APPENDIX A

FIELD INSPECTION FORMS

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APPENDIX A1

TASKS 13 & 18 – FLOW METERINGS, PRESSURE LOGGERS, TURBIDITY LOGGERS, AND BEDLOAD SAMPLING

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 13 & 18**

REPORT DATE: May 23, 2013 **BY:** Garrett Wellwood **POSITION TITLE:** Water Resources EIT

May 14, 2013
ESH-1 installation of 2 turbidity loggers
STA-1 Installation and of water level gauge and flow metering
(Event #1 of 2013)

Weather:

- Cloudy & rainy
- Temperature approximately 15°C

Mobilization 5:30 AM – 10:30 AM

- Drove to Dauphin River Airstrip. Arrived at 9:30
- Organized gear, set up loggers and met pilot at 10:00
- Safety and staging for the day was discussed prior to take-off

Installation of loggers at Buffalo Creek 10:30 AM – 12:30 PM

Turbidity Logger Install

- First, an initial survey (visual) of site conditions and possible appropriate installation locations
- A suitable location for the turbidity logger was found adjacent to helicopter landing pad 18.
- The location was chosen due to:
    - Sufficiently far enough from the Dauphin River to avoid backwater effects for the conditions that are expected to occur during the monitoring program

- Bank stability for entry/installation as well as ease of removal of logger
- Stable channel bottom both for standing and setting the base for the logger. No rocks, drop-offs, uneven ground, etc.
- Sufficient depth and flow
- Typical section (all water within channel banks at this location) (photo 3)

- Base was positioned in order to have the probe oriented downstream
- 1 float was attached to the base for identifying purposes and 2 braided lines were anchored to the base and attached to a tree well above the bank. (Photo 1)

- The logger was set with the following settings:
  - 2 hrs intervals<5/14/2013 start date
  - First reading at 10:00 am – installed in water at 12:30 PM
  - Battery life was 124 days
  - Memory life was 1965 days

Pressure Logger Install

- 1 pressure logger was installed at the same location of the turbidity logger, however slightly (5 ft) upstream. (photo 1)
- To install, a 5 ft length of rebar was driven 2 ft into the channel bottom and positioned completely upright
- A wire loop was attached to the logger allowing it to slide down the shaft to securely rest on the creek bottom.
- 2 accompanying loggers were positioned on shore and hung in a tree adjacent to the logger in the water. They were hung from a spike driven into the trunk of a tree. (photo 2)

Staff Gauge Install

- The area where the turbidity and pressure loggers were installed possessed a significantly large amount of room to work so the staff gauge was installed at the same place.
- A section of rebar was securely driven into the channel bottom and the gauge board was attached. (photo 1)
- The elevation at the bottom of the graduations was recorded.

<u>Flow Metering on Buffalo Creek</u> 1:00 PM – 2:30 PM

- The crew searched for a safe location to cross the creek. Most of the sections possessed either too much depth or high velocity in order for 1 member to cross the creek.
- A location upstream was found and a metering location was sequentially chosen due to:
  - Clean section, no losses
  - Defined shore, clean of brush and gradual slopes
  - No debris or unexpected vortices

- Garrett Wellwood crossed the creek while Patrice Leclercq and Kyle Perry remained with the equipment.
- A tether reaching from both shores was used to manipulate the equipment from both directions
- An Acoustic Doppler Current Profiler (ADCP) was used to measure the flow. 6 passes were completed to obtain an average of 9.5 m^3/s (preliminary results) over 4 measurements that, together, had a standard deviation of less than 5%.
- There was no bed movement identified at this section

GPS Survey

- All installed equipment and metering sites had their location identified by GPS along with desired elevations. The survey data is provided in Table 1
- A benchmark and auxiliary benchmark were installed at the helicopter landing pad.

Installation of Turbidity Logger at Dauphin River 3:00 PM – 6:00 PM

- The pilot picked up the entire crew and remaining supplies and transported all back to the Dauphin River Airstrip.
- Equipment was prepared to install the second turbidity logger
- Same procedure taken to install 2nd logger
- Shoreline was scouted for accessibility and depth to ensure cover
- Due to high velocities in the channel, the base was placed in a location that had some larger rocks that provided some protection by dampening the velocities around the logger.
- Smaller rocks were placed around/on the base of the logger in order to secure it.
- 2 lines were tied to the base and anchored to shore.
- 2 floats were attached and the top was painted for identification (photo 4)
- Location, depth and water level were recorded by GPS – data provided on Table 1
- The same logger settings were applied for this site; the first reading in water was at 6:00 PM

Demobilization 6:30 PM – 10:00 PM

- Drive to Winnipeg from Dauphin River

Table 1 – Survey data

Grid Northing (m)	Grid Easting (m)	Elevation (m)	Code
5753411.52	562948.656	220.29	Zero On Staff Gauge
5753411.52	562948.656	221.55	WTR LVL at Landing Pad
5753412.041	562947.772	220.418	BOTTOM BASE OF PRESSURE LOGGER
5753411.853	562947.278	220.598	CONC BASE TURB METER
5753416.045	562951.683	221.558	WTR LVL REACH3
5753389.743	562945.96	224.12	TREE with BAROMETRIC METER
5753504.904	562996.392	221.298	ACDP/XSECTION
5755027.432	562067.81	219.028	TURBIDITY/METER DR
5755032.405	562068.007	219.99	WTR_LVL_DAUPHIN_RIVER
5753393.504	562934.814	224.179	2FOOT/REBAR – (TBM)

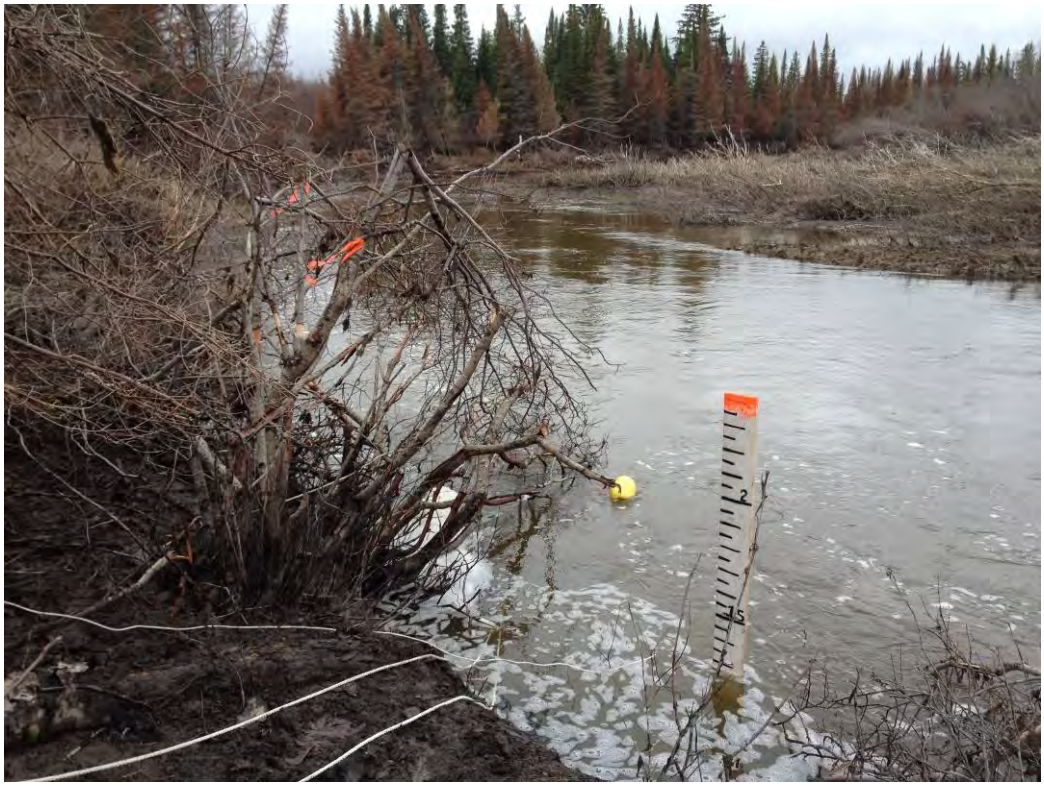

Photo 1: Turbidity Probe with Float, Pressure Logger and Staff Gauge

Photo 2: Pressure logger (center tree)

Photo 3: Typical Section

Photo 4: Turbidity Logger, Dauphin River

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Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 13 & 18**

REPORT DATE: August 15, 2013 **BY:** Dan Leitch **POSITION TITLE:** Environmental Scientist

August 14, 2013 (Event #2 of 2013)

ESH-1 data download, battery change, re-deployment of 2 turbidity loggers

STA-1 data download and re-deployment of pressure loggers and conduct flow metering

Weather:

- Sunny, breezy, 25°C

Mobilization 5:30 – 11:00

- Garrett Wellwood and Dan Leitch drove to Dauphin River. Arrived at 9:30
- Organized gear, loaded canoe, paddled across Dauphin River and up Buffalo Creek to BC-TM site arriving at approximately 11:00

Buffalo Creek 10:30 – 14:30

- Photos 1 and 2 show Buffalo Creek looking upstream and downstream respectively from the logger location.
- Water depth: 0.64 m
- Water level gauge is currently in very shallow water (~4 cm). It appears sediment has been building up around the gauge board (Photo 4)
- Turbidity logger (including anchor block) and pressure logger taken out of water at 11:00. They appeared to be in good shape. The turbidity logger anchor block had sunk a bit on the downstream side, putting the sensor end slightly deeper, while at the upstream end, the plastic tube which housed the

logger was protruding slightly from the water (see Photos 3-4). Photo 5 shows entire turbidity logger and anchor block setup.

- Turbidity Logger
  - Data was uploaded in all 3 formats (PC6000, TXT, ASCII) and confirmed to be complete and successfully saved on laptop hard drive.
  - Batteries were changed. Although when installed on May 14, the estimated battery life was 124 days, 92 days later, the estimated battery life was still 99 days.
  - Left all data on the logger, as there was lots of room.
  - Calibration:
    - Conductivity was calibrated using 447 µS/cm and 1413 µS/cm standards.
      - Turbidity sensor removed and plug was placed on probe for conductivity calibration.
      - The 447 µS/cm standard was reading as 450 µS/cm, while the 1413 µS/cm standard was reading as 1400 µS/cm.
    - Turbidity was then calibrated using 0 NTU and 126 NTU standards.
      - Sensor was pre-rinsed with calibration solutions used during prior calibrations.
      - Sensor was held off the bottom of the calibration cup. When too close, it seemed to interfere with readings. Direct sun also seemed to influence readings, so the cup was kept in the shade.
      - The 0 NTU standard was reading as -2.5 NTU, while the 126 NTU standard was reading as 129.2 NTU.
  - Re-deployment
    - Re-deployment given filename: "BC-TM2"
    - Confirmed the following prior to re-deployment:
      - Frequency of 2 hours
      - Next sample scheduled for 14:00
      - Estimated battery life: 124 days
      - Estimated memory life: 2383 days
      - Battery: 6.4 volts
  - Placed back in water at 13:00.
  - Place in a slightly deeper location, ensuring anchor base was level. Still attached to shore with ropes and has a float attached to anchor block.
  - There was approximately 1.5 feet of water above the logger.

- Pressure Loggers
  - Uploaded all 3 pressure loggers between 13:00 and 13:30 PM
    - Atmosphere-1 (S/N 10197000) saved as "BC_ATM1-2013-08-14"
      - Battery life was "GOOD"
      - Memory was 43% full
      - Interval left at 15 minutes
      - Logging continued during upload
    - Atmosphere-2 (S/N 10197002) saved as "BC_ATM2-2013-08-14"
      - Battery life was "GOOD"

        - Memory was 43% full
        - Interval left at 15 minutes
        - Logging continued during upload
    - Water logger (S/N 10168321) saved as "BC_WATER-2013-08-14"
        - Battery life was "GOOD"
        - Memory was 43% full
        - Interval left at 15 minutes
        - Logging continued during upload
    - All data was left on the loggers as there was plenty of memory space left.
    - Loggers were re-deployed at 13:00 to same location was they were previously (water logger on rebar in water, 2 atmospheric logger on nail in tree).
    - Pressure loggers still attached to wire ring and a tag line attaches it to shore, in the same manner as they were initially installed.
    - Sediment building up between shore and the anchor for the pressure logger. Potential to be covered by slumping clay.

- <u>Flow-metering</u>
    - Was conducted from 13:30 to 14:00.
    - Conducted approximately 50 m upstream from logger location (Photo 6) at a safe location to cross creek.
    - The location was chosen due to clean section, defined shore, gradual slope, no debris or unexpected vortices.
    - Garrett Wellwood crossed the creek while Dan Leitch remained with equipment.
    - A tether from each shore was used to move equipment from shore to shore.
    - An Acoustic Doppler Current Profiler (ADCP) was used to measure the flow. 8 passes were completed to obtain an average of 1.0 m^3/s (preliminary results) over 4 measurements that, together, had a standard deviation of less than 5%.
    - There was no bed movement identified at this section

- <u>Water sampling</u>
    - Collected at 14:00.
    - TSS sample and a duplicate taken from 75 m upstream of turbidity meter location.
    - Turbidity reading (12.76 NTU) taken at 14:15.

- Photo 7 shows a creek draining into Buffalo Creek downstream of the BC-TM site.

<u>Dauphin River</u> 15:00 - 16:30

- <u>Turbidity Logger</u>
    - Turbidity logger anchor block was on its side and appeared to be deeper and further downstream than when deployed.

- Reeds and debris had accumulated on the anchoring ropes causing considerable drag.
- Removed from water at 15:30.
- Steel cable attaching probe to anchor was broken off at both ends (see Photo 8). It's unclear whether this was corrosion or some other factor that caused this. Very peculiar that is broke at both ends. A rope was tied in that location prior to re-deployment.
- Data was uploaded in all 3 formats (PC6000, TXT, ASCII) and confirmed to be complete and successfully saved on laptop hard drive.
- Batteries were changed. Although when installed on May 14, the estimated battery life was 124 days, 92 days later, the estimated battery life was still 104 days.
- Left all data on the logger, as there was lots of room.
- Calibration:
  - Turbidity was calibrated using 0 NTU and 126 NTU standards.
    - Sensor was pre-rinsed with calibration solutions used during prior calibrations.
    - Sensor was held off the bottom of the calibration cup and in the shade.
    - The 0 NTU standard was reading as 6.6 NTU, while the 126 NTU standard was reading as 134.8 NTU.
    - Both solutions took quite a while to stabilize.
  - Conductivity could not be recalibrated as there was insufficient calibration solution remaining.
- Re-deployment
  - Re-deployment given filename: "DAUPHIN2"
  - Confirmed the following prior to re-deployment:
    - Frequency of 2 hours
    - Next sample schedule for 18:00
    - Battery life: 124 days
    - Memory Life: 1870 days
    - Battery voltage: 6.4
- Placed back in water at 16:15.
- Placed slightly closer to shore, but still in deep water with good flow. Base was on solid level footing with sensor faced downstream. All grass was removed. Two floats were still attached and two ropes attached anchor to a tree on shore.

- <u>Water sampling</u>
  - TSS sample taken from 30 m upstream of turbidity meter location.
  - Turbidity reading (4.91 NTU) taken at 16:30.

<u>Demobilization</u> 17:00 PM – 21:15 PM

- Drive to Winnipeg from Dauphin River

<u>Laboratory Drop-off</u>

- Water samples dropped off at ALS lab first thing the next morning (after being kept in cooler overnight)

Photo 1. Looking upstream on Buffalo Creek from BC-TM site.

Photo 2. Looking downstream on Buffalo Creek from BC-TM site.

Photo 3: Turbidity probe, pressure logger, float and staff gauge

Photo 4: Turbidity probe with float and staff gauge

Photo 5: Turbidity logger and anchor block setup

Photo 6: Flow-metering occurred upstream of logger location.

Photo 7. Small creek draining into Buffalo Creek downstream of BC-TM site.

Photo 8. Severed or corroded wire that attached probe to anchor block.

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Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 13 & 18**

REPORT DATE: November 7, 2013 **BY:** Dan Leitch **POSITION TITLE:** Environmental Scientist

October 16, 2013 (Event #3 of 2013)

ESH-1 data download and collection of 2 Turbidity meters

STA-1 data download and re-deployment of pressure loggers and flow measurement

Weather:

- Mix of sun and cloud, breezy, occasional light rain, high of 14°C

Mobilization 5:30 – 11:00

- Garrett Wellwood and Dan Leitch gathered equipment at Wilkes and drove to Dauphin River. Arrived at 10:00.
- Organized gear, loaded canoe, paddled across Dauphin River and up Buffalo Creek to BC-TM site arriving at approximately 11:15

Buffalo Creek 11:15 – 14:00

- Photos 1 and 2 show Buffalo Creek looking upstream and downstream respectively from the logger location.
- Water depth measured on staff gauge: 0.64 m
- Staff gauge was still in water, although it was suspected last time that it wouldn't be.
- Turbidity meter (including anchor block) and pressure logger taken out of water at 11:35 AM. They appeared to be in good shape.

- Turbidity Meter
  - Turbidity meter was 10 cm beneath water surface (measurement was to top of PVC tube)

(Photo 3).

- Some sediment was present within PVC tube which housed turbidity meter (Photo 4).
- Logger was removed from it's housing, cleaned up, and transported back to the truck.
- Cement block with PVC pipe and float was placed on land beside large spruce tree, and is tied to tree (Photo 5)
    - Will need to bring new cable next year to attach turbidity meter to block. Existing cable badly corroded

    Data upload
        - Done in the truck while in transit back to Winnipeg
        - Logging stopped at 16:20 (although had been out of water since 11:35)
        - Logging filename: "BC2"
        - Battery still had 5.5 volts and 107 days remaining
        - Memory still had 2320 days remaining
        - Data was uploaded in all 3 formats (CSV, PC6000, ASCII)
            - CSV file: "BC2.txt"
            - PC6000 file: "BC2.dat"
            - ASCII file: "BC2ASCII.dat"
        - All data was left on logger
        - Batteries were not replaced
        - All files saved to: P:\Projects\2013\13-0431-001\General\Docs\Task 13 - ESH1 erosion, sediment (Turbidity meters)\Data

- Pressure Loggers
    - Uploaded all 3 pressure loggers between 11:45 and 12:30 PM
        - **Water logger (S/N 10168321)** saved as "BC_WATER-2013-10-16"
            - Pressure logger was still on top of the sediment
            - It was suspected that slumping substrate may have raised the pressure logger to a slightly shallower depth
            - Battery life was still "GOOD"
            - Memory was 71% full
            - Logging was stopped and logger was re-deployed to clear memory
            - Did a test launch of 15 minutes to ensure memory was properly cleared – it was
            - Relaunch was set for a delayed start at 12:15
            - Interval left at 15 minutes
            - Memory used: 0%
            - Launch Description (Filename): "10168321"
            - Deployment #: 4
            - Set to record absolute pressure and temperature
            - 225.6 days of logging remaining (21656 samples)
            - Placed back into water before 12:15 (attached to rebar and attached to shore)
        - **Atmosphere (S/N 10197000)** saved as "BC_ATM_10197000_2013_10_16.hobo"
            - Battery life was "GOOD"
            - Memory was 71% full, so logging was stopped and logger was re-deployed to clear memory

        - Relaunch was set for delayed start at 12:30 PM
        - Interval left at 15 minutes
        - Launch Description (Filename): "10197000"
        - Set to record absolute pressure and temperature
        - 225.6 days of logging remaining (21656 samples)
        - Launched at 12:19 PM
        - Placed back on tree spike at 12:20 PM
    - **Atmosphere (S/N 10197002)** saved as "BC_ATM_10197002_2013_10_16.hobo"
        - Battery life was "GOOD"
        - Memory was 71% full, so logging was stopped and logger was re-deployed to clear memory
        - Relaunch was set for delayed start at 12:30 PM
        - Interval left at 15 minutes
        - Launch Description (Filename): "10197002"
        - Set to record absolute pressure and temperature
        - 225.6 days of logging remaining (21656 samples)
        - Launched at 12:15 PM
        - Placed back on tree spike at 12:20 PM
- All pressure logger data stored: P:\Projects\2013\13-0431-001\General\Docs\Task 18 - STA1 Sediment transport, water level, metering\Pressure Loggers\Data

- <u>Water sampling</u>
    - 1 liter sample to be analysed for TSS and turbidity taken at 12:00 PM
    - Labeled "BC-TM"
    - Taken from ~20 m upstream of logger location in area of representative flow (not in eddy or still water)
    - Turbidity readings taken with mobile turbidity meter at 12:45 PM
        - Value obtained: 7.73 NTU
        - Did a 2nd reading to confirm and obtained reading of 7.99 NTU
        - (Manual turbidity meter was calibrated previous day)

- <u>Flow-metering</u>
    - Was conducted between 12:30 and 14:00.
    - Conducted approximately 50 m upstream from logger location (Photo 6) at a safe location to cross creek. This is the same location as used last time.
    - The location was chosen due to a flat/clean section, defined shore, gradual slope, no debris or unexpected vortices. Channel bottom supported sure-footing.
    - There was no bed movement identified at this section

    - <u>Flow Tracker</u>
        - Did flow tracker reading first
        - Garrett did this while Dan did water sampling
        - Tape measure installed across creek width
        - 22 increments were completed across a width of 11 m to obtain an average of

0.67 m^3/s (preliminary results)
    - Depth of channel at this location ranged between 0.4 m and 0.8 m

- <u>RiverRay Acoustic Doppler Current Profiler (ADCP)</u>
    - Garrett crossed the creek while Dan remained with equipment.
    - A tether from each shore was used to move equipment from shore to shore.
    - 6 passes were completed to obtain an average of 0.68 m^3/s (preliminary results) from two pairs of measurements that, together, had a standard deviation of less than 5%.

- Photo 7 shows a creek draining into Buffalo Creek downstream of the BC-TM site.
- A beaver dam was present 1.2 km downstream of BC-TM (see map below)

- Beaver dam at an island with blockages on both sides: river-left had 2 drops, river-right had 1 drop (Photos 8 and 9)
- Drop was measured with tape measure to be 90 cm
- Checked WQ photos from Oct 9 WQ event and see that beaver dam was present at that time
- Was not present August 14 during previous visit to turbidity meters and pressure loggers

<u>Dauphin River</u> 14:45 - 16:15

- <u>Turbidity meter</u>
    - Turbidity meter and anchor block appeared to be positioned as they were left last visit (upright and properly oriented) (Photo 10)
    - Ropes attaching anchor block and turbidity meter to tree on shore appear to have been manually cut (appears to be a clean cut) (Photo 11).
    - Reeds and debris had accumulated on anchor block and ropes attached to floats (Photo 12).

Sensor was clear of vegetation.

- Turbidity meter was 24 cm under water (measurement to top of PVC tube)
- Removed from water at 15:00.
- The rope that was tied from the turbidity meter to the anchor block was still in place (previous cable corroded off).
- Turbidity meter was packed up to be dealt with during trip back to Winnipeg.
- Anchor block was brought back to Wilkes. It will need some attention before being used again (rusty hardware, angle iron loose).

  Data upload
    - Done in the truck while in transit back to Winnipeg
    - Logging stopped at 16:40 (although had been out of water since 15:00)
    - Logging filename: "DAUPHIN2"
    - Battery still had 5.6 volts and 111 days
    - Memory still had 1807 days
    - Data was uploaded in all 3 formats (CSV, PC6000, ASCII)
        - CSV file: "DAUPHIN2.txt"
        - PC6000: "DAUPHIN2.dat"
        - ASCII: "DR2ASCII.dat"
    - All data was left on logger
    - Batteries were not replaced
    - All files saved to: P:\Projects\2013\13-0431-001\General\Docs\Task 13 - ESH1 erosion, sediment (Turbidity meters)\Data

- Water Sampling
  - 1 litre water sample to be analysed for TSS and turbidity taken at 15:30 (labeled "DR-TM")
  - Duplicate sample taken from this location as well (labeled "Duplicate")
  - Taken from 30 m upstream of logger location at the same place as last time. Plenty of good flow.
  - Lots of leaves in river
  - Dauphin River appears higher than during last visit
  - Rained intermittently over hour prior to water sampling
  - Turbidity readings taken with mobile turbidity meter at 15:45
    - Value obtained: 6.11 NTU
    - Did a 2nd reading to confirm and obtained reading of 6.28 NTU

Demobilization (1600 to 20:30)

- After all readings were done at Dauphin River, equipment was packed into truck
- Drove back to Winnipeg
- Plugged in turbidity meters to laptop en route back to stop logging and to upload data (described above)
- Once back in Winnipeg, dropped off canoe, dropped of equipment at Wilkes, placed water samples in refrigerator
- Samples brought to ALS lab early the following morning

Things to do before next year's deployment:

- Repair anchor block at Wilkes
- Replace hardware on this block and acquire enough to do the same for the one at Buffalo Creek
- Get longer calibration cup
- Possibly get new calibration fluids (check volume remaining and expiry date)
- Need new wire cables and possibly new ropes
- Replace batteries in turbidity meter
- Replace "wipe" on turbidity meter
- Replace O-rings in turbidity meter?

Photos

Photo 1. Looking upstream on Buffalo Creek from BC-TM site.

Photo 2. Looking downstream on Buffalo Creek from BC-TM site.

Photo 3: Turbidity probe, rebar for pressure logger, float, and staff gauge.

Photo 4: Turbidity meter housing with accumulated sediment inside.

Photo 5: Anchor block and float tied to tree and stored for future use.

Photo 6: Flow-tracking occurred upstream of logger location.

Photo 7. Small creek draining into Buffalo Creek downstream of BC-TM site.

