitrite (as N)	<0.0010		0.0010	mg/L		07-APR-17	R3701562
Sulfate in Water by IC							
Sulfate (SO4)	162		0.30	mg/L		07-APR-17	R3701562
TDS calculated							
TDS (Calculated)	492		5.0	mg/L		11-APR-17	
Turbidity							
Turbidity	0.75		0.10	NTU		07-APR-17	R3696292
pH							
pH	7.62		0.10	pH units		07-APR-17	R3695945

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1910112-6 K13-12322 Sampled By: ADS/RAP on 06-APR-17 @ 14:45 Matrix: GW							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-CO3CO3-CALC-WP	Water	Alkalinity, Carbonate	CALCULATION
The Alkalinity of water is a measure of its acid neutralizing capacity.Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contributed by carbonate is calculated and reported as mg CO3 2-/L.			
ALK-HCO3HCO3-CALC-WP	Water	Alkalinity, Bicarbonate	CALCULATION
The Alkalinity of water is a measure of its acid neutralizing capacity.Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contributed by bicarbonate is calculated and reported as mg HCO3-/L			
ALK-OHOH-CALC-WP	Water	Alkalinity, Hydroxide	CALCULATION
The Alkalinity of water is a measure of its acid neutralizing capacity.Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contributed by hydroxide is calculated and reported as mg OH-/L.			
ALK-TITR-WP	Water	Alkalinity, Total (as CaCO3)	APHA 2320B
The Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. Total alkalinity is determined by titration with a strong standard mineral acid to the successive HCO3- and H2CO3 endpoints indicated electrometrically.			
CL-IC-N-WP	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-WP	Water	Conductivity	APHA 2510B
Conductivity of an aqueous solution refers to its ability to carry an electric current. Conductance of a solution is measured between two spatially fixed and chemically inert electrodes.			
ETL-SOLIDS-CALC-WP	Water	TDS calculated	CALCULATION
HARDNESS-CALC-WP	Water	Hardness Calculated	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
IONBALANCE-CALC-WP	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance (as % difference) cannot be calculated accurately for waters with very low electrical conductivity (EC), and is reported as "Low EC" where EC < 100 uS/cm (umhos/cm). Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-D-MS-WP	Water	Dissolved Metals by ICP-MS	APHA 3030B/EPA 6020A-D
This analysis involves filtration (APHA 3030B) and analysis by inductively coupled plasma - mass spectrometry (EPA Method 6020A).			
NO2+NO3-CALC-L-WP	Water	Nitrate+Nitrite	CALCULATION
NO2-L-IC-N-WP	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WP	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-WP	Water	pH	APHA 4500H
The pH of a sample is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode.			
SO4-IC-N-WP	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TC,EC-QT97-WP	Water	Total Coliform and E.coli by MPN QT97	APHA 9223B QT97

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
This analysis is carried out using procedures adapted from APHA Method 9223B "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture of hydrolyzable substrates and then sealed in a 97-well packet. The packet is incubated at 35.0 – 0.5°C for 18 or 24 hours and then the number of wells exhibiting positive responses are counted. The final results are obtained by comparing the number of positive responses to a probability table.			
TURBIDITY-WP	Water	Turbidity	APHA 2130B (modified)
Turbidity in aqueous matrices is determined by the nephelometric method.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
Contact: MIKE SMITH

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-WP	**Water**							
Batch R3695945								
WG2507657-5 DUP		**L1910112-1**						
Alkalinity, Total (as CaCO3)		241	240		mg/L	0.2	20	07-APR-17
WG2507657-4 LCS								
Alkalinity, Total (as CaCO3)			106.3		%		85-115	07-APR-17
WG2507657-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	07-APR-17
CL-IC-N-WP	**Water**							
Batch R3701562								
WG2507551-3 DUP		**L1910112-1**						
Chloride (Cl)		7.12	7.26		mg/L	1.8	20	07-APR-17
WG2507551-2 LCS								
Chloride (Cl)			96.7		%		90-110	07-APR-17
WG2507551-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	07-APR-17
WG2507551-4 MS		**L1910112-1**						
Chloride (Cl)			98.0		%		75-125	07-APR-17
EC-WP	**Water**							
Batch R3695945								
WG2507657-5 DUP		**L1910112-1**						
Conductivity		463	464		umhos/cm	0.2	10	07-APR-17
WG2507657-3 LCS								
Conductivity			99.7		%		90-110	07-APR-17
WG2507657-1 MB								
Conductivity			<1.0		umhos/cm		1	07-APR-17
MET-D-MS-WP	**Water**							
Batch R3696515								
WG2507468-2 LCS								
Calcium (Ca)-Dissolved			102.1		%		80-120	07-APR-17
Magnesium (Mg)-Dissolved			108.8		%		80-120	07-APR-17
Potassium (K)-Dissolved			106.4		%		80-120	07-APR-17
Sodium (Na)-Dissolved			109.0		%		80-120	07-APR-17
WG2507468-1 MB								
Calcium (Ca)-Dissolved			<0.20		mg/L		0.2	07-APR-17
Magnesium (Mg)-Dissolved			<0.050		mg/L		0.05	07-APR-17
Potassium (K)-Dissolved			<0.10		mg/L		0.1	07-APR-17
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	07-APR-17
NO2-L-IC-N-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO2-L-IC-N-WP	**Water**							
Batch R3701562								
WG2507551-3 DUP		**L1910112-1**						
Nitrite (as N)		0.0014	0.0011	J	mg/L	0.0003	0.002	07-APR-17
WG2507551-2 LCS								
Nitrite (as N)			98.9		%		90-110	07-APR-17
WG2507551-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	07-APR-17
WG2507551-4 MS		**L1910112-1**						
Nitrite (as N)			96.4		%		75-125	07-APR-17
NO3-L-IC-N-WP	**Water**							
Batch R3701562								
WG2507551-3 DUP		**L1910112-1**						
Nitrate (as N)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	07-APR-17
WG2507551-2 LCS								
Nitrate (as N)			99.2		%		90-110	07-APR-17
WG2507551-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	07-APR-17
WG2507551-4 MS		**L1910112-1**						
Nitrate (as N)			98.7		%		75-125	07-APR-17
PH-WP	**Water**							
Batch R3695945								
WG2507657-5 DUP		**L1910112-1**						
pH		7.73	7.71	J	pH units	0.02	0.2	07-APR-17
WG2507657-2 LCS								
pH			7.40		pH units		7.3-7.5	07-APR-17
SO4-IC-N-WP	**Water**							
Batch R3701562								
WG2507551-3 DUP		**L1910112-1**						
Sulfate (SO4)		14.9	15.1		mg/L	1.4	20	07-APR-17
WG2507551-2 LCS								
Sulfate (SO4)			99.7		%		90-110	07-APR-17
WG2507551-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	07-APR-17
WG2507551-4 MS		**L1910112-1**						
Sulfate (SO4)			97.3		%		75-125	07-APR-17
TC,EC-QT97-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TC,EC-QT97-WP	**Water**							
Batch R3695036								
WG2507032-2 DUP		**L1910112-4**						
Total Coliforms		17	16		MPN/100mL	6.6	65	06-APR-17
Escherichia Coli		1	<1	RPD-NA	MPN/100mL	N/A	65	06-APR-17
WG2507032-1 MB								
Total Coliforms			<1		MPN/100mL		1	06-APR-17
Escherichia Coli			<1		MPN/100mL		1	06-APR-17
TURBIDITY-WP	**Water**							
Batch R3696292								
WG2507688-2 LCS								
Turbidity			103.0		%		85-115	07-APR-17
WG2507688-1 MB								
Turbidity			<0.10		NTU		0.1	07-APR-17

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	06-APR-17 09:00	07-APR-17 12:03	0.25	27	hours	EHTR-FM
	2	06-APR-17 10:00	07-APR-17 12:03	0.25	26	hours	EHTR-FM
	3	06-APR-17 11:30	07-APR-17 12:03	0.25	24	hours	EHTR-FM
	4	06-APR-17 12:45	07-APR-17 12:03	0.25	23	hours	EHTR-FM
	5	06-APR-17 13:45	07-APR-17 12:03	0.25	22	hours	EHTR-FM
	6	06-APR-17 14:45	07-APR-17 12:03	0.25	21	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1910112 were received on 06-APR-17 16:10.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

10- 232026

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

L1910112

Page 1 of 1

L1910112-COFC

Report To MIKE SMITH	**Report Format / Distribution**		**Service Request:** (Rush subject to availability - Contact ALS to confirm TAT)
Company: KGS GROUP	Standard: ✓ Other (specify):		✓ Regular (Standard)
Contact: MIKE SMITH	Select: PDF ✓ Excel Digital Fax		Priority (2-4 Bus...)
Address: 865 WAVERLEY ST, 3RD FLOOR	Email 1: MSMITH@KGSGROUP.COM		Emergency (1-2...)
WINNIPEG, MB, R3T 5P4	Email 2: MF HAMM@KGSGROUP.COM		Same Day or W...
Phone: 204 896-1209 Fax: 204 896-0754	WMACQUARRIE@KGSGROUP.COM		
Invoice To Same as Report ? (circle) Yes or (No) (If No, provide details)	**Client / Project Information**		(Indicate Filtered or Preserved, F/P)
Copy of Invoice with Report? (circle) Yes or (No)	Job #: 16-0300-007		
Company: KGS GROUP	PO / AFE:		
Contact: BILL MACQUARRIE	LSD:		
Address: 865 WAVERLEY ST, 3RD FLOOR, WINNIPEG, MB			
Phone: 204 896-1209 Fax: 204 896-0754	Quote #: Q56271		
Lab Work Order # (lab use only)	**ALS Contact:** CRAIG	**Sampler:** ADS/KAP	

Analyses requested: KGS-Rou[tine]-W-O-FL-[illegible]; TC-EC-Q797-WP

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	KGS-Rou W-O-FL	TC-EC-Q797-WP	Number of Containers
	K09-12011	APRIL 6/17	0900	GW	X		2
	K11-12017	↓	10:00	↓	X		2
	K11-12016	↓	10:30	↓	X		2
	K11-12014	↓	12:45	↓	X	X	3
	K11-12015	↓	13:45	↓	X	X	3
	K13-12322	↓	14:45	↓	X		2

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

METALS - NOT FIELD FILTERED; NOT PRESERVED IN FIELD; LAB TO FILTER AND PRESERVE SAMPLES

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: [signature]	Date: APRIL 6/17	Time:	Received by: 1610	Date: April 6, 17	Time: 4:10 pm	Temperature: 5.6 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION David I   WHITE - LABORATORY COPY   YELLOW - CLIENT COPY   GENF 18.01 Front

DI

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909579
Project Ref: 16-0300-002
Sample ID: K13-12321
Sampled By: AS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909579-1
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	542		mg/L			07-APR-17
Carbonate (CO3)	<0.60		mg/L			07-APR-17
Hydroxide (OH)	<0.34		mg/L			07-APR-17
*Nitrate and Nitrite as N	2.89		mg/L	10		13-APR-17
pH						
pH	7.57		pH units			06-APR-17
Turbidity						
*Turbidity	0.33		NTU			06-APR-17
TDS calculated						
TDS (Calculated)	580		mg/L		500	11-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	75.6		mg/L		500	06-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0020	DLM	mg/L	1		06-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	2.89		mg/L	10		06-APR-17
Ion Balance Calculation						
Ion Balance	105		%			13-APR-17
Cation - Anion Balance	2.3		%			13-APR-17
Anion Sum	11.8		me/L			13-APR-17
Cation Sum	12.4		me/L			13-APR-17
Hardness Calculated						
Hardness (as CaCO3)	552		mg/L		500	11-APR-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	78.2		mg/L			07-APR-17
Magnesium (Mg)-Dissolved	86.6		mg/L			07-APR-17
Potassium (K)-Dissolved	4.89		mg/L			07-APR-17
Sodium (Na)-Dissolved	27.6		mg/L		200	07-APR-17
Conductivity						
Conductivity	1030		umhos/cm			06-APR-17
Chloride in Water by IC						
Chloride (Cl)	40.4		mg/L		250	06-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	445		mg/L			06-APR-17
Total Coliform and E.coli by MPN QT97						

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909579
Project Ref: 16-0300-002
Sample ID: K13-12321
Sampled By: AS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909579-1
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	2		MPN/100mL	0		05-APR-17
Escherichia Coli	<1		MPN/100mL	0		05-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909579
Project Ref: 16-0300-002
Sample ID: K09-12316
Sampled By: AS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909579-2
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	393		mg/L			07-APR-17
Carbonate (CO3)	<0.60		mg/L			07-APR-17
Hydroxide (OH)	<0.34		mg/L			07-APR-17
*Nitrate and Nitrite as N	0.832		mg/L	10		13-APR-17
pH						
pH	7.72		pH units			06-APR-17
Turbidity						
*Turbidity	0.28		NTU			06-APR-17
TDS calculated						
TDS (Calculated)	456		mg/L		500	11-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	73.2		mg/L		500	06-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0020	DLM	mg/L	1		06-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.832		mg/L	10		06-APR-17
Ion Balance Calculation						
Ion Balance	104		%			13-APR-17
Cation - Anion Balance	1.7		%			13-APR-17
Anion Sum	9.00		me/L			13-APR-17
Cation Sum	9.32		me/L			13-APR-17
Hardness Calculated						
Hardness (as CaCO3)	398		mg/L		500	11-APR-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	64.3		mg/L			07-APR-17
Magnesium (Mg)-Dissolved	57.6		mg/L			07-APR-17
Potassium (K)-Dissolved	4.42		mg/L			07-APR-17
Sodium (Na)-Dissolved	28.8		mg/L		200	07-APR-17
Conductivity						
Conductivity	804		umhos/cm			06-APR-17
Chloride in Water by IC						
Chloride (Cl)	34.5		mg/L		250	06-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	323		mg/L			06-APR-17
Total Coliform and E.coli by MPN QT97						

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
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ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909579
Project Ref: 16-0300-002
Sample ID: K09-12316
Sampled By: AS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909579-2
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	2		MPN/100mL	0		05-APR-17
Escherichia Coli	1		MPN/100mL	0		05-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909579
Project Ref: 16-0300-002
Sample ID: U09-13571
Sampled By: AS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909579-3
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	431		mg/L			07-APR-17
Carbonate (CO3)	<0.60		mg/L			07-APR-17
Hydroxide (OH)	<0.34		mg/L			07-APR-17
*Nitrate and Nitrite as N	1.03		mg/L	10		13-APR-17
pH						
pH	7.44		pH units			06-APR-17
Turbidity						
*Turbidity	0.50		NTU			06-APR-17
TDS calculated						
TDS (Calculated)	552		mg/L		500	11-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	105		mg/L		500	06-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0020	DLM	mg/L	1		06-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	1.03		mg/L	10		06-APR-17
Ion Balance Calculation						
Ion Balance	106		%			13-APR-17
Cation - Anion Balance	2.7		%			13-APR-17
Anion Sum	10.6		me/L			13-APR-17
Cation Sum	11.2		me/L			13-APR-17
Hardness Calculated						
Hardness (as CaCO3)	466		mg/L		500	11-APR-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	71.9		mg/L			07-APR-17
Magnesium (Mg)-Dissolved	69.5		mg/L			07-APR-17
Potassium (K)-Dissolved	5.01		mg/L			07-APR-17
Sodium (Na)-Dissolved	41.5		mg/L		200	07-APR-17
Conductivity						
Conductivity	952		umhos/cm			06-APR-17
Chloride in Water by IC						
Chloride (Cl)	46.9		mg/L		250	06-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	353		mg/L			06-APR-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909579
Project Ref: 16-0300-002
Sample ID: U09-13571
Sampled By: AS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909579-3
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
CDWQG = Health Canada Guideline Limits updated	**DECEMBER 2015**					

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909579
Project Ref: 16-0300-002
Sample ID: K11-12018
Sampled By: AS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909579-4
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	741		mg/L			07-APR-17
Carbonate (CO3)	<0.60		mg/L			07-APR-17
Hydroxide (OH)	<0.34		mg/L			07-APR-17
*Nitrate and Nitrite as N	<0.010		mg/L	10		13-APR-17
pH						
pH	7.19		pH units			06-APR-17
Turbidity						
*Turbidity	2.88		NTU			06-APR-17
TDS calculated						
TDS (Calculated)	704		mg/L		500	11-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	107		mg/L		500	06-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0020	DLM	mg/L	1		06-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	<0.010	DLM	mg/L	10		06-APR-17
Ion Balance Calculation						
Ion Balance	101		%			13-APR-17
Cation - Anion Balance	0.6		%			13-APR-17
Anion Sum	14.4		me/L			13-APR-17
Cation Sum	14.6		me/L			13-APR-17
Hardness Calculated						
Hardness (as CaCO3)	657		mg/L		500	11-APR-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	87.7		mg/L			07-APR-17
Magnesium (Mg)-Dissolved	106		mg/L			07-APR-17
Potassium (K)-Dissolved	5.31		mg/L			07-APR-17
Sodium (Na)-Dissolved	31.0		mg/L		200	07-APR-17
Conductivity						
Conductivity	1180		umhos/cm			06-APR-17
Chloride in Water by IC						
Chloride (Cl)	1.8	DLM	mg/L		250	06-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	608		mg/L			06-APR-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909579
Project Ref: 16-0300-002
Sample ID: K11-12018
Sampled By: AS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909579-4
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909579
Project Ref: 16-0300-002
Sample ID: MW-100
Sampled By: AS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909579-5
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	395		mg/L			07-APR-17
Carbonate (CO3)	<0.60		mg/L			07-APR-17
Hydroxide (OH)	<0.34		mg/L			07-APR-17
*Nitrate and Nitrite as N	0.838		mg/L	10		13-APR-17
pH						
pH	7.61		pH units			06-APR-17
Turbidity						
*Turbidity	0.19		NTU			06-APR-17
TDS calculated						
TDS (Calculated)	460		mg/L		500	11-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	73.0		mg/L		500	06-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	0.0021	DLM	mg/L	1		06-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.836		mg/L	10		06-APR-17
Ion Balance Calculation						
Ion Balance	106		%			13-APR-17
Cation - Anion Balance	2.7		%			13-APR-17
Anion Sum	9.03		me/L			13-APR-17
Cation Sum	9.53		me/L			13-APR-17
Hardness Calculated						
Hardness (as CaCO3)	406		mg/L		500	11-APR-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	64.3		mg/L			07-APR-17
Magnesium (Mg)-Dissolved	59.6		mg/L			07-APR-17
Potassium (K)-Dissolved	4.53		mg/L			07-APR-17
Sodium (Na)-Dissolved	29.9		mg/L		200	07-APR-17
Conductivity						
Conductivity	802		umhos/cm			06-APR-17
Chloride in Water by IC						
Chloride (Cl)	34.7		mg/L		250	06-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	324		mg/L			06-APR-17
Total Coliform and E.coli by MPN QT97						

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909579
Project Ref: 16-0300-002
Sample ID: MW-100
Sampled By: AS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909579-5
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	1		MPN/100mL	0		05-APR-17
Escherichia Coli	<1		MPN/100mL	0		05-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

Guidelines & Objectives

Sample Parameter Qualifier key listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Health Canada MAC Health Related Criteria Limits

Nitrate/Nitrite-N*	Criteria limit is 10 mg/L (1.0 mg/L if present as all Nitrite-N). High concentrations may contribute to blue baby syndrome in infants.
Lead*	A cumulative body poison, uncommon in naturally occurring hard waters.
Fluoride*	Present in fluoridated water supplies at 0.8 mg/L to reduce dental caries. Elevated levels causes fluorosis (mottling of teeth).
Total Coliforms*	Criteria is 0 CFU/100mL. Adverse health effects.
E. Coli*	Criteria is 0 CFU/100 mL. Certain E. Coli bacteria can be life threatening.