Photo 8. Beaver dam downstream of BC-TM (river-right)

Photo 9. Beaver dam downstream of BC-TM (river-left)

Photo 10. Turbidity meter in Dauphin River

Photo 11. Cut ropes that were attaching anchor block and turbidity meter to shore

Photo 12. Vegetation accumulation on anchor block

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 13 & 18**

REPORT DATE: May 20, 2014 **BY:** Garrett Wellwood **POSITION TITLE:** E.I.T

May 15, 2014 (Event #1 of 2014)

Deployment of 2 Turbidity meters

STA-1 data download and re-deployment of pressure loggers and flow measurement

Weather:

- Mix of sun and cloud, breezy, high of 13°C

Mobilization 5:30 AM– 8:00 PM

- Garrett Wellwood and Jordan Kiez gathered equipment at Wilkes and drove to Dauphin River. Arrived at 10:00.
- Organized gear, and set up base for GPS base station and collector

Dauphin River 10:15 – 11:30

- Photo 1 shows the location the turbidity logger was installed on the Dauphin River.
- The location is essentially the same as previous efforts, within 20 m.
- Water depth measured from channel bottom near turbidity logger: 1.26 m
- Photos 2 and 3 show the shoreline both upstream and downstream, respectively

Turbidity Meter

- Turbidity meter was installed approximately 2 beneath water surface (measurement was to top of PVC tube) (Photo 4).
- Probe and cement block were lowered over the edge of the shoreline.
- Shoreline had a sever edge and drop-off which appeared to be caused by erosion. This

proved too dangerous for actually entering the water for to properly set the block.
- The block was anchored with rope to a tree up the shoreline, well away from possible erosion effects.
- Loggers were calibrated and initialized in Winnipeg allowed for ease of deployment

Buffalo Creek

- Upon arrival it was noted that the existing gauge board was in fact damaged (as suspected from earlier photos) and as well, the in-water pressure logger and re-bar were both missing. The rope used to anchor the pressure logger to shore was intact suggesting the cable on the logger itself failed.
- In the subsequent trip an effort will be made to retrieve the lost logger.

Turbidity Probe Install

- The base for the meter was left on shore after the October 2013 trip and remained intact.
- The hardware used to hold the probe within the tube was replaced.
- Probe was installed and the base was placed back in the channel at same location.
- Base was installed as far into the channel as possible and had an approximate depth of 1.33 m
- Base is anchored by a rope to an adjacent tree.
- Unit was launched between 1:30 and 1:45 PM
- Both the damaged gauged board and new logger install can be seen in Photo 5

Flow-metering

- Was conducted between 2:30 and 3:00.
- Conducted approximately 50 m upstream from logger location (Photo 6). This is the same location as used last time.
- The location was chosen due to a flat/clean section, defined shore, gradual slope, no debris or unexpected vortices. Channel bottom supported sure-footing.
- There was no bed movement identified at this section
- The helicopter dropped off Dan Leitch on the opposite shore and a rope was tossed to him in order to assist in maneuvering the ADCP. It was not safe to attempt wading across the channel.

- RiverRay Acoustic Doppler Current Profiler (ADCP)
  - A tether from each shore was used to move equipment from shore to shore.
  - 4 passes were completed to obtain an average of 6.42 m^3/s (preliminary results) from two pairs of measurements that, together, had a standard deviation of less than 5%.

- Photos 7,8 and 9 show the metering site specifically, and conditions up and downstream of the location.

Pressure Logger Install

- The data was uploaded from the reaming two pressure loggers, both collecting atmospheric data.
- Both loggers had their memory cleared and were launched
- Logger 10197000:
    - Launched at 2:00 PM
    - 225.6 days to log
    - Battery life = good
    - 21656 available samples to collect.
- Logger 10197002:
    - Launched at 2:15 PM
    - 225.6 days to log
    - 21656 available samples to collect
    - Battery life = good
- Logger 10197000 was used to collect data in the channel. 10197002 remained atmospheric. The repeat procedure was conducted to install the new pressure logger at the same location with the rebar, wire and rope.

Photos

Photo 1. Dauphin River, turbidity probe location - North Shore

Photo 2. Dauphin River turbidity probe location, looking upstream.

Photo 3: Dauphin River turbidity probe location, looking downstream.

Photo 4: Turbidity probe installation, Dauphin River.

Photo 5: Turbidity probe install and old gauge board, Buffalo Creek.

Photo 6: New gauge board location, looking upstream at turbidity probe and float.

Photo 7. New gauge board installation, Gauge Reading is 0.78 m.

Photo 8. Flow metering site, upstream of turbidity probe.

Photo 9. Metering location looking upstream

Photo 10. Metering location looking downstream

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 13**

REPORT DATE: 09/09/2014 **BY:** Garrett Wellwood **POSITION TITLE:** Water Resources E.I.T.

June 17-18, 2014

Deployment of Pressure and Turbidity Loggers

June 17, 2014

- KGS Group crew mobilized from Winnipeg at approximately 6:00 AM. Crew lead by Patrice Leclercq and included Garrett Wellwood and Andrew Chan.
- KGS Group members arrived at the camp at approximately 10:00 AM.
- Prior to scheduled work, Patrice dropped off all anchors, logger bases, cable and gauge boards at each designated site to reduce any carrying of equipment.
- KGS Group members loaded the helicopter (Taiga) at 12:00 PM and arrived at the first site, BC-TM, at 12:30 PM.

- *BC-TM*
  - Turbidity Logger removed from water at 1:05 PM. The logger itself was readjusted on the base and had a King Anchor system attached. The anchor was attached to the logger base by a ¼" steel cable. Both the anchor and base were launched at the same location in the Buffalo Creek at 2:35.
  - The pressure logger, presumed to be in the water, was initially missing but was soon found. As well, the pressure logger, assumed missing from the 2013/2014 winter, was also recovered. Both were sitting on the channel bottom in approximately the same area as deployment. Re-bar was found as well. The subsurface pressure logger was launched at 2:45 PM.
  - Logger #10508044 was launched at 3:05 to record atmospheric pressure at the same location as previous.
  - New (spring install) gauge board read 0.77 m. Old gauge board read 1.41 m.

- Flow metering carried out at 2:00 PM. KGS Group team members deployed the RDI River Ray ADCP and measured 4 transects for an average discharge of 5.58 m^3/s with a water surface elevation of 221.44 m. No moving bed was observed. Measurement did not include a loop test to correct for a potential moving bed.

- *BC-02*
  - Pressure logger #10486636 was deployed at 4:15 PM
  - The blue chord used to anchor the logger base to shore was doubled for security.
  - The logger was installed on the right bank in a pool of relatively low velocity.
  - Rebar installed and surveyed by Andrew Chan.
  - 2 gauge boards were installed at this location.
- *BC-01*
  - Pressure logger #10486633 was deployed at 6:10 PM
  - Turbitdity logger base was assembled including floats and attached to the King Anchor and tied to shore
  - King anchor attached to base with ¼" steel cable (2 cables connected) and launched in the main channel.
  - The turbidity base was left on shore and ready for later deployment with a single white chord used to tie the base to an adjacent tree on shore.
  - Rebar installed and surveyed by Andrew Chan.

June 18, 2014

- *Big Buffalo Lake*
  - Andrew Chan accompanied North/South electro-fishing crew to Big Buffalo Lake. The existing gauge board was deemed sufficient for further readings; however the base was surveyed again to ensure proper measurements.
  - As of 9:30 AM pressure logger # 10486635 had not yet been deployed but would be later that day.
- *Reach 1 D/S*
  - Pressure logger deployed at 10:30 AM.
  - Pressure logger attached to shore with a single blue chord that was anchored to rebar installed up the bank. Elevation of this rebar was recorded.
  - Turbidity logger base was assembled and the attached to the King Anchor. King Anchor launched in main channel, turbidity base remained on shore with floats.
  - Water level, gauge board (read 0.2 m), pressure logger and anchor all surveyed by Andrew Chan.
- *Cableway*
  - KGS Group members arrived to the site just as MIT employees had completes the installation of a weather station. Weather station installed on the windrow on the south bank.
  - 2 gauge boards installed 1 in water and 1 at previous high water mark. Elevations were taken for each; however on the board partially submerged, the elevation was taken at the 1 m mark and read 0.53 m on the board.

- Rebar installed and recorded for future use as BM and on-shore anchor for pressure logger.
- Pressure logger launched at 1:33 PM and attached to shore by doubling up the blue chord. Serial number not recorded.
- 2 barometric loggers placed on weather station adjacent to site. #10486637, #10508041

- *R1 Inlet*
  - Pressure logger #10508045 launched at 2:40
  - 1 gauge board installed on bank at previous high water mark.
  - Rebar installed on bank to secure the line from the pressure logger to shore. Elevation of rebar was recorded.

Photos

Photo 1. BC-TM turbidity logger and base, once removed from channel.

Photo 2: New (2014 install) gauge board.

Photo 3: BC-02 gauge board installation.

Photo 4: BC-02 pressure logger installation.

Photo 5: Survey of rebar at BC-01

Photo 6. Turbidity logger base and gauge board at BC-01

Photo 7. Launching of pressure logger at BC-01

Photo 8. Turbidity logger base and gauge board at BC-01

Photo 9. Rebar, turbidity logger base and gauge board at R1-Downstream

Photo 10. Rebar installed at R1-downstream

Photo 9. Turbidity logger base configured at R1-Downstream

Photo 10. Gauge Board at R1-Downstream

Photo 9. Rebar, gauge board and pressure logger install at R1-Cableway

Photo 10. R1-Cableway gauge board

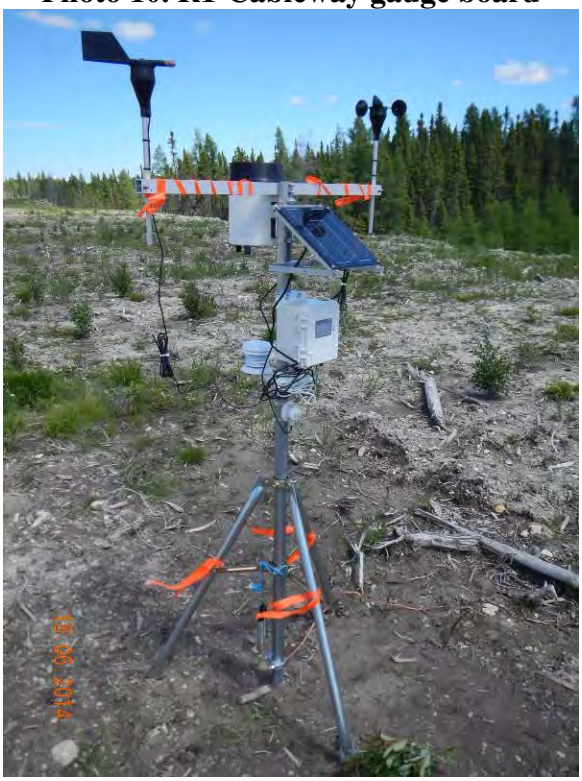

Photo 9. Weather station at R1-Cableway

Photo 10. Barometric loggers on weather station at R1-Cableway

Photo 9. Gauge board installed at high water mark at R1-Inlet

Photo 10. Rebar on bank at R1-Inlet

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 13**

REPORT DATE: July 22, 2014 **BY:** Dan Leitch **POSITION TITLE:** Environmental Scientist

June 24-25, 2014

Deployment of 2 Turbidity Loggers

June 24, 2014

- Two turbidity loggers were ordered as soon as it was known that operation of the LSMEOC was to occur.
- Loggers (and new calibration standards) arrived at the office in the morning of June 24, 2014.
- DL calibrated and launched both loggers that afternoon.
- See the following write-up for details about calibration:
    - P:\Projects\2013\13-0431-001\General\Docs\Task 30 - REP1 Reporting\Field Inspections\Task 13 - 2014-06-24 Turbidity Meter Calibration.docx)
- DL and SO drove to LSM arriving at Benson's Big Rock near 8:00 PM.
- One logger (S/N 14F101436) was plugged into laptop to ensure it had been logging correctly since it was launched. To do this, logging was stopped and then restarted. The second logger was not stopped to check if logging.

June 25, 2014

- Taiga pilot was Jeff Mark.
- At 8:00 AM, John Burns and Ariel Melvin flew to Reach 1 to work on cableway.
- Following this, the helicopter went to Dauphin River to ferry cutters to Buffalo Creek.
- MIT arrived at Benson's (Paul Graveline and Halya)
- At 10:00 AM, helicopter brought MIT to Reach 1 and DL and SO to BC1.

- BC1 (10:15 AM to 11:00 AM)

- Previously, the hydraulics group transported the anchor block (with ABS and hardware), anchor, cable and rope to site. It was set up with the exception of the logger and an additional float and rope to shore.
- Sonde S/N 14F101435 was secured to ABS pipe with wrench.
- Top of ABS pipe sprayed with orange spray paint to make it easier to locate in the future.
- A second buoy was added to base (now has one on each side) with approx. 5 m of rope.
- A second rope was added to attach block to tree on shore.
  - Both ropes attached to shore-side of block.
  - Attached to tree on river-right (south) shore.
- A steel cable was attached from logger to base and crimped on. A shackle will allow it to be removed without having to cut it.
- King anchor was walked upstream until taught and placed in the water.
- Logger was walked into creek (wearing chest waders) approximately 20' from shore in approximately 3' deep water.
- Logger was oriented parallel with current with the sensor downstream.
- Anchor was moved again until taught.
- A small creek / wetland drainage enters Buffalo Creek just upstream of the logger location on the south side. The water from this wetland drainage appears clearer.
- Turbidity meter was placed in main flow with water coming from upstream, but it was close to the clearer water from the wetland drainage. There was also an eddy between the logger and the wetland drainage.
- The meter was placed in the water at 10:30 AM.

<u>EC2 (11:00 AM to 11:45 AM)</u>

- Previously, the hydraulics group transported the anchor block (with ABS and hardware), anchor, cable and rope to site. It was set up with the exception of a rope to shore.
- Sonde S/N 14F101436 was secured to ABS pipe with wrench.
- Top of ABS pipe sprayed with orange spray paint to make it easier to locate in the future.
- A rope to attach it to shore was added.
- A steel cable was attached from logger to base and crimped on.
- Anchor was walked upstream until taught and placed in the water.
- Logger was walked into creek in approximately 4' deep water. The base was stepped on to try to secure it in place as bottom was sloped.
- Logger was oriented parallel with current with the sensor downstream.
- A piece of rebar was hammered into the ground using rocks. Rope which was attached to the base was attached the rebar on shore.
  - Attached to river-right (south) shore.
- The meter was placed in the water at 11:45 AM.
- Staff gauge board was read: 0.205 m.

    - Numerous fish skeletons were observed (same location as where ‘fish kill’ was observed last year.

- While the turbidity logger at EC2 was being installed, helicopter brought John Burns and Ariel Melvin back to Big Rock. They finished their work and drove back to Winnipeg.

Boat Slinging (12:00 PM to 1:00 PM)

- When the helicopter returned, DL and SO went to Big Buffalo Lake to sling NSC’s boat to the inlet of Reach 1.
- The boat was tipped to drain water. The outboard, fuel tank, paddles and two other cases were loaded into the helicopter with DL. Straps were left with SO to attach to the boat.
- Helicopter brought DL and boat equipment to the inlet at Reach 1 where it was all unloaded. DL stayed at Reach 1.
- An old fire extinguisher and other garbage were found at the base of Reach 1 (Photo 10). It was moved out of the Reach and placed near the large sign on the south bank.
- Numerous fish skeletons were observed here as well.
- Helicopter returned to sling boat.
- Helicopter moved slowly from BBL to Reach 1 with boat. Boat was unhooked. DL got back in helicopter.
- Helicopter went to EC2 so DL could pick up gear, then on to BBL to pick up SO.
- SO observed many large fish jumping out of the water at BBL. Several videos were taken.

Egress

- After boat was moved, helicopter returned to Benson’s.
- Due to a scheduling conflict, Cabin #1 had to be emptied of all KGS Group gear.
- Once truck was loaded, DL and SO drove back to Winnipeg.

Photos

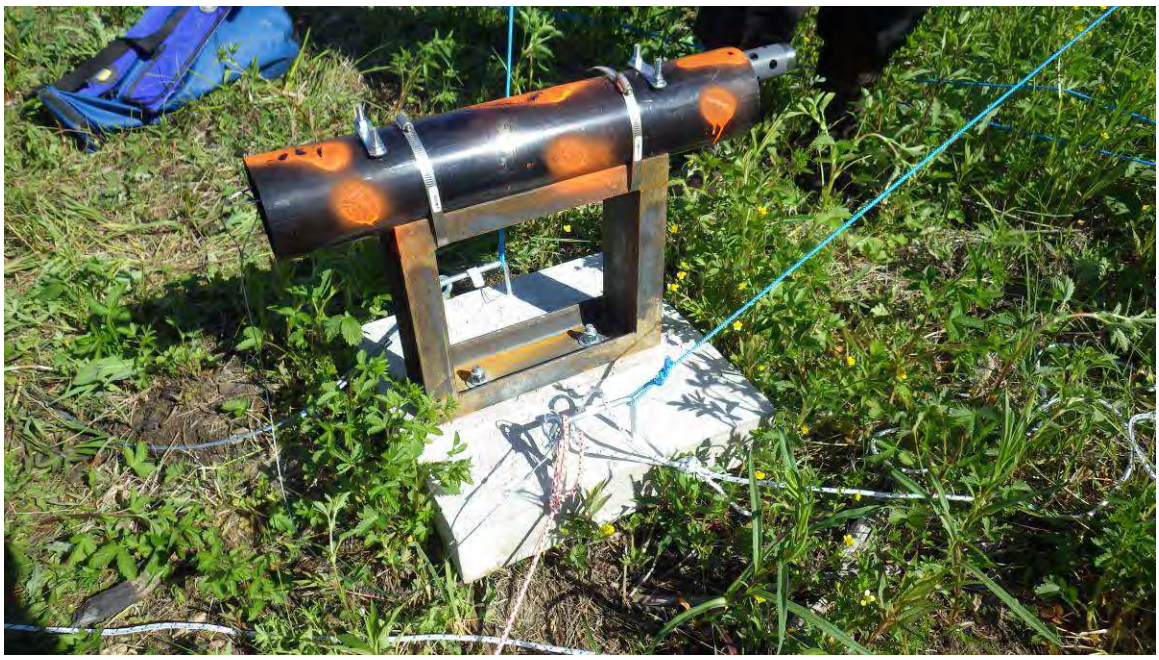

Photo 1. BC1 turbidity logger.

Photo 2: Location of BC1 turbidity meter. Ropes attached to large spruce.

Photo 3: Turbidity probe location (left), pressure logger float (right) at BC1 – looking downstream.

Photo 4: Turbidity probe floats (left). Small creek / wetland drainage on right. Photo taken looking downstream.

Photo 5: Logger at BC1 . Small creek on right. Photo taken looking downstream.

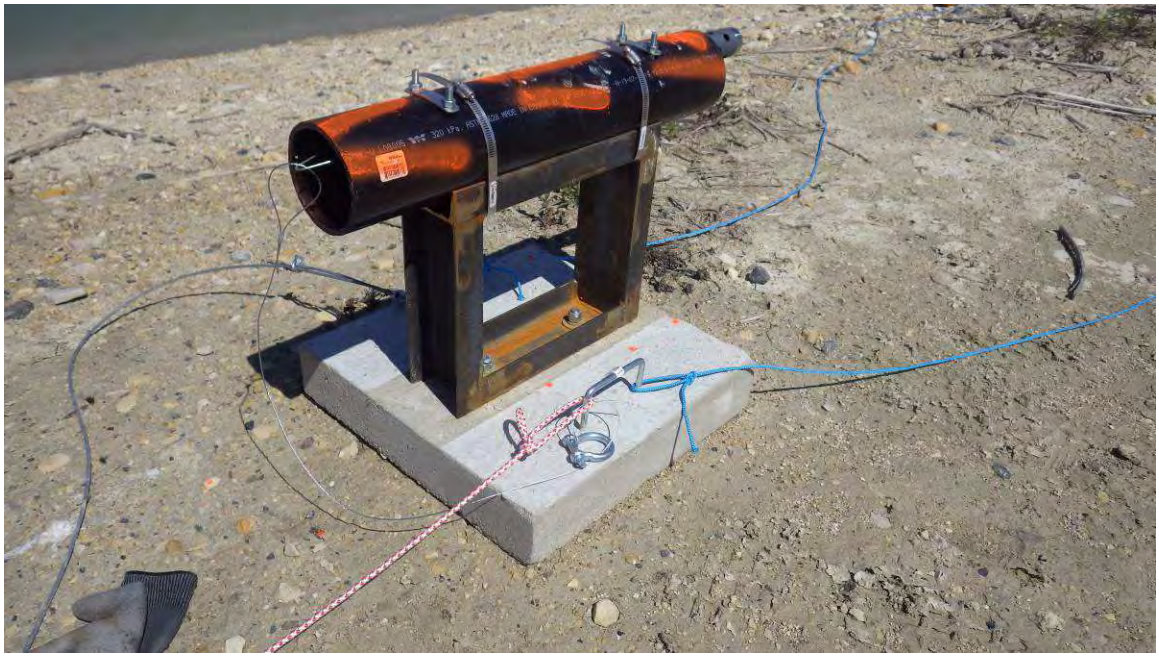

Photo 6. EC2 turbidity logger.

Photo 7. EC2 turbidity logger location – looking downstream.

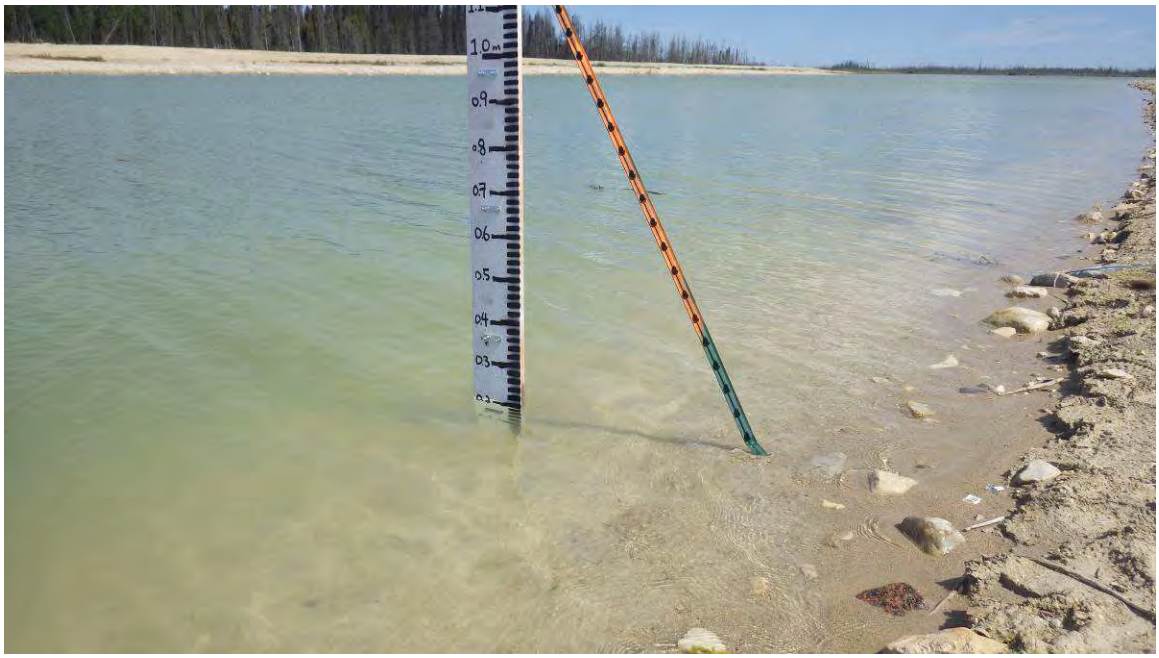

Photo 8. EC2 staff gauge board: 0.205 m.

Photo 9. Some of several fish skeletons observed at EC2.

Photo 10. Fire extinguisher and other garbage found at base of Reach 1 – looking downstream.

Turbidity Meter Calibration – June 24, 2014

Sonde #1

- S/N 14F101435
- Set time as current CST time (was initially set at +1 hr)
- Calibrated Conductivity 447 and 1413 uS/com with plug in (both were within 10%)
- Enabled turbidity sensor Optic-T Turbidity-6136
- Confirmed that it is set to report: Date, Time, SpCond mS/cm, Turb+NTU, Battery volts
- Wipe interval set at 5
- Turb-6136 temp co %/C=0.6
- Turb std 0 was reading 17.3 NTU (replaced cal solution to confirm and received same values)
- Turb std 126 was reading 131.6 NTU
- Set interval for 2hours
- Start time 16:00, June 23, 2014
- Battery Life: 124 days
- Battery Volts: 6.4
- Memory Life: 2503 days
- Set “Site” as “LSM”
- Set “File” as “June2014”
- Set to log Temp C, Cond mS/cm, Turbid+ NTU, Battery volts
- Logging began at 14:30 on June 24, 2014, prior to deployment in the field

Sonde #2

- S/N 14F101436
- Set time as current CST time (was initially set at +1 hr)
- Calibrated Conductivity 447 and 1413 uS/com with plug in (both were within 10%)
- Enabled turbidity sensor Optic-T Turbidity-6136
- Confirmed that it is set to report: Date, Time, SpCond mS/cm, Turb+NTU, Battery volts
- Wipe interval set at 5
- Turb-6136 temp co %/C=0.6
- Turb std 0 was reading 19.5 NTU. “out of range” warning
- Turb std 126 was reading 136.0 NTU. “out of range” warning
- Set interval for 2hours
- Start time 16:00, June 23, 2014
- Battery Life: 124 days
- Battery Volts: 6.4
- Memory Life: 2505 days
- Set “Site” as “LSM”
- Set “File” as “June2014B”
- Set to log Temp C, Cond mS/cm, Turbid+ NTU, Battery volts
- Logging began at 15:15 on June 24, 2014, prior to deployment in the field

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 13 & 18**

REPORT DATE: August 26&27, 2014 **BY:** Steve Offman **POSITION TITLE:** Sr. Env. Scientist

August 26 & 27, 2014 (Event #2 of 2014)

Download data from loggers, re-deployment and record Gauge board readings (NO flow measurements)

August 26, 2014
Reach 1 (Emergency Channel)

- Steve Offman and Dan Leitch, while completing a water quality sampling event along the LSMEOC, accessed station EC2 using a helicopter. At the site after conducting the procedures required for sampling TSS, Nutrients, and Hg, commenced the retrieval and downloading of the pressure logger and turbidity meter at the site.