*Health Canada Canadian Drinking Water Quality Guidelines (MAC limit)

Aesthetic Objective Concentration Levels

Alkalinity	Acid neutralizing capacity. Usually a measure of carbonate and bicarbonates and calculated and reported as calcium carbonate.
Balance	Quality control parameter ratioing cations to anions
Bicarbonate	See Alkalinity. Report as the anion HCO3-1
Carbonate	See Alkalinity. Reported at the anion CO3-2
Calcium	See Hardness. Common major cation of water chemistry.
Chloride	Common major anion of water chemistry.
Conductance	Physical test measuring water salinity (dissolved ions or solids)
Hardness	Classical measure or capacity of water to precipitate soap (chiefly calcium and magnesium ions). Causes scaling tendency in water if carbonates/bicarbonates are present (if >200 mg/L). For drinking water purposes waters with results <200 mg/L are considered acceptable, results >200 mg/L are considered poor but can be tolerated. Results >500 mg/L are unacceptable.
Hydroxide	See alkalinity
Magnesium	See hardness. Common major cation of water chemistry. Elevated levels (>125 mg/L) may exert a cathartic or diuretic action.
pH	Measure of water acidity/alkalinity. Normal range is 7.0-8.5.
Potassium	Common major cation of water chemistry.
Sodium	Common major cation of water chemistry. Measure of salinity (saltiness).The aesthetic objective (not related to health) for sodium in drinking water is 200 mg/L. However, where sodium concentration of the drinking water exceeds 20 mg/L, it is recommended that any person on a sodium restricted diet consult with his/her physician or Medical Officer of Health concerning the use of that water.
Sulphate	Common major anion of water chemistry. Elevated levels may exert a cathartic or diuretic action.
Total Dissolved Solids	A measure of water salinity.
Iron	Causes staining to laundry and porcelain and astringent taste. Oxidizes to red-brown precipitate on exposure to air.
Manganese	Elevated levels may cause staining of laundry and porcelain.
Heterotrophic Plate Count	Criteria is 500 cfu/mL Measure of heterotrophic bacteria present.

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
Contact: MIKE SMITH

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-WP	**Water**							
Batch R3694853								
WG2506984-4 LCS								
Alkalinity, Total (as CaCO3)			106.6		%		85-115	06-APR-17
WG2506984-9 LCS								
Alkalinity, Total (as CaCO3)			103.7		%		85-115	06-APR-17
WG2506984-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	06-APR-17
WG2506984-6 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	06-APR-17
CL-IC-N-WP	**Water**							
Batch R3699289								
WG2506750-2 LCS								
Chloride (Cl)			97.3		%		90-110	06-APR-17
WG2506750-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	06-APR-17
EC-WP	**Water**							
Batch R3694853								
WG2506984-3 LCS								
Conductivity			100.1		%		90-110	06-APR-17
WG2506984-8 LCS								
Conductivity			100.5		%		90-110	06-APR-17
WG2506984-1 MB								
Conductivity			<1.0		umhos/cm		1	06-APR-17
WG2506984-6 MB								
Conductivity			<1.0		umhos/cm		1	06-APR-17
MET-D-MS-WP	**Water**							
Batch R3696515								
WG2507468-2 LCS								
Calcium (Ca)-Dissolved			102.1		%		80-120	07-APR-17
Magnesium (Mg)-Dissolved			108.8		%		80-120	07-APR-17
Potassium (K)-Dissolved			106.4		%		80-120	07-APR-17
Sodium (Na)-Dissolved			109.0		%		80-120	07-APR-17
WG2507468-1 MB								
Calcium (Ca)-Dissolved			<0.20		mg/L		0.2	07-APR-17
Magnesium (Mg)-Dissolved			<0.050		mg/L		0.05	07-APR-17
Potassium (K)-Dissolved			<0.10		mg/L		0.1	07-APR-17
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	07-APR-17
NO2-L-IC-N-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO2-L-IC-N-WP	**Water**							
Batch R3699289								
WG2506750-2 LCS								
Nitrite (as N)			97.8		%		90-110	06-APR-17
WG2506750-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	06-APR-17
NO3-L-IC-N-WP	**Water**							
Batch R3699289								
WG2506750-2 LCS								
Nitrate (as N)			98.6		%		90-110	06-APR-17
WG2506750-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	06-APR-17
PH-WP	**Water**							
Batch R3694853								
WG2506984-2 LCS								
pH			7.40		pH units		7.3-7.5	06-APR-17
WG2506984-7 LCS								
pH			7.40		pH units		7.3-7.5	06-APR-17
SO4-IC-N-WP	**Water**							
Batch R3699289								
WG2506750-2 LCS								
Sulfate (SO4)			98.3		%		90-110	06-APR-17
WG2506750-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	06-APR-17
TC,EC-QT97-WP	**Water**							
Batch R3694400								
WG2506317-1 DUP		**L1909579-1**						
Total Coliforms		2	1	J	MPN/100mL	1	2	05-APR-17
Escherichia Coli		<1	<1	RPD-NA	MPN/100mL	N/A	65	05-APR-17
WG2506317-2 MB								
Total Coliforms			<1		MPN/100mL		1	05-APR-17
Escherichia Coli			<1		MPN/100mL		1	05-APR-17
TURBIDITY-WP	**Water**							
Batch R3695959								
WG2506922-2 LCS								
Turbidity			104.0		%		85-115	06-APR-17
WG2506922-1 MB								
Turbidity			<0.10		NTU		0.1	06-APR-17

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	05-APR-17 10:30	06-APR-17 12:52	0.25	26	hours	EHTR-FM
	2	05-APR-17 11:25	06-APR-17 12:52	0.25	25	hours	EHTR-FM
	3	05-APR-17 13:00	06-APR-17 12:52	0.25	24	hours	EHTR-FM
	4	05-APR-17 15:00	06-APR-17 12:52	0.25	22	hours	EHTR-FM
	5	05-APR-17 14:25	06-APR-17 12:52	0.25	23	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1909579 were received on 05-APR-17 16:50.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

10- 232025

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

L1909579

Page 1 of 1

L1909579-COFC

Report To	MIKE SMITH
Company:	KGS GROUP
Contact:	865 WAVERLEY ST, 3RD FLOOR
Address:	WINNIPEG, MB R3T 5P4
Phone:	204 896-1209 Fax: 204 896-0754
Invoice To	Same as Report ? (circle) Yes or (No) (if No, provide details)
	Copy of Invoice with Report? (circle) Yes or (No)
Company:	KGS GROUP
Contact:	BILL MACQUARRIE
Address:	865 WAVERLEY ST, 3RD FLOOR
Phone:	204 896-1209 Fax: 204 896-0754
Lab Work Order # (lab use only)	

Report Format / Distribution
Standard: ✓ Other (specify):
Select: PDF ✓ Excel ✓ Digital Fax
Email 1: MSMITH@KGSGROUP.COM
Email 2: MFHAMM@KGSGROUP.COM
WMACQUARRIE@KGSGROUP.COM

Client / Project Information
Job #: 16-0300-002
PO / AFE:
LSD:
Quote #: Q56271

ALS Contact: CRAIG
Sampler: ARS/RAP

Service Request:(Rush sub...
✓ Regular (Standard Tu...
Priority(2-4 Business ...
Emergency (1-2 Busi...
Same Day or Weeken...

(Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	KGS-ROUW-D-FLDW-WP	TC,EC-QT97-WP	Number of Containers
	K13-12321	April 5/17	1030	GW	X	X	3
	K09-12316	↓	1125	↓	X	X	3
	009-13571	↓	1300	↓	X	X	2
	K11-12018	↓	1500	↓	X	X	2
	MW-100	April 5/17	1425	GW	X	X	3

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

METALS NOT Field Filtered; Not Preserved in field; LAB TO FILTER AND PRESERVE SAMPLES

1x1L Routine
1x250mL Metals
Bacteria→ 1x250mL L-S...

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: [signature]	Date: April 5/17	Time: 16:50	Received by: [signature]	Date: 5-4-17	Time: 16:50	Temperature: 4 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909582
Project Ref: 16-0300-002
Sample ID: PTH-44
Sampled By: APS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909582-1
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Total Floodway						
Bicarbonate (HCO3)	164		mg/L			07-APR-17
Carbonate (CO3)	<0.60		mg/L			07-APR-17
Hydroxide (OH)	<0.34		mg/L			07-APR-17
*Nitrate and Nitrite as N	0.943		mg/L	10		13-APR-17
pH						
pH	7.84		pH units			06-APR-17
Turbidity						
*Turbidity	171		NTU			06-APR-17
Total Metals by ICP-MS						
Calcium (Ca)-Total	44.3		mg/L			07-APR-17
Magnesium (Mg)-Total	20.4		mg/L			07-APR-17
Potassium (K)-Total	9.13		mg/L			07-APR-17
Sodium (Na)-Total	15.1		mg/L		200	07-APR-17
TDS calculated						
TDS (Calculated)	236		mg/L		500	11-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	54.0		mg/L		500	06-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	0.0521		mg/L	1		06-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.890		mg/L	10		06-APR-17
Ion Balance Calculation						
Ion Balance	113		%			13-APR-17
Cation - Anion Balance	6.2		%			13-APR-17
Anion Sum	4.23		me/L			13-APR-17
Cation Sum	4.79		me/L			13-APR-17
Hardness Calculated						
Hardness (as CaCO3)	195	HTC	mg/L		500	11-APR-17
Conductivity						
Conductivity	394		umhos/cm			06-APR-17
Chloride in Water by IC						
Chloride (Cl)	12.5		mg/L		250	06-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	134		mg/L			06-APR-17
Phosphorus (P)-Total	0.520		mg/L			11-APR-17
Ammonia, Total (as N)	0.137		mg/L			07-APR-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909582
Project Ref: 16-0300-002
Sample ID: PTH-44
Sampled By: APS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909582-1
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Escherichia Coli	8		MPN/100mL	0		06-APR-17
Total Coliforms	2090		MPN/100mL	0		06-APR-17
Total Kjeldahl Nitrogen	1.19		mg/L			13-APR-17
Total Suspended Solids	173		mg/L			10-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909582
Project Ref: 16-0300-002
Sample ID: PTH-59
Sampled By: APS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909582-2
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Total Floodway						
Bicarbonate (HCO3)	165		mg/L			07-APR-17
Carbonate (CO3)	<0.60		mg/L			07-APR-17
Hydroxide (OH)	<0.34		mg/L			07-APR-17
*Nitrate and Nitrite as N	0.945		mg/L	10		13-APR-17
pH						
pH	7.86		pH units			06-APR-17
Turbidity						
*Turbidity	163		NTU			06-APR-17
Total Metals by ICP-MS						
Calcium (Ca)-Total	44.0		mg/L			07-APR-17
Magnesium (Mg)-Total	20.6		mg/L			07-APR-17
Potassium (K)-Total	9.19		mg/L			07-APR-17
Sodium (Na)-Total	15.5		mg/L		200	07-APR-17
TDS calculated						
TDS (Calculated)	239		mg/L		500	11-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	55.9		mg/L		500	06-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	0.0490		mg/L	1		06-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.896		mg/L	10		06-APR-17
Ion Balance Calculation						
Ion Balance	112		%			13-APR-17
Cation - Anion Balance	5.6		%			13-APR-17
Anion Sum	4.30		me/L			13-APR-17
Cation Sum	4.81		me/L			13-APR-17
Hardness Calculated						
Hardness (as CaCO3)	195	HTC	mg/L		500	11-APR-17
Conductivity						
Conductivity	403		umhos/cm			06-APR-17
Chloride in Water by IC						
Chloride (Cl)	12.8		mg/L		250	06-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	135		mg/L			06-APR-17
Phosphorus (P)-Total	0.505		mg/L			11-APR-17
Ammonia, Total (as N)	0.134		mg/L			07-APR-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909582
Project Ref: 16-0300-002
Sample ID: PTH-59
Sampled By: APS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909582-2
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Escherichia Coli	3		MPN/100mL	0		06-APR-17
Total Coliforms	2430		MPN/100mL	0		06-APR-17
Total Kjeldahl Nitrogen	1.19		mg/L			13-APR-17
Total Suspended Solids	172		mg/L			10-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909582
Project Ref: 16-0300-002
Sample ID: SW-100
Sampled By: APS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909582-3
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Total Floodway						
Bicarbonate (HCO3)	164		mg/L			07-APR-17
Carbonate (CO3)	<0.60		mg/L			07-APR-17
Hydroxide (OH)	<0.34		mg/L			07-APR-17
*Nitrate and Nitrite as N	0.943		mg/L	10		13-APR-17
pH						
pH	7.83		pH units			06-APR-17
Turbidity						
*Turbidity	172		NTU			06-APR-17
Total Metals by ICP-MS						
Calcium (Ca)-Total	43.8		mg/L			07-APR-17
Magnesium (Mg)-Total	20.6		mg/L			07-APR-17
Potassium (K)-Total	9.51		mg/L			07-APR-17
Sodium (Na)-Total	15.1		mg/L		200	07-APR-17
TDS calculated						
TDS (Calculated)	236		mg/L		500	11-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	54.1		mg/L		500	06-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	0.0513		mg/L	1		06-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.892		mg/L	10		06-APR-17
Ion Balance Calculation						
Ion Balance	113		%			13-APR-17
Cation - Anion Balance	6.2		%			13-APR-17
Anion Sum	4.23		me/L			13-APR-17
Cation Sum	4.79		me/L			13-APR-17
Hardness Calculated						
Hardness (as CaCO3)	194	HTC	mg/L		500	11-APR-17
Conductivity						
Conductivity	398		umhos/cm			06-APR-17
Chloride in Water by IC						
Chloride (Cl)	12.4		mg/L		250	06-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	135		mg/L			06-APR-17
Phosphorus (P)-Total	0.519		mg/L			11-APR-17
Ammonia, Total (as N)	0.145		mg/L			07-APR-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 13-APR-17
PO No.:
WO No.: L1909582
Project Ref: 16-0300-002
Sample ID: SW-100
Sampled By: APS/RAP
Date Collected: 05-APR-17
Lab Sample ID: L1909582-3
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Escherichia Coli	4		MPN/100mL	0		06-APR-17
Total Coliforms	1450		MPN/100mL	0		06-APR-17
Total Kjeldahl Nitrogen	1.22		mg/L			13-APR-17
Total Suspended Solids	176		mg/L			10-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

Guidelines & Objectives

Sample Parameter Qualifier key listed:

Qualifier	Description
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).

Health Canada MAC Health Related Criteria Limits

Nitrate/Nitrite-N*	Criteria limit is 10 mg/L (1.0 mg/L if present as all Nitrite-N). High concentrations may contribute to blue baby syndrome in infants.
Lead*	A cumulative body poison, uncommon in naturally occurring hard waters.
Fluoride*	Present in fluoridated water supplies at 0.8 mg/L to reduce dental caries. Elevated levels causes fluorosis (mottling of teeth).
Total Coliforms*	Criteria is 0 CFU/100mL. Adverse health effects.
E. Coli*	Criteria is 0 CFU/100 mL. Certain E. Coli bacteria can be life threatening.

*Health Canada Canadian Drinking Water Quality Guidelines (MAC limit)

Aesthetic Objective Concentration Levels

Alkalinity	Acid neutralizing capacity. Usually a measure of carbonate and bicarbonates and calculated and reported as calcium carbonate.
Balance	Quality control parameter ratioing cations to anions
Bicarbonate	See Alkalinity. Report as the anion HCO3-1
Carbonate	See Alkalinity. Reported at the anion CO3-2
Calcium	See Hardness. Common major cation of water chemistry.
Chloride	Common major anion of water chemistry.
Conductance	Physical test measuring water salinity (dissolved ions or solids)
Hardness	Classical measure or capacity of water to precipitate soap (chiefly calcium and magnesium ions). Causes scaling tendency in water if carbonates/bicarbonates are present (if >200 mg/L). For drinking water purposes waters with results <200 mg/L are considered acceptable, results >200 mg/L are considered poor but can be tolerated. Results >500 mg/L are unacceptable.
Hydroxide	See alkalinity
Magnesium	See hardness. Common major cation of water chemistry. Elevated levels (>125 mg/L) may exert a cathartic or diuretic action.
pH	Measure of water acidity/alkalinity. Normal range is 7.0-8.5.
Potassium	Common major cation of water chemistry.
Sodium	Common major cation of water chemistry. Measure of salinity (saltiness).The aesthetic objective (not related to health) for sodium in drinking water is 200 mg/L. However, where sodium concentration of the drinking water exceeds 20 mg/L, it is recommended that any person on a sodium restricted diet consult with his/her physician or Medical Officer of Health concerning the use of that water.
Sulphate	Common major anion of water chemistry. Elevated levels may exert a cathartic or diuretic action.
Total Dissolved Solids	A measure of water salinity.
Iron	Causes staining to laundry and porcelain and astringent taste. Oxidizes to red-brown precipitate on exposure to air.
Manganese	Elevated levels may cause staining of laundry and porcelain.
Heterotrophic Plate Count	Criteria is 500 cfu/mL Measure of heterotrophic bacteria present.

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
Contact: MIKE SMITH

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-WP	**Water**							
Batch R3694853								
WG2506984-9 LCS								
Alkalinity, Total (as CaCO3)			103.7		%		85-115	06-APR-17
WG2506984-6 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	06-APR-17
CL-IC-N-WP	**Water**							
Batch R3699289								
WG2506750-3 DUP		**L1909582-1**						
Chloride (Cl)		12.5	12.4		mg/L	0.1	20	06-APR-17
WG2506750-2 LCS								
Chloride (Cl)			97.3		%		90-110	06-APR-17
WG2506750-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	06-APR-17
WG2506750-4 MS		**L1909582-1**						
Chloride (Cl)			91.8		%		75-125	06-APR-17
EC-QT97-ENDPT-WP	**Water**							
Batch R3695066								
WG2506616-1 DUP		**L1909582-2**						
Escherichia Coli		3	2		MPN/100mL	43	65	06-APR-17
WG2506616-2 MB								
Escherichia Coli			<1		MPN/100mL		1	06-APR-17
EC-WP	**Water**							
Batch R3694853								
WG2506984-8 LCS								
Conductivity			100.5		%		90-110	06-APR-17
WG2506984-6 MB								
Conductivity			<1.0		umhos/cm		1	06-APR-17
MET-T-MS-WP	**Water**							
Batch R3696515								
WG2507424-2 LCS								
Calcium (Ca)-Total			103.4		%		80-120	07-APR-17
Magnesium (Mg)-Total			108.9		%		80-120	07-APR-17
Potassium (K)-Total			105.7		%		80-120	07-APR-17
Sodium (Na)-Total			107.3		%		80-120	07-APR-17
WG2507424-1 MB								
Calcium (Ca)-Total			<0.20		mg/L		0.2	07-APR-17
Magnesium (Mg)-Total			<0.050		mg/L		0.05	07-APR-17
Potassium (K)-Total			<0.10		mg/L		0.1	07-APR-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-MS-WP	**Water**							
Batch R3696515								
WG2507424-1 MB								
Sodium (Na)-Total			<0.050		mg/L		0.05	07-APR-17
N-TOTKJ-WP	**Water**							
Batch R3699448								
WG2509472-14 LCS								
Total Kjeldahl Nitrogen			85.9		%		75-125	13-APR-17
WG2509472-13 MB								
Total Kjeldahl Nitrogen			<0.20		mg/L		0.2	13-APR-17
NH3-COL-WP	**Water**							
Batch R3695662								
WG2507672-2 LCS								
Ammonia, Total (as N)			99.9		%		85-115	07-APR-17
WG2507672-1 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	07-APR-17
NO2-L-IC-N-WP	**Water**							
Batch R3699289								
WG2506750-3 DUP		**L1909582-1**						
Nitrite (as N)		0.0521	0.0515		mg/L	1.1	20	06-APR-17
WG2506750-2 LCS								
Nitrite (as N)			97.8		%		90-110	06-APR-17
WG2506750-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	06-APR-17
WG2506750-4 MS		**L1909582-1**						
Nitrite (as N)			93.3		%		75-125	06-APR-17
NO3-L-IC-N-WP	**Water**							
Batch R3699289								
WG2506750-3 DUP		**L1909582-1**						
Nitrate (as N)		0.890	0.895		mg/L	0.5	20	06-APR-17
WG2506750-2 LCS								
Nitrate (as N)			98.6		%		90-110	06-APR-17
WG2506750-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	06-APR-17
WG2506750-4 MS		**L1909582-1**						
Nitrate (as N)			92.3		%		75-125	06-APR-17
P-T-COL-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
P-T-COL-WP	**Water**							
Batch R3696605								
WG2508785-2 LCS								
Phosphorus (P)-Total			97.2		%		80-120	11-APR-17
WG2508785-1 MB								
Phosphorus (P)-Total			<0.010		mg/L		0.01	11-APR-17
PH-WP	**Water**							
Batch R3694853								
WG2506984-7 LCS								
pH			7.40		pH units		7.3-7.5	06-APR-17
SO4-IC-N-WP	**Water**							
Batch R3699289								
WG2506750-3 DUP		**L1909582-1**						
Sulfate (SO4)		54.0	54.1		mg/L	0.0	20	06-APR-17
WG2506750-2 LCS								
Sulfate (SO4)			98.3		%		90-110	06-APR-17
WG2506750-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	06-APR-17
WG2506750-4 MS		**L1909582-1**						
Sulfate (SO4)			90.1		%		75-125	06-APR-17
SOLIDS-TOTSUS-WP	**Water**							
Batch R3696607								
WG2508320-10 LCS								
Total Suspended Solids			93.3		%		85-115	10-APR-17
WG2508320-9 MB								
Total Suspended Solids			<5.0		mg/L		5	10-APR-17
TC-QT97-ENDPT-WP	**Water**							
Batch R3695063								
WG2506628-1 DUP		**L1909582-2**						
Total Coliforms		2430	1580		MPN/100mL	42	65	06-APR-17
WG2506628-2 MB								
Total Coliforms			<1		MPN/100mL		1	06-APR-17
TURBIDITY-WP	**Water**							
Batch R3695959								
WG2506922-3 DUP		**L1909582-1**						
Turbidity		171	167		NTU	2.4	15	06-APR-17
WG2506922-2 LCS								
Turbidity			104.0		%		85-115	06-APR-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TURBIDITY-WP	**Water**							
Batch R3695959								
WG2506922-1 MB								
Turbidity			<0.10		NTU		0.1	06-APR-17

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	05-APR-17 12:00	06-APR-17 12:52	0.25	25	hours	EHTR-FM
	2	05-APR-17 16:00	06-APR-17 12:52	0.25	21	hours	EHTR-FM
	3	05-APR-17 14:00	06-APR-17 12:52	0.25	23	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1909582 were received on 05-APR-17 16:50.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

10- 232023

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

L1909582 Page 1 of 1

L1909582-COFC

Report To	MIKE SMITH	**Report Format / Distribution**	**Service Request:** (R)
Company:	KGS GROUP	Standard: ✓ Other (specify):	✓ Regular (Stand
Contact:	MIKE SMITH	Select: PDF ✓ Excel ✓ Digital Fax	Priority (2-4 Bu
Address:	865 WALLEY ST, 3RD Floor, WINNIPEG MB, R3T 5P4	Email 1: MSMITH@KGSGROUP.COM	Emergency (1
		Email 2: MEHARRIS@KGSGROUP.COM BMACQUARRIE@KGSGROUP.COM	Same Day or
Phone:	204 896-1209 Fax: 204 896-0754		**Analysis Reque**
Invoice To	Same as Report ? (circle) Yes or (No) (if No, provide details)	**Client / Project Information**	(Indicate Filtered or Preserved, F/P)
	Copy of Invoice with Report? (circle) Yes or (No)	Job #: 16-0300-002	
Company:	KGS GROUP	PO / AFE:	
Contact:	BILL MACQUARRIE	LSD:	
Address:	865 WALLEY ST, 3RD Floor		
Phone:	204 896 1209 Fax:	Quote #: Q56271	
Lab Work Order # (lab use only)		**ALS Contact:** CRAIG	**Sampler:** APS/RAP

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	KGS ROUTINE-T-FLWP	P-T-COL	N-TOTKJ-WP	NH3-COL-WP	SOLIDS-TOTSUS-WP	TC-QT-97ENDPT-WP	EC-QT97-ENDPT-WP	Number of Containers
	PTH-44	APR 5/17	12:00	SW	X	X	X	X	X	X	X	5
	PTH-59	APR 5/17	16:00	SW	X	X	X	X	X	X	X	
	SW-100	APR 5/17	14:00	SW	X	X	X	X	X	X	X	

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

SAMPLES NOT FILTERED; SAMPLES PRESERVED IN FIELD | 1xIL ROUTINE 1x250mL METALS (NIT) | 1x250mL Amber (SULF) 2x250mL (Large Square) Bacti

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
	APRIL 5/17	16:50		5-4-17	16:50	4° °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 17-APR-17
PO No.:
WO No.: L1910474
Project Ref: 16-0300-002
Sample ID: K09-12012
Sampled By: ADS/RAP
Date Collected: 07-APR-17
Lab Sample ID: L1910474-1
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	395		mg/L			10-APR-17
Carbonate (CO3)	<0.60		mg/L			10-APR-17
Hydroxide (OH)	<0.34		mg/L			10-APR-17
*Nitrate and Nitrite as N	<0.010		mg/L	10		17-APR-17
pH						
pH	7.55		pH units			07-APR-17
Turbidity						
*Turbidity	16.5		NTU			07-APR-17
TDS calculated						
TDS (Calculated)	575		mg/L		500	11-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	180		mg/L		500	07-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0020	DLM	mg/L	1		07-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	<0.010	DLM	mg/L	10		07-APR-17
Ion Balance Calculation						
Ion Balance	96.0		%			17-APR-17
Cation - Anion Balance	-2.0		%			17-APR-17
Anion Sum	10.9		me/L			17-APR-17
Cation Sum	10.5		me/L			17-APR-17
Hardness Calculated						
Hardness (as CaCO3)	430		mg/L		500	11-APR-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	71.0		mg/L			10-APR-17
Magnesium (Mg)-Dissolved	61.3		mg/L			10-APR-17
Potassium (K)-Dissolved	3.83		mg/L			10-APR-17
Sodium (Na)-Dissolved	40.7		mg/L		200	10-APR-17
Conductivity						
Conductivity	934		umhos/cm			07-APR-17
Chloride in Water by IC						
Chloride (Cl)	23.6		mg/L		250	07-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	324		mg/L			07-APR-17
Total Coliform and E.coli by MPN QT97						

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 17-APR-17
PO No.:
WO No.: L1910474
Project Ref: 16-0300-002
Sample ID: K09-12012
Sampled By: ADS/RAP
Date Collected: 07-APR-17
Lab Sample ID: L1910474-1
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	1		MPN/100mL	0		07-APR-17
Escherichia Coli	<1		MPN/100mL	0		07-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 17-APR-17
PO No.:
WO No.: L1910474
Project Ref: 16-0300-002
Sample ID: G050C006
Sampled By: ADS/RAP
Date Collected: 07-APR-17
Lab Sample ID: L1910474-2
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Total Floodway						
Bicarbonate (HCO3)	285		mg/L			10-APR-17
Carbonate (CO3)	<0.60		mg/L			10-APR-17
Hydroxide (OH)	<0.34		mg/L			10-APR-17
*Nitrate and Nitrite as N	<0.051		mg/L	10		17-APR-17
pH						
pH	7.75		pH units			07-APR-17
Turbidity						
*Turbidity	37.0		NTU			07-APR-17
Total Metals by ICP-MS						
Calcium (Ca)-Total	89.2		mg/L			10-APR-17
Magnesium (Mg)-Total	59.4		mg/L			10-APR-17
Potassium (K)-Total	12.3		mg/L			10-APR-17
Sodium (Na)-Total	304		mg/L		200	10-APR-17
TDS calculated						
TDS (Calculated)	1310		mg/L		500	11-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	282		mg/L		500	07-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.010	DLM	mg/L	1		07-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	<0.050	DLM	mg/L	10		07-APR-17
Ion Balance Calculation						
Ion Balance	102		%			17-APR-17
Cation - Anion Balance	1.0		%			17-APR-17
Anion Sum	22.4		me/L			17-APR-17
Cation Sum	22.9		me/L			17-APR-17
Hardness Calculated						
Hardness (as CaCO3)	467	HTC	mg/L		500	11-APR-17
Conductivity						
Conductivity	2240		umhos/cm			07-APR-17
Chloride in Water by IC						
Chloride (Cl)	422		mg/L		250	07-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	233		mg/L			07-APR-17
Total Coliform and E.coli						
Total Coliforms	0		MPN/100mL	0		07-APR-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: MIKE SMITH

Date: 17-APR-17
PO No.:
WO No.: L1910474
Project Ref: 16-0300-002
Sample ID: G050C006
Sampled By: ADS/RAP
Date Collected: 07-APR-17
Lab Sample ID: L1910474-2
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli						
Escherichia Coli	0		MPN/100mL	0		07-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

Guidelines & Objectives

Sample Parameter Qualifier key listed:

Qualifier	Description
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Health Canada MAC Health Related Criteria Limits

Nitrate/Nitrite-N*	Criteria limit is 10 mg/L (1.0 mg/L if present as all Nitrite-N). High concentrations may contribute to blue baby syndrome in infants.
Lead*	A cumulative body poison, uncommon in naturally occurring hard waters.
Fluoride*	Present in fluoridated water supplies at 0.8 mg/L to reduce dental caries. Elevated levels causes fluorosis (mottling of teeth).
Total Coliforms*	Criteria is 0 CFU/100mL. Adverse health effects.
E. Coli*	Criteria is 0 CFU/100 mL. Certain E. Coli bacteria can be life threatening.

*Health Canada Canadian Drinking Water Quality Guidelines (MAC limit)

Aesthetic Objective Concentration Levels

Alkalinity	Acid neutralizing capacity. Usually a measure of carbonate and bicarbonates and calculated and reported as calcium carbonate.
Balance	Quality control parameter ratioing cations to anions
Bicarbonate	See Alkalinity. Report as the anion HCO3-1
Carbonate	See Alkalinity. Reported at the anion CO3-2
Calcium	See Hardness. Common major cation of water chemistry.
Chloride	Common major anion of water chemistry.
Conductance	Physical test measuring water salinity (dissolved ions or solids)
Hardness	Classical measure or capacity of water to precipitate soap (chiefly calcium and magnesium ions). Causes scaling tendency in water if carbonates/bicarbonates are present (if >200 mg/L). For drinking water purposes waters with results <200 mg/L are considered acceptable, results >200 mg/L are considered poor but can be tolerated. Results >500 mg/L are unacceptable.
Hydroxide	See alkalinity
Magnesium	See hardness. Common major cation of water chemistry. Elevated levels (>125 mg/L) may exert a cathartic or diuretic action.
pH	Measure of water acidity/alkalinity. Normal range is 7.0-8.5.
Potassium	Common major cation of water chemistry.
Sodium	Common major cation of water chemistry. Measure of salinity (saltiness).The aesthetic objective (not related to health) for sodium in drinking water is 200 mg/L. However, where sodium concentration of the drinking water exceeds 20 mg/L, it is recommended that any person on a sodium restricted diet consult with his/her physician or Medical Officer of Health concerning the use of that water.
Sulphate	Common major anion of water chemistry. Elevated levels may exert a cathartic or diuretic action.
Total Dissolved Solids	A measure of water salinity.
Iron	Causes staining to laundry and porcelain and astringent taste. Oxidizes to red-brown precipitate on exposure to air.
Manganese	Elevated levels may cause staining of laundry and porcelain.
Heterotrophic Plate Count	Criteria is 500 cfu/mL Measure of heterotrophic bacteria present.

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
Contact: MIKE SMITH

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-WP	**Water**							
Batch R3695945								
WG2507657-14 LCS								
Alkalinity, Total (as CaCO3)			104.4		%		85-115	07-APR-17
WG2507657-11 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	07-APR-17
CL-IC-N-WP	**Water**							
Batch R3701562								
WG2507551-10 LCS								
Chloride (Cl)			98.8		%		90-110	07-APR-17
WG2507551-9 MB								
Chloride (Cl)			<0.50		mg/L		0.5	07-APR-17
EC-WP	**Water**							
Batch R3695945								
WG2507657-13 LCS								
Conductivity			99.6		%		90-110	07-APR-17
WG2507657-11 MB								
Conductivity			<1.0		umhos/cm		1	07-APR-17
MET-D-MS-WP	**Water**							
Batch R3696478								
WG2508671-2 LCS								
Calcium (Ca)-Dissolved			100.2		%		80-120	10-APR-17
Magnesium (Mg)-Dissolved			98.4		%		80-120	10-APR-17
Potassium (K)-Dissolved			99.2		%		80-120	10-APR-17
Sodium (Na)-Dissolved			99.9		%		80-120	10-APR-17
WG2508671-1 MB								
Calcium (Ca)-Dissolved			<0.20		mg/L		0.2	10-APR-17
Magnesium (Mg)-Dissolved			<0.050		mg/L		0.05	10-APR-17
Potassium (K)-Dissolved			<0.10		mg/L		0.1	10-APR-17
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	10-APR-17
MET-T-MS-WP	**Water**							
Batch R3696478								
WG2508594-2 LCS								
Calcium (Ca)-Total			100.1		%		80-120	10-APR-17
Magnesium (Mg)-Total			104.9		%		80-120	10-APR-17
Potassium (K)-Total			101.7		%		80-120	10-APR-17
Sodium (Na)-Total			100.3		%		80-120	10-APR-17
WG2508594-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-MS-WP	**Water**							
Batch R3696478								
WG2508594-1 MB								
Calcium (Ca)-Total			<0.20		mg/L		0.2	10-APR-17
Magnesium (Mg)-Total			<0.050		mg/L		0.05	10-APR-17
Potassium (K)-Total			<0.10		mg/L		0.1	10-APR-17
Sodium (Na)-Total			<0.050		mg/L		0.05	10-APR-17
NO2-L-IC-N-WP	**Water**							
Batch R3701562								
WG2507551-10 LCS								
Nitrite (as N)			99.3		%		90-110	07-APR-17
WG2507551-9 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	07-APR-17
NO3-L-IC-N-WP	**Water**							
Batch R3701562								
WG2507551-10 LCS								
Nitrate (as N)			99.98		%		90-110	07-APR-17
WG2507551-9 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	07-APR-17
PH-WP	**Water**							
Batch R3695945								
WG2507657-12 LCS								
pH			7.41		pH units		7.3-7.5	07-APR-17
SO4-IC-N-WP	**Water**							
Batch R3701562								
WG2507551-10 LCS								
Sulfate (SO4)			99.1		%		90-110	07-APR-17
WG2507551-9 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	07-APR-17
TC,EC-QT51-WP	**Water**							
Batch R3695522								
WG2507727-3 DUP		**L1910474-2**						
Total Coliforms		0	0		MPN/100mL	0.0	65	07-APR-17
Escherichia Coli		0	0		MPN/100mL	0.0	65	07-APR-17
WG2507727-2 MB								
Total Coliforms			0		MPN/100mL		1	07-APR-17
Escherichia Coli			0		MPN/100mL		1	07-APR-17
TC,EC-QT97-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TC,EC-QT97-WP	**Water**							
Batch R3695519								
WG2507701-2 DUP		**L1910474-1**						
Total Coliforms		1	<1	RPD-NA	MPN/100mL	N/A	65	07-APR-17
Escherichia Coli		<1	<1	RPD-NA	MPN/100mL	N/A	65	07-APR-17
WG2507701-1 MB								
Total Coliforms			<1		MPN/100mL		1	07-APR-17
Escherichia Coli			<1		MPN/100mL		1	07-APR-17
TURBIDITY-WP	**Water**							
Batch R3696292								
WG2507688-5 LCS								
Turbidity			103.0		%		85-115	07-APR-17
WG2507688-4 MB								
Turbidity			<0.10		NTU		0.1	07-APR-17

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	07-APR-17 09:30	07-APR-17 12:03	0.25	2.6	hours	EHTR-FM
	2	07-APR-17 11:30	07-APR-17 12:03	0.25	0.48	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1910474 were received on 07-APR-17 12:20.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental

L1910474-COFC

10- 232892

Page 1 of 1

Report To		Report Format / Distribution		Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company:	KGS GROUP	Standard: ✓	Other (specify):	✓ Regular (Standard Turnaround Times - Business Days)
Contact:	MIKE SMITH	Select: PDF ✓	Excel ✓ Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	865 WAVERLEY ST, 3RD FLOOR, WINNIPEG MB, R3T 5P4	Email 1:	MSMITH@KGSGROUP.COM	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
		Email 2:	MFHAMM@KGSGROUP.COM	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone:	204-896-1209 Fax: 204-896-0754		BMACQUARRIE@KGSGROUP.COM	**Analysis Request**
Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**		(Indicate Filtered or Preserved, F/P)
	Copy of Invoice with Report? (circle) Yes or No	Job #:	16-0300-008	
Company:	KGS GROUP	PO / AFE:		
Contact:	BILL MACQUARRIE	LSD:		
Address:	865 WAVERLY ST, 3RD FLOOR			
Phone:	204-896-1209 Fax:	Quote #:	Q56271	
Lab Work Order # (lab use only)		**ALS Contact:**	CRAIG	**Sampler:** MDS/RNP

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	KGS-ROUW-D-FLDWY-WP	TC,EC-QT97-WP	KGS-ROU4W-T-FLDWY-WP	TCEC-QT51-WP	Number of Containers
	K09-12012	07-04-17	0930	GW	X	X			3
	G050C006	07-04-17	1130	GW			X	X	3

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

GROUND WATER SAMPLES: METALS TO BE FILTERED AND PRESERVED

G050C006: NOT FIELD FILTERED BUT PRESERVED IN FIELD

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
	07/04/17	1215		7-4-17	12:20	10 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 24-APR-17
PO No.:
WO No.: L1912053
Project Ref: 16-0300-002.1100.02
Sample ID: PTH 44
Sampled By: AN/RP
Date Collected: 12-APR-17
Lab Sample ID: L1912053-1
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Total Floodway						
Bicarbonate (HCO3)	195		mg/L			13-APR-17
Carbonate (CO3)	<0.60		mg/L			13-APR-17
Hydroxide (OH)	<0.34		mg/L			13-APR-17
*Nitrate and Nitrite as N	0.893		mg/L	10		20-APR-17
pH						
pH	7.97		pH units			12-APR-17
Turbidity						
*Turbidity	107		NTU			13-APR-17
Total Metals by ICP-MS						
Calcium (Ca)-Total	53.6		mg/L			13-APR-17
Magnesium (Mg)-Total	22.8		mg/L			13-APR-17
Potassium (K)-Total	7.85		mg/L			13-APR-17
Sodium (Na)-Total	21.3		mg/L		200	13-APR-17
TDS calculated						
TDS (Calculated)	316		mg/L		500	17-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	95.8		mg/L		500	12-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	0.0226		mg/L	1		12-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.870		mg/L	10		12-APR-17
Ion Balance Calculation						
Ion Balance	98.3		%			20-APR-17
Cation - Anion Balance	-0.8		%			20-APR-17
Anion Sum	5.78		me/L			20-APR-17
Cation Sum	5.68		me/L			20-APR-17
Hardness Calculated						
Hardness (as CaCO3)	228	HTC	mg/L		500	17-APR-17
Conductivity						
Conductivity	524		umhos/cm			12-APR-17
Chloride in Water by IC						
Chloride (Cl)	18.6		mg/L		250	12-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	160		mg/L			12-APR-17
Phosphorus (P)-Total	0.329		mg/L			17-APR-17
Ammonia, Total (as N)	0.048		mg/L			13-APR-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
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Date: 24-APR-17
PO No.:
WO No.: L1912053
Project Ref: 16-0300-002.1100.02
Sample ID: PTH 44
Sampled By: AN/RP
Date Collected: 12-APR-17
Lab Sample ID: L1912053-1
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Escherichia Coli	6	MBHT	MPN/100mL	0		12-APR-17
Total Coliforms	1300	MBHT	MPN/100mL	0		12-APR-17
Total Kjeldahl Nitrogen	1.10		mg/L			21-APR-17
Total Suspended Solids	124		mg/L			13-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 24-APR-17
PO No.:
WO No.: L1912053
Project Ref: 16-0300-002.1100.02
Sample ID: PTH 59
Sampled By: AN/RP
Date Collected: 12-APR-17
Lab Sample ID: L1912053-2
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Total Floodway						
Bicarbonate (HCO3)	199		mg/L			13-APR-17
Carbonate (CO3)	<0.60		mg/L			13-APR-17
Hydroxide (OH)	<0.34		mg/L			13-APR-17
*Nitrate and Nitrite as N	0.885		mg/L	10		20-APR-17
pH						
pH	7.96		pH units			12-APR-17
Turbidity						
*Turbidity	112		NTU			13-APR-17
Total Metals by ICP-MS						
Calcium (Ca)-Total	54.7		mg/L			13-APR-17
Magnesium (Mg)-Total	24.9		mg/L			13-APR-17
Potassium (K)-Total	8.26		mg/L			13-APR-17
Sodium (Na)-Total	22.6		mg/L		200	13-APR-17
TDS calculated						
TDS (Calculated)	327		mg/L		500	17-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	99.0		mg/L		500	12-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	0.0220		mg/L	1		12-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.863		mg/L	10		12-APR-17
Ion Balance Calculation						
Ion Balance	101		%			20-APR-17
Cation - Anion Balance	0.4		%			20-APR-17
Anion Sum	5.93		me/L			20-APR-17
Cation Sum	5.98		me/L			20-APR-17
Hardness Calculated						
Hardness (as CaCO3)	239	HTC	mg/L		500	17-APR-17
Conductivity						
Conductivity	534		umhos/cm			12-APR-17
Chloride in Water by IC						
Chloride (Cl)	19.3		mg/L		250	12-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	163		mg/L			12-APR-17
Phosphorus (P)-Total	0.336		mg/L			17-APR-17
Ammonia, Total (as N)	0.048		mg/L			13-APR-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 24-APR-17
PO No.:
WO No.: L1912053
Project Ref: 16-0300-002.1100.02
Sample ID: PTH 59
Sampled By: AN/RP
Date Collected: 12-APR-17
Lab Sample ID: L1912053-2
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Escherichia Coli	9		MPN/100mL	0		12-APR-17
Total Coliforms	1550		MPN/100mL	0		12-APR-17
Total Kjeldahl Nitrogen	1.19		mg/L			21-APR-17
Total Suspended Solids	62		mg/L			13-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

Guidelines & Objectives

Sample Parameter Qualifier key listed:

Qualifier	Description
MBHT	The APHA 30 hour hold time was exceeded for microbiological testing. Samples processed within 48 hours from time of sampling may

	be valid in some cases (refer to Health Canada guidance).
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).

Health Canada MAC Health Related Criteria Limits

Nitrate/Nitrite-N*	Criteria limit is 10 mg/L (1.0 mg/L if present as all Nitrite-N). High concentrations may contribute to blue baby syndrome in infants.
Lead*	A cumulative body poison, uncommon in naturally occurring hard waters.
Fluoride*	Present in fluoridated water supplies at 0.8 mg/L to reduce dental caries. Elevated levels causes fluorosis (mottling of teeth).
Total Coliforms*	Criteria is 0 CFU/100mL. Adverse health effects.
E. Coli*	Criteria is 0 CFU/100 mL. Certain E. Coli bacteria can be life threatening.

*Health Canada Canadian Drinking Water Quality Guidelines (MAC limit)

Aesthetic Objective Concentration Levels

Alkalinity	Acid neutralizing capacity. Usually a measure of carbonate and bicarbonates and calculated and reported as calcium carbonate.
Balance	Quality control parameter ratioing cations to anions
Bicarbonate	See Alkalinity. Report as the anion HCO3-1
Carbonate	See Alkalinity. Reported at the anion CO3-2
Calcium	See Hardness. Common major cation of water chemistry.
Chloride	Common major anion of water chemistry.
Conductance	Physical test measuring water salinity (dissolved ions or solids)
Hardness	Classical measure or capacity of water to precipitate soap (chiefly calcium and magnesium ions). Causes scaling tendency in water if carbonates/bicarbonates are present (if >200 mg/L). For drinking water purposes waters with results <200 mg/L are considered acceptable, results >200 mg/L are considered poor but can be tolerated. Results >500 mg/L are unacceptable.
Hydroxide	See alkalinity
Magnesium	See hardness. Common major cation of water chemistry. Elevated levels (>125 mg/L) may exert a cathartic or diuretic action.
pH	Measure of water acidity/alkalinity. Normal range is 7.0-8.5.
Potassium	Common major cation of water chemistry.
Sodium	Common major cation of water chemistry. Measure of salinity (saltiness).The aesthetic objective (not related to health) for sodium in drinking water is 200 mg/L. However, where sodium concentration of the drinking water exceeds 20 mg/L, it is recommended that any person on a sodium restricted diet consult with his/her physician or Medical Officer of Health concerning the use of that water.
Sulphate	Common major anion of water chemistry. Elevated levels may exert a cathartic or diuretic action.
Total Dissolved Solids	A measure of water salinity.
Iron	Causes staining to laundry and porcelain and astringent taste. Oxidizes to red-brown precipitate on exposure to air.
Manganese	Elevated levels may cause staining of laundry and porcelain.
Heterotrophic Plate Count	Criteria is 500 cfu/mL Measure of heterotrophic bacteria present.

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L1912053 Report Date: 24-APR-17

Client: KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
Contact: Marci Friedman Hamm

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-WP	**Water**							
Batch R3699078								
WG2510283-5 DUP		**L1912053-2**						
Alkalinity, Total (as CaCO3)		163	166		mg/L	1.6	20	12-APR-17
WG2510283-4 LCS								
Alkalinity, Total (as CaCO3)			103.7		%		85-115	12-APR-17
WG2510283-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	12-APR-17
CL-IC-N-WP	**Water**							
Batch R3703428								
WG2510009-7 DUP		**L1912053-1**						
Chloride (Cl)		18.6	18.6		mg/L	0.2	20	12-APR-17
WG2510009-6 LCS								
Chloride (Cl)			100.4		%		90-110	12-APR-17
WG2510009-5 MB								
Chloride (Cl)			<0.50		mg/L		0.5	12-APR-17
WG2510009-8 MS		**L1912053-1**						
Chloride (Cl)			92.4		%		75-125	12-APR-17
EC-QT97-ENDPT-WP	**Water**							
Batch R3699144								
WG2510249-2 DUP		**L1912053-1**						
Escherichia Coli		6	6		MPN/100mL	0.0	65	12-APR-17
WG2510249-1 MB								
Escherichia Coli			<1		MPN/100mL		1	12-APR-17
EC-WP	**Water**							
Batch R3699078								
WG2510283-5 DUP		**L1912053-2**						
Conductivity		534	534		umhos/cm	0.0	10	12-APR-17
WG2510283-3 LCS								
Conductivity			98.3		%		90-110	12-APR-17
WG2510283-1 MB								
Conductivity			<1.0		umhos/cm		1	12-APR-17
MET-T-MS-WP	**Water**							
Batch R3700483								
WG2510758-2 LCS								
Calcium (Ca)-Total			101.6		%		80-120	13-APR-17
Magnesium (Mg)-Total			106.6		%		80-120	13-APR-17
Potassium (K)-Total			108.5		%		80-120	13-APR-17
Sodium (Na)-Total			106.5		%		80-120	13-APR-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-MS-WP	**Water**							
Batch R3700483								
WG2510758-1 MB								
Calcium (Ca)-Total			<0.20		mg/L		0.2	13-APR-17
Magnesium (Mg)-Total			<0.050		mg/L		0.05	13-APR-17
Potassium (K)-Total			<0.10		mg/L		0.1	13-APR-17
Sodium (Na)-Total			<0.050		mg/L		0.05	13-APR-17
N-TOTKJ-WP	**Water**							
Batch R3704391								
WG2513163-14 LCS								
Total Kjeldahl Nitrogen			110.3		%		75-125	21-APR-17
WG2513163-13 MB								
Total Kjeldahl Nitrogen			<0.20		mg/L		0.2	21-APR-17
NH3-COL-WP	**Water**							
Batch R3700525								
WG2509993-6 LCS								
Ammonia, Total (as N)			100.3		%		85-115	13-APR-17
WG2509993-5 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	13-APR-17
NO2-L-IC-N-WP	**Water**							
Batch R3703428								
WG2510009-7 DUP		**L1912053-1**						
Nitrite (as N)		0.0226	0.0228		mg/L	0.8	20	12-APR-17
WG2510009-6 LCS								
Nitrite (as N)			99.5		%		90-110	12-APR-17
WG2510009-5 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	12-APR-17
WG2510009-8 MS		**L1912053-1**						
Nitrite (as N)			89.4		%		75-125	12-APR-17
NO3-L-IC-N-WP	**Water**							
Batch R3703428								
WG2510009-7 DUP		**L1912053-1**						
Nitrate (as N)		0.870	0.865		mg/L	0.6	20	12-APR-17
WG2510009-6 LCS								
Nitrate (as N)			101.3		%		90-110	12-APR-17
WG2510009-5 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	12-APR-17
WG2510009-8 MS		**L1912053-1**						
Nitrate (as N)			92.1		%		75-125	12-APR-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
P-T-COL-WP	**Water**							
Batch R3701485								
WG2511815-2 LCS								
Phosphorus (P)-Total			98.0		%		80-120	17-APR-17
WG2511815-1 MB								
Phosphorus (P)-Total			<0.010		mg/L		0.01	17-APR-17
PH-WP	**Water**							
Batch R3699078								
WG2510283-5 DUP		**L1912053-2**						
pH		7.96	7.95	J	pH units	0.01	0.2	12-APR-17
WG2510283-2 LCS								
pH			7.41		pH units		7.3-7.5	12-APR-17
SO4-IC-N-WP	**Water**							
Batch R3703428								
WG2510009-7 DUP		**L1912053-1**						
Sulfate (SO4)		95.8	95.8		mg/L	0.1	20	12-APR-17
WG2510009-6 LCS								
Sulfate (SO4)			101.7		%		90-110	12-APR-17
WG2510009-5 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	12-APR-17
WG2510009-8 MS		**L1912053-1**						
Sulfate (SO4)			89.5		%		75-125	12-APR-17
SOLIDS-TOTSUS-WP	**Water**							
Batch R3700847								
WG2510503-14 LCS								
Total Suspended Solids			99.3		%		85-115	13-APR-17
WG2510503-13 MB								
Total Suspended Solids			<5.0		mg/L		5	13-APR-17
TC-QT97-ENDPT-WP	**Water**							
Batch R3699141								
WG2510255-2 DUP		**L1912053-1**						
Total Coliforms		1300	1200		MPN/100mL	7.7	65	12-APR-17
WG2510255-1 MB								
Total Coliforms			<1		MPN/100mL		1	12-APR-17
TURBIDITY-WP	**Water**							
Batch R3699557								
WG2511053-3 DUP		**L1912053-1**						
Turbidity		107	105		NTU	1.9	15	13-APR-17
WG2511053-2 LCS								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TURBIDITY-WP	**Water**							
Batch R3699557								
WG2511053-2 LCS								
Turbidity			100.5		%		85-115	13-APR-17
WG2511053-1 MB								
Turbidity			<0.10		NTU		0.1	13-APR-17

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	12-APR-17 09:25	12-APR-17 12:58	0.25	3.6	hours	EHTR-FM
	2	12-APR-17 10:25	12-APR-17 12:58	0.25	2.6	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1912053 were received on 12-APR-17 10:50.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

10-

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L1912053

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company:	Standard: Other (specify):	Regula
Contact:	Select: PDF Excel Digital Fax	Priority
Address:	Email 1:	Emerg
Phone: Fax:	Email 2:	Same I
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	
Copy of Invoice with Report? (circle) Yes or No	Job #:	
Company:	PO / AFE:	
Contact: Accounts Payable	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only)	**ALS Contact:** / **Sampler:**	

L1912053-COFC

(Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Number of Containers
		12-Apr-17	9:25		5
		12-Apr-17	10:25		5

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
[signature]	Apr 12/17	10:55	[signature]	Apr 12/17	10:50	10 °C				

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: PAUL LINDELL

Date: 24-APR-17
PO No.:
WO No.: L1915625
Project Ref: 16-0300-002
Sample ID: K13-12321
Sampled By: PJL/RP
Date Collected: 20-APR-17
Lab Sample ID: L1915625-1
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	<1		MPN/100mL	0		21-APR-17
Escherichia Coli	<1		MPN/100mL	0		21-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: PAUL LINDELL

Date: 24-APR-17
PO No.:
WO No.: L1915625
Project Ref: 16-0300-002
Sample ID: K09-12316
Sampled By: PJL/RP
Date Collected: 20-APR-17
Lab Sample ID: L1915625-2
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	3		MPN/100mL	0		21-APR-17
Escherichia Coli	<1		MPN/100mL	0		21-APR-17

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* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: PAUL LINDELL

Date: 24-APR-17
PO No.:
WO No.: L1915625
Project Ref: 16-0300-002
Sample ID: K09-12012
Sampled By: PJL/RP
Date Collected: 20-APR-17
Lab Sample ID: L1915625-3
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	<1		MPN/100mL	0		21-APR-17
Escherichia Coli	<1		MPN/100mL	0		21-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: PAUL LINDELL

Date: 24-APR-17
PO No.:
WO No.: L1915625
Project Ref: 16-0300-002
Sample ID: K11-12014
Sampled By: PJL/RP
Date Collected: 20-APR-17
Lab Sample ID: L1915625-4
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	3		MPN/100mL	0		21-APR-17
Escherichia Coli	<1		MPN/100mL	0		21-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: PAUL LINDELL

Date: 24-APR-17
PO No.:
WO No.: L1915625
Project Ref: 16-0300-002
Sample ID: K11-12015
Sampled By: PJL/RP
Date Collected: 20-APR-17
Lab Sample ID: L1915625-5
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	3		MPN/100mL	0		21-APR-17
Escherichia Coli	<1		MPN/100mL	0		21-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
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Approved by

Hua Wo
Account Manager

Guidelines & Objectives

Health Canada MAC Health Related Criteria Limits

Nitrate/Nitrite-N*	Criteria limit is 10 mg/L (1.0 mg/L if present as all Nitrite-N). High concentrations may contribute to blue baby syndrome in infants.
Lead*	A cumulative body poison, uncommon in naturally occurring hard waters.
Fluoride*	Present in fluoridated water supplies at 0.8 mg/L to reduce dental caries. Elevated levels causes fluorosis (mottling of teeth).
Total Coliforms*	Criteria is 0 CFU/100mL. Adverse health effects.
E. Coli*	Criteria is 0 CFU/100 mL. Certain E. Coli bacteria can be life threatening.