EC2 – Turbidity meter

- Turbidity meter was pulled at approximately 12:20
- Uploaded files at approximately 12:45 see June014B.dat and June014B.txt
- For full calibration procedures, see YSI sonde manual or KGS Group summary of procedures
- Note that the extended calibration cup for turbidity was used during the both the current calibration procedure as well as the calibration conducted in May 2014.
- During calibration procedures, the conductivity was:
    - 0.461 ms when immersed in 0.447 ms solution before calibrating (minimal drift)
    - 1.394 ms when immersed in 1.413 ms solution before calibrating (minimal drift
- During calibration procedures, the turbidity was:
    - 0.5 NTU when immersed in 0 NTU solution before calibration (minimal drift)
    - 129.9 NTU when immersed in 126 NTU before calibrating (some/minimal drift)
- Redeployed at approximately 13:45 with the following file information:
    - File name: AUG2614A

- Site name: EC2
- Next Reading: 16:00, Aug 26, 2014
- Battery: 124 days
- File memory 2437 days

EC2 – Pressure logger

- Pressure logger was removed from the water at 14:15
- Logging stopped at 2:30 pm (some points may have to be removed during processing)
- File uploaded as " 10508043EC2Aug26.hobo"
- Re-launched program at 14:35
    - Battery "good"
    - 15 min intervals
    - 1st reading at 15:00
    - 225.6 days remaining
    - Device S/N: 10508043
- Pressure logger was redeployed at 16:18 into the water

GAUGE BOARD reading during deployment was just less than 101 – See photo provided below.

- Once all work was completed at station EC2, the helicopter moved the staff to inlet of Reach 1 to finish the WQ sampling event. Afterwards Warren Bernhardt of NorthSouth Consultants arrived in a jet boat. Steve Offman and Warren Bernhardt accessed all other stations using the Jet boat.

Reach 1 Cableway – pressure logger (water only, did not download the ambient loggers)

- Pressure logger was removed from water at 16:46
- Logging stopped at 16:51
- File uploaded as "10486634Aug2614b.hobo"
- Re-launched at 16:54
    - Battery "good"
    - 15 min intervals
    - 1st reading at 17:00
    - 225.6 days remaining
    - Device S/N: 10486634
- Pressure logger was redeployed at 17:00 into the water

GAUGE BOARD reading during deployment was just less than 0.390 – See photo provided below

U.S. R1 – pressure logger

- Pressure logger was removed from water at 17:06
    - Was originally launched 06/14/2014@9:28 with a delayed start @9:30
- Logging stopped at 17:10
- File uploaded as "10508045aug26c.hobo"
- Re-launched at 17:12 pm
    - Battery "good"
    - 15 min intervals
    - 1st reading at 18:00 on August 26, 2014

- 225.6 days remaining
- Device S/N: 10508045

- Pressure logger was redeployed at 17:21 into the water

GAUGE BOARD reading during deployment was approximately 0.51 m – See photo provided below

Dauphin River

DR – Turbidity meter

- Turbidity meter was pulled to shore at approximately 19:15
- Uploaded files at approximately between 19:32 and 19:40 see file names:
  - DR2014.txt
  - DR26.DAT
  - DR2014.dat
- For full calibration procedures, see YSI sonde manual or KGS Group summary of procedures
- During calibration procedures, the conductivity was:
  - 0.437 ms when immersed in 0.447 ms solution before calibrating (minimal drift)
  - 1.417 ms when immersed in 1.413 ms solution before calibrating (minimal drift
- During calibration procedures, the turbidity was:
  - 0.3 NTU when immersed in 0 NTU solution before calibration (minimal drift)
  - 124.7 NTU when immersed in 126 NTU before calibrating (some/minimal drift)
  - Handheld turbidity meter was taken at 19:45 = 4.21 NTU
- Battery on the computer died after re-calibration just prior to deploying, so the sonde was taken to cabin (Helgi's) and a second calibration was run to verify the program was properly set.
- Program was re-launched at approximately 21:30 with the following file information:
  - File name: AUG2714A
  - Site name: DR
  - Next Reading: 8:00, Aug 27, 2014
  - Battery: 124 days
  - File memory: 2392 days
  - Intervals: 2 hours

August 26, 2014
Dauphin River

DR – Turbidity meter

The turbidity meter was attached to the stand assembly and redeployed into the DR at 9:00 (1 hr after the first reading would have occurred; remove during post processing).

Buffalo Creek

BC1 – Pressure logger

Located and pulled pressure logger from BC1 at 9:48 (excessive debris long ropes made this process

difficult). Placed on shore until we could retrieve the Turbidity logger so that we could calibrate the turbidity meter and download/re-launch both devices at the same time; saving battery power on computer.

- Logging stopped at 11:30
- File uploaded as "10486633bc1aug27.hobo"
- Re-launched at 11:40
    - Battery "good"
    - 15 min intervals
    - 1st reading at 12:00 on August 27, 2014
    - 225.6 days remaining
    - Device S/N: 10486633
- Pressure logger was redeployed into water at 11:58

GAUGE BOARD reading during deployment was 0.97 at 11:58 – See photo provided below

BC1 – Turbidity meter

- Turbidity meter was pulled to shore at approximately 10:00 to 10:25 (took 25 minutes to get to surface on the boat (see image below)
- Uploaded files at approximately between 10:44 and 10:48 see file names:
    - June2014.txt
    - BC1.DAT
    - June2014.dat
- During calibration procedures, the conductivity was:
    - 0.461 ms when immersed in 0.447 ms solution before calibrating (minimal drift)
    - 1.401 ms when immersed in 1.413 ms solution before calibrating (minimal drift
- During calibration procedures, the turbidity was:
    - -0.1 NTU when immersed in 0 NTU solution before calibration (minimal drift)
    - 128.0 NTU when immersed in 126 NTU before calibrating (some/minimal drift)
    - Handheld turbidity meter was taken at 11:46 = 3.17 NTU
- Program was re-launched at approximately 11:30 with the following file information:
    - File name: BC1AG27
    - Site name: BC1
    - Next Reading: 12:00, Aug 27, 2014
    - Battery: 124 days
    - File memory: 2436 days
    - Intervals: 2 hours

BC2 – Pressure logger

Located and pulled pressure logger from BC2 at 12:22 (very difficult due to extent of woody and vegetation debris). No debris build-up was observed in canister of stand as seen at prior sites; however, any debris would have been washed out as the stand was brought to surface. Velocities appear faster at this location, which may have resulted in less sediment settling out in the canister of the stand. Logging stopped at 12:30

- File uploaded as “10486636bc2aug27.hobo”
- Re-launched at 12:40
    - Battery “good”
    - 15 min intervals
    - 1st reading at 13:00 on August 27, 2014
    - 225.6 days remaining
    - Device S/N: 10486636
- Pressure logger was redeployed into water at 12:55

GAUGE BOARD reading during deployment was 0.8 at 12:58 – See photo provided below

BCTM – Pressure logger (water)

Located and pulled pressure logger from BCTM at 13:20 (very difficult due to extent of woody and vegetation debris). Put aside until after the Turbidity meter was retrieved downloaded and calibrated/re-launched.
Logging stopped at 14:45 (need to REMOVE some points during post processing while on land)

- File uploaded as “10197000bctmAug27.hobo”
- Re-launched at 14:50
    - Battery “good”
    - 15 min intervals
    - 1st reading at 14:56 on August 27, 2014
    - 225.6 days remaining
    - Device S/N: 10197000
- Pressure logger was redeployed into water at 15:29 (need to remove some points during Post Processing before put into water)

GAUGE BOARD reading during deployment was 1m at 15:32 – See photo provided below

BCTM – Pressure logger (Ambient #1)

- File uploaded as “10197002bctmL1Aug27.hobo”
- Re-launched at 15:00
    - Battery “good”
    - 15 min intervals
    - 1st reading at 16:00 on August 27, 2014
    - 225.6 days remaining
    - Device S/N: 10197002

BCTM – Pressure logger (Ambient #2)

- File uploaded as “10508044bctmL2Aug27.hobo”
- Re-launched at 15:14

- Battery “good”
- 15 min intervals
- 1st reading at 16:00 on August 27, 2014
- 225.6 days remaining
- Device S/N: 10508044

BCTM – Turbidity meter

- Turbidity meter was pulled to shore at approximately 13:43 (took 23 minutes to get to surface on the boat (see image below). No debris build-up was observed in canister of stand as seen at prior sites; however, any debris would have been washed out as the stand was brought to surface. Velocities appear faster at this location, which may have resulted in less sediment settling out in the canister of the stand.
- Uploaded files between 14:12 and 14:17 see file names:
  - BC2014.txt
  - BC2014.DAT
  - BCTMAG26.dat (this should have been AG27 …but saved as 26)
- During calibration procedures, the conductivity was:
  - 0.453 ms when immersed in 0.447 ms solution before calibrating (minimal drift)
  - 1.418 ms when immersed in 1.413 ms solution before calibrating (minimal drift
- During calibration procedures, the turbidity was:
  - -2.8 NTU when immersed in 0 NTU solution before calibration (some drift)
  - 125.5 NTU when immersed in 126 NTU before calibrating (some/minimal drift)
  - Handheld turbidity meter was taken at 15:12 = 7.60 NTU
- Program was re-launched at approximately 11:30 with the following file information:
  - File name: Aug2714C
  - Site name: BCTM1
  - Next Reading: 16:00, Aug 27, 2014
  - Battery: 124 days
  - File memory: 2390 days
  - Intervals: 2 hours

Photos

Photo 1. Reach 1 (EC2), turbidity meter and debris when pulled to shore (Aug 26, 1014)

Photo 2. Reach 1 (EC2), turbidity meter upstream end (Aug 26, 2014)

Photo 3: Reach 1 (EC2) turbidity meter – sediment in canister on downstream end of stand (Aug, 26, 2014).

Photo 4: Reach 1 (EC2) pressure logger (Aug, 26, 2014).

Photo 5: Reach 1 (EC2) gauge board at 16:18 on Aug. 26, 2014.

Photo 6: Reach 1 (Cableway) gauge board at 17:00 on Aug. 26, 2014.

Photo 7. Reach 1 (US) gauge board at 17:21 on August 26, 2014

Photo 8. Dauphin River turbidity meter pulled to shore on Aug 26, 2014, redeployed on the following morning.

Photo 9. Dauphin River turbidity meter – debris in canister, downstream end (Aug 26, 2014).

Photo 10. Buffalo Creek (BC1) turbidity meter (Aug 27, 2014)

Photo 11. Buffalo Creek (BC1) turbidity meter – no debris in canister (Aug 27, 2014).

Photo 12. Buffalo Creek (BC1) gauge board at 11:58 on Aug 27, 2014.

Photo 13. Buffalo Creek (BC2) gauge board at 12:58 on Aug. 27, 2014.

Photo 14. Buffalo Creek (BCTM) turbidity meter (Aug. 27, 2014).

Photo 15. Buffalo Creek (BCTM) – no debris in canister (Aug 27, 2014).

Photo 16. Bufflao Creek (BCTM) gauge board at 15:32 on Aug. 27, 2014.

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Phase 1006, Task 33**

REPORT DATE: Sept 8, 2014 **BY:** Patrice Leclercq **POSITION TITLE:** Water Resources Designer

Septebmer 6, 2014
Reach 1 Flow Metering

Weather:

- Rain and windy in the morning cleared once arrived on site – sunny afternoon with temperatures climbing from 12°C to a high of 20°C.

Chronology of the day:

Driving / Boating to site

- Christine Baljko and Amber (MIT) as well as Patrice Leclercq (KGS Group) arrived at the Big Rock Boat Lunch area at 10:00 AM and met with Rick Postlethwaite (MIT) and Rick (MC&WS).
- Went directly to Reach 1 to begin Flow Metering.
- Travelled by Boat to Reach 1 and then by ATV to the Cableway.

Flow Metering

- A gauge board reading was taken on site prior to the start of the flow metering – The reading was 0.39 on the “high” gauge board. The “low” gauge board is submerged and damaged.
- Both MIT and KGS Group executed a compass calibration of the ADCP before the flow metering.
- The flow metering was first conducted by MIT using the Sontek M9 with DGPS.
- The metering started at about 11:45 and was completed by 12:30.
- Based on preliminary field results, MIT measured a flow of 3761 cfs.
- KGS Group then proceeded with their measurement using the RDI River Ray 600 (without GPS)
- Due to communication issues between the laptop and the ADCP, the start of the measurement was delayed and started at about 2:30 PM, and was completed by about 3:15 PM.
- To ensure a continuous communication between the ADCP and the laptop, the laptop was attached to the cableway and dual transects were collected within a single measurement.
- The transects were then subsectioned during post processing of the data.
- A loop test was conducted and the results showed that a moving bed was not present at the site.

- Based on preliminary field results, KGS Group measured a flow of 3960 cfs.
- MIT and KGS Group's metering results were similar and within 5% of each other, which suggest consistency between readings.
- A gauge board reading was taken prior to leaving the site and showed the WL as at the beginning of the day; The reading was still 0.39 m on the "high" gauge board.
- Summary Photos are provided below.

Photos

Photo 1. Looking downstream on Reach 1 from cableway.

Photo 2. Looking upstream on Reach 1 from cableway.

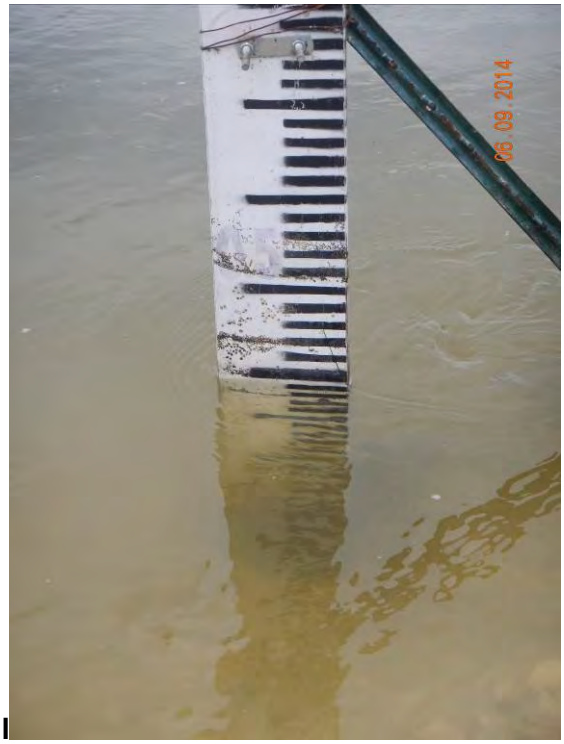

Photo 3. Gauge board Reading of 0.39

Photo 4. MIT Flow Metering

Photo 5. Buoys installed on cableway prior to leaving site.

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Phase 1006, Task 13 & 18**

REPORT DATE: November 3, 2014 **BY:** Dan Leitch **POSITION TITLE:** Environmental Scientist

October 22-23, 2014
Collection of turbidity meters, and uploading and redeploying of pressure loggers

Weather:

- Overcast, windy, cool.

Chronology:

- Dan Leitch and Wayne Decaire drove to Dauphin River on October 22, arriving at 10:30 AM.
- Met with Jon Peakes of North/South at Helgi's cabins.
- Launched the NSC jetboat and went up Buffalo Creek, through the bog and up Reach 1 on Oct 22.
- Instruments were collected and redeployed in a downstream direction. All instruments except for BC-TM were dealt with on Oct 22. BC-TM was dealt with on the morning of Oct 23.

EC2

Turbidity meter (S/N 14F101436)

- Removed from water at 1:10 PM on October 22, 2014 (Photo 1)
- Logger was stopped and file "AUG2614A.DAT" was uploaded in tab-delimited and PC6000 formats to field laptop.
- Logger was re-launched to run discrete sampling while handheld from side of boat (to test calibration and offset requirements)
    - Values ranged from 0.8 to 1.5 NTU.
- Handheld turbidity meter sample taken at 1:30 PM with value of 12.86 NTU
- TSS water sample "EC2-Turb" collected at 1:35 PM from side of boat.
- Turbidity logger base, including ABS pipe, hose clamps, U-bolts, and steel cable used to attach to king anchor were left onsite up the bank.
- King anchor was collected and left with NSC.

Pressure logger (S/N 10508043)

- Removed from water at 1:40 PM
- Logger stopped and uploaded as "2014-10-22-10508043.hobo"
- Memory had been 25% full (but is cleared when relaunched).
- Launched at 1:45 PM with delayed start to begin recording at 2:00 PM. Description: "10508043".
- Rope was replaced with lead line. Lead line was tied to sideline rope attached to a stake which was hammered in the channel bank.
- Shackle attaching rope to logger base was replaced.

Staff Gauge

- Water level was 0.98 m at 1:45 PM (see Photo #2 below).

Reach 1 Cableway

Pressure logger (S/N 10486634)

- Removed from water at 2:10 PM.
- Logger stopped and uploaded at 2:13 PM as "2014-10-22-10486634.hobo"
- Memory had been 25% full (but is cleared when relaunched).
- Launched at 2:15 PM with delayed start to begin recording at 3:00 PM. Description: "10486634".
- Rope was replaced with lead line.
- Shackle attaching rope to logger base was replaced.

Staff Gauge

- Water level was 0.24 m at 2:15 PM (see Photo #3 below).

Atmospheric pressure loggers

- Were situated on MIT weather station
- Atmospheric pressure logger #1 (S/N 10486637)
    - Uploaded at 2:22 PM and saved as "2014-10-22-10486637.hobo"
    - Memory had been 57% full (but is cleared when relaunched).
    - Relaunched at 2:24 PM with delayed start to begin at 3:00 PM
    - Description: "10486637"
- Atmospheric pressure logger #2 (S/N 10508041)
    - Uploaded at 2:25 PM and saved as "2014-10-22-10508041.hobo"
    - Memory had been 57% full (but is cleared when relaunched).
    - Relaunched at 2:27 PM with delayed start to begin at 3:00 PM
    - Description: "10508041"
- Loggers were returned to the weather station.

- Two northern leopard frogs were observed in the water at the Reach 1 Cableway

Reach 1 Inlet

Pressure logger (S/N 10508045)

- Removed from water at 2:35 PM.
- Logger stopped at 2:40 PM and uploaded as "2014-10-22-10508045.hobo"
- Memory had been 25% full (but is cleared when relaunched).
- Launched at 2:42 PM with delayed start to begin recording at 3:00 PM. Description: "10508045".

- Rope was replaced with lead line.
- Shackle attaching rope to logger base was replaced.

Staff Gauge
- Water level was 0.38 m at 2:45 PM (see Photo #4 below).

Big Buffalo Lake

Pressure logger (S/N 10486635)
- Removed from water at 3:35 PM.
- Logger stopped at 3:36 PM and uploaded as "2014-10-22-10486635.hobo"
- Memory had been 57% full (but is cleared when relaunched).
- Launched at 3:38 PM with delayed start to begin recording at 4:00 PM. Description: "10486635".
- Logger was left attached to the float. NSC was to "sink" the float the following week.
- The shackle was replaced by the rope was not replaced.

Staff Gauge
- Water level was 0.88 m at 3:30 PM (see Photo #5 below).

BC1

Turbidity meter (S/N 14F101435)
- Removed from water at 4:30 PM on October 22, 2014
- Logger was stopped and file "BC1AG27.DAT" was uploaded in tab-delimited and PC6000 formats to field laptop.
- Logger was re-launched to run discrete sampling while handheld from side of boat (to test calibration and offset requirements)
    - Value of -9.5 NTU.
- Handheld turbidity meter sample taken at 4:50 PM with value of 2.33 NTU
- TSS water sample "BC1-Turb" collected at 4:55 PM from side of boat.
- Turbidity logger base and all associated pieces were brought back to Winnipeg, as there was no high enough land where we could be certain it wouldn't be flooded if the inlet were to be further opened.
- King anchor was collected and left with NSC.

Pressure logger (S/N 10486633)
- Removed from water at 4:30 PM.
- Logger stopped at 4:57 PM and uploaded as "2014-10-22-10486633.hobo"
- Memory had been 25% full (but is cleared when relaunched).
- Launched at 5:00 PM with delayed start to begin recording at 6:00 PM. Description: "10486633".
- The shackle was replaced and the rope was replaced with lead line.

Staff Gauge
- Water level was 0.74 m at 5:05 PM (see Photo #6 below).

BC2

Pressure logger (S/N 10486636)

- Removed from water at 5:15 PM.
- Lots of vegetation was on rope that attached the pressure logger to shore.
- Logger stopped at 5:20 PM and uploaded as “2014-10-22-10486636.hobo”
- Memory had been 25% full (but is cleared when relaunched).
- Launched at 5:20 PM with delayed start to begin recording at 6:00 PM. Description: “10486636”.
- The shackle was replaced and the rope was replaced with lead line.

Staff Gauge
- Water level was 0.64 m at 5:20 PM (see Photo #7 below).

DR-TM

Turbidity Meter (S/N 13C100688)
- Removed from water at 5:50 PM on October 22, 2014
- Logger was stopped and file “AUG2714A.DAT” was uploaded in tab-delimited and PC6000 formats to field laptop.
- Logger was re-launched to run discrete sampling while handheld from side of boat (to test calibration and offset requirements)
    - Value of -5.1 NTU.
- Handheld turbidity meter sample taken at 6:10 PM with value of 5.53 NTU
- TSS water sample “DR-TM” collected at 6:10 PM from side of boat.
- Turbidity logger base and all associated pieces were brought back to Winnipeg.
- King anchor was collected and left with NSC.

Pressure Logger
- There are no pressure loggers at this location (Water Survey of Canada data is used from upstream gauge)

NEXT DAY:

BC-TM

Turbidity Meter (S/N 12K101402)
- Removed from water at 8:45 AM on October 23, 2014
- Logger was stopped and file “AUG2714C.DAT” was uploaded in tab-delimited and PC6000 formats to field laptop.
- Logger was re-launched to run discrete sampling while handheld from side of boat (to test calibration and offset requirements)
    - Value of -6.4 NTU.
- Handheld turbidity meter sample taken at 9:00 AM with value of 5.02 NTU
- TSS water sample “BC-TM-Turb” collected at 9:05 AM from side of boat.
- Turbidity logger base, including ABS pipe, hose clamps, U-bolts, and steel cable used to attach to king anchor were left onsite up the bank (Photo 8).
- King anchor was collected and left with NSC.
-

Pressure logger (S/N 10197000)

- Removed from water at 8:50 AM.
- Logger stopped and uploaded at 9:08 AM as “2014-10-23-10197000.hobo”
- Memory had been 25% full (but is cleared when relaunched).
- Launched at 9:10 AM with delayed start to begin recording at 9:15 PM. Description: “10197000”.
- Rope was replaced with lead line. Previous rope was quite worn.
- Shackle attaching rope to logger base was replaced.

Atmospheric pressure loggers

- Were situated on tree up the bank. Tree has sustained damage and the base is broken (see Photo 10).
- Atmospheric pressure logger #1 (S/N 10197002)
    - Uploaded at 9:20 AM and saved as “2014-10-23-10197002.hobo”
    - Memory had been 25% full (but is cleared when relaunched).
    - Relaunched at 9:25 AM with delayed start to begin at 9:30 AM
    - Description: “10197002”
- Atmospheric pressure logger #2 (S/N 10508044)
    - Uploaded at 9:20 AM and saved as “2014-10-23-10508044.hobo”
    - Memory had been 25% full (but is cleared when relaunched).
    - Relaunched at 9:25 AM with delayed start to begin at 9:30 AM
    - Description: “10508044”
- Loggers were returned to the tree they came from.

Staff Gauge

- Water level was 0.72 m at 9:30 AM (see Photo #11 below).
- Gauge board was covered with slimy vegetation near water surface, so it was cleaned.

THE REMAINDER OF DAY #2 WAS SPENT WATER SAMPLING (SEE OTHER FIELD INSPECTION REPORT FOR MORE INFORMATION)

Turbidity Meter Tests

- The following day in Winnipeg, turbidity meters were cleaned and run in 0 NTU solution to determine correction / offset required for plotting.
- This is to correct for the fact that sondes were not calibrated using the probe guard as there was conflicting information in the YSI manual. As they were calibrated using the extended length calibration, a certain amount of noise was introduced meaning that the 0 NTU standard it was calibrated to, was in fact ~10 NTU. Therefore when placed in the appropriate calibration cup with the probe guard, the 0 NTU standard read negative values.
- S/N 12K101402 (BC-TM) – read -10.3 NTU
- S/N 14F101436 (EC2) – read -10.7 NTU
- S/N 14F101435 (BC1) – read -10.0 NTU
- S/N 13C100688 (DR-TM) – read -10.1 NTU
- These values were used to correct readings recorded by the turbidity meters.

Photos

Photo 1. Turbidity logger from EC2.

Photo 2. Staff gauge board reading 0.98 m at EC2 on Oct 22, 2014 at 1:45 PM.

Photo 3. Staff gauge board reading 0.24 m at Reach 1 cableway on Oct 22, 2014 at 2:15 PM.

Photo 4. Staff gauge board reading 0.38 m at Reach 1 inlet on Oct 22, 2014 at 2:45 PM.

Photo 5. Staff gauge board reading 0.88 m at BBL on Oct 22, 2014 at 3:30 PM.

Photo 6. Staff gauge board reading 0.74 m at BC1 on Oct 22, 2014 at 5:05 PM.

Photo 7. Staff gauge board reading 0.64 m at BC2 on Oct 22, 2014 at 5:20 PM.

Photo 8. Turbidity logger base and cable left at BC-TM site.

Photo 9. Turbidity logger from BC-TM.

Photo 10. Atmospheric pressure loggers on fallen tree at BC-TM.

Photo 11. Staff gauge board reading 0.72 m at BC-TM on Oct 23, 2014 at 9:30 AM.

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Phase 1006, Task 13**

REPORT DATE: Nov 24, 2014 **BY:** Steve Offman **POSITION TITLE:** Environmental Scientist

November 14, 2014
Deployment of two turbidity meters

Permission to Proceed:

- On Wednesday November 12, 2014, MIT indicated that more of the berm at the Reach 1 inlet would be removed beginning on November 14. As part of the work, MIT requested installation of the Turbidity meters that had been removed the prior month. Due to logistical issues, it was determined that only two meters would be used (KGS had left the anchor block/stands at two sites in case further opening of the berm would occur). KGS Group, through NSC, indicated to MIT that there is increased risk to the equipment from ice, and that, while we would deploy the devices as requested, we would not assume liability for damage or loss of equipment being deployed under the current conditions.