*Health Canada Canadian Drinking Water Quality Guidelines (MAC limit)

Aesthetic Objective Concentration Levels

Alkalinity	Acid neutralizing capacity. Usually a measure of carbonate and bicarbonates and calculated and reported as calcium carbonate.
Balance	Quality control parameter ratioing cations to anions
Bicarbonate	See Alkalinity. Report as the anion HCO3-1
Carbonate	See Alkalinity. Reported at the anion CO3-2
Calcium	See Hardness. Common major cation of water chemistry.
Chloride	Common major anion of water chemistry.
Conductance	Physical test measuring water salinity (dissolved ions or solids)
Hardness	Classical measure or capacity of water to precipitate soap (chiefly calcium and magnesium ions). Causes scaling tendency in water if carbonates/bicarbonates are present (if >200 mg/L). For drinking water purposes waters with results <200 mg/L are considered acceptable, results >200 mg/L are considered poor but can be tolerated. Results >500 mg/L are unacceptable.
Hydroxide	See alkalinity
Magnesium	See hardness. Common major cation of water chemistry. Elevated levels (>125 mg/L) may exert a cathartic or diuretic action.
pH	Measure of water acidity/alkalinity. Normal range is 7.0-8.5.
Potassium	Common major cation of water chemistry.
Sodium	Common major cation of water chemistry. Measure of salinity (saltiness).The aesthetic objective (not related to health) for sodium in drinking water is 200 mg/L. However, where sodium concentration of the drinking water exceeds 20 mg/L, it is recommended that any person on a sodium restricted diet consult with his/her physician or Medical Officer of Health concerning the use of that water.
Sulphate	Common major anion of water chemistry. Elevated levels may exert a cathartic or diuretic action.
Total Dissolved Solids	A measure of water salinity.
Iron	Causes staining to laundry and porcelain and astringent taste. Oxidizes to red-brown precipitate on exposure to air.
Manganese	Elevated levels may cause staining of laundry and porcelain.
Heterotrophic Plate Count	Criteria is 500 cfu/mL Measure of heterotrophic bacteria present.

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L1915625 Report Date: 24-APR-17

Client: KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
Contact: PAUL LINDELL

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TC,EC-QT97-WP	**Water**							
Batch R3704398								
WG2514899-1 DUP		**L1915625-2**						
Total Coliforms		3	2		MPN/100mL	43	65	21-APR-17
Escherichia Coli		<1	<1	RPD-NA	MPN/100mL	N/A	65	21-APR-17
WG2514899-2 MB								
Total Coliforms			<1		MPN/100mL		1	21-APR-17
Escherichia Coli			<1		MPN/100mL		1	21-APR-17

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental

L1915625-COFC

Report To		Report Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company:	KGS Group	Standard: ✓ Other (specify):	✓ Regular (Standard Turnaround Times - Business Days)
Contact:	Paul Lindell	Select: PDF ✓ Excel ✓ Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	865 Waverley St. Wpg MB R4A 2A6	Email 1: plindell@kgsgroup.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
		Email 2: msmith@kgsgroup.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone:	204-803-0720 Fax:	mfhamm@kgsgroup.com	Analysis Request

Invoice To		Client / Project Information	
Same as Report ? (circle) (Yes) or No (if No, provide details)			
Copy of Invoice with Report? (circle) Yes or No		Job #:	16-0300-002
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	Q56271
Lab Work Order # (lab use only)		ALS Contact: Judy D.	Sampler: PJL/RP

(Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	~~[illegible]~~	TC,EC-QT97-WP	Number of Containers
	K13-12321	20-Apr-17	13:06	GW		X	1
	K09-12316	↓	14:05	↓		X	1
	K09-12012	↓	15:02	↓		X	1
	K11-12014	↓	16:40	↓		X	1
	K11-12015	↓	16:05	↓		X	1

100

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: P Lindell	Date: Apr. 20/17	Time:	Received by: J	Date: Apr 21/17	Time: 8:02	Temperature: 5 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 25-APR-17
PO No.:
WO No.: L1914447
Project Ref: 16-0300-002.1100.62
Sample ID: PTH 44
Sampled By: ATM+GS
Date Collected: 19-APR-17
Lab Sample ID: L1914447-1
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Total Floodway						
Bicarbonate (HCO3)	230		mg/L			21-APR-17
Carbonate (CO3)	9.96		mg/L			21-APR-17
Hydroxide (OH)	<0.34		mg/L			21-APR-17
*Nitrate and Nitrite as N	0.597		mg/L	10		20-APR-17
pH						
pH	8.53		pH units			20-APR-17
Turbidity						
*Turbidity	54.0		NTU			20-APR-17
Total Metals by ICP-MS						
Calcium (Ca)-Total	69.3		mg/L			20-APR-17
Magnesium (Mg)-Total	33.0		mg/L			20-APR-17
Potassium (K)-Total	7.61		mg/L			20-APR-17
Sodium (Na)-Total	36.4		mg/L		200	20-APR-17
TDS calculated						
TDS (Calculated)	423		mg/L		500	21-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	124		mg/L		500	19-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	0.0109		mg/L	1		19-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.586		mg/L	10		19-APR-17
Ion Balance Calculation						
Ion Balance	106		%			21-APR-17
Cation - Anion Balance	2.9		%			21-APR-17
Anion Sum	7.50		me/L			21-APR-17
Cation Sum	7.95		me/L			21-APR-17
Hardness Calculated						
Hardness (as CaCO3)	309	HTC	mg/L		500	21-APR-17
Conductivity						
Conductivity	644		umhos/cm			20-APR-17
Chloride in Water by IC						
Chloride (Cl)	27.4		mg/L		250	19-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	205		mg/L			20-APR-17
Phosphorus (P)-Total	0.219		mg/L			20-APR-17
Escherichia Coli	4		MPN/100mL	0		19-APR-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 25-APR-17
PO No.:
WO No.: L1914447
Project Ref: 16-0300-002.1100.62
Sample ID: PTH 44
Sampled By: ATM+GS
Date Collected: 19-APR-17
Lab Sample ID: L1914447-1
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliforms	236		MPN/100mL	0		19-APR-17
Total Kjeldahl Nitrogen	0.85		mg/L			25-APR-17
Total Suspended Solids	52		mg/L			21-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 25-APR-17
PO No.:
WO No.: L1914447
Project Ref: 16-0300-002.1100.62
Sample ID: PTH 59
Sampled By: ATM+GS
Date Collected: 19-APR-17
Lab Sample ID: L1914447-2
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Total Floodway						
Bicarbonate (HCO3)	241		mg/L			21-APR-17
Carbonate (CO3)	<0.60		mg/L			21-APR-17
Hydroxide (OH)	<0.34		mg/L			21-APR-17
*Nitrate and Nitrite as N	0.522		mg/L	10		20-APR-17
pH						
pH	8.03		pH units			20-APR-17
Turbidity						
*Turbidity	26.0		NTU			20-APR-17
Total Metals by ICP-MS						
Calcium (Ca)-Total	63.6		mg/L			20-APR-17
Magnesium (Mg)-Total	33.7		mg/L			20-APR-17
Potassium (K)-Total	7.26		mg/L			20-APR-17
Sodium (Na)-Total	43.4		mg/L		200	20-APR-17
TDS calculated						
TDS (Calculated)	437		mg/L		500	21-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	123		mg/L		500	19-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	0.0056		mg/L	1		19-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.517		mg/L	10		19-APR-17
Ion Balance Calculation						
Ion Balance	102		%			21-APR-17
Cation - Anion Balance	1.2		%			21-APR-17
Anion Sum	7.83		me/L			21-APR-17
Cation Sum	8.02		me/L			21-APR-17
Hardness Calculated						
Hardness (as CaCO3)	298	HTC	mg/L		500	21-APR-17
Conductivity						
Conductivity	696		umhos/cm			20-APR-17
Chloride in Water by IC						
Chloride (Cl)	45.3		mg/L		250	19-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	198		mg/L			20-APR-17
Phosphorus (P)-Total	0.176		mg/L			20-APR-17
Escherichia Coli	<1		MPN/100mL	0		19-APR-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 25-APR-17
PO No.:
WO No.: L1914447
Project Ref: 16-0300-002.1100.62
Sample ID: PTH 59
Sampled By: ATM+GS
Date Collected: 19-APR-17
Lab Sample ID: L1914447-2
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliforms	34		MPN/100mL	0		19-APR-17
Total Kjeldahl Nitrogen	0.66		mg/L			25-APR-17
Total Suspended Solids	<20		mg/L			21-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

Guidelines & Objectives

Sample Parameter Qualifier key listed:

Qualifier	Description
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).

Health Canada MAC Health Related Criteria Limits

Nitrate/Nitrite-N*	Criteria limit is 10 mg/L (1.0 mg/L if present as all Nitrite-N). High concentrations may contribute to blue baby syndrome in infants.
Lead*	A cumulative body poison, uncommon in naturally occurring hard waters.
Fluoride*	Present in fluoridated water supplies at 0.8 mg/L to reduce dental caries. Elevated levels causes fluorosis (mottling of teeth).
Total Coliforms*	Criteria is 0 CFU/100mL. Adverse health effects.
E. Coli*	Criteria is 0 CFU/100 mL. Certain E. Coli bacteria can be life threatening.

*Health Canada Canadian Drinking Water Quality Guidelines (MAC limit)

Aesthetic Objective Concentration Levels

Alkalinity	Acid neutralizing capacity. Usually a measure of carbonate and bicarbonates and calculated and reported as calcium carbonate.
Balance	Quality control parameter ratioing cations to anions
Bicarbonate	See Alkalinity. Report as the anion HCO3-1
Carbonate	See Alkalinity. Reported at the anion CO3-2
Calcium	See Hardness. Common major cation of water chemistry.
Chloride	Common major anion of water chemistry.
Conductance	Physical test measuring water salinity (dissolved ions or solids)
Hardness	Classical measure or capacity of water to precipitate soap (chiefly calcium and magnesium ions). Causes scaling tendency in water if carbonates/bicarbonates are present (if >200 mg/L). For drinking water purposes waters with results <200 mg/L are considered acceptable, results >200 mg/L are considered poor but can be tolerated. Results >500 mg/L are unacceptable.
Hydroxide	See alkalinity
Magnesium	See hardness. Common major cation of water chemistry. Elevated levels (>125 mg/L) may exert a cathartic or diuretic action.
pH	Measure of water acidity/alkalinity. Normal range is 7.0-8.5.
Potassium	Common major cation of water chemistry.
Sodium	Common major cation of water chemistry. Measure of salinity (saltiness).The aesthetic objective (not related to health) for sodium in drinking water is 200 mg/L. However, where sodium concentration of the drinking water exceeds 20 mg/L, it is recommended that any person on a sodium restricted diet consult with his/her physician or Medical Officer of Health concerning the use of that water.
Sulphate	Common major anion of water chemistry. Elevated levels may exert a cathartic or diuretic action.
Total Dissolved Solids	A measure of water salinity.
Iron	Causes staining to laundry and porcelain and astringent taste. Oxidizes to red-brown precipitate on exposure to air.
Manganese	Elevated levels may cause staining of laundry and porcelain.
Heterotrophic Plate Count	Criteria is 500 cfu/mL Measure of heterotrophic bacteria present.

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
Contact: Marci Friedman Hamm

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-WP	**Water**							
Batch R3703793								
WG2514610-4 LCS								
Alkalinity, Total (as CaCO3)			106.0		%		85-115	20-APR-17
WG2514610-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	20-APR-17
CL-IC-N-WP	**Water**							
Batch R3703254								
WG2513477-6 LCS								
Chloride (Cl)			101.4		%		90-110	19-APR-17
WG2513477-5 MB								
Chloride (Cl)			<0.50		mg/L		0.5	19-APR-17
EC-QT97-ENDPT-WP	**Water**							
Batch R3703405								
WG2513621-2 DUP		**L1914447-1**						
Escherichia Coli		4	4		MPN/100mL	0.0	65	19-APR-17
WG2513621-1 MB								
Escherichia Coli			<1		MPN/100mL		1	19-APR-17
EC-WP	**Water**							
Batch R3703793								
WG2514610-3 LCS								
Conductivity			100.8		%		90-110	20-APR-17
WG2514610-1 MB								
Conductivity			<1.0		umhos/cm		1	20-APR-17
MET-T-MS-WP	**Water**							
Batch R3703747								
WG2513897-2 LCS								
Calcium (Ca)-Total			104.1		%		80-120	20-APR-17
Magnesium (Mg)-Total			105.9		%		80-120	20-APR-17
Potassium (K)-Total			104.1		%		80-120	20-APR-17
Sodium (Na)-Total			105.8		%		80-120	20-APR-17
WG2513897-1 MB								
Calcium (Ca)-Total			<0.20		mg/L		0.2	20-APR-17
Magnesium (Mg)-Total			<0.050		mg/L		0.05	20-APR-17
Potassium (K)-Total			<0.10		mg/L		0.1	20-APR-17
Sodium (Na)-Total			<0.050		mg/L		0.05	20-APR-17
N-TOTKJ-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
N-TOTKJ-WP	**Water**							
Batch R3706224								
WG2514643-16 LCS								
Total Kjeldahl Nitrogen			84.3		%		75-125	24-APR-17
WG2514643-13 MB								
Total Kjeldahl Nitrogen			<0.20		mg/L		0.2	24-APR-17
NO2-L-IC-N-WP	**Water**							
Batch R3703254								
WG2513477-6 LCS								
Nitrite (as N)			102.0		%		90-110	19-APR-17
WG2513477-5 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	19-APR-17
NO3-L-IC-N-WP	**Water**							
Batch R3703254								
WG2513477-6 LCS								
Nitrate (as N)			101.9		%		90-110	19-APR-17
WG2513477-5 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	19-APR-17
P-T-COL-WP	**Water**							
Batch R3703768								
WG2513584-2 LCS								
Phosphorus (P)-Total			99.8		%		80-120	20-APR-17
WG2513584-1 MB								
Phosphorus (P)-Total			<0.010		mg/L		0.01	20-APR-17
PH-WP	**Water**							
Batch R3703793								
WG2514610-2 LCS								
pH			7.39		pH units		7.3-7.5	20-APR-17
SO4-IC-N-WP	**Water**							
Batch R3703254								
WG2513477-6 LCS								
Sulfate (SO4)			102.6		%		90-110	19-APR-17
WG2513477-5 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	19-APR-17
SOLIDS-TOTSUS-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SOLIDS-TOTSUS-WP	**Water**							
Batch R3704970								
WG2514724-2 LCS								
Total Suspended Solids			98.7		%		85-115	21-APR-17
WG2514724-1 MB								
Total Suspended Solids			<5.0		mg/L		5	21-APR-17
TC-QT97-ENDPT-WP	**Water**							
Batch R3703402								
WG2513617-2 DUP		**L1914447-1**						
Total Coliforms		236	187		MPN/100mL	23	65	19-APR-17
WG2513617-1 MB								
Total Coliforms			<1		MPN/100mL		1	19-APR-17
TURBIDITY-WP	**Water**							
Batch R3703917								
WG2514357-2 LCS								
Turbidity			100.5		%		85-115	20-APR-17
WG2514357-1 MB								
Turbidity			<0.10		NTU		0.1	20-APR-17

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	19-APR-17 09:50	20-APR-17 12:00	0.25	26	hours	EHTR-FM
	2	19-APR-17 10:00	20-APR-17 12:00	0.25	26	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1914447 were received on 19-APR-17 11:00.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1914447-COFC

COC Number: 14 - 503764

Page 1 of 1

Report To
Company: KGS group
Contact: Marci Friedman Hamm
Address: 865 Waverly Street 3rd floor Wpg MB R3T 5P4
Phone: 204-896-1209

Report Format / Distribution
Select Report Format: [X] PDF [ ] EXCEL [X] EDD (DIGITAL)
Quality Control (QC) Report with Report [X] Yes [ ] No
[ ] Criteria on Report - provide details below if box checked
Select Distribution: [X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax: MFHamm@kgsgroup.com, MSmith@kgsgroup.com
Email 2: AMelvin@kgsgroup.com

Service Requested (Rush Turnaround Time (TAT) is not available for all tests)
R [X] Regular (Standard TAT if received by 3pm)
P [ ] Priority (2-4 business days if received by 3pm)
E [ ] Emergency (1-2 business days if received by 3pm)
E2 [ ] Same day or weekend emergency if received by 10am – contact ALS for surcharge.
Specify Date Required for E2,E or P:

Invoice To
Same as Report To: (Yes) [ ] No
Copy of Invoice with Report: [ ] Yes [ ] No
Company:
Contact:

Invoice Distribution
Select Invoice Distribution: [X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax: Accounts Payable
Email 2:

Project Information
ALS Quote #: Q56271
Job #: 16-0300-002.1100.62
PO / AFE: Floodway
LSD: Floodway

Oil and Gas Required Fields (client use)
Approver ID:
Cost Center:
GL Account:
Routing Code:
Activity Code:
Location:

ALS Lab Work Order # (lab use only)
ALS Contact: Judy D
Sampler: ATm + GS

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	KGS-Rouw-T-Flowy-WP + P-T-COL +	N-TOTKS-WP+	Solids-Totsos-WP+	TC-QT-97-ENDpoint	EC-QT-97-Endpoint	Number of Containers
	PTH 44	19-April-17	9:50	SW	X	X	X	X	X	5
	PTH 59	19-April-17	10:00	SW	X	X	X	X	X	5

Drinking Water (DW) Samples[1] (client use)
Are samples taken from a Regulated DW System? [ ] Yes [X] No
Are samples for human drinking water use? [ ] Yes [X] No

Special Instructions / Specify Criteria to add on report (client Use)

SAMPLE CONDITION AS RECEIVED (lab use only)
Frozen [ ] SIF Observations Yes [ ] No [ ]
Ice packs Yes [ ] No [ ] Custody seal intact Yes [ ] No [ ]
Cooling Initiated [ ]
INITIAL COOLER TEMPERATURES °C: 8.8°C
FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Ariel Melvin	Date: April 19	Time:	Received by: David I.	Date: 4/19/17	Time: 11:00am	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION   WHITE - LABORATORY COPY   YELLOW - CLIENT COPY