Weather:

- Sunny, approx. -15°C.

Chronology:

- Steve Offman and Dan Leitch drove to Gypsumville on November 14, 2014; arriving at 9:30 AM.
- Met with Matt Martens (NSC) who brought a 16 ft. Lund (boat), Doug (helicopter pilot), Rick Postlethwaite (MIT) and two construction workers.
- Helicopter brought construction workers to Reach 1 while SO, DL and MM drove to Benson's to prep gear and the sling load (boat)
- Helicopter returned to Benson's and brought SO, DL, MM and all equipment (except boat) to Station BC-TM.

Station BC-TM

- Dropped off at landing pad at BC-TM, although it is becoming overgrown. Searched for better locations to land but could not find any.
- Prepared turbidity meter anchor block/stand, ropes and floats, hardware, king anchor and cable, and

lead line, while helicopter returned for boat.
    - The anchor block, which had been left on site, was frozen to the ground. The ground was uneven, so it only required a few minutes to free the block.
- The Turbidity meters were calibrated on November 13, 2014 and the program was launched before heading to site as we would not have been able to calibrate effectively under current field conditions.
- Boat was slung to Station BC-TM and placed on heli landing area. The helicopter then left to be at hand on Reach 1.
- The stern of the boat was placed perpendicular with the flow; extended approximately 12 ft. from the edge of the bank (hanging approximately 3 ft. past the edge of the ice over the open water, and secured to a tree.
- Guide ropes with floats were tied to the sides of the anchor block to allow the two staff to slowly lower the device to the substrate of the creek and orient the block/stand so that the turbidity meter sensors faced downstream.
- Once in place, the guide ropes and floats were cut so that the ropes would not become encased in ice and potentially move the probe further downstream when the ice breaks up during the spring melt in 2015.
- The turbidity meter at Station BCTM was **deployed at 12:30 pm**.
- A king anchor that had been secured to a cable, which was attached to the anchor block, was then deployed upstream by pulling the cable until it was tight and throwing the anchor from shore into the water.
- A lead line, which was attached to the anchor block, was laid across the border ice (Photo 1) and the ice coated bank of the creek and tied off to two trees approximately 60 ft from the water's edge.
- The boat was then returned to the pick-up location and the slings, lanyards and nets were attached.
- Dan and Steve were moved with all the gear to Station EC2 while Matt remained on site to connect the sling load to the long line cable on the helicopter.
- Once the boat was at Station EC2, the pilot returned to retrieve Matt.

Station EC2

- Dan and Steve attempted to set up all of the gear, however, the anchor block of the turbidity meter stand was sitting on flat loose till and had been frozen into the ground, which had > 1 inch of frost layer.
    - After more than 45 minutes of digging out the concrete block, the stand was inadvertently hit causing the stand to be separated from the block.
    - Once the block was freed from the ground, KGS staff used some of the cable for the king anchor, spare brackets, and U-bolts to rig the stand so that it was fastened to the block and unable to move. This took more than 30 minutes to accomplish.
- The turbidity meter, anchor and cable, ropes and floats, and lead lines were attached to the stand and block.
- The stern of the boat was placed perpendicular with the flow; extended approximately 14 ft. from the edge of the bank (hanging approximately 3 ft. past the edge of the ice over the open water, and secured to the skid on the helicopter.
- **At 3:00 pm** the turbidity meter/stand was lowered to the substrate of the Reach and moved so that the concrete block was resting on as flat an area possible given the conditions (seemed to be at the toe of the slope)
- The guide ropes and floats were then cut and the king anchor extended and thrown into the reach upstream.
- The lead line was laid across the border ice (Photo 2) and attached to a steel rebar anchor that was installed at that location earlier in the season.
- Of interest, there was ice for approximately 5 feet up the gradual slope from the water's edge (Photo 3) indicating that water levels may have dropped within Reach 1 during freeze up, possibly from cutting

back the flow at the Fairford River Water Control Structure on the prior Thursday (Nov. 6, 2014).

- Photos were taken along Reach 1 and at the inlet while leaving the site.
    - There was no visible plume within Reach 1 (Photos 4 and 5)
    - The water flowing through the inlet in the rapids did appear to have a darker colour; however, there is no indication of any plume extending downstream (Photo 6 and 7).
- Once all of the gear, staff and boat were back at the boat launch at Benson's (3:45 pm), the pilot felt that it was too late to conduct the water quality sample event (even the reduce turbidity-only event), as he still had to retrieve the two construction workers and return to the MNR yard before dark, which on that date occurred at approximately 4:45.

Photos

Photo 1. Lead Line that is connected to base of turbidity meter stand, laying across border ice (Station BCTM).

Photo 2. Lead Line that is connected to base of turbidity meter stand, laying across border ice (Station EC2).

Photo 3. Broken ice along the slope of bank and the border ice at St. EC2 facing upstream.

Photo 4. Reach 1 taken from approx. 500 m upstream of St. EC2, facing upstream.

Photo 5. Reach 1 taken from approx. 1 km downstream of inlet, facing upstream.

Photo 6. Reach 1 inlet at end of 1st day of recommencement of removal of berm, facing downstream.

Photo 7. Reach 1 inlet at end of 1st day of recommencement of removal of berm, facing NW.

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Phase 1006, Task 18**

REPORT DATE: Nov 19, 2014 **BY: Andrew Weiss** **POSITION TITLE:** Water Resources EIT

November 18, 2014
Reach 1 Flow Metering

Weather:

- Clear weather upon arrival at site with temperatures from -12°C to -7°C.

Chronology of the day:

Access to site

- Two KGS Group crews, Ambroise Percheron, Andrew Weiss, Dan Leitch and Steve Offman, arrived at the MNR Gypsumville District Office at 9:30 AM, and met with Doug (Pilot from Taiga).
    - A crew of four staff were assigned to this task due to safety requirements. Ice conditions observed at the downstream end of Reach 1 on November 14, 2014 were deemed hazardous. Reduced water levels in Reach 1 (after cutback of FRWCS the previous week) resulted in Ice along the banks extended approximately 7 feet up the slope and border ice (approximately 1 to 2 inches thick) extended nearly 14 feet from the banks. As such, it was determined that a flat duck boat secured to the helicopter would be used to access the water over the border ice to install the RDI River Ray and a harness/ropes system would be used by the individual that was working on the boat.
    - As well, due to concerns with frazil ice chunks and ice pans flowing down the channel and hitting the RDI River Ray, one staff was assigned as lookout for floating ice pans
- NSC Staff arrived at the MNR yard with a boat purchased to leave on site and were provided with slings and lanyards so that a sling load (the boat) could be prepared and left at the boat launch area at Benson's Big Rock Camp. Once the loads were set, NSC staff delivered the sling load to Benson's and continued with other tasks (setting up time-lapse cameras at Dauphin River First Nation community).
- The four KGS staff travelled directly to the Reach 1 Cableway by helicopter to begin setting up the gear required to conduct the flow metering and then Doug made a trip to Big Rock Boat Launch to pick up a boat to bring to the Reach 1 Cableway.
- After the boat was received, the flow metering took place.
- The conditions at the cableway were not as hazardous as those encountered on the downstream end of

Reach 1 because the banks are more steep at the cableway, and the cableway is at a distance upstream that backwater effects do not result in water levels as high as are observed at the downstream end. As such, there was approximately 1.5 feet of ice extending up the slope and only 3 to 4 feet of border ice extending into the water from the banks. KGS staff used various tools to break away the ice at the shoreline, and some of the border ice, in order to create a safe access area to the water. The border ice was also removed from around the gauge board in order to get an accurate reading; prior to doing so, the gauge board was entirely encased in ice.

Flow Metering

- A gauge board reading was taken on site prior to the start of the flow metering – The reading was 0.19 on the "high" gauge board. The "low" gauge board was submerged.
- KGS Group executed a compass calibration of the ADCP before the flow metering.
- KGS Group then proceeded with their measurement using the RDI River Ray 600 (without GPS)
- The ADCP measurement started at about 11:30 PM, and was completed by about 12:30 PM.
- To ensure a continuous communication between the ADCP and the laptop, the laptop was attached to the cableway and dual transects were collected within a single measurement.
- The transects were then subsectioned during post processing of the data.
- A loop test was conducted and the results showed that a moving bed was not present at the site.
- Based on preliminary field results, KGS Group measured a flow of 3100 cfs.
- Buoys were reattached to the cableway prior to departure.
- Summary Photos are provided below.

Photos

Photo 1. Looking downstream on Reach 1 from cableway.

Photo 2. Looking upstream on Reach 1 from cableway.

Photo 3. Gauge board Reading of 0.19

Photo 4. KGS Flow Metering

Photo 5. Reach 1 inlet looking upstream

Photo 6, Reach 1 Inlet looking downstream

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 18**

REPORT DATE: May 1, 2015 **BY:** Garrett Wellwood **POSITION TITLE:** E.I.T

May 01, 2015 (Event #1 of 2015)

Reach 1 Flow Metering

Water Level Survey

Weather:

- Mostly sunny, breezy, high of 23°C

Mobilization 6:30 AM– 6:00 PM

- Garrett Wellwood and Elaine Salter met Steve Offman and Dan Leitch at the Wilkes storages locker, gathered equipment, and drove to Gypsumville. Arrived at 9:45.
- Organized gear, and loaded helicopter

Transit 10:15 AM - 10:30 AM

- Flow metering equipment was dropped off at the Reach 1 Cableway, while the flow metering crew was dropped off at the Reach 1 outlet with the survey equipment.

Reach 1 10:30 – 2:30, walking between sites

R1-D-A

- Elaine Salter and Garrett Wellwood began the WL survey at bench mark R1-D-A. A level of 242.187 m was recorded. The location can be seen in Photo's 1 and 2 while the benchmark itself is seen in Photo 3.
- Gauge board was damaged and completely submerged as can be seen in Photo 4.

R1-M-B

- Elaine Salter and Garrett Wellwood recorded the water level at bench mark R1-M-B as 242.678 m
- No gauge board
- Photos looking north across the channel, east (downstream), and west (upstream) can be seen in Photo's 5, 6, and 7.

R1-C-A

- Cableway mechanism was unlocked upon arrival.
- ADCP was attached and 4 passes were completed with one loop completed to correct for a potential moving bed. The field results yielded 94.0 cms. See Photo 8.
- Water level surveyed at R1-C-A was 242.694 m
- The gauge board was damaged and unable to provide an accurate water level. See Photo 9.
- The water sampling crew arrived via helicopter to the cableway after completing their work. They waited for the flow metering crew to walk to the inlet and finish their measurements.

R1-I-A

- Elaine and Garrett walked from the cableway to the Reach 1 inlet and surveyed a water level of 243.097 m. See Photo 10 and 12.
- Gauge board was damaged. See Photo 11.
- The helicopter and water sampling crew picked up the flow metering team, already having packed the flow metering equipment, and flew back to Gypsumville with 4 aboard and gear.

Transit 3:00 PM – 6:30 PM

The truck was loaded and departed for Winnipeg with Steve Offman, Dan Lietch, Garrett Wellwood and Elaine Salter.

Photos

Photo 1. Reach 1 Bench Mark R1-D-A, looking east D/S

Photo 2. Reach 1 Bench Mark R1-D-A, looking west U/S

Photo 3: Bench Mark R1-D-A, anchor to staff gauge

Photo 4: Submerged gauge board at Bench Mark R1-D-A

Photo 5: Bench Mark R1-M-B, looking north-west

Photo 6: Bench Mark R1-M-B looking west, U/S

Photo 7. Bench Mark R1-M-B looking east, D/S

Photo 8. Flow metering with ADCP at Cableway, looking north

Photo 9. Cableway and staff gauge at R1-C-A, looking north

Photo 10. Bench Mark R1-I-A looking west, U/S

Photo 11. At Bench Mark R1-I-A, damaged gauge board

Photo 12. Bench Mark R1-I-A looking east, D/S

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Tasks 12, 13 & 18**

REPORT DATE: June 15, 2015 **BY:** Dan Leitch **POSITION TITLE:** Env. Scientist

June 10-11, 2015

Download data from loggers, re-deployment and WQ sampling

** Separate Field Inspection Form completed for flow reading and water levels**

June 9, 2015

- Prior to going to the field, two turbidity meters were calibrated and launched from the office (June 9, 2015) with a delayed start to begin logging on June 10 at 14:00.
- A new turbidity logger base was also constructed to replace the base at Reach 1 which was damaged.

June 10, 2015

- D. Leitch and W. Bernhardt (NSC) left the KGS Group office at 10:00 AM, picked up gear at Wilkes, drove to Ashern for groceries, Benson's to pick up the boat, and then to Dauphin River
- The drive was slow due to road construction.
- Once in Dauphin River, boat was launched.
- A. Weiss took separate vehicle because had to be in office longer.

DR-TM

Turbidity Logger

- No logger was left there for the winter
- Turbidity logger (pre-launched) was deployed at 17:13 (S/N 14F101436)
- 2 floats attached to base, rope attached to tree on shore, king anchor placed upstream

- Deployment location was upstream of a recent bank slump, but downstream of grassy flat area.

BC-TM

Turbidity Logger

- Turbidity logger was retrieved using rope from shore. Logger base appears to have been on its side as evidenced by the amount of sediment on its side.
- Deployed the other pre-launched sonde at this location (S/N 14F101435)
- Deployed at 18:10
- Previous logger (S/N 12K101402) was brought back to the office to upload data.

Pressure Loggers

- Atmospheric pressure loggers were uploaded and redeployed (S/N 1050844 and 10197002)
- Both had full memory, and battery state was "good"
- Files saved as *2015-06-10-1050844.hobo* and *2015-06-10-10197002.hobo*
- Relaunched with 15 minute intervals, 225.6 days of memory remaining
- Delayed start to begin logging at 18:00 (S/N 1050844) and 18:15 (S/N 10197002)

- Water logger (S/N 10197000) was retrieved
- Rope was tangled in nearby trees and log debris in the water but the logger appears to have been in reasonably deep water.
- File saved as *2015-06-10-10197000.hobo*
- Relaunched with 15 minute intervals, 225.6 days of memory remaining
- Delayed start to begin logging at 18:30

June 11, 2015

- W. Bernhardt, A. Weiss and D. Leitch left Dauphin River in boat at 7:30
- Drove up to LSM to begin sampling operations and work in a downstream direction
- En route, dropped off turbidity logger bases at BC-1 and at EC-2 to offload weight.

LSM-1

- Drove boat up inlet and sampled approx. 200 m west of berm
- Lake was calm

Water Sample

- WQ sample and in situ measurements taken at 9:05

Reach 1 – Upstream

Pressure Logger

- Pressure logger (S/N 10508045) uploaded
- Memory was full, battery state "good"
- Logger appeared to be in fairly deep water
- File saved as *2015-06-11-10508045.hobo*
- Launched for 10:00 delayed start
- Set for 15 min intervals, 225.6 days memory remaining
- Water level taken via rod and level (gauge board damaged)

Water Level

- Water level taken via rod and level (gauge board damaged)

Reach 1 – Cableway

Pressure Loggers

- Water logger (S/N 10486634) uploaded
- Memory was full, battery state "good"
- Logger appeared to be in fairly deep water
- File saved as *2015-06-11-10486634.hobo*
- Lunched for 10:15 delayed start (in water at 10:23)
- Set for 15 min intervals, 225.6 days memory remaining
- Water level taken via rod and level (gauge board damaged)

- Atmospheric pressure loggers on the cableway structure were uploaded and redeployed (S/N 10508041 and 10486637)
- Both had full memory, and battery state was "good"
- Files saved as *2015-06-10-1050841.hobo* and *2015-06-10-10486637.hobo*
- Relaunched with 15 minute intervals, 225.6 days of memory remaining
- Delayed start to begin logging at 10:45 for both loggers

Water Level

- Water level taken via rod and level (gauge board damaged)

Flow Reading

- Separate Field Inspection completed by A. Weiss

Reach 1 – EC2

Turbidity Logger

- Turbidity logger retrieved
- Logger appears to have been upright
- Parts of rope attaching it to shore were buried in sediment
- Sonde (S/N 13C100688) brought back to office to upload data
- New base was left on site with ABS pipe, hose clamps, u-bolts, king anchor and cable for king anchor
- If to be used, will need rope to attach to shore and floats (and rope)
- Steel frame brought back to office, broken concrete block left on site for now.

Pressure Logger

- Water logger (S/N 10508043) was retrieved
- File saved as *2015-06-11-10508043.hobo*
- Relaunched with 15 minute intervals, 225.6 days of memory remaining
- Delayed start to begin logging at 11:45 (in water at 11:50)

Water Sample

- WQ sample and in situ measurements taken at 11:55

Water Level

- Water level taken via rod and level (gauge board damaged)

BBL

Pressure Logger

- Pressure logger (S/N 10486635) uploaded
- Memory was full, battery state "good"
- Logger was still attached to floats which were left for the winter time
- File saved as *2015-06-11-10486635.hobo*
- Launched for 12:45 delayed start (in water at 12:35)
- Set for 15 min intervals, 225.6 days memory remaining

Water Sample

- WQ sample and in situ measurements taken at 12:30

Water Level

- Water level taken on gauge board

BC1

Turbidity Logger

- Logger not deployed

- Turbidity logger base was left on site (with base, ABS, u-bolts, hose clamps, king anchor)
- If it will be used, needs rope (lead line) and cable to attached anchor to base as well as associated hardware

Pressure Logger

- Pressure logger (S/N 10486633) uploaded
- Memory was full, battery state "good"
- File saved as *2015-06-11-10486633.hobo*
- Launched for 13:00 delayed start (in water at 12:59)
- Set for 15 min intervals, 225.6 days memory remaining

Water Sample

- WQ sample and in situ measurements taken at 12:50

Water Level

- Water level taken via rod and level (gauge board damaged)

BC2

Pressure Logger

- Logger was no longer attached to rope
- Rope was severed, and the tree it was attached to was bent
- It is likely debris got caught on the rope and broke it off
- Lead line was left on site
- Logger may be located when water levels drop

Water Level

- Water level taken on gauge board

BC-TM

Water Sample

- WQ sample and in situ measurements taken at 13:50

Water Level

- Water level taken via rod and level (gauge board damaged)

BC3

Water Sample

- WQ sample and in situ measurements taken at 14:00

DR-C

Water Sample

- WQ sample and in situ measurements taken at 14:10

DR-C TSS2

Water Sample

- WQ sample and in situ measurements taken at 14:15

DR-D

Water Sample

- WQ sample and in situ measurements taken at 14:20

DR-D TSS2

Water Sample

- WQ sample and in situ measurements taken at 14:25

Egress

- Trailered boat and left at Benson's
- WQ samples brought to ALS lab early the following morning

Turbidity Logger Follow-Up

- The following day, loggers were brought back to the office to be assessed
- The logger from EC-2 would not communicate with the laptop.
- Subsequent follow-up with YSI to troubleshoot the sonde did not solve the problem. YSI suggested sending the sonde in for assessment / repairs.
- Upon assessment at Hoskins, the sonde had water inside the central cavity and corrosion had occurred. The sonde was not repairable and data was not retrievable.
- Data was therefore not obtained from the EC-2 sonde.

- Data uploaded properly from the logger from BC-TM.
- Data recorded until April 4, 2015 when batteries died.

Photos

Photo 1. Turbidity logger taken from BC-TM (June 10, 2015).

Photo 2. Turbidity logger taken from BC-TM (June 10, 2015).

Photo 3: Dead trees along Buffalo Creek (June 11, 2015).

Photo 4: Erosion along Buffalo Creek (June 11, 2015).

Photo 5: Bog upstream from BC-1 (June 11, 2015).

Photo 6: Reach 1 Inlet (June 11, 2015).

Photo 7. Reach 1 – Upstream gauge board (June 11, 2015)

Photo 8. Water pressure logger at Reach 1 Cableway (June 11, 2015).

Photo 9. Turbidity meter at EC-2 (June 11, 2015).

Photo 10. Gauge board at BBL (June 11, 2015) reading 0.82 m.

Photo 11. Erosion at 15+000 on Buffalo Creek (June 11, 2015).

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 18**

REPORT DATE: June 12, 2015 **BY:** Andrew Weiss **POSITION TITLE:** E.I.T

June 11, 2015 (Event #2 of 2015)

Reach 1 Flow Metering

Water Level Survey

Weather:

- Mostly sunny, breezy, high of 24°C

Mobilization 6:30 AM– 8:00 PM

- Andrew Weiss, Dan Leitch and Warren Bernhardt organized the water quality and survey gear and loaded it into the boat. Replacement weighted bases were also loaded into the boat. Departed at approximately 6:45 AM.

Transit 6:45 AM - 8:30 AM

- One weighted base was dropped off at BC_TM, while the other weighted base was dropped off at R1-C.

Reach 1 8:30 – 12:45, boating between sites

R1-I-A

- Warren Bernhardt and Andrew Weiss began the WL survey at bench mark R1-I-A. A level of 243.109 m was surveyed.
- Gauge board was damaged and partially submerged as can be seen in Photo 1. A view upstream of Reach 1 at the survey site is shown in Photo 2.

R1-C-A

- Cableway mechanism was unlocked upon arrival.
- Warren Bernhardt and Andrew Weiss surveyed the water level at bench mark R1-C-A as 242.769 m.
- The gauge board was damaged and unable to provide an accurate water level. See Photo 3.
- A photo showing the upstream (east) view at Reach 1 at the cableway is shown in Photo 4.
- ADCP was attached and 4 passes were completed with one loop completed to correct for a potential moving bed. The field results yielded 91.0 cms.

R1-D-A

- Warren Bernhardt and Andrew Weiss surveyed the water level at bench mark R1-C-A as 242.267 m.

Big Buffalo Lake

- Andrew Weiss recorded the water level at Big Buffalo Lake as 242.062. The gaugeboard was used to measure the water level, and was marked as 0.82 m, as shown in Photo 5.

Buffalo Inlet

- Warren Bernhardt and Andrew Weiss surveyed the water level at bench mark BC-01 as 239.477 m.
- A gaugeboard reading of 0.50 m was taken, indicating a water level of 239.324 m. The gaugeboard was not level, as shown in Photo 6, suggesting that ice may have moved the gauge.

Reach 3 Inlet

- Andrew Weiss recorded the water level at BC-02 as 233.739 m. The gaugeboard was used to measure the water level, and was marked as 0.48 m. The water level was not surveyed as it was deemed irrelevant, as the rope for the pressure logger had broken and thus could not be re-deployed.

BC-TM

- Warren Bernhardt and Andrew Weiss surveyed the water level at bench mark BC-TM as 223.228 m.

<u>Transit</u> 12:45 PM – 8:00 PM

Upon return to Dauphin River, the ADCP, survey, and water quality equipment were removed from the boat, which was then loaded onto a trailer. The equipment was loaded into vehicles, and then transported back to Winnipeg by Dan Leitch, Warren Bernhardt and Andrew Weiss.

Photos

Photo 1. Damaged Gaugeboard at Reach 1 Bench Mark R1-I-A, looking east D/S

Photo 2. R1-I-A, looking west U/S

Photo 3. Damaged Gaugeboard at Reach 1 Bench Mark R1-C-A, looking east D/S

Photo 4. R1-C-A, looking west U/S

Photo 5: Big Buffalo Lake Gaugeboard

Photo 6: Gaugeboard at BC-01

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Tasks 13**

REPORT DATE: August 11, 2015 **BY:** Dan Leitch **POSITION TITLE:** Env. Scientist

July 29, 2015

Dauphin River - Bedload sampling

** A Separate Field Inspection Form was completed for Water Quality sampling done as part of the same trip **

July 29, 2015

- Dan Leitch, Gene Senior and Jonny Peake (NSC) met at Wilkes at 7:00 AM
- Picked up boat from Benson's Big Rock
- Arrived at Dauphin River at 12:00
- Boat was launched at the marina and loaded from Helgi's
- Weather: very windy with occasional drizzle. Fair amounts of recent rain in the region.

Bedload sampling

- Transect was identified approximately 100 m downstream from Helgi's
- Transect is perpendicular to the river.
- Station locations are as follows, and as shown on image below:

Station	Easting	Northing
Site 1	563824	5755837
Site 2	563833	5755818
Site 3	563850	5755790
Site 4	563804	5755856
Site 5	563787	5755878

Procedures followed at each station:

- Bedload Sampler:
  - Site was identified using handheld GPS.
  - King anchor was deployed to hold boat in place.
  - Bedload sampler (Model BL-84, Rickly Hydrological) was slowly and gently deployed to sediment surface.
  - Timer was started (for 10 minutes).
  - After 10 minutes, bedload sampler was brought out of the water.
  - Using a spray bottle, the contents of the bedload sampler net were sprayed into a jar for collection.
  - The bedload sampler net was rinsed and then re-deployed for another 10 minutes.
  - 5 replicates were done at each site.
  - The following was recorded: Depth, times, waypoint, general observations re: substrate

- Current measurements:
  - A Price Meter was used to measure the current at the water surface (15 cm down) and at the bottom (30 cm up).
  - Depths were approximate due to very strong current and inability to see device at the bottom of the water column.
  - A large weight was attached to the device to lower in strong current.
  - Price Meter was set to beep every 5 rotations.
  - Beeps were counted over a 40 second period, timed using a stopwatch.

- TSS and Turbidity *in situ* sampling
  - A Van Dorn sampler was used to collect water from the surface (30 cm below surface) and the bottom (15 cm up from sediment) of the water column.
  - A 25-lb weight was added to the sampler to get it to depth in the strong current.
  - A 1-litre routine water quality bottle was used for each of the surface and bottom water at all 5 sites (10 samples total)
  - Water bottle was submitted to ALS laboratory for analysis of TSS and turbidity.

- *In situ* turbidity was also measured and recorded at the surface and bottom of each site.

Bedload sampling observations:

Site 1 (mid-channel)

- Two samples contained large rocks
- Black gravel
- Small portion is woody debris
- Sample 1-3:

- Site 2 (left quarter – when facing upstream)
  - Mainly organic, but also some fine sand
  - Sample 2-2:

- Site 3 (left bank – when facing upstream)
  - Lots of organics, no noticeable sand or gravel

- Sample 3-2:

- Site 4 (right quarter – when facing upstream)
  - Small amount of fine sand
  - Sample 4-1:

- Site 5 (right bank – when facing upstream)
  - Small amount of sand and gravel
  - Sample 5-3:

The sediment surface could not be seen from the boat as the water was too turbid. Recent precipitation may have contributed to higher turbidity in the river.

Sample times, in situ data, depths, currents, and sample ID's can be found in Tables 1 and 2 below.

Table 1. Dauphin River Bedload Sampling (13-0431-001)

Date	Location Description	Site ID	Waypoint	Total Depth (m)	Sample ID	Photo #	Start time	End Time	Time elapsed (hh:mm:ss)	Flow Readings (Price Meter)					Water Sampling			
										Location	Beeps	Rotations/Beep	Seconds	Time	Location	TSS Sample ID	Time	*In situ* Turbidity
29-Jul-15	Mid Channel	Site 1	001	1.9	1-1	6923-6924	12:50	13:00	0:10:00	Surface	10	5	40	13:42	Surface	1T	12:59	9.67
29-Jul-15	Mid Channel	Site 1	001	1.9	1-2	6929-6932	13:04	13:14	0:10:00	Bottom	8	5	40		Bottom	1B	13:11	13.42
29-Jul-15	Mid Channel	Site 1	001	1.9	1-3	6935-6936	13:22	13:32	0:10:00									
29-Jul-15	Mid Channel	Site 1	001	1.9	1-4	6940	13:40	13:50	0:10:00									
29-Jul-15	Mid Channel	Site 1	001	1.9	1-5	6941	19:51	20:01	0:10:00									
29-Jul-15	Left Quarter (facing U/S)	Site 2	002	2.3	2-1	6943	14:14	14:24	0:10:00	Surface	12	5	40	14:29	Surface	2T	14:48	11.45
29-Jul-15	Left Quarter (facing U/S)	Site 2	002	2.3	2-2	6944	14:27	14:37	0:10:00	Bottom	12	5	40		Bottom	2B	14:50	10.07
29-Jul-15	Left Quarter (facing U/S)	Site 2	002	2.3	2-3	6945	14:45	14:55	0:10:00									
29-Jul-15	Left Quarter (facing U/S)	Site 2	002	2.3	2-4	6946	14:58	15:08	0:10:00									
29-Jul-15	Left Quarter (facing U/S)	Site 2	002	2.3	2-5	6947	15:15	15:25	0:10:00									
29-Jul-15	Left Bank (facing U/S)	Site 3	003	2.3	3-1	6948	15:31	15:41	0:10:00	Surface	12	5	40	15:50	Surface	3T	16:19	7.80
29-Jul-15	Left Bank (facing U/S)	Site 3	003	2.3	3-2	6949	15:45	15:55	0:10:00	Bottom	10	5	40	15:52	Bottom	3B	16:22	7.37
29-Jul-15	Left Bank (facing U/S)	Site 3	003	2.3	3-3	6950	16:01	16:11	0:10:00									
29-Jul-15	Left Bank (facing U/S)	Site 3	003	2.3	3-4	6954	16:14	16:24	0:10:00									
29-Jul-15	Left Bank (facing U/S)	Site 3	003	2.3	3-5	6955	16:30	16:40	0:10:00									
29-Jul-15	Right Quarter (facing U/S)	Site 4	004	2.4	4-1	6956	16:48	16:48	0:00:00	Surface	10	5	40	17:00	Surface	4T	17:17	12.88
29-Jul-15	Right Quarter (facing U/S)	Site 4	004	2.4	4-2	6957	17:02	17:12	0:10:00	Bottom	10	5	40	17:02	Bottom	4B	17:21	13.11
29-Jul-15	Right Quarter (facing U/S)	Site 4	004	2.4	4-3	6958	17:15	17:25	0:10:00									
29-Jul-15	Right Quarter (facing U/S)	Site 4	004	2.4	4-4	6959	17:28	17:38	0:10:00									
29-Jul-15	Right Quarter (facing U/S)	Site 4	004	2.4	4-5	6960	17:43	17:53	0:10:00									
29-Jul-15	Right Bank (facing U/S)	Site 5	005	2.1	5-1	6962	17:59	18:09	0:10:00	Surface	11	5	40		Surface	5T	18:27	11.46
29-Jul-15	Right Bank (facing U/S)	Site 5	005	2.1	5-2	6963	18:13	18:23	0:10:00	Bottom	8	5	40		Bottom	5B	18:31	11.91
29-Jul-15	Right Bank (facing U/S)	Site 5	005	2.1	5-3	6964	18:27	18:37	0:10:00									
29-Jul-15	Right Bank (facing U/S)	Site 5	005	2.1	5-4	6965	18:40	18:50	0:10:00									
29-Jul-15	Right Bank (facing U/S)	Site 5	005	2.1	5-5	6966	18:53	19:03	0:10:00									

* "Surface Water" was taken from approximately 15 cm below surface; "Bottom Water" was taken from approximatley 30 above the sediments

Table 2. Velocity Calculations (Price Meter)

Date	Location Description	Site ID	Waypoint	Easting	Northing	Total Depth (m)	Sample Zone	Time elapsed (sec)	No. Revolutions	Revs*5	Calculated Velocity (m/sec)
29-Jul-15	Mid Channel	Site 1	001	563824	5755838	1.9	Surface	40	10	50	0.839
29-Jul-15	Mid Channel	Site 1	001	563824	5755838	1.9	Bottom	40	8	40	0.673
29-Jul-15	Left Quarter (facing U/S)	Site 2	002	563833	5755819	2.3	Surface	40	12	60	1.006
29-Jul-15	Left Quarter (facing U/S)	Site 2	002	563833	5755819	2.3	Bottom	40	12	60	1.006
29-Jul-15	Left Bank (facing U/S)	Site 3	003	563850	5755790	2.3	Surface	40	12	60	1.006
29-Jul-15	Left Bank (facing U/S)	Site 3	003	563850	5755790	2.3	Bottom	40	10	50	0.839
29-Jul-15	Right Quarter (facing U/S)	Site 4	004	563804	5755856	2.4	Surface	40	10	50	0.839
29-Jul-15	Right Quarter (facing U/S)	Site 4	004	563804	5755856	2.4	Bottom	40	10	50	0.839
29-Jul-15	Right Bank (facing U/S)	Site 5	005	563787	5755878	2.1	Bottom	40	11	55	0.923
29-Jul-15	Right Bank (facing U/S)	Site 5	005	563787	5755878	2.1	Surface	40	8	40	0.673

Photos

Photo 1.Bedload sampler being deployed.

Photo 2. Sample being sprayed into collection jar.

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001**

REPORT DATE: September 14, 2015 **BY:** Garrett Wellwood **POSITION TITLE:** E.I.T

September 14, 2015 (Project close-out)

Buffalo Creek Flow Metering

Water Level Survey

Weather:

- Mostly sunny, some clouds, high of 23°C

Mobilization 6:45 AM– 10:30 AM

- Garrett Wellwood and Steve Offman met at the Wilkes storages locker, gathered equipment, and drove to the Gypsumville MNR yard at 9:30. The Taiga helicopter and pilot Jeff Mark had already arrived.
- Organized gear, and loaded helicopter
- All remaining crews then drove all vehicles, gear and crews to the heli-pad at Bensons Camp
- The flow metering crew was in the 3rd helicopter flight.

Transit 12:15 PM - 12:30 PM

- Flow metering equipment and crew were dropped off at BC-TM on the Buffalo Creek after dispatching the water quality crew.

Flow Metering and Water Level Survey 12:45 PM – 1:15 PM

BC-TM

- Garrett Wellwood and Steve Offman completed the flow metering by 1:15 PM. A flow of 0.5 m/s^3 was recorded at the same location of the stream as measured previously. (Photo 3)
- A water level of 220.90 m was surveyed from the benchmark (ele. 224.199 m) on Helipad 18.

Turbidity Meter and Pressure Logger Retrieval 1:15 PM – 3:30 PM

BC-TM

- The turbidity meter was located in the same area as was launched; however it was lying on its side and no sign as too how long it had been this way. It was also entangled in a fair amount of debris. The anchor was still in place but the cable attaching it to the logger base had completely eroded through. The lead-line which connected the base to a tree on shore remained intact. (Photo 4)
- The pressure logger stationed in the water was located downstream of the turbidity meter. It is assumed that it travelled downstream from its original position however it must not have been too far. The lead-line anchoring it to shore remained intact but was taught suggesting the logger traveled downstream. (logger 10197000)
- The two pressure loggers recording atmospheric data were located in the same tree they were positioned in when launched. (loggers 10197002, 10508044)

Transit 3:45 PM – 4:00 PM

The helicopter picked up Steve Offman and Garrett Wellwood at approximately 3:45 PM and carried all the gear including the turbidity logger base and anchor back to the pad at Bensons. Steve and Garrett were first to arrive and traveled to the MNR yard in Gypsumville.

Notes

- Depth of creek seemed to be slightly less than expected. Although, previously in October of 2013 a flow was measured to be 0.7 m3/s with a WL of 220.93 m.
- Extensive vegetation damage seen throughout the overbank.
- Visible and distinct markings on adjacent tree's indicating the high water mark and ice flow of the increased levels in the Buffalo Creek during operation of the emergency channel. (Photo 1, 5)
- Large amounts of deposited sediment can be seen across the low-lying areas of the overbank. Although some areas appear bare, others appear to have up to, and more possibly more than, 2 ft of material deposited on top of existing ground. Grain size ranged from fine sand to approximately 1 cm. (Photo 6)
- The creek appeared to follow the previous alignment.
- Minimal slope failure visible. As well, the grade in some areas appeared to potentially be shallower than previously observed. (Photo 5)
- All gauge boards damaged beyond salvageable. (Photo 5)
- Rebar on Helipad 18 remained visible and in place (ele. 224.199 m)

Photos

Photo 1. Looking D/S at BC-TM from metering cross section.

Photo 2. Looking U/S from metering cross section.

Photo 3: Looking north across metering cross section.

Photo 4: Turbidity meter at BC-TM, as found.

Photo 5: Damaged gauge board and slope failure, looking D/S from BC-TM.

Photo 6: Example of deposition, 75 m upstream of BC-TM

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Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Tasks 13 & 18**

REPORT DATE: September 21, 2015 **BY:** Dan Leitch **POSITION TITLE:** Env. Scientist

September 14-16, 2015

Collection of turbidity meters and pressure loggers

BC-TM

Turbidity Logger (S/N 14F101435)

- While at BC-TM to conduct a flow metering, Steve Offman and Garrett Wellwood collected the turbidity meter on site as well as the three pressure loggers (1 in water, 2 atmospheric) on September 14, 2015.
- Base was tipped over and sonde was in the sediment (see photo below).
- Appeared as though something may have snagged on the ropes and flipped the base.
- Base was no longer attached to anchor (wire had corroded through).
- Data was uploaded on Sept 17 and saved as "*2015-09-17.readout.txt*"

Pressure Loggers

Atmospheric pressure loggers (S/N 1050844 and 10197002)

- Retrieved on Sept 14, 2015
- Files saved as "*2015-09-17-1050844.hobo"* and "*2015-09-17-10197002.hobo"*.

Water logger (S/N 10197000)

- Retrieved at 14:00 on Sept 14, 2015
- Water surface elevation was 220.90 m

- Logger was in 0.78 m of water when retrieved, therefore logger was at 220.12 m (220.90 m - 078 m)
- File uploaded on Sept and saved as "*2015-09-17-10197000.hobo"*.
- Based on a quick look at the (unprocessed) data, water levels began to decrease on August 14, 2015, and decreased until August 22, 2015

BC1

Pressure Logger (S/N 10486633)

- Survey crew (Wayne Decaire) collected pressure logger from BC1 on September 14, 2015 while otherwise on site.
- The rope attaching it to shore was severed.
- Was in approximately 30 cm of water when collected.
- Remaining rope which was still tied to tree was collected on Sept 16, 2015.
- Logger was uploaded on Sept 17, 2015 at 16:35.
- Logger was still logging.
- File uploaded on Sept 17 and saved as "*2015-09-17-10486633.hobo*".
- Based on a quick look at the (unprocessed) data, water levels began to decrease on August 13, 2015, and decreased until August 22, 2015.

- The turbidity logger base and anchor were retrieved from this location. They had been left on site in the event a logger would be deployed again.

BC2

- The pressure logger at this location was not found during the previous site visit.
- As water levels were now much receded, the logger was looked for, but not located.
- It seems likely that the logger may be beneath deposited sediment in the area.
- The lead line attached to the tree was recovered.

BBL

Pressure Logger (S/N 10486635)

- Pressure logger retrieved on September 16, 2015 at 13:10.
- Logger was in same location as previous visit.
- File saved as "*2015-09-17-10486635.hobo*"
- Based on a quick look at the (unprocessed) data, water levels began to decrease on August 13, 2015. By August 30, 2015, levels appear to have leveled off. There are further reductions, but it is difficult to tell if this is a continuation of the bog draining or if this is

natural variation due to precipitation and dry spells.

Reach 1 – Upstream

Pressure Logger (S/N 10508045)

- Logger had previously been removed from water (by contractor?). W. Bernhardt (NSC) placed the logger on the Reach 1 banks. It was collected on Sept 14, 2015.
- File uploaded on Sept 17 and saved as "*2015-09-17-10508045.hobo"*.
- Based on a quick look at the (unprocessed) data, water levels began to decrease on Aug 13, 2015 and dropped sharply until Aug 16, after which levels slowly dropped a bit longer.
- The logger appears to have been removed from the water on Aug 27, 2015 as there is a sudden change in temperature and pressure at this time.

Reach 1 – Cableway

Pressure Loggers

Atmospheric loggers (S/N 10508041 and 10486637)

- Were located on the cableway structure.
- Files uploaded on Sept 17 and saved as "*2015-09-17-1050841.hobo"* and "*2015-09-17-10486637.hobo"*.

Water logger (S/N 10486634)

- Collected on Sept 16, 2015 at 13:30.
- Logger appeared to be in fairly deep water (was retrieved by pulling rope from shore).
- File uploaded on Sept 17 and saved as "*2015-09-17-10486634.hobo"*.
- Based on a quick look at the (unprocessed) data, water levels began to decrease on Aug 13, 2015 and dropped sharply until Aug 16, after which levels slowly dropped a bit longer.

Reach 1 – EC2

Turbidity Logger

- No logger was deployed at this location however the logger base and anchor which were on site were retrieved.

Pressure Logger (S/N 10508043)

- Logger was retrieved on Sept 17 at 13:20.
- Logger appeared to be in fairly deep water (was retrieved by pulling rope from shore).
- File uploaded on Sept 17 and saved as "*2015-09-11-10508043.hobo*".

- Based on a quick look at the (unprocessed) data, water levels began to decrease on Aug 13, 2015 and dropped sharply until Aug 16.

DR-TM

Turbidity Logger (S/N 14F101436)

- Base was retrieved on Sept 15, 2015 from shore by pulling rope up over the bank.
- Logger appears to have been upright.
- The metal cable attaching it to the upstream king anchor corroded through and was no longer attached to base.
- Rope with floats had lots of vegetation debris and bits of dead fish stuck on it.
- Data was uploaded on Sept 17, 2015 and saved as "*2015-09-17 Readout.txt*".

Photos

Photo 1. Turbidity logger at BC-TM (September 14, 2015).

Photo 2. Sediment deposited inside sonde base structure.

Photo 3. Buffalo Creek at BC1 near pressure logger location (looking downstream).

Photo 4. Location of missing pressure logger at BC-2 (Sept 16, 2015).

Photo 5. Big Buffalo Lake.

Photo 6. Reach 1 as seen from inlet berm. Reach 1 U/S pressure logger was deployed near gravel pile seen on right.

Photo 7. Reach 1, looking downstream.

Photo 8. Turbidity meter from Dauphin River.

Photo 9. Corroded steel cable from turbidity meter at Dauphin River.

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Tasks 13**

REPORT DATE: September 21, 2015 **BY:** Dan Leitch **POSITION TITLE:** Env. Scientist

Dauphin River - Bedload sampling

September 15, 2015

Reach 1 was fully closed in mid-August therefore very little flow was coming out of the Buffalo Creek at the time of this sample event.

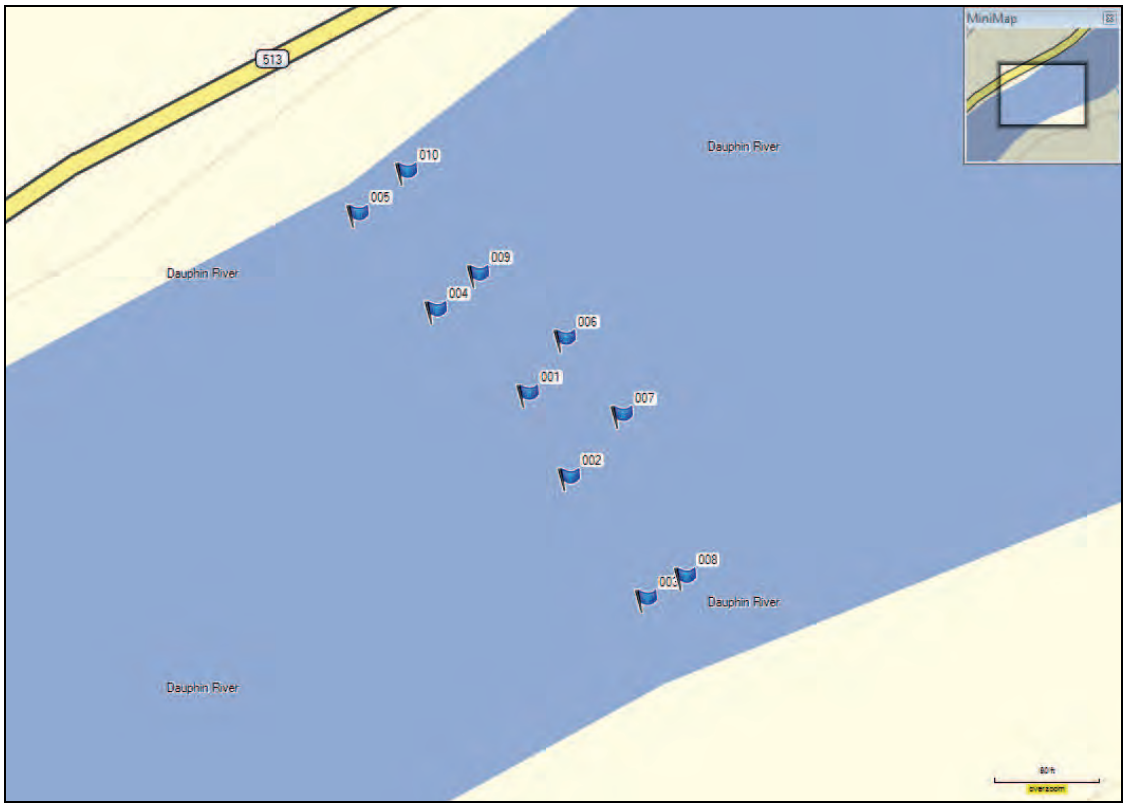
Pre-sampling

- Dan Leitch and Loni Andres drove to Dauphin River following meeting in Gypsumville Conservation Base.
- Arrived at Helgi's at 12:00 and loaded gear on boat (rented boat from Einarsson's Guide Service & Boat Rental).
- Weather: ~15ºC, very windy at times, overcast, occasional drizzle.

Bedload sampling

- Sites were located using waypoints from previous bedload sampling event.
- Sites sampled were generally within 10 m of sites sampled in July.
- Transect was perpendicular to river approximately 100 m downstream from Helgi's.
- Station locations are as follows, and as shown on image below:

Station	Easting	Northing
Site 1	563832	5755850
Site 2	563844	5755832
Site 3	563858	5755795
Site 4	563813	5755864
Site 5	563797	5755888



Sites 1-5 sampled at Waypoints 006 to 010 above on September 15, 2015 (Waypoints 001 to 005 above are from July 29, 2015 sampling event).

Procedures followed at each station:

- Bedload Sampler:
  - Site was identified using handheld GPS.
  - King anchor was deployed to hold boat in place.
  - Bedload sampler (Model BL-84, Rickly Hydrological) was slowly and gently deployed to sediment surface.
  - Timer was started (for 50 minutes).
  - After 50 minutes, bedload sampler was brought out of the water.
  - Using a spray bottle, the contents of the bedload sampler net were sprayed into a jar for collection.
  - The bedload sampler net was rinsed and then re-deployed for another 10 minutes.
  - **While previous bedload sampling events had 5 replicates of 10 minutes at each site, insufficient sample volume has required that these samples be combined in order to to have the samples analysed by the laboratory. For this reason, a single replicate of 50 minutes was conducted during this sample event.**
  - The following was recorded: Depth, times, waypoint, general observations re: substrate

- Current measurements:
    - A Price Meter was used to measure the current at the water surface (15 cm down) and at the bottom (30 cm up).
    - Depths were approximate due to very strong current and inability to see device at the bottom of the water column.
    - A large weight was attached to the device to lower in strong current.
    - Price Meter was set to beep every 5 rotations.
    - Beeps were counted over a 40 second period, timed using a stopwatch.

- TSS and Turbidity *in situ* sampling
    - A Van Dorn sampler was used to collect water from the surface (30 cm below surface) and the bottom (15 cm up from sediment) of the water column.
    - A weight was added to the sampler to get it to depth in the strong current.
    - A 1-litre routine water quality bottle was used for each of the surface and bottom water at all 5 sites (10 samples total)
    - Water bottle was submitted to ALS laboratory for analysis of TSS and turbidity.
    - *In situ* turbidity was also measured and recorded at the surface and bottom of each site.

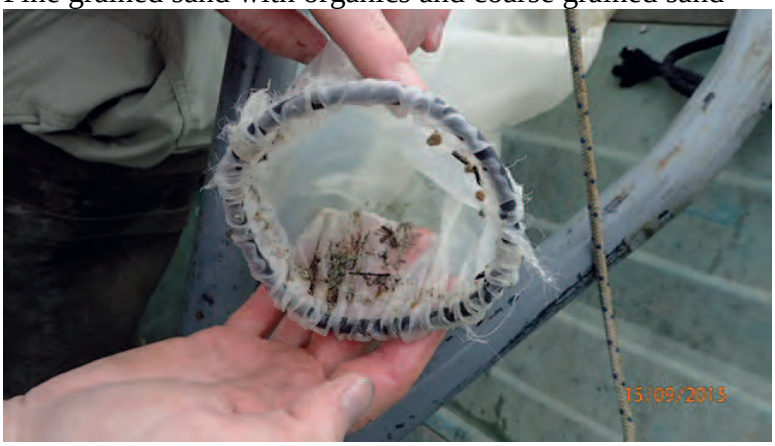
Bedload sampling observations:

Site 1 (mid-channel)

- Fine-grained sand with organics, trace coard grained gravel

- Site 2 (left quarter – when facing upstream)
    - Fine to coarse grain sand with organics, trace invertebrates.

- Site 3 (left bank – when facing upstream)
    - Fine grained sand with organics and coarse grained sand



- Site 4 (right quarter – when facing upstream)
    - Fine grained sand, organics

- Site 5 (right bank – when facing upstream)
    - Fine-grained sand, organics

General Observations:

- The sediment surface could not be seen from the boat as the water was too turbid.
- It appears that less sediment was captured relative to the previous sample event.
- Less organics (in particular on the left bank- facing upstream) were captured. This may be related to cessation of the Emergency Channel operation and the subsequent reduction in flow from the Buffalo Creek.
- Measured flow was lower than previous sample event, particularly at depth.
- *In situ* turbidity measurements were consistent (ranging from 5.75 to 6.41 NTU) which is lower than during the previous sample event (when turbidity ranged from 7.37 to 13.42 NTU).

Sample times, in situ data, depths, currents, and sample ID's can be found in Tables 1 and 2 below.

Table 1. Dauphin River Bedload Sampling (13-0431-001)

Date	Location Description	Site ID	Waypoint	Total Depth (m)	Sample ID	Photo #	Start time	End Time	Time elapsed (hh:mm:ss)	Flow Readings (Price Meter)					Water Sampling			
										Location	Beeps	Rotations/Beep	Seconds	Time	Location	TSS Sample ID	Time	*In situ* Turbidity
15-Aug-15	Mid Channel	Site 1	006	1.8	Site 1	211-218	12:35	13:25	0:50:00	Surface	10	5	40	12:59	Surface	1T	13:12	6.17
										Bottom	7	5	40		Bottom	1B	13:22	6.13
15-Aug-15	Left Quarter (facing U/S)	Site 2	007	1.9	Site 2	218-227	13:46	14:36	0:50:00	Surface	11	5	40	13:57	Surface	2T	14:00	5.77
										Bottom	7	5	40		Bottom	2B	14:10	5.87
15-Aug-15	Left Bank (facing U/S)	Site 3	008	2.3	Site 3	228-233	13:09	13:59	0:50:00	Surface	9	5	40	15:20	Surface	3T	15:37	5.75
										Bottom	5	5	40		Bottom	3B	15:47	6.13
15-Aug-15	Right Quarter (facing U/S)	Site 4	009	2.2	Site 4	234-239	16:13	17:03	0:50:00	Surface	10	5	40		Surface	4T	14:30	6.32
										Bottom	7	5	40		Bottom	4B	16:40	6.42
15-Aug-15	Right Bank (facing U/S)	Site 5	010	2	Site 5	240-247	17:16	18:06	0:50:00	Surface	9	5	40		Surface	5T	17:33	6.11
										Bottom	4	5	40		Bottom	5B	17:43	6.51

* "Surface Water" was taken from approximately 15 cm below surface; "Bottom Water" was taken from approximatley 30 above the sediments

Table 2. Velocity Calculations (Price Meter)

Date	Location Description	Site ID	Waypoint	Easting	Northing	Total Depth (m)	Sample Zone	Time elapsed (sec)	No. Revolutions	Revs*5	Calculated Velocity (m/sec)
15-Sep-15	Mid Channel	Site 1	006	563832	5755850	1.8	Surface	40	10	50	0.839
15-Sep-15	Mid Channel	Site 1	006	563832	5755850	1.8	Bottom	40	7	35	0.589
15-Sep-15	Left Quarter (facing U/S)	Site 2	007	563844	5755832	1.9	Surface	40	11	55	0.923
15-Sep-15	Left Quarter (facing U/S)	Site 2	007	563844	5755832	1.9	Bottom	40	7	35	0.589
15-Sep-15	Left Bank (facing U/S)	Site 3	008	563858	5755795	2.3	Surface	40	9	45	0.756
15-Sep-15	Left Bank (facing U/S)	Site 3	008	563858	5755795	2.3	Bottom	40	5	25	0.422
15-Sep-15	Right Quarter (facing U/S)	Site 4	009	563813	5755864	2.2	Surface	40	10	50	0.839
15-Sep-15	Right Quarter (facing U/S)	Site 4	009	563813	5755864	2.2	Bottom	40	7	35	0.589
15-Sep-15	Right Bank (facing U/S)	Site 5	010	563797	5755888	2.0	Bottom	40	9	45	0.756
15-Sep-15	Right Bank (facing U/S)	Site 5	010	563797	5755888	2.0	Surface	40	4	20	0.339

PHOTOS

Photo 1. Buffalo Creek confluence with Dauphin River.