NA-FM-0326e v09 Front/04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 28-APR-17
PO No.: FLOODWAY
WO No.: L1917469
Project Ref: 16-0300-002.1100.02
Sample ID: PTH 44
Sampled By: ATM+GS
Date Collected: 26-APR-17
Lab Sample ID: L1917469-1
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Total Floodway						
Bicarbonate (HCO3)	337		mg/L			27-APR-17
Carbonate (CO3)	3.96		mg/L			27-APR-17
Hydroxide (OH)	<0.34		mg/L			27-APR-17
*Nitrate and Nitrite as N	0.0552		mg/L	10		28-APR-17
pH						
pH	8.33		pH units			26-APR-17
Turbidity						
*Turbidity	24.0		NTU			27-APR-17
Total Metals by ICP-MS						
Calcium (Ca)-Total	73.2		mg/L			27-APR-17
Magnesium (Mg)-Total	43.6		mg/L			27-APR-17
Potassium (K)-Total	4.69		mg/L			27-APR-17
Sodium (Na)-Total	29.3		mg/L		200	27-APR-17
TDS calculated						
TDS (Calculated)	431		mg/L		500	28-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	71.9		mg/L		500	26-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	0.0016		mg/L	1		26-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.0536		mg/L	10		26-APR-17
Ion Balance Calculation						
Ion Balance	105		%			28-APR-17
Cation - Anion Balance	2.4		%			28-APR-17
Anion Sum	8.23		me/L			28-APR-17
Cation Sum	8.64		me/L			28-APR-17
Hardness Calculated						
Hardness (as CaCO3)	362	HTC	mg/L		500	28-APR-17
Conductivity						
Conductivity	704		umhos/cm			26-APR-17
Chloride in Water by IC						
Chloride (Cl)	38.1		mg/L		250	26-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	283		mg/L			26-APR-17
Phosphorus (P)-Total	0.100		mg/L			28-APR-17
Escherichia Coli	30		MPN/100mL	0		26-APR-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
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Date: 28-APR-17
PO No.: FLOODWAY
WO No.: L1917469
Project Ref: 16-0300-002.1100.02
Sample ID: PTH 44
Sampled By: ATM+GS
Date Collected: 26-APR-17
Lab Sample ID: L1917469-1
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliforms	548		MPN/100mL	0		26-APR-17
Total Kjeldahl Nitrogen	0.56		mg/L			28-APR-17
Total Suspended Solids	26.0		mg/L			27-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 28-APR-17
PO No.: FLOODWAY
WO No.: L1917469
Project Ref: 16-0300-002.1100.02
Sample ID: PTH 59
Sampled By: ATM+GS
Date Collected: 26-APR-17
Lab Sample ID: L1917469-2
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Total Floodway						
Bicarbonate (HCO3)	336		mg/L			27-APR-17
Carbonate (CO3)	6.00		mg/L			27-APR-17
Hydroxide (OH)	<0.34		mg/L			27-APR-17
*Nitrate and Nitrite as N	0.0233		mg/L	10		28-APR-17
pH						
pH	8.38		pH units			26-APR-17
Turbidity						
*Turbidity	22.3		NTU			27-APR-17
Total Metals by ICP-MS						
Calcium (Ca)-Total	71.5		mg/L			27-APR-17
Magnesium (Mg)-Total	41.7		mg/L			27-APR-17
Potassium (K)-Total	4.15		mg/L			27-APR-17
Sodium (Na)-Total	20.7		mg/L		200	27-APR-17
TDS calculated						
TDS (Calculated)	396		mg/L		500	28-APR-17
Sulfate in Water by IC						
Sulfate (SO4)	63.0		mg/L		500	26-APR-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	0.0011		mg/L	1		26-APR-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.0221		mg/L	10		26-APR-17
Ion Balance Calculation						
Ion Balance	104		%			28-APR-17
Cation - Anion Balance	1.9		%			28-APR-17
Anion Sum	7.71		me/L			28-APR-17
Cation Sum	8.01		me/L			28-APR-17
Hardness Calculated						
Hardness (as CaCO3)	350	HTC	mg/L		500	28-APR-17
Conductivity						
Conductivity	649		umhos/cm			26-APR-17
Chloride in Water by IC						
Chloride (Cl)	24.3		mg/L		250	26-APR-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	285		mg/L			26-APR-17
Phosphorus (P)-Total	0.092		mg/L			28-APR-17
Escherichia Coli	6		MPN/100mL	0		26-APR-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: Marci Friedman Hamm

Date: 28-APR-17
PO No.: FLOODWAY
WO No.: L1917469
Project Ref: 16-0300-002.1100.02
Sample ID: PTH 59
Sampled By: ATM+GS
Date Collected: 26-APR-17
Lab Sample ID: L1917469-2
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliforms	308		MPN/100mL	0		26-APR-17
Total Kjeldahl Nitrogen	<0.20		mg/L			28-APR-17
Total Suspended Solids	18.0		mg/L			27-APR-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

Guidelines & Objectives

Sample Parameter Qualifier key listed:

Qualifier	Description
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).

Health Canada MAC Health Related Criteria Limits

Nitrate/Nitrite-N*	Criteria limit is 10 mg/L (1.0 mg/L if present as all Nitrite-N). High concentrations may contribute to blue baby syndrome in infants.
Lead*	A cumulative body poison, uncommon in naturally occurring hard waters.
Fluoride*	Present in fluoridated water supplies at 0.8 mg/L to reduce dental caries. Elevated levels causes fluorosis (mottling of teeth).
Total Coliforms*	Criteria is 0 CFU/100mL. Adverse health effects.
E. Coli*	Criteria is 0 CFU/100 mL. Certain E. Coli bacteria can be life threatening.

*Health Canada Canadian Drinking Water Quality Guidelines (MAC limit)

Aesthetic Objective Concentration Levels

Alkalinity	Acid neutralizing capacity. Usually a measure of carbonate and bicarbonates and calculated and reported as calcium carbonate.
Balance	Quality control parameter ratioing cations to anions
Bicarbonate	See Alkalinity. Report as the anion HCO3-1
Carbonate	See Alkalinity. Reported at the anion CO3-2
Calcium	See Hardness. Common major cation of water chemistry.
Chloride	Common major anion of water chemistry.
Conductance	Physical test measuring water salinity (dissolved ions or solids)
Hardness	Classical measure or capacity of water to precipitate soap (chiefly calcium and magnesium ions). Causes scaling tendency in water if carbonates/bicarbonates are present (if >200 mg/L). For drinking water purposes waters with results <200 mg/L are considered acceptable, results >200 mg/L are considered poor but can be tolerated. Results >500 mg/L are unacceptable.
Hydroxide	See alkalinity
Magnesium	See hardness. Common major cation of water chemistry. Elevated levels (>125 mg/L) may exert a cathartic or diuretic action.
pH	Measure of water acidity/alkalinity. Normal range is 7.0-8.5.
Potassium	Common major cation of water chemistry.
Sodium	Common major cation of water chemistry. Measure of salinity (saltiness).The aesthetic objective (not related to health) for sodium in drinking water is 200 mg/L. However, where sodium concentration of the drinking water exceeds 20 mg/L, it is recommended that any person on a sodium restricted diet consult with his/her physician or Medical Officer of Health concerning the use of that water.
Sulphate	Common major anion of water chemistry. Elevated levels may exert a cathartic or diuretic action.
Total Dissolved Solids	A measure of water salinity.
Iron	Causes staining to laundry and porcelain and astringent taste. Oxidizes to red-brown precipitate on exposure to air.
Manganese	Elevated levels may cause staining of laundry and porcelain.
Heterotrophic Plate Count	Criteria is 500 cfu/mL Measure of heterotrophic bacteria present.

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
Contact: Marci Friedman Hamm

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-WP	**Water**							
Batch R3708790								
WG2517804-14 LCS								
Alkalinity, Total (as CaCO3)			103.4		%		85-115	26-APR-17
WG2517804-11 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	26-APR-17
CL-IC-N-WP	**Water**							
Batch R3709509								
WG2517201-6 LCS								
Chloride (Cl)			102.1		%		90-110	26-APR-17
WG2517201-5 MB								
Chloride (Cl)			<0.50		mg/L		0.5	26-APR-17
EC-QT97-ENDPT-WP	**Water**							
Batch R3709048								
WG2517560-2 DUP		**L1917469-1**						
Escherichia Coli		30	15	DUP-H	MPN/100mL	66	65	26-APR-17
WG2517560-1 MB								
Escherichia Coli			<1		MPN/100mL		1	26-APR-17
EC-WP	**Water**							
Batch R3708790								
WG2517804-13 LCS								
Conductivity			98.9		%		90-110	26-APR-17
WG2517804-11 MB								
Conductivity			<1.0		umhos/cm		1	26-APR-17
MET-T-MS-WP	**Water**							
Batch R3709489								
WG2518022-2 LCS								
Calcium (Ca)-Total			99.2		%		80-120	27-APR-17
Magnesium (Mg)-Total			99.3		%		80-120	27-APR-17
Potassium (K)-Total			97.8		%		80-120	27-APR-17
Sodium (Na)-Total			104.3		%		80-120	27-APR-17
WG2518022-1 MB								
Calcium (Ca)-Total			<0.20		mg/L		0.2	27-APR-17
Magnesium (Mg)-Total			<0.050		mg/L		0.05	27-APR-17
Potassium (K)-Total			<0.10		mg/L		0.1	27-APR-17
Sodium (Na)-Total			<0.050		mg/L		0.05	27-APR-17
N-TOTKJ-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
N-TOTKJ-WP	**Water**							
Batch R3709933								
WG2517909-10 LCS								
Total Kjeldahl Nitrogen			86.6		%		75-125	28-APR-17
WG2517909-9 MB								
Total Kjeldahl Nitrogen			<0.20		mg/L		0.2	28-APR-17
NO2-L-IC-N-WP	**Water**							
Batch R3709509								
WG2517201-6 LCS								
Nitrite (as N)			99.9		%		90-110	26-APR-17
WG2517201-5 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	26-APR-17
NO3-L-IC-N-WP	**Water**							
Batch R3709509								
WG2517201-6 LCS								
Nitrate (as N)			102.7		%		90-110	26-APR-17
WG2517201-5 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	26-APR-17
P-T-COL-WP	**Water**							
Batch R3709860								
WG2518578-2 LCS								
Phosphorus (P)-Total			97.2		%		80-120	28-APR-17
WG2518578-1 MB								
Phosphorus (P)-Total			<0.010		mg/L		0.01	28-APR-17
PH-WP	**Water**							
Batch R3708790								
WG2517804-12 LCS								
pH			7.43		pH units		7.3-7.5	26-APR-17
SO4-IC-N-WP	**Water**							
Batch R3709509								
WG2517201-6 LCS								
Sulfate (SO4)			103.5		%		90-110	26-APR-17
WG2517201-5 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	26-APR-17
SOLIDS-TOTSUS-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SOLIDS-TOTSUS-WP	**Water**							
Batch R3709608								
WG2517427-6 LCS								
Total Suspended Solids			94.7		%		85-115	27-APR-17
WG2517427-5 MB								
Total Suspended Solids			<5.0		mg/L		5	27-APR-17
TC-QT97-ENDPT-WP	**Water**							
Batch R3709045								
WG2517557-2 DUP		**L1917469-1**						
Total Coliforms		548	488		MPN/100mL	11	65	26-APR-17
WG2517557-1 MB								
Total Coliforms			<1		MPN/100mL		1	26-APR-17
TURBIDITY-WP	**Water**							
Batch R3709522								
WG2518234-2 LCS								
Turbidity			100.0		%		85-115	27-APR-17
WG2518234-1 MB								
Turbidity			<0.10		NTU		0.1	27-APR-17

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	26-APR-17 09:30	26-APR-17 12:30	0.25	3.1	hours	EHTR-FM
	2	26-APR-17 10:00	26-APR-17 12:30	0.25	2.4	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1917469 were received on 26-APR-17 10:50.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1917469-COFC

COC Number: 14 - 503854

Page ___ of ___

L1917469

Report To	
Company:	KGS group
Contact:	Marci Felderhammer
Address:	865 Waverley Street 3rd floor wpg MB R3T5P4
Phone:	

Report Format / Distribution	
Select Report Format:	[X] PDF [X] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report	[X] Yes [ ] No
[ ] Criteria on Report - provide details below if box checked	
Select Distribution:	[X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	mfelhammer@kgsgroup.com, msmith@kgsgroup.co
Email 2	Amelund@kgsgroup.com, PLindell@kgsgroup.com

Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)

R	[ ]	Regular (Standard TAT if received by 3pm)
P	[ ]	Priority (2-4 business days if received by 3pm)
E	[ ]	Emergency (1-2 business days if received by 3pm)
E2	[ ]	Same day or weekend emergency if received by 10am – contact ALS for surcharge.

Specify Date Required for E2,E or P:

Invoice To		
Same as Report To	[X] Yes	[ ] No
Copy of Invoice with Report	[ ] Yes	[ ] No
Company:		
Contact:		

Invoice Distribution	
Select Invoice Distribution:	[ ] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	Accounts Payable
Email 2	

Project Information	
ALS Quote #:	Q56271
Job #:	16-0300-002, 1100.02
PO / AFE:	Floodway
LSD:	Floodway

Oil and Gas Required Fields (client use)	
Approver ID:	Cost Center:
GL Account:	Routing Code:
Activity Code:	
Location:	

ALS Lab Work Order # (lab use only)

ALS Contact: Judy D

Sampler: ATM + GS

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	KGS-Basic-T-Flow-T-Col-T+	N-TOTKJ-Wpt	Solids-Tot-SUS-Wpt	TC-QT-97-EndPoint	EC-QT-97-EndPoint	Number of Containers
	PTH 44	26-Apr-17	9:30	SW	X	X	X	X	X	5
	PTH 59	26-Apr-17	1000	SW	X	X	X	X	X	5

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? [ ] Yes [ ] No	
Are samples for human drinking water use? [ ] Yes [ ] No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	[ ]			SIF Observations	Yes [ ]	No [ ]	
Ice packs	Yes [ ]	No [ ]		Custody seal intact	Yes [ ]	No [ ]	
Cooling Initiated	[ ]						

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
4					

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: Apr 26	Time:	Received by: [signature]	Date: 26-4-17	Time: 10:50	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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NA-FM-0326e v09 Front/04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: PAUL LINDELL

Date: 19-MAY-17
PO No.:
WO No.: L1925268
Project Ref: 16-0300-002
Sample ID: K13-12321
Sampled By: PJL/LM
Date Collected: 11-MAY-17
Lab Sample ID: L1925268-1
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	661		mg/L			16-MAY-17
Carbonate (CO3)	<0.60		mg/L			16-MAY-17
Hydroxide (OH)	<0.34		mg/L			16-MAY-17
*Nitrate and Nitrite as N	3.31		mg/L	10		19-MAY-17
pH						
pH	7.30		pH units			12-MAY-17
Turbidity						
*Turbidity	16.0		NTU			12-MAY-17
TDS calculated						
TDS (Calculated)	836		mg/L		500	16-MAY-17
Sulfate in Water by IC						
Sulfate (SO4)	86.9		mg/L		500	13-MAY-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0050	DLM	mg/L	1		13-MAY-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	3.31		mg/L	10		13-MAY-17
Ion Balance Calculation						
Ion Balance	106		%			19-MAY-17
Cation - Anion Balance	2.9		%			19-MAY-17
Anion Sum	16.9		me/L			19-MAY-17
Cation Sum	17.9		me/L			19-MAY-17
Hardness Calculated						
Hardness (as CaCO3)	792		mg/L		500	16-MAY-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	105		mg/L			15-MAY-17
Magnesium (Mg)-Dissolved	129		mg/L			15-MAY-17
Potassium (K)-Dissolved	6.13		mg/L			15-MAY-17
Sodium (Na)-Dissolved	42.9		mg/L		200	15-MAY-17
Conductivity						
Conductivity	1440		umhos/cm			12-MAY-17
Chloride in Water by IC						
Chloride (Cl)	141		mg/L		250	13-MAY-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	542		mg/L			12-MAY-17
Total Coliform and E.coli by MPN QT97						

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ATTN: PAUL LINDELL

Date: 19-MAY-17
PO No.:
WO No.: L1925268
Project Ref: 16-0300-002
Sample ID: K13-12321
Sampled By: PJL/LM
Date Collected: 11-MAY-17
Lab Sample ID: L1925268-1
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	<1		MPN/100mL	0		12-MAY-17
Escherichia Coli	<1		MPN/100mL	0		12-MAY-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Shannon Sawatzky
Account Manager

KGS Group Consultants (Winnipeg)
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ATTN: PAUL LINDELL

Date: 19-MAY-17
PO No.:
WO No.: L1925268
Project Ref: 16-0300-002
Sample ID: K09-12316
Sampled By: PJL/LM
Date Collected: 11-MAY-17
Lab Sample ID: L1925268-2
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	465		mg/L			16-MAY-17
Carbonate (CO3)	<0.60		mg/L			16-MAY-17
Hydroxide (OH)	<0.34		mg/L			16-MAY-17
*Nitrate and Nitrite as N	1.49		mg/L	10		19-MAY-17
pH						
pH	7.50		pH units			12-MAY-17
Turbidity						
*Turbidity	0.25		NTU			12-MAY-17
TDS calculated						
TDS (Calculated)	486		mg/L		500	16-MAY-17
Sulfate in Water by IC						
Sulfate (SO4)	63.4		mg/L		500	13-MAY-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	0.0080		mg/L	1		13-MAY-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	1.48		mg/L	10		13-MAY-17
Ion Balance Calculation						
Ion Balance	102		%			19-MAY-17
Cation - Anion Balance	1.2		%			19-MAY-17
Anion Sum	9.85		me/L			19-MAY-17
Cation Sum	10.1		me/L			19-MAY-17
Hardness Calculated						
Hardness (as CaCO3)	452		mg/L		500	16-MAY-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	74.2		mg/L			15-MAY-17
Magnesium (Mg)-Dissolved	64.8		mg/L			15-MAY-17
Potassium (K)-Dissolved	4.46		mg/L			15-MAY-17
Sodium (Na)-Dissolved	21.7		mg/L		200	15-MAY-17
Conductivity						
Conductivity	844		umhos/cm			12-MAY-17
Chloride in Water by IC						
Chloride (Cl)	28.5		mg/L		250	13-MAY-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	381		mg/L			12-MAY-17
Total Coliform and E.coli by MPN QT97						

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Project Ref: 16-0300-002
Sample ID: K09-12316
Sampled By: PJL/LM
Date Collected: 11-MAY-17
Lab Sample ID: L1925268-2
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	<1		MPN/100mL	0		12-MAY-17
Escherichia Coli	<1		MPN/100mL	0		12-MAY-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

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* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

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Account Manager

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ATTN: PAUL LINDELL

Date: 19-MAY-17
PO No.:
WO No.: L1925268
Project Ref: 16-0300-002
Sample ID: K09-12012
Sampled By: PJL/LM
Date Collected: 11-MAY-17
Lab Sample ID: L1925268-3
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	473		mg/L			16-MAY-17
Carbonate (CO3)	<0.60		mg/L			16-MAY-17
Hydroxide (OH)	<0.34		mg/L			16-MAY-17
*Nitrate and Nitrite as N	<0.010		mg/L	10		19-MAY-17
pH						
pH	7.47		pH units			12-MAY-17
Turbidity						
*Turbidity	0.50		NTU			12-MAY-17
TDS calculated						
TDS (Calculated)	728		mg/L		500	16-MAY-17
Sulfate in Water by IC						
Sulfate (SO4)	242		mg/L		500	13-MAY-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0020	DLM	mg/L	1		13-MAY-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	<0.010	DLM	mg/L	10		13-MAY-17
Ion Balance Calculation						
Ion Balance	105		%			19-MAY-17
Cation - Anion Balance	2.4		%			19-MAY-17
Anion Sum	13.3		me/L			19-MAY-17
Cation Sum	14.0		me/L			19-MAY-17
Hardness Calculated						
Hardness (as CaCO3)	589		mg/L		500	16-MAY-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	97.9		mg/L			15-MAY-17
Magnesium (Mg)-Dissolved	83.7		mg/L			15-MAY-17
Potassium (K)-Dissolved	4.85		mg/L			15-MAY-17
Sodium (Na)-Dissolved	47.9		mg/L		200	15-MAY-17
Conductivity						
Conductivity	1090		umhos/cm			12-MAY-17
Chloride in Water by IC						
Chloride (Cl)	19.2		mg/L		250	13-MAY-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	387		mg/L			12-MAY-17
Total Coliform and E.coli by MPN QT97						