Photo 2. Looking upstream Dauphin River. Note: Helgi's place on bottom right of photo. Sample transect just outside of photo at bottom.

DRAFT

APPENDIX A2

TASK 16 – BUFFALO CREEK VEGETATION COVER SURVEYS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 16**

REPORT DATE: September 3, 2013

BY: Dan Leitch

POSITION TITLE: Environmental Scientist

Buffalo Creek Vegetation Cover Survey Results
July 3-5, 2013

1.0 Introduction

As part of the Buffalo Creek Watershed – Post-Project Evaluation (Task ESH-4) for the Lake St. Martin Emergency Relief Channel – Monitoring and Development of Habitat Compensation project, KGS Group completed 31 vegetation survey transects along Buffalo Creek between station 13+000 m and 28+000 m. Field work was completed between July 3, 2013 and July 5, 2013 with helicopter support for daily access. A canoe was used to navigate down the river between transects.

The purpose of the vegetation survey along the Buffalo Creek was to assist in monitoring and assessing the impacts of the emergency channel operation and changes to the riparian vegetation community as well as erosion along the river. The vegetation survey program involved walking perpendicular 100 m transects on both sides of the creek, and documenting the cover types along this transect. Vegetation cover types were used to estimate the amount of protection from erosion afforded to the soil via plant cover. Representative sample photos were taken. The soil organic layer depth was also measured to compare against pre-project observations as an indication of the quantity of organic fines that may have moved downstream.

In addition to the vegetation cover survey program, a detailed cross section survey program was completed concurrently by the GIS team. The results of the detailed cross section survey will be presented separately.

2.0 Methodology

Sampling locations were set every 500 m along the length of the Buffalo Creek beginning at Station 13+000 m and continuing to just upstream of the confluence with the Dauphin River at Station 28+000 (Figure 1). The vegetation survey transects were run perpendicular to creek when possible, starting from centreline of the stream and continuing for a distance of 100 m on each side of the creek. Transect orientation was modified for those locations where the meander of the creek resulted in overlap of a transect from another location.

The river bank on both sides of the creek was recorded to determine the centreline. Transect orientation (cardinal direction), start and end point, general description of cover types, start and end distance of each cover type within the transect, and depth of soil organic layer were also recorded. Cover types were placed in four broad categories:

- Bare: exposed mineral soil with no vegetation or soil organic layer;
- Grass: vegetation cover consists of Grass, sedge, or rush families;
- Shrub : vegetation cover consists of woody species which do not form distinct trunks or canopies of leaves, especially those which do not normally exceed 10m in height; At times, a distinction was made between short herbaceous shrubs and taller woodier shrubs.
- Treed: vegetation cover consists of woody species which form distinct trunks and leaf canopies, and which normally can or do exceed 10m in height.

Photos 1 to 4 show the four representative cover types. A photo log was compiled with several photos taken along most transects. Photos are stored on the project drive for possible future comparison or verification.

Composites or matrices of these four types were possible, and their corresponding ground cover was provided e.g. 50% area covered by Grass 50% area covered by Shrubs. Due to plant morphology and habit, total percentages greater than 100% were possible.

Organic soil depths were measured from a representative area within each cover change along a transect (i.e. if substrate changes from grass to trees, a soil measurement was taken in each section). Soil was removed using a garden trowel and measured using a tape measure. When the

organic soil depth was greater than could be measured within reason using the garden trowel, soil depth was recorded as greater than the depth that was excavated (i.e. > x cm)

3.0 Results

The following subsections detail the results found for each transect, including orientation, description of terrain, cover types, and organic layer depths in soil. Unique features related to the investigation are also mentioned where appropriate. Where possible, observations were compared against conditions described during the 2011 survey. Due to the accuracy of the GPS, movement of creek banks due to varying water levels, and possible use of different starting points for the transects, detailed comparisons are not feasible. A detailed GIS survey was also conducted along the Buffalo Creek in order to quantify many of these differences. Photos contrasting several locations in 2011 and 2013 are included. Full records for each transect are found in Table 1 with the transect data broken into subsection A (left bank, when facing downstream) and subsection B (right bank, when facing downstream).

The organic soils in several areas, particularly at and beyond 19+500 appeared to be overlain with varying amounts of inorganic soils. When present, the inorganic soil depth was also measured. There was no note of inorganic soils observed in 2011.

General observations include large extents of dead shrubs and trees and bare areas where no vegetation is currently established along the creek. Many areas have recently begun to be colonized by young grass and shrub species. A comparison between the two surveys must consider the different time of year in which the surveys were conducted. The 2013 survey was done in early July following a late spring, while the 2011 survey was conducted in late September. It is possible that much of the bare areas noted in 2013 would be covered with grass and shrubs by late fall of 2013. It was also noted that water levels were lower in 2013 than in 2011. This may affect vegetation composition, transect centerlines and soil sampling. An abundance of beaver dams was also observed in 2011 creating large inundated areas at some of the transects. No beaver dams were observed in 2013.

The following sections provide a brief description of each of the transects surveyed. For more detail, see Table 1.

3.1 13+000

This transect runs in a northeast-southwest orientation. This section is within the vast open bog area surrounding Buffalo Lake. Both sides of the creek show grass and bare areas with some dead shrubs (willows) further away from the creek. The shrubs on the left side where at the beginning of the forest, while the shrubs on the right side were a small slightly elevated 'island' of shrubs which was otherwise surrounded by grass and bare areas. Organic soil depths along this transect varied from 13 to >16 cm. In 2011, this transect had much more water with large areas thick grass (sedges and rushes) being inundated with water. A small component (20%) of shrubs was also noted. No soil samples were taken in 2011 due to the high water levels. Photo 5 contrasts the transect as seen in 2011 and 2013.

3.2 13+500

This transect runs in a northwest-southeast orientation and is comprised of grass, shrubs and bare ground cover. To the southeast, the transect ends in a marshy area with stagnant water with sedges and aquatic vegetation. The vast majority of shrubs on the transect were dead and the ground cover was largely bare, but with a high percentage of young grass species emerging (especially on the northeast side). The organic layer of soil varied between 2 cm and 9 cm. When this transect was surveyed in 2011, the grasses were tall and thick and the wetland described above was drained. The wetland showed bare areas and many dead shrubs, while the shrubs on the northwest side were alive.

3.3 14+000

This transect runs in a northwest-southeast orientation. The ground surface nearest the creek is comprised of bare areas, young grass and dead shrubs. The side slopes are gentle leading to a mixture of trees and shrubs. The left side transect runs into a flooded marsh area comprised of grasses, cattails and willows at approximately 40 m. The right side transect had a slightly steeper bank and led to drier ground where a mixture of trees and shrubs predominated. Organic soil layers ranged from 2 to 5 cm. The 2011 survey made no note of a wetland along this transect, while the area nearest the channel consisted of thick grass and shrub layers at that time.

3.4 14+500

This transect runs in a northwest-southeast orientation. The area nearest the channel was largely bare with exposed soil and cobbles. Young grass species were starting to emerge. Further away from the creek, there is a relatively thin strip of dead shrubs on both banks as the slope increases slightly. Beyond this, both sides transitioned from largely shrubs to largely trees. The organic layer

of soils ranged from <1 to 5 cm. The 2011 survey described very similar vegetation composition, but with grass near the channel, and no mention of any dead vegetation (Photo 6 compares 2011 and 2013 photos). The 2011 survey also observed deeper organic soils (14-15 cm) in the grassy creek bed area.

3.5 15+000

This transect runs in a northwest-southeast orientation. Bare areas of cobble and gravel were observed adjacent to the channel. Exposed roots along the steep slope on the right side suggest recent erosion activity (Photo 7). Above the slope, trees transition to shrubs as the transect enters a sphagnum bog at 52 m. The slope on the left side of the river is much more gradual (inside bend of river) and is bare (cobble, gravel) with dead shrubs for the first 42 m before it transitions to shrubs and then to trees. The organic layer of soils ranged from 0 (adjacent to creek channel) to 9 cm (in sphagnum bog). The 2011 description of this transect described grass and shrubs adjacent to the channel, no bare areas, and slightly higher measurements of organic soil in that area (2-4 cm).

3.6 15+500

The orientation of this transect followed a northwest-southeast direction. Bare areas with dead shrub and young grass were found adjacent to the creek channel. On the right side, shrubs transitioned to trees for approximately 23 m, and then back to shrubs. On the left side, the transect was dominated by trees once up from the river bank. The trees shifted from pine to aspen at 59 m. The organic layer of soil varied between <1 and 6 cm. The 2011 survey noted no bare areas, but a steady transition from grass to shrubs to trees. The soils found near the channel in 2011 were measured at 20 cm on both sides of the creek.

3.7 16+000

This transect is oriented in a northwest-southeast direction. A bare area (cobble, sand) was noted on both banks along with dead shrubs and young grass species. Further from the channel, a dense mixture of shrubs and trees was present. The transect on both sides of the river entered a sphagnum bog. The organic layer of soil varied from <1 cm near the channel to >10 cm in the sphagnum areas. Observations from 2011 noted some bare areas on the left side of the creek, but largely thick grass adjacent to the channel and a mixture of shrubs and trees further from the water. Organic soil depths in 2011 were measured between 0 and 6 cm.

3.8 16+500

This transect runs in a north-northwest to south-southwest orientation. Directly adjacent to the creek channel, a short area of bare cobbles and gravel was observed beneath an eroded bank. The slope on the left side was more gradual, and shows a large area of thick dead shrubs and trees that have been knocked over. Beneath the trees the substrate was largely bare. Once past the dead trees at 81 m, a line of grass and shrubs transitions to predominantly trees. The bank was slightly steeper on the right side and the extent of dead trees was much less. Above the bank, shrubs transition to trees, then to a mixture of shrubs and trees in a sphagnum bog. The depth of organic soil varied from 0 along the creek's edge to >10 in the sphagnum. The 2011 description of the transect noted the entire transect to be comprised of shrubs, and also observed the muskeg along the transect on the right side of the creek.

3.9 17+000

This transect runs in a northwest-southeast orientation. Both sides of the creek show a mix of bare cover, grass and dead shrubs extending 20 to 35 m from the creek centerline. Up the slope on the left side of the river is an area of herbaceous plants and very young poplar trees which transitions into a mixture of trees and shrubs comprised of poplar, willow and alder. A similar mixture of taller shrubs was observed on the right side of the river. The depth of organic soil varied from 0 along the creek's edge to 7 cm in the shrub area. Observations made in 2011 noted a mixture of grass and shrubs along the transect line, but made no mention of bare areas or dead vegetation. Photo 8 compares 2011 and 2013 photos.

3.10 17+500

This transect runs west-northwest to east-southeast. Adjacent to the channel is a mixture of largely bare ground with dead shrubs and grass. The right slope is slightly steeper and leads to small area of short shrubs and herbaceous vegetation and then on to taller shrubs with some young trees and a bog starting at 62 m. The left side had a gentler slope (inside bend of river), a larger area of bare cover and dead vegetation ending up in shrubs at 77 m. The organic layer of soil varied between 1 cm near the river to >10 cm in the bog. 2011 observations mainly grass and shrubs near the river leading into primarily shrubs with some trees. The muskeg area was also observed in 2011. Soil organic layers observed in 2011 were thicker near the channel (5-15 cm) than observed in 2013, while depths further from the creek were similar.

3.11 18+000

This transect runs in a northeast-southwest direction. A large bare area (20 m) of cobble and gravel was observed on the left side of the creek which had a band of dead shrubs beyond it (17 m) which was also bare beneath. Beyond this, as the slope increased, an area of short shrubs (herbaceous and young poplar) transitioned to taller shrubs (alder) and then to trees. On the right side of the river the first 18 m were largely bare soil with grass and some dead shrubs. Up the slope, shrubs transitioned to trees with a largely sphagnum understory. The depth of organic soil varied from 0 cm (cobble, gravel) to >10 cm (sphagnum). Observations made in 2011 noted high concentrations of grass adjacent to the creek as well as deep layers of organic soil (>25 cm) in the same area. Photo 9 compares 2011 and 2013 photos.

3.12 18+500

This transect runs in a northwest-southeast orientation. Bare areas with dead shrubs and grass were observed on both sides of the river, however more extensively on the right side. At 35 m on the left side the understory was largely sphagnum beneath shrubs with a small percentage of trees. On the right side, beyond the dead shrub area, vegetation transitioned to shrubs, then largely trees before ending in a grassy marsh area with standing water. The organic soil depths varied from 0 to 8 cm along this transect. During the 2011 survey, this area was inundated by a beaver dam which flooded areas near the channel. No beaver dam was observed in 2013. The 2011 survey recorded almost exclusively shrubs along this transect with grass on the right side of the river.

3.13 19+000

This transect runs in a northeast-southeast orientation. Both sides of the channel had large areas of bare soil, dead shrubs and young grass for the first 37-57 m. The left side transitions to short shrubs followed by tall shrubs with a high percentage of grass before becoming largely trees. Standing water was present at the end of the transect. The right side has a small area of short shrubs before entering a tree/shrub mixture. At 94 m, the understory became sphagnum-dominated. The organic soil depths varied from 0 to >12 cm. In 2011, the first 12-20 m on either side of the channel was inundated as a result of a beaver dam downstream. Similar compositions of grass/shrubs/trees were noted, as was the sphagnum terrain at the end of the transect on the left side. Organic soil depths measured in 2011 were slightly deeper, particularly close the creek channel. Photo 10 contrasts a shrub area in 2011 with a dead shrub area seen in 2013 at the same transect (we cannot confirm if the photos are from exactly the same locations, but they were both taken at 19+000).

3.14 19+500

This transect followed an east-west alignment. The left side was bare along the creek, followed by a large area of mature dead trees which were largely bare beneath. Many trees were on the ground, as it appeared the mature trees acted as a catch/dam/strainer for dead vegetation moving down the creek from upstream (see Photo 11). Live trees were encountered at 96 m of the left transect. The terrain on the right side of the creek was much flatter. Bare areas were observed near the creek channel, with a combination of dead shrubs and trees for the entire transect distance. Aquatic emergent vegetation was found at several locations on this side. Organic soil depths varied from 0 to 7 cm with several locations being overlain by 1 to 5 cm of inorganic soils (see Photo 12). In 2011, the right side was inundated by beaver activity with a combination of grass and shrub transitioning to largely trees at 21 m, while the left side showed a grass and bare area along the creek, then trees at 21 m which transitioned to shrubs at 91 m. Organic soil depths in 2011 were similar in range (1-12 cm) as those observed in 2013 with >30 cm measured deep along the left transect. No sample was taken from the same area in 2013. There was no mention of inorganic soils overtop of organic soils in 2011.

3.15 20+000

This transect runs in a south-southwest to north-northeast direction. The left side had a large bare area of cobble and gravel which extended to 41 m, followed by an area of dead shrub which was largely bare beneath. The right side had a smaller bare area, followed by dead shrubs underlain by grass, then dead trees underlain by grass. At 73 m the understory became sphagnum. Organic soil depths varied from 0 (near the creek) to >10 (sphagnum). Much of the organic soils on the transect were overlain by inorganic soils between 1 and 5 cm deep. In 2011, the left side was inundated due to beaver activity. The vegetation observed was a mix of grass and shrubs with no mention of any bare of treed areas. Organic soils varied from 4 to >30 cm. The cobble area observed in 2013 was inundated in 2011.

3.16 20+500

This transect was oriented in an east-west orientation. Both sides had bare areas with dead shrubs. On the left side, live trees were encountered at 54 m. On the right side the dead shrubs transitioned to a mixture of dead trees and shrubs. Soils on the entire transect were overlain by inorganic soils of 1 to 13 cm depth. Organic soils beneath varied from >3 to >5 cm. Due to the depth of inorganic soils, the depth of organic soils could only be measured as greater than a certain measurement, therefore, the precise organic soil depth is not known at many locations (deepest measurement to bottom of organic layer was 10 cm). The 2011 survey noted the same transition of grass to shrubs

to trees, but with no mention of dead vegetation or bare areas. Organic soils depths in 2011 were between 5 to >30 cm with no mention of inorganic soils on top.

3.17 21+000

This transect runs in an east-west direction. The left side of the creek was comprised largely of dead shrubs, with bare areas near the creek channel and some dead trees near the end of the transect. The right side had dead shrubs and grass until 19 m, followed by a shrub layer underlain by sphagnum which transitioned to trees at 59 m. Organic soils depths varied from 0 to >10 cm, with some sites containing 4 to 13 cm of inorganic soils. 2011 observations showed high concentrations of grass near the creek channel followed by shrubs on both sides, which transitioned to trees on the right side. Organic soil depths varied from 5 to >30 cm, with no mention of inorganic soils.

3.18 21+500

This transect runs in a southwest-northeast orientation. The left side of the creek was dominated by dead shrubs for the first 32 m, followed by dead trees up to 57 m, followed by live trees. The right side of the creek had dead shrubs, followed by live trees at 25 m which developed a sphagnum understory beyond 36 m. Organic soil depths varied from 3 to >17 cm, with much of the area overlain by inorganic soils of 3 to 7 cm. 2011 observations noted predominantly shrubs and grass along the creek channel with trees beyond that. The first 10 m on the left side was flooded due to beaver activity. Soil depths measured varied from 6 to >30, with most measurements showing farily thick layers of organic soils.

3.19 22+000

This transect runs in a southwest-northeast direction. The first approximately 40 m on both sides of the creek were dominated by dead shrubs, but also had bare areas and grass. Away from the creek, the further half on both sides were dominated by trees with a sphagnum understory beyond approximately 45 m on both sides. Organic soils varied from 0 to >21 cm, much of which was overlain by inorganic soils. In 2011, the transect was described as being dominated by trees and showed organic soil depths from 8 to >30 cm.

3.20 22+500

This transect runs in an east-west direction. The creek is particularly wide in this reach (44 m across). The left side had a large bare area, followed by dead trees at 39 m and then live trees at 73 m. The right side had an area of dead trees immediately adjacent to the creek which ran until 43

m where the trees were alive. Soil depths varied from 0 to >21 cm, with some areas have deposits of inorganic soil above the organic soil. In 2011, a similar tree-dominated transect was observed, but with all trees being alive. Soil depths noted in 2011 varied from 6 to >30 cm.

3.21 23+000

This transect runs in a southwest-northeast direction. Dead shrubs ringed the creek channel on both sides which transitioned to trees at 49 and 33 m on the right and left sides of the creek respectively. On the right side, the trees were dead for the first 15 m, with live trees starting at 48 m. On the left side, trees were alive from 49 m to the end of the transect. Organic soils were 0 to >14 cm in depth, with 5-9 cm of inorganic soils on top of much of the organic soils. 2011 observations showed a similar progression of shrubs to trees with organic soils of 3 to >30 cm.

3.22 23+500

This transect runs in a north-south orientation. All vegetation on the left side of the river was dead with shrubs from the creek bank to 50 m and trees from 50 m to 100 m. On the right side, dead trees were adjacent to the creek bank for the first 21 m, part of which was underlain by herbaceous shrubs. The remainder of the right side transect consisted of live trees with a sphagnum understory. Organic soil depths varied from 0 to >20 cm, some of which was under up to 10 cm of inorganic soil. 2011 observations showed a high concentration of shrubs on the left side of the river as well as grass (where dead shrubs and bare ground was found in 2013). The remainder of the transect was noted be treed. Organic soil depths varied from 6 to >30 cm.

3.23 24+000

This transect runs in an east-west orientation. The left bank was steep and showed signs of erosion. At the top of the bank was a mixture of deciduous shrubs and trees for the duration of the transect. At 61 m, where the transect approached the river bank further down stream, the trees and shrubs were dead. On the right side of the river, the slope was much gentler, and the sediments were largely wet and muddy. Dead trees and shrubs dominated the first 68 m of the transect. The understory of that section was largely bare, but with increasing concentrations of grass as the transect progressed away from the river. Live trees began at 68 m. Due to the amount of inorganic sediment overlying the organic sediments in most locations, we were not able to get to the bottom of the organic layer. Inorganic sediments varied from 8 to 13 cm. In 2011 the transect was dominated by shrubs and trees, with a grass component on the right side of the river. Organic soil depths measured in 2011 varied from 8 to >30 cm.

3.24 24+500

This transect is oriented in an east-west direction. The left side of the river is composed of dense dead shrubs with a bare understory until 34 m where a layer of live shrubs begins. Beyond this, the vegetation becomes largely treed with a sphagnum understory. On the right side, bare areas with dead shrubs and trees span the entire transect. The bottom of the organic soils was not reached using our sampling methodology as they were beneath sizable amounts of inorganic soils (2-15 cm). 2011 observations noted similar compositions of shrubs and trees and organic soil depths of 9 to >30 cm.

3.25 25+000

This transect is oriented in a northwest-southeast direction. The left side of the creek had a steeper bank and the presence of slump suggested recent erosion (see Photo 13). At the top of the slope were shrubs which were followed by deciduous trees and then coniferous trees. The right side was less steep and had dead shrubs and a bare understory until 36 m. Much of the area consisted of cobbles, gravel and sand. Beyond this was a mixture of live trees and shrubs. The organic soil depths varied from 0 (cobble, gravel, sand) to >13 cm with some areas having 1-4 cm of inorganic soils on top. In 2011, a similar shrub and tree mixture was described. Organic soils depths were between 7 and >30 cm. There was no mention of bare ground or dead vegetation during the 2011 survey.

3.26 25+500

This transect was oriented in an east-west direction. The left side of the creek had a very gentle slope and consisted of dead shrubs and a largely bare understory for the entire left-side transect. The right side of the creek had a thin layer of dead shrubs, followed by a progression of live shrubs to live trees with a sphagnum understory starting at 54 m. Organic soil depths varied from 7 to >13 cm. In 2011, organic soil depth measurements were lower (3-8 cm) with the exception of near the end of the transects were depths were >30 m. In 2011, extensive grass and shrub concentrations align with what was observed to be dead shrub and bare understory in 2013.

3.27 26+000

This transect runs in a east-northeast to west-southwest direction. The left transect approximately paralleled the river and there was very little topography. The cover was entirely comprised of dead shrubs and bare understory, with a small percentage of grass. The transect on the right side of the river had a similar area of dead shrub and bare understory adjacent to the river until the transect went up the slope and a dense shrub coverage was encountered. Due to the winding nature of the

creek at this point, this transect approaches the creek near its end. In this area, dead shrubs and trees and a bare understory were encountered. Organic soils were 2 to >9 cm in depth. All sites had some inorganic soils above the organic soils, which was deeper on the lower left side. In 2011, it was noted that the level terrain in the area appeared to be a flood plain for the creek. Similar grass/shrub compositions were observed with organic soils of 4 to 17 cm in depth.

3.28 26+500

This transect runs in a south-southeast to north-northwest direction. The left side was fairly low and flat and was comprised entirely of dead shrubs and trees with a small amount of grass, but largely with a bare understory. The right side was also largely bare adjacent to the river, but with a higher coverage of grass. Dead shrubs were found until 59 m where the transect entered 100% trees. Organic soils were 3 to >10 cm in depth, with most areas buried beneath 2-5 cm of inorganic soil. Similar shrub/grass and tree compositions were observed in 2011, but without the bare areas or dead vegetation. Organic soil depths were measured from 2 to 20 cm in 2011.

3.29 27+000

This transect runs in an east-west direction. The left side of the river was composed of mainly dead shrubs with a smaller portion of grass and a largely bare understory. At 77 m the transect entered live trees. On the right side, a similar composition of dead shrubs, grass and bare understory was encountered. At 42 m, the transect transitioned to shrubs and at 58 m, there was a mixture of shrubs and trees. The organic soil depths varied from 1 to >11 cm, with 2-3 cm of inorganic soil overlaying several of the soil sample locations. The 2011 survey recorded similar compositions of shrubs and trees, but with grass where the 2013 survey noted bare ground. Organic soil depths of 5 to >30 cm were observed in 2011.

3.30 27+500

This transect runs in an east-west direction. The left side of the river had an area of dead shrubs with some grass but largely bare until the slope increased at 34 m. Beyond this is a mixture of thick shrubs and trees until 59 m where 100% trees were encountered along with a sphagnum understory. The right side had a larger flat area which was largely bare (cobble, sand) until 25 m. Beyond this, an area of dead shrubs with grass and bare understory transitions to largely trees at 51 m, and then back to shrubs at 92 m. Organic soils depths varied from 0 to >8 cm, with 1-5 cm of inorganic soils overlaying organic soils. In 2011, similar compositions were observed, but with high concentrations of grass adjacent to the creek. Organic soils measured in 2011 were between 5 and 25 cm.

3.31 28+000

This transect runs in an east-southeast to north-northwest direction. There is a fairly steep rise in topography on the left side of the creek where a small bare/grass patch transitions to shrubs and then to trees. On the right side of the creek, a large flat and largely bare area leads to a band of shrubs, followed by trees. Organic soils varied from 0 to >16 cm. In 2011 the vegetation description was similar to what was observed in 2013, with the exception of a large grassy area noted where it was observed to be largely bare in 2013 (on the right side). Organic soils in 2011 varied from 6 to 23 cm deep.