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Date: 19-MAY-17
PO No.:
WO No.: L1925268
Project Ref: 16-0300-002
Sample ID: K09-12012
Sampled By: PJL/LM
Date Collected: 11-MAY-17
Lab Sample ID: L1925268-3
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	<1		MPN/100mL	0		12-MAY-17
Escherichia Coli	<1		MPN/100mL	0		12-MAY-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Shannon Sawatzky
Account Manager

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ATTN: PAUL LINDELL

Date: 19-MAY-17
PO No.:
WO No.: L1925268
Project Ref: 16-0300-002
Sample ID: K11-12015
Sampled By: PJL/LM
Date Collected: 11-MAY-17
Lab Sample ID: L1925268-4
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	302		mg/L			16-MAY-17
Carbonate (CO3)	<0.60		mg/L			16-MAY-17
Hydroxide (OH)	<0.34		mg/L			16-MAY-17
*Nitrate and Nitrite as N	0.143		mg/L	10		19-MAY-17
pH						
pH	7.68		pH units			12-MAY-17
Turbidity						
*Turbidity	0.21		NTU			12-MAY-17
TDS calculated						
TDS (Calculated)	361		mg/L		500	16-MAY-17
Sulfate in Water by IC						
Sulfate (SO4)	78.9		mg/L		500	13-MAY-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	0.0153		mg/L	1		13-MAY-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.128		mg/L	10		13-MAY-17
Ion Balance Calculation						
Ion Balance	101		%			19-MAY-17
Cation - Anion Balance	0.7		%			19-MAY-17
Anion Sum	7.02		me/L			19-MAY-17
Cation Sum	7.12		me/L			19-MAY-17
Hardness Calculated						
Hardness (as CaCO3)	331		mg/L		500	16-MAY-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	63.9		mg/L			15-MAY-17
Magnesium (Mg)-Dissolved	41.7		mg/L			15-MAY-17
Potassium (K)-Dissolved	4.44		mg/L			15-MAY-17
Sodium (Na)-Dissolved	8.94		mg/L		200	15-MAY-17
Conductivity						
Conductivity	615		umhos/cm			12-MAY-17
Chloride in Water by IC						
Chloride (Cl)	14.9		mg/L		250	13-MAY-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	248		mg/L			12-MAY-17
Total Coliform and E.coli by MPN QT97						

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Date: 19-MAY-17
PO No.:
WO No.: L1925268
Project Ref: 16-0300-002
Sample ID: K11-12015
Sampled By: PJL/LM
Date Collected: 11-MAY-17
Lab Sample ID: L1925268-4
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	<1		MPN/100mL	0		12-MAY-17
Escherichia Coli	<1		MPN/100mL	0		12-MAY-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Shannon Sawatzky
Account Manager

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ATTN: PAUL LINDELL

Date: 19-MAY-17
PO No.:
WO No.: L1925268
Project Ref: 16-0300-002
Sample ID: K11-12014
Sampled By: PJL/LM
Date Collected: 11-MAY-17
Lab Sample ID: L1925268-5
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	370		mg/L			16-MAY-17
Carbonate (CO3)	<0.60		mg/L			16-MAY-17
Hydroxide (OH)	<0.34		mg/L			16-MAY-17
*Nitrate and Nitrite as N	0.314		mg/L	10		19-MAY-17
pH						
pH	7.52		pH units			12-MAY-17
Turbidity						
*Turbidity	1.50		NTU			12-MAY-17
TDS calculated						
TDS (Calculated)	394		mg/L		500	16-MAY-17
Sulfate in Water by IC						
Sulfate (SO4)	65.4		mg/L		500	13-MAY-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0010		mg/L	1		13-MAY-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.314		mg/L	10		13-MAY-17
Ion Balance Calculation						
Ion Balance	103		%			19-MAY-17
Cation - Anion Balance	1.6		%			19-MAY-17
Anion Sum	7.79		me/L			19-MAY-17
Cation Sum	8.04		me/L			19-MAY-17
Hardness Calculated						
Hardness (as CaCO3)	379		mg/L		500	16-MAY-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	75.6		mg/L			15-MAY-17
Magnesium (Mg)-Dissolved	46.3		mg/L			15-MAY-17
Potassium (K)-Dissolved	4.48		mg/L			15-MAY-17
Sodium (Na)-Dissolved	7.98		mg/L		200	15-MAY-17
Conductivity						
Conductivity	672		umhos/cm			12-MAY-17
Chloride in Water by IC						
Chloride (Cl)	12.3		mg/L		250	13-MAY-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	303		mg/L			12-MAY-17
Total Coliform and E.coli by MPN QT97						

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Date: 19-MAY-17
PO No.:
WO No.: L1925268
Project Ref: 16-0300-002
Sample ID: K11-12014
Sampled By: PJL/LM
Date Collected: 11-MAY-17
Lab Sample ID: L1925268-5
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	<1		MPN/100mL	0		12-MAY-17
Escherichia Coli	<1		MPN/100mL	0		12-MAY-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Shannon Sawatzky
Account Manager

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Winnipeg MB R3T 5P4
ATTN: PAUL LINDELL

Date: 19-MAY-17
PO No.:
WO No.: L1925268
Project Ref: 16-0300-002
Sample ID: K11-100
Sampled By: PJL/LM
Date Collected: 11-MAY-17
Lab Sample ID: L1925268-6
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Dissolved Floodway						
Bicarbonate (HCO3)	368		mg/L			16-MAY-17
Carbonate (CO3)	<0.60		mg/L			16-MAY-17
Hydroxide (OH)	<0.34		mg/L			16-MAY-17
*Nitrate and Nitrite as N	0.321		mg/L	10		19-MAY-17
pH						
pH	7.48		pH units			12-MAY-17
Turbidity						
*Turbidity	1.60		NTU			12-MAY-17
TDS calculated						
TDS (Calculated)	396		mg/L		500	16-MAY-17
Sulfate in Water by IC						
Sulfate (SO4)	65.9		mg/L		500	13-MAY-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0010		mg/L	1		13-MAY-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.321		mg/L	10		13-MAY-17
Ion Balance Calculation						
Ion Balance	105		%			19-MAY-17
Cation - Anion Balance	2.5		%			19-MAY-17
Anion Sum	7.77		me/L			19-MAY-17
Cation Sum	8.17		me/L			19-MAY-17
Hardness Calculated						
Hardness (as CaCO3)	385		mg/L		500	16-MAY-17
Dissolved Metals by ICP-MS						
Calcium (Ca)-Dissolved	76.8		mg/L			15-MAY-17
Magnesium (Mg)-Dissolved	47.0		mg/L			15-MAY-17
Potassium (K)-Dissolved	4.58		mg/L			15-MAY-17
Sodium (Na)-Dissolved	8.11		mg/L		200	15-MAY-17
Conductivity						
Conductivity	678		umhos/cm			12-MAY-17
Chloride in Water by IC						
Chloride (Cl)	12.2		mg/L		250	13-MAY-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	302		mg/L			12-MAY-17
Total Coliform and E.coli by MPN QT97						

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ATTN: PAUL LINDELL

Date: 19-MAY-17
PO No.:
WO No.: L1925268
Project Ref: 16-0300-002
Sample ID: K11-100
Sampled By: PJL/LM
Date Collected: 11-MAY-17
Lab Sample ID: L1925268-6
Matrix: GW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Total Coliform and E.coli by MPN QT97						
Total Coliforms	<1		MPN/100mL	0		12-MAY-17
Escherichia Coli	<1		MPN/100mL	0		12-MAY-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Shannon Sawatzky
Account Manager

Guidelines & Objectives

Sample Parameter Qualifier key listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Health Canada MAC Health Related Criteria Limits

Nitrate/Nitrite-N*	Criteria limit is 10 mg/L (1.0 mg/L if present as all Nitrite-N). High concentrations may contribute to blue baby syndrome in infants.
Lead*	A cumulative body poison, uncommon in naturally occurring hard waters.
Fluoride*	Present in fluoridated water supplies at 0.8 mg/L to reduce dental caries. Elevated levels causes fluorosis (mottling of teeth).
Total Coliforms*	Criteria is 0 CFU/100mL. Adverse health effects.
E. Coli*	Criteria is 0 CFU/100 mL. Certain E. Coli bacteria can be life threatening.

*Health Canada Canadian Drinking Water Quality Guidelines (MAC limit)

Aesthetic Objective Concentration Levels

Alkalinity	Acid neutralizing capacity. Usually a measure of carbonate and bicarbonates and calculated and reported as calcium carbonate.
Balance	Quality control parameter ratioing cations to anions
Bicarbonate	See Alkalinity. Report as the anion HCO3-1
Carbonate	See Alkalinity. Reported at the anion CO3-2
Calcium	See Hardness. Common major cation of water chemistry.
Chloride	Common major anion of water chemistry.
Conductance	Physical test measuring water salinity (dissolved ions or solids)
Hardness	Classical measure or capacity of water to precipitate soap (chiefly calcium and magnesium ions). Causes scaling tendency in water if carbonates/bicarbonates are present (if >200 mg/L). For drinking water purposes waters with results <200 mg/L are considered acceptable, results >200 mg/L are considered poor but can be tolerated. Results >500 mg/L are unacceptable.
Hydroxide	See alkalinity
Magnesium	See hardness. Common major cation of water chemistry. Elevated levels (>125 mg/L) may exert a cathartic or diuretic action.
pH	Measure of water acidity/alkalinity. Normal range is 7.0-8.5.
Potassium	Common major cation of water chemistry.
Sodium	Common major cation of water chemistry. Measure of salinity (saltiness).The aesthetic objective (not related to health) for sodium in drinking water is 200 mg/L. However, where sodium concentration of the drinking water exceeds 20 mg/L, it is recommended that any person on a sodium restricted diet consult with his/her physician or Medical Officer of Health concerning the use of that water.
Sulphate	Common major anion of water chemistry. Elevated levels may exert a cathartic or diuretic action.
Total Dissolved Solids	A measure of water salinity.
Iron	Causes staining to laundry and porcelain and astringent taste. Oxidizes to red-brown precipitate on exposure to air.
Manganese	Elevated levels may cause staining of laundry and porcelain.
Heterotrophic Plate Count	Criteria is 500 cfu/mL Measure of heterotrophic bacteria present.

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
Contact: PAUL LINDELL

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-WP	**Water**							
Batch R3723163								
WG2528203-4 LCS								
Alkalinity, Total (as CaCO3)			101.7		%		85-115	12-MAY-17
WG2528203-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	12-MAY-17
CL-IC-N-WP	**Water**							
Batch R3727082								
WG2528207-2 LCS								
Chloride (Cl)			99.6		%		90-110	13-MAY-17
WG2528207-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	13-MAY-17
EC-WP	**Water**							
Batch R3723163								
WG2528203-3 LCS								
Conductivity			100.4		%		90-110	12-MAY-17
WG2528203-1 MB								
Conductivity			<1.0		umhos/cm		1	12-MAY-17
MET-D-MS-WP	**Water**							
Batch R3724764								
WG2528480-2 LCS								
Calcium (Ca)-Dissolved			103.7		%		80-120	15-MAY-17
Magnesium (Mg)-Dissolved			99.0		%		80-120	15-MAY-17
Potassium (K)-Dissolved			104.0		%		80-120	15-MAY-17
Sodium (Na)-Dissolved			103.1		%		80-120	15-MAY-17
WG2528480-1 MB								
Calcium (Ca)-Dissolved			<0.20		mg/L		0.2	15-MAY-17
Magnesium (Mg)-Dissolved			<0.050		mg/L		0.05	15-MAY-17
Potassium (K)-Dissolved			<0.10		mg/L		0.1	15-MAY-17
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	15-MAY-17
NO2-L-IC-N-WP	**Water**							
Batch R3727082								
WG2528207-2 LCS								
Nitrite (as N)			99.3		%		90-110	13-MAY-17
WG2528207-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	13-MAY-17
NO3-L-IC-N-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO3-L-IC-N-WP	**Water**							
Batch R3727082								
WG2528207-2 LCS								
Nitrate (as N)			100.2		%		90-110	13-MAY-17
WG2528207-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	13-MAY-17
PH-WP	**Water**							
Batch R3723163								
WG2528203-2 LCS								
pH			7.39		pH units		7.3-7.5	12-MAY-17
SO4-IC-N-WP	**Water**							
Batch R3727082								
WG2528207-2 LCS								
Sulfate (SO4)			100.5		%		90-110	13-MAY-17
WG2528207-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	13-MAY-17
TC,EC-QT97-WP	**Water**							
Batch R3720747								
WG2527190-2 DUP		**L1925268-1**						
Total Coliforms		<1	<1	RPD-NA	MPN/100mL	N/A	65	12-MAY-17
Escherichia Coli		<1	<1	RPD-NA	MPN/100mL	N/A	65	12-MAY-17
WG2527190-1 MB								
Total Coliforms			<1		MPN/100mL		1	12-MAY-17
Escherichia Coli			<1		MPN/100mL		1	12-MAY-17
TURBIDITY-WP	**Water**							
Batch R3725707								
WG2527406-5 LCS								
Turbidity			99.5		%		85-115	12-MAY-17
WG2527406-4 MB								
Turbidity			<0.10		NTU		0.1	12-MAY-17

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	11-MAY-17 10:43	12-MAY-17 12:00	0.25	25	hours	EHTR-FM
	2	11-MAY-17 11:30	12-MAY-17 12:00	0.25	24	hours	EHTR-FM
	3	11-MAY-17 13:35	12-MAY-17 12:00	0.25	22	hours	EHTR-FM
	4	11-MAY-17 14:35	12-MAY-17 12:00	0.25	21	hours	EHTR-FM
	5	11-MAY-17 15:30	12-MAY-17 12:00	0.25	20	hours	EHTR-FM
	6	11-MAY-17 18:10	12-MAY-17 12:00	0.25	18	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1925268 were received on 12-MAY-17 08:00.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1925268-COFC

COC Number: 14 - 503958

Page 1 of 1

Report To
Company: KGS Group
Contact: Paul Lindell
Address: 865 Waverley St. Wpg MB R3T 5P4
Phone: 204-896-1209

Report Format / Distribution
Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☐ Yes ☐ No
☐ Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: msmith@kgsgroup.com / mfhanna@kgsgroup.com
Email 2: plindell@kgsgroup.com

Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
R ☑ Regular (Standard TAT if received by 3pm)
P ☐ Priority (2-4 business days if received by 3pm)
E ☐ Emergency (1-2 business days if received by 3pm)
E2 ☐ Same day or weekend emergency if received by 10am – contact ALS for surcharge.
Specify Date Required for E2,E or P:

Invoice To Same as Report To ☐ Yes ☐ No
Copy of Invoice with Report ☐ Yes ☐ No
Company:
Contact:

Invoice Distribution
Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax
Email 2

Project Information
ALS Quote #: Q56271
Job #: 16-0300-002
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)
Approver ID: | Cost Center:
GL Account: | Routing Code:
Activity Code:
Location:

ALS Lab Work Order # (lab use only)
ALS Contact: Jody D
Sampler: PJL / LM

Analysis Request
Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	KGS-ROU1W-D-FLOWY-WP	TCEC-QT97-WP	Number of Containers
	K13-12321	11-May-17	10:43	GW	X	X	3
	K09-12316	↓	11:30	↓	X	X	3
	K09-12012	↓	13:35	↓	X	X	3
	K11-12015	↓	14:35	↓	X	X	3
	K11-12014	↓	15:30	↓	X	X	3
	K11-100	↓	18:10	↓	X	X	3

Drinking Water (DW) Samples[1] (client use)
Are samples taken from a Regulated DW System? ☐ Yes ☑ No
Are samples for human drinking water use? ☐ Yes ☑ No

Special Instructions / Specify Criteria to add on report (client Use)

SAMPLE CONDITION AS RECEIVED (lab use only)
Frozen ☐ SIF Observations Yes ☐ No ☐
Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐
INITIAL COOLER TEMPERATURES °C: 4.2°C
FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: P Lindell	Date: May 11/17	Time: 18:00	Received by: David I.	Date: 5-12-17	Time: 8:00 am	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
WHITE - LABORATORY COPY YELLOW - CLIENT COPY
NA-FM-0326e v09 Front/04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: PAUL LINDELL

Date: 29-MAY-17
PO No.:
WO No.: L1925270
Project Ref: 16-0300-002
Sample ID: SW44
Sampled By:
Date Collected: 11-MAY-17
Lab Sample ID: L1925270-1
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Total Floodway						
Bicarbonate (HCO3)	349		mg/L			16-MAY-17
Carbonate (CO3)	4.44		mg/L			16-MAY-17
Hydroxide (OH)	<0.34		mg/L			16-MAY-17
*Nitrate and Nitrite as N	0.0116		mg/L	10		19-MAY-17
pH						
pH	8.34		pH units			12-MAY-17
Turbidity						
*Turbidity	9.30		NTU			12-MAY-17
Total Metals by ICP-MS						
Calcium (Ca)-Total	76.3		mg/L			15-MAY-17
Magnesium (Mg)-Total	40.3		mg/L			15-MAY-17
Potassium (K)-Total	3.95		mg/L			15-MAY-17
Sodium (Na)-Total	22.1		mg/L		200	15-MAY-17
TDS calculated						
TDS (Calculated)	408		mg/L		500	16-MAY-17
Sulfate in Water by IC						
Sulfate (SO4)	65.9		mg/L		500	13-MAY-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0010		mg/L	1		13-MAY-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	0.0116		mg/L	10		13-MAY-17
Ion Balance Calculation						
Ion Balance	104		%			19-MAY-17
Cation - Anion Balance	1.8		%			19-MAY-17
Anion Sum	7.90		me/L			19-MAY-17
Cation Sum	8.19		me/L			19-MAY-17
Hardness Calculated						
Hardness (as CaCO3)	357	HTC	mg/L		500	16-MAY-17
Conductivity						
Conductivity	679		umhos/cm			12-MAY-17
Chloride in Water by IC						
Chloride (Cl)	23.5		mg/L		250	13-MAY-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	293		mg/L			12-MAY-17
Phosphorus (P)-Total	0.065		mg/L			16-MAY-17
Ammonia, Total (as N)	<0.010		mg/L			12-MAY-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: PAUL LINDELL