TABLE 1 – RESULTS OF VEGETATION COVER SURVEY

Station	Sub-Section	Bank *1	Transect Orientation	Cover Type	Start (m)	End (m)	Organic Layer (cm)
13+000	A	Left	Northeast	River	0	6	-
				Bare 50%; Grass 50%	6	47	16
				Shrub (dead) 80%; Grass 50%	47	100	16
	B	Right	Southwest	River	0	6	-
				Bare 50%; Grass 50%; Shrub (dead) 40%	6	65	14
				Grass 90%; Shrub 10%	65	82	>16
				Shrub (dead) 90%; Grass 10%	82	100	13
13+500	A	Left	Northwest	River	0	7	-
				Grass 90%; Bare 10%	7	13	4
				Grass 70%; Shrub 30%	13	27	5
				Shrub 100%	27	59	4
				Grass 100%	59	66	5
				Shrub 80%; Grass 20%	66	100	2
	B	Right	Southeast	River	0	7	-
				Bare 70%; Grass 30%	7	18	9
				Bare 40%; Grass 40%; Shrub 20%	18	22	5
				Grass 80% (~½ flooded≈marsh); Treed 20%	22	48	6
				Grass 70% (~¾ flooded≈marsh); Shrub 20%	48	100	5
14+000	A	Left	Northwest	River	0	13	-
				Bare 90%; Grass 10%	13	18	4
				Shrub 60%; Grass 40%	18	22	2
				Grass 80% (~¼ flooded≈marsh); Shrub 20%	22	41	4 (wet)
				Trees 50%; Grass (marsh) 50%	41	48	3 (wet)
				Grass 80%; Shrub 20% (all marsh)	48	68	not sampled - too much water
				Shrub 90%; Grass 10% (all marsh)	68	100	not sampled - too much water
	B	Right	Southeast	River	0	13	-
				Bare 80%; Grass 20%	13	24	2
				Grass 90%; Shrub 10%	24	31	2
				Trees 40%; Shrub 40%; Grass 20%	31	41	5
				Trees 100%	41	97	4
				Shrub 80%; Trees 20%	97	100	3

TABLE 1 – RESULTS OF VEGETATION COVER SURVEY

Station	Sub-Section	Bank *1	Transect Orientation	Cover Type	Start (m)	End (m)	Organic Layer (cm)
14+500	A	Left	Northwest	River	0	9	-
				Bare 70%; Grass 30%	9	16	3
				Bare 60%; Shrub (dead) 40% (bare understory)	16	17	4
				Shrub 50%; Grass 40%; Tree 10%	17	30	2
				Tree 80%; Shrub 20%	30	100	4
	B	Right	Southeast	River	0	9	-
				Bare 100%	9	19	4
				Shrub (dead) 80%; Bare 20%	19	25	<1
				Shrub 80%; Grass 20%	25	34	5
				Trees 80%; Shrub 20%	44	100	5
15+000	A	Left	Northwest	River	0	7	-
				Bare (cobble, gravel) 100%	7	23	0
				Shrub (dead) 100% (bare understory)	23	42	4
				Shrub 100%	42	59	4
				Tree 80%; Shrub 20%	59	100	7
	B	Right	Southeast	River	0	7	-
				Bare 100%	7	9	0
				Trees 100%	9	37	5
				Trees 50%; Shrub 50%	37	52	8
				Shrub 60%; Trees 40% (sphagnum understory)	52	100	9 (sphagnum)
15+500	A	Left	Northwest	River	0	5	-
				Bare 80%; Grass 20%	5	10	<1
				Shrub (dead) 70%; Bare 30% (bare understory)	10	14	3
				Bare 60%; Shrub 40%	14	16	<1
				Trees 100% (transitions from pine to aspen at 59 m)	16	100	4
	B	Right	Southeast	River	0	5	-
				Shrub (dead) 50%; Bare 40%; Grass 30%	5	22	5
				Shrub 100%	22	25	5
				Trees 100%	25	48	3
				Shrub 100%	48	100	6

TABLE 1 – RESULTS OF VEGETATION COVER SURVEY

Station	Sub-Section	Bank *1	Transect Orientation	Cover Type	Start (m)	End (m)	Organic Layer (cm)
16+000	A	Left	Northwest	River	0	9	-
				Bare (cobbles) 100%	9	10	<1
				Grass 80%; Bare 10%; Shrub (dead) 10%	10	19	7
				Shrub 100%	19	23	3
				Trees 100%	23	37	7
				Shrub 100%	37	55	7
				Shrub 70% (sphagnum understory)	55	86	>10 (sphagnum)
				Trees 100%	86	100	7
	B	Right	Southeast	River	0	9	-
				Bare 50%; Shrub (dead) 40%; Grass 10% (bare understory)	9	37	<1
				Shrub 100%	37	82	9
				Trees 80% (100% sphagnum bog)	82	100	>10 (sphagnum)
16+500	A	Left	North-Northwest	River	0	9	-
				Bare 100%	9	11	0
				Grass 60%; Shrub (dead) 30%; Bare 30%	11	31	6
				Trees (dead) 100% (bare understory)	31	81	1
				Shrub 50%; Grass 50%	81	90	5
				Trees 80%; Shrub 20%	90	100	4
	B	Right	South-Southeast	River	0	9	-
				Bare 100%	9	12	0
				Shrub (dead) 100% (bare understory)	12	15	8
				Shrub 100%	15	19	8
				Trees 100%	19	33	6
				Shrub 80%; Trees 20%	33	47	8
				Trees 50% (100% sphagnum bog)	47	100	>10
17+000	A	Left	Northwest	River	0	13	-
				Grass 50%; Bare 50%	13	22	1
				Shrub (herbaceous and young trees) 100%	22	39	4
				Shrub (tall) 90%; Trees 10%	39	100	7
	B	Right	Southeast	River	0	13	-

TABLE 1 – RESULTS OF VEGETATION COVER SURVEY

Station	Sub-Section	Bank *1	Transect Orientation	Cover Type	Start (m)	End (m)	Organic Layer (cm)
				Bare 90%; Shrub (dead) 10%	13	24	0
				Shrub (dead) 90%; Bare 10%	24	35	3
				Shrub 100%	35	100	5
17+500	A	Left	West-Northwest	River	0	9	-
				Tree/Shrub (dead) 80%; Grass 10% (bare understory)	9	77	1
				Shrub 100%	77	100	5
	B	Right	East-Southeast	River	0	9	-
				Bare 90%; Grass 10%	9	19	1
				Shrub (herbaceous, short) 100%	19	22	4
				Shrub (tall) 100%	22	62	8
				Shrub (short, young trees) 100% (sphagnum understory)	62	100	>10
18+000	A	Left	Northeast	River	0	7	-
				Bare 100%	7	27	0
				Shrub (dead) 60%; Grass 10%; Bare 30%	27	44	3
				Shrub (short) 100%	44	47	3
				Shrub (tall) 100%	47	68	5
				Trees 100%	68	100	7
	B	Right	Southwest	River	0	7	-
				Bare 50%; Grass 50%; Shrub (dead) 10%	7	25	4
				Shrub (short) 100%	25	28	7
				Shrub (tall) 90%; Trees 10% (sphagnum understory)	28	93	5
				Trees 100% (sphagnum understory)	93	100	>10
18+500	A	Left	Northwest	River	0	13	-
				Bare 70%; Shrub (dead) 40%; Grass 30%	13	24	5
				Shrub (short) 80%; Grass 20%	24	25	5
				Shrub (½ short, ½ tall) 90%; Grass 10%	25	35	7
				Shrub 70%; Trees 30% (sphagnum understory)	35	95	8
				Shrub 80% (100% sphagnum understory)	95	100	
	B	Right	Southeast	River	0	13	-
				Bare 100%	13	15	0
				Grass 50%; Shrub (dead) 50%; Bare 10%	15	74	2

TABLE 1 – RESULTS OF VEGETATION COVER SURVEY

Station	Sub-Section	Bank *1	Transect Orientation	Cover Type	Start (m)	End (m)	Organic Layer (cm)
				Shrub 100%	74	75	5
				Trees 70% Shrub 30%	75	89	7
				Grass (marsh) 100%	89	100	not sampled - too much water
19+000	A	Left	Southwest	River	0	6	-
				Bare 100%	6	8	0
				Shrub (dead) 70%; Bare 40%; Grass 40%	8	37	10
				Shrub (short) 70%; Grass 30%	37	47	11
				Shrub (short) 70%; Trees 50%	47	60	-
				Grass 100%; Shrub (tall) 70%	60	70	>12
				Trees 70%; Shrub (tall) 20%; Grass 10%	70	100	not sampled - too much water
	B	Right	Northeast	River	0	6	-
				Shrub (dead) 70%; Grass 50%; Bare 10%	6	57	2
				Shrub (short) 60%; Grass 40%	57	65	8
				Trees 60%; Shrub (tall) 40%	65	84	7
				Shrub (tall) 100%	84	94	7
				Shrub (tall) 100% (sphagnum understory)	94	100	>10 (sphagnum)
19+500	A	Left	East	River	0	11	-
				Bare 80%; Grass 20%	11	16	7 (under 3 cm inorg.)
				Trees (dead) 90%; Grass 10% (bare understory)	16	96	3 (under 1 cm inorg.)
				Trees 100%	96	100	-
	B	Right	West	River	0	11	-
				Bare 100%	11	13	0
				Shrub (dead) 40%; Bare 40%; Grass 20%	13	31	6
				Trees (dead) 100%; Grass 40%; Bare 10%	31	100	>5 (under 5 cm inorg.)
20+000	A	Left	South-Southwest	River	0	8	-
				Bare (cobble, gravel) 100%	8	41	0
				Shrub (dead) 70%; Bare 20%; Grass 10% (bare understory)	41	100	8 (under 1 cm inorg.)
	B	Right	North-Northeast	River	0	8	-
				Bare 100%	8	11	0
				Grass 70%; Shrub (dead) 50%; Bare 30%	11	32	9 (under 3 cm inorg.)

TABLE 1 – RESULTS OF VEGETATION COVER SURVEY

Station	Sub-Section	Bank *1	Transect Orientation	Cover Type	Start (m)	End (m)	Organic Layer (cm)
				Trees (dead) 100%; Grass 50%	32	73	>5 (under 5 cm inorg.)
				Trees (dead) 100% (sphagnum understory)	73	100	>10
20+500	A	Left	West	River	0	7	-
				Shrub (dead) 40%; Bare 30%; Grass 30%	7	35	10 (under 2 cm inorg.)
				Shrub (dead) 100%; Grass 70%	35	54	>5 (under 13 cm inorg.)
				Trees 100%	54	100	>3 (under 8 cm inorg.)
	B	Right	East	River	0	7	-
				Bare 80%; Shrubs (dead) 10%; Grass 10%	7	24	>5 (under 5 cm inorg.)
				Shrub (dead) 90%; Bare 10%	24	62	6 (under 1 cm inorg.)
				Tree (dead) 50%; Shrub (dead) 50%	62	100	>4 (under 6 cm inorg.)
21+000	A	Left	West	River	0	11	-
				Bare 100%	11	16	0
				Shrub (dead) 70%; Bare 30%; Grass 10% (bare understory)	16	77	4 (under 6 cm inorg.)
				Shrub (dead) 70%; Tree (dead) 30%; Grass 10% (bare understory)	77	100	>2 (under 13 cm inorg.)
	B	Right	East	River	0	11	-
				Grass 70%; Shrub (dead) 60%; Bare 30%	11	31	>6 (under 4 cm inorg.)
				Shrub 70%; Grass 30% (sphagnum understory)	31	59	>10
				Trees 100% (sphagnum understory)	59	100	>10
21+500	A	Left	Southwest	River	0	11	-
				Shrub (dead) 70%; Shrub 30% (bare understory)	11	19	3 (under 3 cm inorg.)
				Shrub (dead) 100% (bare understory)	19	32	>4 (under 3 cm inorg.)
				Trees (dead) 100% (bare understory)	32	57	7
				Trees 100%	57	100	>17
	B	Right	Northeast	River	0	11	-
				Shrub (dead) 70%; Bare 30%; Grass 10%	11	25	>3 (under 7 cm inorg.)
				Trees 100%	25	36	>3 (under 7 cm inorg.)
				Trees 100% (sphagnum understory)	36	100	>10

TABLE 1 – RESULTS OF VEGETATION COVER SURVEY

Station	Sub-Section	Bank *1	Transect Orientation	Cover Type	Start (m)	End (m)	Organic Layer (cm)
22+000	A	Left	Southwest	River	0	9	-
				Shrub (dead) 60%; Bare 40% (bare understory)	9	13	0 (I>13)
				Shrub (dead) 100% (bare understory)	13	27	>5 (under 5 cm inorg.)
				Trees 100%	27	45	>5 (under 6 cm inorg.)
				Trees 100% (sphagnum understory)	45	100	>21 cm
	B	Right	Northeast	River	0	9	-
				Shrub (dead) 70%; Grass 50%	9	21	>1 (under 11 cm of inorg.)
				Trees (dead) 100% (bare understory)	21	42	13 (under 7 cm of inorg.)
				Trees 80%; Shrub 20% (sphagnum understory)	42	100	>10
22+500	A	Left	West	River	0	22	-
				Bare 100%	22	39	0
				Trees (dead) 100% (bare understory)	39	66	0
				Trees (dead) 90%; Grass 10% (bare understory)	66	73	>6 (under 9 cm inorg.)
				Trees 100%	73	98	-
				Trees 90%; Shrubs 20%	98	100	>12
	B	Right	East	River	0	22	-
				Trees (dead) 100% (bare understory)	22	43	>5 (under 5 cm inorg.)
				Trees 100%; Grass 30%	43	100	>21
23+000	A	Left	Southwest	River	0	19	-
				Shrub (dead) 100% (bare understory)	19	49	6 (under 5 cm inorg.)
				Trees 100%	49	74	>4 (under 9 cm inorg.)
				Trees 100%; Grass 30%	74	100	>23
	B	Right	Northeast	River	0	19	-
				Shrub (dead) 50%; Bare 40%; Grass 10%	19	33	0 (I>16)
				Trees (dead) 100%	33	48	>4 (under 8 cm inorg.)
				Trees 100%; Grass 30%	48	100	>14
23+500	A	Left	South	River	0	5	-
				Shrub (dead) 80%; Bare 20% (bare understory)	5	50	>4 (under 10 cm inorg.)
				Trees (dead) 100% (bare understory)	50	100	0 (I>20)
	B	Right	North	River	0	5	-
				Trees (dead) 100% (bare understory)	5	9	>4 (under 6 cm inorg.)

TABLE 1 – RESULTS OF VEGETATION COVER SURVEY

Station	Sub-Section	Bank *1	Transect Orientation	Cover Type	Start (m)	End (m)	Organic Layer (cm)
				Trees (dead) 100% (herbacious understory)	9	21	10
				Trees 100% (sphagnum understory)	21	100	>20
24+000	A	Left	West	River	0	11	-
				Shrub 100%	11	20	>4 (under 8 cm inorg.)
				Trees 100%; Shrubs (short) 50%	20	61	>13
				Trees (dead) 50%; Shrub (dead) 50% (bare understory)	61	100	>15
	B	Right	East	River	0	11	-
				Trees (dead) 80%; Shrub (dead) 20% (bare understory)	11	42	0 (I>13)
				Trees (dead) 80%; Shrub (dead) 20%; Grass 50%	42	68	>6 (under 12 cm inorg.)
				Trees 100%	68	100	>1 (under 13 cm inorg.)
24+500	A	Left	West	River	0	13	-
				Shrub (dead) 90%; Grass 10% (bare understory)	13	21	>1 (under 14 cm inorg.)
				Shrub (dead) 80%; Trees (dead) 20% (bare understory)	21	34	>1 (under 15 cm inorg.)
				Shrub 100%	34	43	>8 (under 2 cm inorg.)
				Trees 100% (sphagnum understory)	43	62	>15
				Trees 50%; Shrubs 50% (sphagnum understory)	62	100	>15
	B	Right	East	River	0	13	-
				Trees (dead) 40%; Shrub (dead) 40%; Bare 20% (bare understory)	13	28	0 (I>19)
				Shrub (dead) 100%; Grass 50%	28	64	>3 (under 6 cm inorg.)
				Trees (dead) 60%; Shrub (dead) 40% (bare understory)	64	100	>6 (under 6 cm inorg.)
25+000	A	Left	Northwest	River	0	12	-
				Shrubs 100%	12	27	7 (under 4 cm inorg.)
				Trees (deciduous) 100%; Shrubs 80%	27	53	9
				Trees (coniferous) 100%; Shrubs 80%	53	100	>10
	B	Right	Southeast	River	0	12	-
				Shrubs (dead) 60%; Bare 40% (bare understory)	12	35	0
				Shrubs (dead) 100% (bare understory)	35	36	10 (under 3 cm inorg.)
				Trees 100%	36	86	>13 (under 1 cm inorg.)
				Trees 50%; Shrubs 50%	86	100	-

TABLE 1 – RESULTS OF VEGETATION COVER SURVEY

Station	Sub-Section	Bank *1	Transect Orientation	Cover Type	Start (m)	End (m)	Organic Layer (cm)
25+500	A	Left	West	River	0	11	-
				Shrub (dead) 100%; Grass 10% (bare understory)	11	91	7 (under 4 cm inorg.)
				Shrub (dead) 90%; Tree (dead) 10% (bare understory)	91	100	-
	B	Right	East	River	0	11	-
				Shrub (dead) 100% (bare understory)	11	15	9 (under 1 cm inorg.)
				Shrub (short) 100%	15	18	>6
				Shrub (tall) 100%	18	54	>10
				Shrub 80%; Trees 20% (sphagnum understory)	54	85	>13
				Trees 100%	85	100	>13
26+000	A	Left	East-Northeast	River	0	8	-
				Shrub (dead) 60%; Grass 20% (bare understory)	8	77	2 (under 1 cm inorg.)
				Shrub (dead) 100% (bare understory)	77	100	-
	B	Right	West-Southwest	River	0	8	-
				Shrub (dead) 50%; Bare 50% (bare understory)	8	25	>9 (under 5 cm inorg.)
				Shrub 100%	25	66	>6 (under 13 cm inorg.)
				Shrub (dead) 80%; Trees (dead) 20% (bare understory)	66	100	>6 (under 4 cm inorg.)
26+500	A	Left	South-Southeast	River	0	9	-
				Shrub (dead) 70%; Grass 10% (bare understory)	9	80	7 (under 2 cm inorg.)
				Shrub (dead) 60%; Trees (dead) 40% (bare understory)	80	100	>8 (under 5 cm inorg.)
	B	Right	North-Northwest	River	0	9	-
				Bare 60%; Grass 40%; Shrub (dead) 30%	9	32	6 (under 3 cm inorg.)
				Shrub (dead) 100%; Grass 20% (bare understory)	32	59	3
				Trees 100%; Shrub (short) 100%	59	100	>10
27+000	A	Left	West	River	0	13	-
				Shrub (dead) 80%; Grass 40% (bare understory)	13	77	1 (under 2 cm inorg.)
				Trees 100%	77	100	>11
	B	Right	East	River	0	13	-
				Shrub (dead) 70%; Grass 20% (bare understory)	13	42	5 (under 3 cm inorg.)
				Shrub 90%; Grass 10%	42	58	>11
				Trees 60%; Shrub (tall) 40%	58	100	-

TABLE 1 – RESULTS OF VEGETATION COVER SURVEY

Station	Sub-Section	Bank *1	Transect Orientation	Cover Type	Start (m)	End (m)	Organic Layer (cm)
27+500	A	Left	West	River	0	7	-
				Shrub (dead) 60%; Grass 10% (bare understory)	7	34	5 (under 1 cm inorg.)
				Trees 50%; Shrubs 50%	34	59	4 (under 1 cm inorg.)
				Trees 100%; Shrubs 80% (sphagnum understory)	59	100	-
	B	Right	East	River	0	7	-
				Bare 90%; Grass 10%	7	25	0
				Shrubs (dead) 60%; Grass 50% (bare understory)	25	51	>8 (under 5 cm inorg.)
				Trees 80% Shrubs 30%	51	92	>7 (under 3 cm inorg.)
				Shrubs 100%	92	100	-
28+000	A	Left	East-Southeast	River	0	5	-
				Grass 50%; Bare 50%	5	10	11
				Shrubs 100%	10	23	6
				Trees 50%; Shrubs 50%	23	45	>8
				Trees 100%	45	100	>16
	B	Right	West-Northwest	River	0	5	-
				Bare 70%; Grass 30%	5	45	0
				Grass 50%; Bare 50%	45	68	12 (under 1 cm inorg.)
				Shrub 90%; Trees 10%	68	75	>10
				Trees 80%; Shrub 40%	75	100	>10

*[1] Note: Bank left or bank right is based on facing downstream.

Photo 1. “Bare” substrate observed at 18+000.

Photo 2. “Grass” vegetation observed at 13+500.

Photo 3. “Shrub” vegetation observed at 26+000.

Photo 4. “Treed” vegetation observed at 25+000.

Photo 5. Buffalo Creek at transect 13+000 (left photo: 2011; right photo: 2013)

Photo 6. Looking downstream from 14+500 (left photo: 2011; right photo: 2013)

Photo 7. Steep bank along Buffalo Creek at 15+000.

Photo 8. Looking downstream from 17+000 (left photo: 2011; right photo: 2013)

Photo 9. Looking downstream from 18+000 (left photo: 2011; right photo: 2013)

Photo 10. Shrub area adjacent to creek channel at 19+000 (left: 2011; right: 2013)

Photo 11. Left side of river at 19+500 showing large amount of dead trees.

Photo 12. Soil sampling hole at 19+500 showing organic soils (black) overlain by inorganic soils (grey).

Photo 13. Slump on left side of creek at 25+000 (looking upstream).

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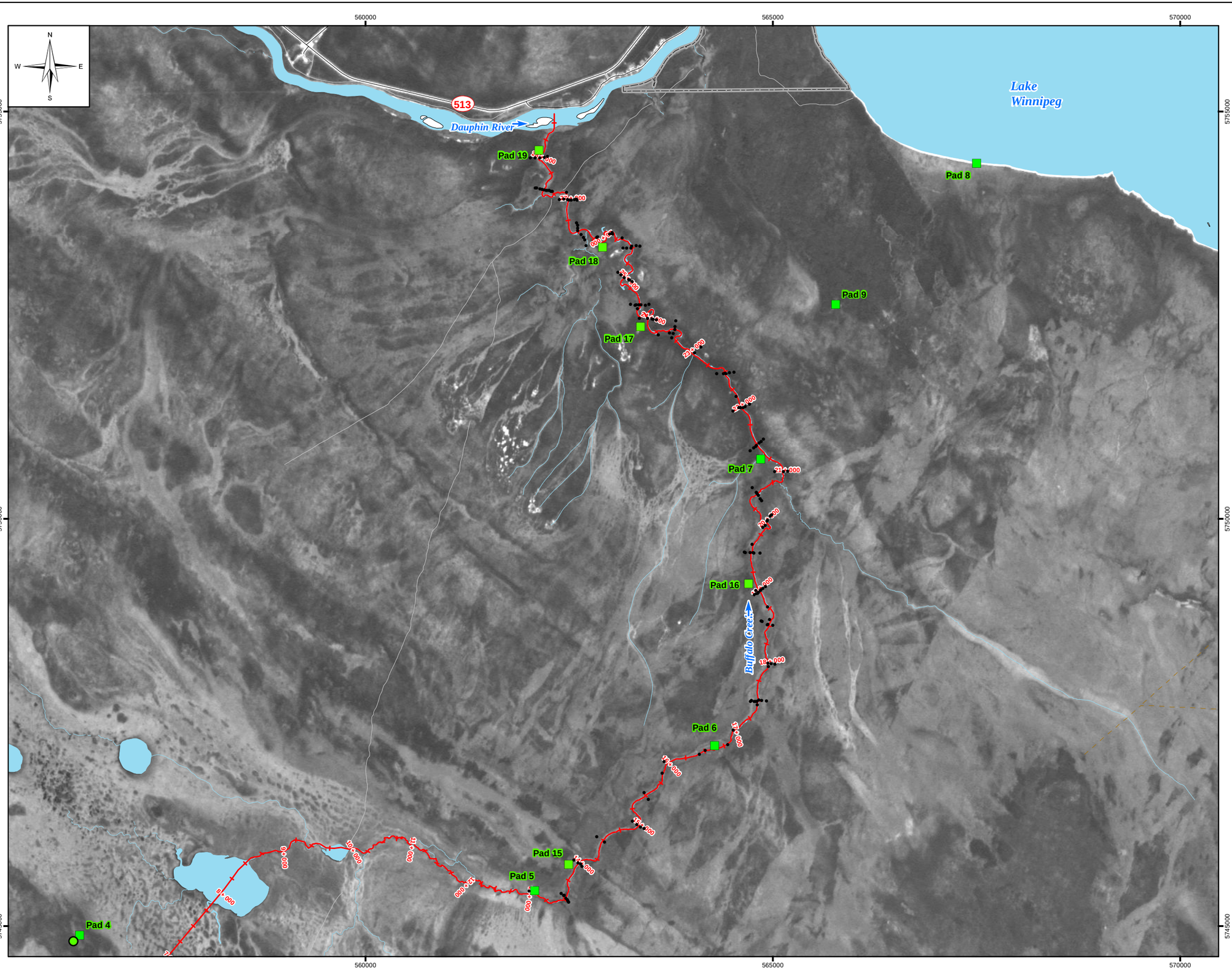
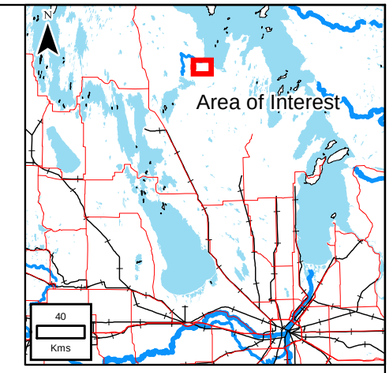




LEGEND:

- Vegetation Survey Transect Location
- Helicopter Landing Pad
- Lake St. Martin Channel Option L
- Road Paved 2 or more lanes
- Paved Street or Road
- Gravel Road
- Unclassified Road
- Accessway or Backlane
- Trail
- Railway
- Ditch
- River/Stream, Indefinite
- River/Stream
- Dugout; Pond;
- Lake
- Aboriginal Lands

DRAFT

0.5 0 0.5 1 1.5
Kilometres

SCALE: 1:45,000 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	BY
0	13/08/30	ISSUED WITH DRAFT REPORT	STO

REVISIONS / ISSUE

KGS GROUP CONSULTING ENGINEERS

Manitoba INFRASTRUCTURE AND TRANSPORTATION

LAKE ST. MARTIN EMERGENCY RELIEF CHANNEL

TRANSECT LOCATIONS OF VEGETATION COVER SURVEY

AUGUST 2013 | FIGURE 01 | REV: 0

FileName: P:\Projects\2013\13-0431-001\Dwg\GIS\MXDs\Rev0\DraftReport_20130830\13-0431-001_F02_Rev0.mxd
11"x17" PLOT SCALE 1:1

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 16 (161 Additional Work)**

REPORT DATE: March 9, 2015

BY: Dan Leitch

POSITION TITLE: Environmental Scientist

Buffalo Creek Vegetation Cover Survey Results
June 17-19, 2014

1.0 Introduction

During a Steering committee meeting held on April 16, 2014, MIT expressed interest in conducting a follow-up vegetation cover survey along the banks of Buffalo Creek. This task was categorized as additional work under Task 16 (ESH-4) Buffalo Creek Watershed – Post-Project Evaluation. The intent of the 2014 survey was to discern the extent of natural regrowth of vegetation that had occurred after one full growing season following the 2011/2012 operation of the LSMEOC system. A survey had been conducted in July 2013; however, the LSMEOC System was closed in November 2012 during freeze-up and, with the late spring in 2014, ice was still melting off the lakes and creeks at the beginning of May. As such, during the 2013 survey, the water was still in the process of receding and there was not sufficient time for any natural regrowth of vegetation. Conversely, large stands of trees, that appeared to have survived inundation in 2011/2012, may have yet to show signs of distress. This led to additional concern of whether large woody debris that remains in Buffalo Creek could likely be washed into Sturgeon bay if the LSMEOC System was ever to be operated in the future. Prior to conducting the survey, figures produced for MIT using the 2011 and 2013 GAIM data to show the extent of trees that

were likely killed and could likely fall into the creek potentially be washed downstream should the LSMEOC be operated again in the future.