Date: 29-MAY-17
PO No.:
WO No.: L1925270
Project Ref: 16-0300-002
Sample ID: SW44
Sampled By:
Date Collected: 11-MAY-17
Lab Sample ID: L1925270-1
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Escherichia Coli	12		MPN/100mL	0		12-MAY-17
Total Coliforms	411		MPN/100mL	0		12-MAY-17
Total Kjeldahl Nitrogen	0.65		mg/L			26-MAY-17
Total Suspended Solids	9.0		mg/L			15-MAY-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: PAUL LINDELL

Date: 29-MAY-17
PO No.:
WO No.: L1925270
Project Ref: 16-0300-002
Sample ID: SW59
Sampled By:
Date Collected: 11-MAY-17
Lab Sample ID: L1925270-2
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Total Floodway						
Bicarbonate (HCO3)	328		mg/L			16-MAY-17
Carbonate (CO3)	8.40		mg/L			16-MAY-17
Hydroxide (OH)	<0.34		mg/L			16-MAY-17
*Nitrate and Nitrite as N	<0.0051		mg/L	10		24-MAY-17
pH						
pH	8.45		pH units			12-MAY-17
Turbidity						
*Turbidity	12.0		NTU			12-MAY-17
Total Metals by ICP-MS						
Calcium (Ca)-Total	74.0		mg/L			15-MAY-17
Magnesium (Mg)-Total	37.8		mg/L			15-MAY-17
Potassium (K)-Total	3.65		mg/L			15-MAY-17
Sodium (Na)-Total	20.7		mg/L		200	15-MAY-17
TDS calculated						
TDS (Calculated)	387		mg/L		500	16-MAY-17
Sulfate in Water by IC						
Sulfate (SO4)	59.1		mg/L		500	15-MAY-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0010	HTD	mg/L	1		15-MAY-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	<0.0050	HTD	mg/L	10		15-MAY-17
Ion Balance Calculation						
Ion Balance	104		%			24-MAY-17
Cation - Anion Balance	2.0		%			24-MAY-17
Anion Sum	7.50		me/L			24-MAY-17
Cation Sum	7.80		me/L			24-MAY-17
Hardness Calculated						
Hardness (as CaCO3)	340	HTC	mg/L		500	16-MAY-17
Conductivity						
Conductivity	634		umhos/cm			12-MAY-17
Chloride in Water by IC						
Chloride (Cl)	21.7		mg/L		250	15-MAY-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	283		mg/L			12-MAY-17
Phosphorus (P)-Total	0.077		mg/L			16-MAY-17
Ammonia, Total (as N)	<0.010		mg/L			12-MAY-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: PAUL LINDELL

Date: 29-MAY-17
PO No.:
WO No.: L1925270
Project Ref: 16-0300-002
Sample ID: SW59
Sampled By:
Date Collected: 11-MAY-17
Lab Sample ID: L1925270-2
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Escherichia Coli	78		MPN/100mL	0		12-MAY-17
Total Coliforms	1050		MPN/100mL	0		12-MAY-17
Total Kjeldahl Nitrogen	0.75		mg/L			26-MAY-17
Total Suspended Solids	9.0		mg/L			15-MAY-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: PAUL LINDELL

Date: 29-MAY-17
PO No.:
WO No.: L1925270
Project Ref: 16-0300-002
Sample ID: SW100
Sampled By:
Date Collected: 11-MAY-17
Lab Sample ID: L1925270-3
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
ROU1W Total Floodway						
Bicarbonate (HCO3)	328		mg/L			16-MAY-17
Carbonate (CO3)	8.52		mg/L			16-MAY-17
Hydroxide (OH)	<0.34		mg/L			16-MAY-17
*Nitrate and Nitrite as N	<0.0051		mg/L	10		24-MAY-17
pH						
pH	8.45		pH units			12-MAY-17
Turbidity						
*Turbidity	11.6		NTU			12-MAY-17
Total Metals by ICP-MS						
Calcium (Ca)-Total	75.2		mg/L			15-MAY-17
Magnesium (Mg)-Total	38.1		mg/L			15-MAY-17
Potassium (K)-Total	3.77		mg/L			15-MAY-17
Sodium (Na)-Total	21.0		mg/L		200	15-MAY-17
TDS calculated						
TDS (Calculated)	389		mg/L		500	16-MAY-17
Sulfate in Water by IC						
Sulfate (SO4)	59.2		mg/L		500	15-MAY-17
Nitrite in Water by IC (Low Level)						
*Nitrite (as N)	<0.0010	HTD	mg/L	1		15-MAY-17
Nitrate in Water by IC (Low Level)						
*Nitrate (as N)	<0.0050	HTD	mg/L	10		15-MAY-17
Ion Balance Calculation						
Ion Balance	105		%			24-MAY-17
Cation - Anion Balance	2.6		%			24-MAY-17
Anion Sum	7.50		me/L			24-MAY-17
Cation Sum	7.90		me/L			24-MAY-17
Hardness Calculated						
Hardness (as CaCO3)	345	HTC	mg/L		500	16-MAY-17
Conductivity						
Conductivity	632		umhos/cm			12-MAY-17
Chloride in Water by IC						
Chloride (Cl)	21.7		mg/L		250	15-MAY-17
Alkalinity, Total (as CaCO3)						
Alkalinity, Total (as CaCO3)	283		mg/L			12-MAY-17
Phosphorus (P)-Total	0.077		mg/L			16-MAY-17
Ammonia, Total (as N)	<0.010		mg/L			12-MAY-17

KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
ATTN: PAUL LINDELL

Date: 29-MAY-17
PO No.:
WO No.: L1925270
Project Ref: 16-0300-002
Sample ID: SW100
Sampled By:
Date Collected: 11-MAY-17
Lab Sample ID: L1925270-3
Matrix: SW

Test Description	Result	Qualifier	Units of Measure	CDWQG MAC	Aesthetic Objective	Date Analyzed
Escherichia Coli	73		MPN/100mL	0		12-MAY-17
Total Coliforms	1200		MPN/100mL	0		12-MAY-17
Total Kjeldahl Nitrogen	0.78		mg/L			26-MAY-17
Total Suspended Solids	10.0		mg/L			15-MAY-17

CDWQG = Health Canada Guideline Limits updated DECEMBER 2015

* CDWQG for Nitrate+Nitrite-N is the limit for nitrate only. If present as Nitrate then the limit is 10mg/L < or N.D. = less than detection limit.
* Turbidity guideline based on membrane filtration. For guidelines on conventional treatment and slow sand or diatomaceous earth filtration please see Summary Table of Guidelines for Canadian Drinking Water Quality
- A blank entry designates no known limit.
- A shaded value in the Results column exceeds CDWQG MAC and/ or Aesthetic Objective.

Approved by

Hua Wo
Account Manager

Guidelines & Objectives

Sample Parameter Qualifier key listed:

Qualifier	Description
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).

Health Canada MAC Health Related Criteria Limits

Nitrate/Nitrite-N*	Criteria limit is 10 mg/L (1.0 mg/L if present as all Nitrite-N). High concentrations may contribute to blue baby syndrome in infants.
Lead*	A cumulative body poison, uncommon in naturally occurring hard waters.
Fluoride*	Present in fluoridated water supplies at 0.8 mg/L to reduce dental caries. Elevated levels causes fluorosis (mottling of teeth).
Total Coliforms*	Criteria is 0 CFU/100mL. Adverse health effects.
E. Coli*	Criteria is 0 CFU/100 mL. Certain E. Coli bacteria can be life threatening.

*Health Canada Canadian Drinking Water Quality Guidelines (MAC limit)

Aesthetic Objective Concentration Levels

Alkalinity	Acid neutralizing capacity. Usually a measure of carbonate and bicarbonates and calculated and reported as calcium carbonate.
Balance	Quality control parameter ratioing cations to anions
Bicarbonate	See Alkalinity. Report as the anion HCO3-1
Carbonate	See Alkalinity. Reported at the anion CO3-2
Calcium	See Hardness. Common major cation of water chemistry.
Chloride	Common major anion of water chemistry.
Conductance	Physical test measuring water salinity (dissolved ions or solids)
Hardness	Classical measure or capacity of water to precipitate soap (chiefly calcium and magnesium ions). Causes scaling tendency in water if carbonates/bicarbonates are present (if >200 mg/L). For drinking water purposes waters with results <200 mg/L are considered acceptable, results >200 mg/L are considered poor but can be tolerated. Results >500 mg/L are unacceptable.
Hydroxide	See alkalinity
Magnesium	See hardness. Common major cation of water chemistry. Elevated levels (>125 mg/L) may exert a cathartic or diuretic action.
pH	Measure of water acidity/alkalinity. Normal range is 7.0-8.5.
Potassium	Common major cation of water chemistry.
Sodium	Common major cation of water chemistry. Measure of salinity (saltiness).The aesthetic objective (not related to health) for sodium in drinking water is 200 mg/L. However, where sodium concentration of the drinking water exceeds 20 mg/L, it is recommended that any person on a sodium restricted diet consult with his/her physician or Medical Officer of Health concerning the use of that water.
Sulphate	Common major anion of water chemistry. Elevated levels may exert a cathartic or diuretic action.
Total Dissolved Solids	A measure of water salinity.
Iron	Causes staining to laundry and porcelain and astringent taste. Oxidizes to red-brown precipitate on exposure to air.
Manganese	Elevated levels may cause staining of laundry and porcelain.
Heterotrophic Plate Count	Criteria is 500 cfu/mL Measure of heterotrophic bacteria present.

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L1925270 Report Date: 29-MAY-17

Client: KGS Group Consultants (Winnipeg)
865 Waverly Street - 3rd Floor
Winnipeg MB R3T 5P4
Contact: PAUL LINDELL

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-WP	**Water**							
Batch R3723163								
WG2528203-10 DUP		**L1925270-1**						
Alkalinity, Total (as CaCO3)		293	292		mg/L	0.4	20	12-MAY-17
WG2528203-9 LCS								
Alkalinity, Total (as CaCO3)			102.0		%		85-115	12-MAY-17
WG2528203-6 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	12-MAY-17
CL-IC-N-WP	**Water**							
Batch R3727082								
WG2528207-2 LCS								
Chloride (Cl)			99.6		%		90-110	13-MAY-17
WG2528207-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	13-MAY-17
Batch R3727602								
WG2528682-3 DUP		**L1925270-2**						
Chloride (Cl)		21.7	21.7		mg/L	0.1	20	15-MAY-17
WG2528682-2 LCS								
Chloride (Cl)			100.5		%		90-110	15-MAY-17
WG2528682-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	15-MAY-17
WG2528682-4 MS		**L1925270-2**						
Chloride (Cl)			92.9		%		75-125	15-MAY-17
EC-QT97-ENDPT-WP	**Water**							
Batch R3720583								
WG2527180-2 DUP		**L1925270-1**						
Escherichia Coli		12	10		MPN/100mL	22	65	12-MAY-17
WG2527180-1 MB								
Escherichia Coli			<1		MPN/100mL		1	12-MAY-17
EC-WP	**Water**							
Batch R3723163								
WG2528203-10 DUP		**L1925270-1**						
Conductivity		679	674		umhos/cm	0.7	10	12-MAY-17
WG2528203-8 LCS								
Conductivity			100.4		%		90-110	12-MAY-17
WG2528203-6 MB								
Conductivity			<1.0		umhos/cm		1	12-MAY-17
MET-T-MS-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-MS-WP	**Water**							
Batch R3724764								
WG2528458-2 LCS								
Calcium (Ca)-Total			105.0		%		80-120	15-MAY-17
Magnesium (Mg)-Total			100.7		%		80-120	15-MAY-17
Potassium (K)-Total			108.0		%		80-120	15-MAY-17
Sodium (Na)-Total			104.1		%		80-120	15-MAY-17
WG2528458-1 MB								
Calcium (Ca)-Total			<0.20		mg/L		0.2	15-MAY-17
Magnesium (Mg)-Total			<0.050		mg/L		0.05	15-MAY-17
Potassium (K)-Total			<0.10		mg/L		0.1	15-MAY-17
Sodium (Na)-Total			<0.050		mg/L		0.05	15-MAY-17
NH3-COL-WP	**Water**							
Batch R3720724								
WG2527165-6 LCS								
Ammonia, Total (as N)			100.5		%		85-115	12-MAY-17
WG2527165-5 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	12-MAY-17
NO2-L-IC-N-WP	**Water**							
Batch R3727082								
WG2528207-2 LCS								
Nitrite (as N)			99.3		%		90-110	13-MAY-17
WG2528207-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	13-MAY-17
Batch R3727602								
WG2528682-3 DUP		**L1925270-2**						
Nitrite (as N)		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	15-MAY-17
WG2528682-2 LCS								
Nitrite (as N)			99.7		%		90-110	15-MAY-17
WG2528682-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	15-MAY-17
WG2528682-4 MS		**L1925270-2**						
Nitrite (as N)			92.2		%		75-125	15-MAY-17
NO3-L-IC-N-WP	**Water**							
Batch R3727082								
WG2528207-2 LCS								
Nitrate (as N)			100.2		%		90-110	13-MAY-17
WG2528207-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	13-MAY-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO3-L-IC-N-WP	**Water**							
Batch R3727602								
WG2528682-3 DUP		**L1925270-2**						
Nitrate (as N)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	15-MAY-17
WG2528682-2 LCS								
Nitrate (as N)			101.1		%		90-110	15-MAY-17
WG2528682-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	15-MAY-17
WG2528682-4 MS		**L1925270-2**						
Nitrate (as N)			93.9		%		75-125	15-MAY-17
P-T-COL-WP	**Water**							
Batch R3725270								
WG2527421-2 LCS								
Phosphorus (P)-Total			100.0		%		80-120	16-MAY-17
WG2527421-1 MB								
Phosphorus (P)-Total			<0.010		mg/L		0.01	16-MAY-17
PH-WP	**Water**							
Batch R3723163								
WG2528203-10 DUP		**L1925270-1**						
pH		8.34	8.34	J	pH units	0.00	0.2	12-MAY-17
WG2528203-7 LCS								
pH			7.39		pH units		7.3-7.5	12-MAY-17
SO4-IC-N-WP	**Water**							
Batch R3727082								
WG2528207-2 LCS								
Sulfate (SO4)			100.5		%		90-110	13-MAY-17
WG2528207-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	13-MAY-17
Batch R3727602								
WG2528682-3 DUP		**L1925270-2**						
Sulfate (SO4)		59.1	59.1		mg/L	0.0	20	15-MAY-17
WG2528682-2 LCS								
Sulfate (SO4)			100.8		%		90-110	15-MAY-17
WG2528682-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	15-MAY-17
WG2528682-4 MS		**L1925270-2**						
Sulfate (SO4)			90.3		%		75-125	15-MAY-17
SOLIDS-TOTSUS-WP	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SOLIDS-TOTSUS-WP	**Water**							
Batch R3724485								
WG2528165-6 LCS								
Total Suspended Solids			96.7		%		85-115	15-MAY-17
WG2528165-5 MB								
Total Suspended Solids			<5.0		mg/L		5	15-MAY-17
TC-QT97-ENDPT-WP	**Water**							
Batch R3720566								
WG2527186-2 DUP		**L1925270-1**						
Total Coliforms		411	308		MPN/100mL	29	65	12-MAY-17
WG2527186-1 MB								
Total Coliforms			<1		MPN/100mL		1	12-MAY-17
TKN-WT	**Water**							
Batch R3732321								
WG2535166-2 LCS								
Total Kjeldahl Nitrogen			99.4		%		75-125	26-MAY-17
WG2535166-1 MB								
Total Kjeldahl Nitrogen			<0.15		mg/L		0.15	26-MAY-17
TURBIDITY-WP	**Water**							
Batch R3725707								
WG2527406-8 LCS								
Turbidity			99.5		%		85-115	12-MAY-17
WG2527406-7 MB								
Turbidity			<0.10		NTU		0.1	12-MAY-17

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	11-MAY-17 12:20	12-MAY-17 12:00	0.25	24	hours	EHTR-FM
	2	11-MAY-17 16:00	12-MAY-17 12:00	0.25	20	hours	EHTR-FM
	3	11-MAY-17 18:00	12-MAY-17 12:00	0.25	18	hours	EHTR-FM
Anions and Nutrients							
Nitrate in Water by IC (Low Level)							
	2	11-MAY-17 16:00	15-MAY-17 12:00	3	4	days	EHT
	3	11-MAY-17 18:00	15-MAY-17 12:00	3	4	days	EHT
Nitrite in Water by IC (Low Level)							
	2	11-MAY-17 16:00	15-MAY-17 12:00	3	4	days	EHT
	3	11-MAY-17 18:00	15-MAY-17 12:00	3	4	days	EHT

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1925270 were received on 12-MAY-17 08:00.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1925270-COFC

COC Number: 14 - 503959

Report To
Company: KGS Group
Contact: Paul Lindell
Address: 865 Waverley St. Wpg MB R3T 5P4
Phone:

Report Format / Distribution
Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☐ Yes ☐ No
☐ Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: msmith@kgsgroup.com
Email 2: mphamm@kgsgroup.com / plindell@kgsgroup.com

Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
R ☑ Regular (Standard TAT if received by 3pm)
P ☐ Priority (2-4 business days if received by 3pm)
E ☐ Emergency (1-2 business days if received by 3pm)
E2 ☐ Same day or weekend emergency if received by 10am – contact ALS for surcharge.
Specify Date Required for E2,E or P:

Invoice To
Same as Report To ☐ Yes ☐ No
Copy of Invoice with Report ☐ Yes ☐ No
Company:
Contact:

Invoice Distribution
Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax
Email 2

Project Information
ALS Quote #: Q56271
Job #: 16-0300-002
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)
Approver ID: | Cost Center:
GL Account: | Routing Code:
Activity Code:
Location:

ALS Lab Work Order # (lab use only)
ALS Contact:
Sampler:

Analysis Request
Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	KGS-ROUIN-T-Fhg-WP	P-T-COL-WP	N,TotKJ-WP	NH3-COL-WP	SOLIDS-TOTSUS-WP	TC-OT97-ENDPT-WP	EC-OT97-ENDPT-WP	Number of Containers
	SW44	11-May-17	12:20	SW	X	X	X	X	X	X	X	5
	SW59	11-May-17	16:00	SW	X	X	X	X	X	X	X	5
	SW100	11-May-17	18:00	SW	X	X	X	X	X	X	X	

Drinking Water (DW) Samples[1] (client use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No
Are samples for human drinking water use? ☐ Yes ☐ No

Special Instructions / Specify Criteria to add on report (client Use)

SAMPLE CONDITION AS RECEIVED (lab use only)
Frozen ☐ SIF Observations Yes ☐ No ☐
Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐
INITIAL COOLER TEMPERATURES °C: 3.8°C
FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 11-May-2017	Time: 18:00	Received by: David I.	Date: 5-12-17	Time: 8:00am	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION   WHITE - LABORATORY COPY   YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

KGS GROUP

CONSULTING ENGINEERS