In June 2015, it was determined that the LSMEOC would be operated again in late June/early July 2015. As such the proposed vegetation survey was pushed forward and was conducted between June 17 and June 19, 2014, in order to be complete prior to the 2014/2015 operation of the LSMEOC system. Using a helicopter for daily access/egress, and a canoe to navigate downstream, KGS Group completed vegetation surveys along 31 transects between Station 13+000 m and 28+000 m along Buffalo Creek.

The purpose of the vegetation survey along the Buffalo Creek was to assist in monitoring and assessing the impacts and recovery from operation of the emergency channel, specifically the changes to the riparian vegetation community and erosion along the river. The vegetation survey program involved walking perpendicular 100 m transects on both sides of the creek, and documenting the cover types along the transects. Vegetation cover types were used to estimate the amount of protection from erosion afforded to the soil via plant cover. Representative sample photos were taken. The soil composition was also recorded, particularly within the previously flooded area from past operation of the LSMEOC.

In addition to the vegetation cover survey, observations of areas with deadfall and larger amount of erosion were documented with photographs and waypoints. In the event of future operation, it is possible that deadfall near the creek could be carried away with higher water levels and moved downstream resulting in various issues including log jams and interference with fishing nets in the lower Dauphin River and Sturgeon Bay (Lake Winnipeg). Observations of areas of erosion will help identify when the erosion occurred (e.g. during 2011-2012 operation or during 2014-2015 operation).

2.0 Methodology

Sampling locations were set every 500 m along the length of the Buffalo Creek beginning at Station 13+000 m and continuing to just upstream of the confluence with the Dauphin River at Station 28+000 (Figure 1). The vegetation survey transects were run perpendicular to the creek when possible, starting from centreline and continuing for a distance of 100 m on each bank. Transect orientation was modified

for those locations where the meander of the creek resulted in overlap of a transect from another location.

The bank on both sides of the creek was recorded to determine the centreline. Transect orientation (cardinal direction), start and end point, general description of cover types, start and end distance of each cover type within the transect, and soil composition and depth were also recorded. Cover types were placed in four broad categories:

- Bare: exposed mineral soil with no vegetation or soil organic layer;
- Grass: vegetation cover consists of grass, sedge, or rush families;
- Shrub: vegetation cover consists of woody species that do not form distinct trunks or canopies of leaves, especially those which do not normally exceed 10m in height; At times, a distinction was made between short herbaceous shrubs and taller woodier shrubs.
- Treed: vegetation cover consists of woody species which form distinct trunks and leaf canopies, and which normally can or do exceed 10m in height.

Photos 1 to 4 show the four representative cover types. A photo log was compiled with several photos taken along each transect. Some of these photos are provided in the results section below.

Photo 1. “Bare” substrate observed at 18+000.

Photo 2. “Grass” vegetation observed at 13+500.

Photo 3. “Shrub” vegetation observed at 26+000.

Photo 4. “Treed” vegetation observed at 25+000.

Composites or matrices of these four types were possible, and their corresponding ground cover was provided e.g. 50% area covered by grass 50% area covered by shrubs. Due to plant morphology and habit, total percentages greater than 100% were possible.

Soil composition including organic soil depths were measured from representative areas within each change in cover along a transect, where feasible (i.e. if substrate changes from grass to trees, a soil measurement was taken in each section). Soil was removed using a garden trowel and measured using a tape measure. When the organic soil depth was greater than could be measured within reason using the

garden trowel, soil depth was recorded as 'greater than' the depth that was excavated (i.e. > x cm).

The survey was conducted over a 3 day period coinciding with other project activities (fisheries work, hydraulics work, brush cutters, and a GAIM flight). Personnel were: Day 1: Dan Leitch and Steve Offman; Day 2: Dan Leitch and John Burns; Day 3: Dan Leitch and Garrett Wellwood.

3.0 Results

The following subsections detail the results found for each transect, including orientation, description of terrain, cover types, and organic layer depths in soil. Unique features related to the investigation are also mentioned where appropriate. Where possible, observations were compared against conditions described during the 2013 and 2014 surveys. Due to the accuracy of the GPS and movement of creek banks due to varying water levels, detailed comparisons are not feasible. Photos contrasting several locations in 2013 and 2014 are included. Full records for each transect are found in Table 1 with the transect data broken into subsection A (left bank, when facing downstream) and subsection B (right bank, when facing downstream).

Soils along the length of Buffalo Creek were variable and showed signs of recent erosion along the riverbed. Soils further from the creek are outside of the flooded area and are generally dominated by sphagnum peat moss. Soil composition and depths are highly spatially variable so comparisons are difficult. At the upstream end of the creek (Stations 13+000 to 16+500), organic soils were predominant on the surface near the creek, with depths ranging from 1 to 20 cm. Beneath the organic soils was a mixture of inorganic soils including silt, clay, sand, gravel, and cobble. Beginning around Station 17+000, inorganic soils were more frequently seen above organic soils. These inorganic soils appeared to be recently deposited, and consisted predominantly of silt, but also sand, gravel, and cobble. At some locations, a thin layer of organic soil deposition was observed above the deposited inorganic soils, which was above the original organic soil. In 2013, many soils were also overlain with inorganic deposition, with observations of this beginning around 19+500 and continuing along much of the creek until Dauphin River. There was no note of inorganic soils observed in 2011.

Change at each transect from pre-operation (2011 survey) to post-operation (2013 survey) is described in the field inspection form for the 2013 survey (Appendix A). The focus of this field inspection form is primarily to document potential improvements after a full growing season following the 2011/2012 operation of the LSMEOC. The photos and descriptions provided herein are supplemented by imagery captured during GAIM flights that tended to correspond with the surveys, particularly in 2013 and 2014 (Appendix B). The 2013 survey was done in early July following a late spring, while the 2011 survey was conducted in late September. It is possible that some of the bare areas noted in 2013 were more related, in part, to the season. The 2014 survey was conducted in late June of 2014. While this is reasonably early in the growing season, it is one more year removed from operation of the LSMEOC and, therefore, vegetation had a full growing year since the previous survey. As noted earlier, due to the planned 2014/2015 operation of the LSMEOC, the survey had to be conducted earlier than initially planned. The survey in essence provided a baseline condition for the 2014/2015 operation of the LSMEOC.

An additional task included as part of the substrate cover survey of Buffalo Creek was the determination of the extent of potentially dead stands of trees and woody debris that could end up in the creek over time and/or if the LSMEOC channel was to be operated. Imagery captured during GAIM flights in 2011 and 2013 were used to create a figure highlighting the "Vegetation Impact Zone". Figure 2 (Sheets 1 to 8) shows areas adjacent to Buffalo Creek where vegetation died as a result of 2012-2013 operation of the LSMEOC. It shows narrower vegetation impact zones from 13+000 to 19+000, and generally broader impact zones from 19+000 downstream to the confluence with the Dauphin River.

In general, the large areas of dead trees observed in 2014 remained similar to what was observed in 2013. In some locations, dead trees have fallen over, possibly due to high wind events and the declining strength of the trunks and root structure. While many of the shrubs were still dead, regeneration from the roots had resulted in the resurgence of shrubs in numerous locations, particularly willows. The branches from the dead shrubs were still present above the surface, but are more frequently found along the ground with new green vegetation growing through and above it. In some cases (particularly between stations 20+500 and 22+500), trees that had appeared to be alive in 2013, appeared dead in 2014. Many areas were showing early successional stages of grass and herbaceous species during the 2013 survey. Many areas near the creek bank were relatively barren in 2013 however. Ground cover in 2014 near the creek bank

was much thicker, taller and greener than what was observer in 2013.

Below is a brief description of each transect surveyed. For more detail, see Table 1.

3.1 13+000

This transect runs in a northeast-southwest orientation. This section is within the vast open bog area surrounding Buffalo Lake that was widely flooded during operation of the emergency channel. During the 2013 survey, both sides had dead shrubs and approximately 50% bare and 50% grass. A dense patch of dead willows was present near end of the right transect. In 2014, some bare areas were present in the first 2 m adjacent to the creek, but otherwise the grass was much thicker (90%-100% coverage) and taller. Also, some of the shrubs which appeared dead in 2013 had begun regrowth, particularly on the right transect. Most shrubs did not recover however. Organic soil depths were similar during both surveys and were fairly deep (>12 cm). There was no sign of deposition.

13+000 – Left. Transect from creek bank in 2013 (left) and 2014 (right)

13+000 – Left. Looking across creek from left bank in 2013 (left) and 2014 (right)

13+000-Right: Willows at end of right transect in 2013 (left) and 2014 (right).

3.2 13+500

This transect runs in a northwest-southeast orientation and is situated at a left turn in the creek and is comprised of grass, shrubs and bare ground cover. On the right, the transect ended in a marshy area with stagnant water with sedges and aquatic vegetation, while on the left, the transect ended in thick bush. In 2013, the majority of shrubs on the transect were dead and the ground cover was largely bare, but with a high percentage of young grass species emerging (especially on the left side). In 2014, with the exception of a small area (1 m) along the right creek bank, grass coverage was thick (100%) for the entire transect except for the flooded portion along the right transect where cattails (*typha spp.*) were observed. treed areas, which typically may not have thick groundcover had thick vegetative cover, possibly as a result of the lack of leaves on dead shrubs and trees, subsequently allowed sunlight to penetrate to the ground. In 2014, 100% grass coverage was observed in the open areas along the creek. None of the dead trees or

shrubs appeared to have recovered. The flooded area on the right transect appeared to be larger and deeper in 2014 than in 2013, possibly as a result of recent beaver activity. Organic soils were present at the surface on both sides of the creek with depths of at least 2 cm. Beneath the organic soils, a mixture of till, silty clay and gravel were observed.

13+500-Right: Transect from creek in 2013 (left) and 2014 (right).

13+500-Left: Transect from creek in 2013 (left) and 2014 (right).

3.3 14+000

This transect runs in a northwest-southeast orientation. In 2013, greater than 50% of the area along the creek (up to the slope) was bare exposed soil, while the slopes were a mixture of grass, dead shrubs, and a dried up residue remnant from high water. In 2014, the same area along the creek was almost entirely grassed over with small bare areas (5%). None of the dead shrubs along the slope regenerated. High water from operation of the LSMEOC does not appear to have gone above the top of the slopes, and therefore the forested area in this section of the transect (on both sides) is similar between years. The left side transect runs into a flooded marsh area comprised of grasses, cattails and willows. This was observed in both 2013 and 2014. More and deeper open water was present in 2014, likely related to the obvious sign

of beaver presence at that location. Similar to 2013, organic soil was present at the surface in 2014 (1-4 cm). Beneath the organic soil was a mixture of silty and sandy clays. An area with gravel deposition was noted approximately 100 m upstream from 14+000 and an area with erosion on left and deposition on right was noted 75 m downstream from 14+000 (photos below).

14+000-Right. Transect from creek in 2013 (left) and 2014 (right).

14+000-Left: Wet area above high water mark on left side in 2013 (left) and 2014 (right).

14+000: Looking downstream from left bank in 2013 (left) and 2014 (right).

14+000: Deposition on left side of creek 100 m upstream from 14+000 (2014).

14+000: Erosion on left side and deposition on right approximately 75 m downstream from 14+000 (2014).

3.4 14+500

This transect runs in a northwest-southeast orientation. In 2013, the area nearest the channel was largely bare on both sides of the creek with exposed soil on the left side and exposed cobble on the right. Young grass species were starting to emerge. In 2014, much of this area was covered with grass and other herbaceous plants, but much of the exposed cobble on the right transect was still bare. Further away from the creek, there is a relatively thin strip of dead shrubs on both banks as the slope increases slightly. This was present both years, but grass was growing in the understory and through the dead shrubs in 2014. Beyond the slope and outside of the flooded area, both sides transitioned from largely shrubs to largely trees. Organic soils near the creek ranged from 0 (cobble) to 15 cm. Cobble appeared to be depositional. Some of the cobble was also overlain with depositional organic soils. Beneath the organic soils was silty clay and sand. At a creek bend upstream from 14+500, obvious signs of erosion and deposition were noted (photos below).

14+500: Bare area on right side of creek in 2013 (left) and 2014 (right).

14+500: Right transect from creek bank in 2013 (left) and 2014 (right).

14+500: Left transect from creek bank in 2013 (left) and 2014 (right).

14+500: On right side of creek, looking downstream in 2013 (left) and 2014 (right).

14+500: On left side of creek, looking downstream in 2013 (left) and 2014 (right).

14+500: Erosion on right side approximately 175 m upstream from 14+500 (2014).

14+500: Erosion on left side (left) and deposition on right side (right) approximately 250 m upstream from 14+500 (2014).

3.5 15+000

This transect runs in a northwest-southeast orientation at a left turn in the creek. Extensive erosion on the right side and deposition on the left side have occurred at this location. Exposed silt on the right side appears to be as a result of erosion, while cobble on the left side appears to be depositional. In 2013, large bare areas of inorganic materials were observed adjacent to the channel. On the right side was a steep bank of exposed till which appeared to be actively eroding, as evidenced by the exposed tree roots and clumps of vegetation slumping down the slope. On the left side (inside bend) was a gently sloping

expansive bare area of cobble deposition, and beyond that was a large area of dead shrubs with bare understory. In 2014, little appears to have changed. The right transect still had a steep unvegetated slope with exposed silt, while the left side of the creek still had large areas of exposed cobble. The area with dead shrubs further along the left transect had developed a thick layer of vegetation beneath it which has begun to grow through the dead shrubs. As the high water levels do not appear to have reached above the bank on the right, the vegetative composition appears to be the same between years. The slope on the left side is very gentle and the bank is much further away from the creek. Above the slope, the vegetative composition of short shrubs and young trees followed by larger trees remained the same. Organic soils were present further away from the creek up the slopes. Exposed cobble and silt covered the areas closer to the creek channel. Several areas of significant erosion and deposition were seen both upstream and downstream from transect 15+000 (photos below).

15+000: On right side of creek, looking downstream in 2013 (left) and 2014 (right).

15+000: On right side of creek, looking downstream in 2013 (left) and 2014 (right).

15+000: On left side of creek. Looking at transect from near creek bank in 2013 (left) and 2014 (right).

15+000: On left side of creek in 2013 (left) and 2014 (right).

15+000: On left side of creek above slope in 2013 (left) and 2014 (right).

15+000: Erosion approximately 150 m upstream from 15+000 (2014).

15+000: Erosion on right bank approximately 200 m downstream from 15+000 (2014).

15+000: Deposition on right bank approximately 300 m downstream from 15+000 (2014).

15+000: Erosion on left bank approximately 360 m downstream from 15+000 (2014).

3.6 15+500

The orientation of this transect followed a northwest-southeast direction. In 2013, bare areas (30-80%) with dead shrubs and young grass were found adjacent to the creek channel from the creek bank to the top of the slopes. In 2014, much of the bare areas were vegetated by grass and herbaceous species, but some bare areas remained, particularly on the left side slope. Several shrub species (willow, alder) were beginning to get established by 2014 on the top of the left slope however. Vegetation on the right side of the creek in 2014 was long and dense grass with a small amount of dead shrubs along the ground. Above

the slopes on each side was outside of the impact zone from the elevated water levels and little change was observed. A mixture of jack pine, black spruce, aspen and willow were observed. Organic soils from 3 to 18 cm deep were observed at the surface in both 2013 and 2014 at most locations on both sides of the creek with clayey silt and silty clay beneath. The slope on the left side had negligible organics and was primarily clayey silt. There doesn't appear to any significant erosion or deposition at this transect.

15+500: Looking downstream on left side of creek in 2013 (left) and 2014 (right).

15+500: Right transect from near creek bank in 2013 (left) and 2014 (right).

3.7 16+000

This transect is oriented in a northwest-southeast direction at a gentle right bend in the creek. In 2013, a relatively small bare eroded area (cobble, sand, silt) was noted on the left bank, while a larger bare area with deposition of sand, gravel and cobble was observed on the right side (inside bend). Both sides of the creek had dead shrubs with young grass species beginning to emerge in 2013. In 2014, the transect had largely been revegetated by grass and other herbaceous species although a thin strip of bare cobble, sand and silt remained along the creek bank on the left side while patches of deposited cobble, sand and silt were scattered for the first 20 m on the right side. Dead shrubs did not regenerate, but have largely fallen to the ground and are obscured by the thick layer of vegetation that has developed. Further from the

channel, a dense mixture of shrubs and trees which was above the high water level was unchanged between years. Both ends of the transect ended in sphagnum bog. Where bare inorganic soils were not present, 4-5 cm of organic soils overlaid a clayey soil within the flooded portion of the transect. The ends of the transect were in sphagnum and therefor had a thick organic layer which was unchanged between years. An extended area of erosion was present on the left side approximately 50 m downstream from the transect (photos below).

16+000: Left bank, looking downstream in 2013 (left) and 2014 (right).

16+000: Right transect from creek bank in 2013 (left) and 2014 (right).

16+000: Deposition on left side (left) and erosion on right side (right) approximately 150 m upstream from 16+000.

16+000: Erosion on left side approximately 50 m downstream from 16+000 (2014).

3.8 16+500

This transect runs in a north-northwest to south-southwest orientation. Directly adjacent to the creek channel, a short eroded area exposing bare cobbles and gravel was observed on the right side beneath an area of bank failure. This was little changed between 2013 and 2014, although some vegetation was beginning to grow on the top of the bank failure and some emergent vegetation had begun to grow near the creek bank in 2014. Above the relatively steep bank and beyond the high water mark, shrubs transition to trees, then to a mixture of shrubs and trees in a sphagnum bog, which was unchanged between 2013 and 2014. A thin strip of dead shrubs was observed at the top of the right slope which does not appear to be regenerating. The slope on the left side was more gradual, and shows a large area of thick dead shrubs and trees that have been knocked over. In 2013, 30% of this area was bare, with extensive areas being covered with dead shrubs, deadfall and debris accumulation. Approximately 60% of the ground was covered with young grass growth. In 2014, none of dead shrubs or trees regenerated, but a thick layer of grass covered 100% of the area including beneath the dead shrubs and trees. Past the dead trees and debris and up a slight bank there is a well-defined end to the impacts of the high water (see photo below). Above the bank, shrubs transition to trees, then to a mixture of shrubs and trees in a sphagnum bog in both 2013 and 2014. Organic soils were observed on the surface at most locations, with depths up to 15 cm. Beneath the organic soils was a mixture of clayey silt and silty clay. With the exception of near the creek, no obvious signs of erosion or deposition were noted. Near the creek on the right side was an area showing both deposition and erosion. Deposited clayey silt with gravel and sand (5 cm) was above organic soil (10 cm), with much of the bank showing signs of erosion (see photo below). Beneath the organic soils was cobble. An area of erosion was observed approximately 175 m downstream

from the transect (photo below).

16+500: On left side of creek, looking downstream in 2013 (left) and 2014 (right).

16+500: On left side of creek at end of dead vegetation zone, looking downstream in 2013 (left) and 2014 (right).

16+500: Looking downstream from right bank in 2013 (left) and from left bank 2014 (right).

16+500: Right bank looking upstream in 2013 (left) and from left bank 2014 (right).

16+500: Right bank: Deposition above eroding bank.

16+500: Erosion on right of creek 175 m downstream from transect (2014).

3.9 17+000

This transect runs in a northwest-southeast orientation and is situation immediately upstream of the beginning of Reach 3. In 2013, both sides of the creek showed a mix of bare cover, grass and dead shrubs extending 10 to 15 m from the creek banks. Bare areas were much reduced in 2014 compared to 2013 as most areas are now covered with a thick grass layer. Larger bare areas consisting of deposited cobbles and sand were still present on the right side of the creek. Dead shrubs observed in 2013 did not recover in 2014, but have become less obvious as they fall to the ground and the grass grows up and around it. Up the slope on the left side of the river is an area of herbaceous plants and very young poplar trees which transitions into a mixture of trees and shrubs comprised of poplar, willow and alder. This area is above the high water mark and did not change between years. A similar mixture of taller shrubs was observed on the right side of the river. The transect on the right side ended in wet peaty bush. Soils near the creek show signs of deposition of inorganic clayey silt, coarse sand, and gravel above the organic soils (1-5 cm). Above the creek banks, organic soils were observed at the surface at depths of 10 to >15 cm.

17+000: Right transect from near creek bank in 2013 (left) and 2014 (right).

17+000: Left side of creek looking downstream in 2013 (left) and 2014 (right).

17+000: Shrubs and young trees at clearing on top of left side bank in 2013 (left) and 2014 (right).

3.10 17+500

This transect runs west-northwest to east-southeast. In 2013, the area adjacent to the channel was largely bare ground with dead shrubs and grass. In 2014, much of this area has been vegetated by grass, but a large area of exposed deposited sand and gravel remained on the left side of the creek. Dead shrubs observed in 2013 did not recover, but are much less prominent in 2014 as many have fallen to the ground and grass grows above it. The right slope is slightly steeper and leads to small area of short shrubs and herbaceous vegetation and then on to taller shrubs with some young trees and a bog. High water does not

appear to have breached the bank, and the vegetative community noted above the bank did not change between years. The left side had a gentler slope as this was the inside bend of river. Beyond the large area with dead shrubs and inorganic deposition, was an area with live shrubs where it appears high water levels did not reach. Inorganic soils overlay organic soils at most locations sampled along this transect. Soils on the left side were mainly sand near the creek and silt further away from the creek. On the right side was a mixture of silts and clays. Areas with sand were 3 to 15 cm deep, while silty soils ranged from 1 to 5 cm deep. Peat was observed at the end of the right transect

17+500: Right bank seen from creek bank in 2013 (left) and 2014 (right).

17+500: On left side of creek in 2013 (left) and 2014 (right).

17+500: Inorganic deposition on left side of creek, looking downstream (2014).

3.11 18+000

This transect runs in a northeast-southwest direction at a relatively strait section of the creek. A large bare area (20 m) of cobble and gravel was observed on the left side of the creek in 2013. In 2014, this area looked very similar as only a small area was revegetated. Beyond the bare exposed area on the left side in 2013 was a band of dead shrubs (17 m) which was also bare beneath. When visited in 2014, much of this area was now covered by grass, but up to 40% of some areas remained bare. The dead shrubs and trees did not recover. Beyond this, as the slope increased, an area of short shrubs (herbaceous and young poplar) transitioned to taller shrubs (alder) and then to trees. This area appears to be outside of the impacts of high water and was unchanged between years. On the right side of the river, the first 18 m were largely bare soil with grass and some dead shrubs in 2013. In 2014, this area was entirely covered by grass, but dead shrubs still protruded above. Up the slope and beyond the impact area of high water, shrubs transitioned to trees with a largely sphagnum understory which was unchanged between years. Depositional inorganic soils were noted at most sites along this transect, but particularly on the left side. On the left side, large areas of sand, gravel and cobble were observed closer to the creek, while further from creek, organic soils are overlain with 0.5 to 5 cm of silt. On the right side of the creek, a thin layer of organic soil overlaid silt which was above the organic soil.

18+000: Right transect seen from creek bank in 2013 (left) and 2014 (right).

18+000: Right side, looking downstream in 2013 (left) and 2014 (right).

18+000: Bare area on left transect in 2013 (left) and 2014 (right).

18+000: Left transect looking upstream in 2013 (left) and looking downstream in 2014 (right).

18+000: Silt overlaying organic soils on left side of creek (2014).

3.12 18+500

This transect runs in a northwest-southeast orientation. In 2013, bare areas with dead shrubs and grass were observed on both sides of the river, however most extensively on the right side. In 2014, the bare areas were much smaller (5%) as most of the area was covered with thick grass. The dead shrubs and trees did not recover, but new vegetation was beginning to grow beneath and through the dead shrubs and trees. Above the slope on the left side, and beyond the high water impact zone, the understory was largely sphagnum beneath shrubs with a small percentage of trees in both 2013 and 2014. On the right side, beyond the dead shrub area, vegetation transitioned to shrubs, then largely trees before ending in a grassy marsh area with standing water. This area was unchanged between 2013 and 2014. In 2013, inorganic soils were observed at the surface adjacent to the creek on the right side, while elsewhere 2-7 cm of organic soils were measured at the surface. On the right side in 2014, sand was noted near the creek, and deposited silt was noted throughout the area where dead shrubs and trees were seen. On the left side in 2014, a small amount of silt deposition was present above the organic soils. Peat was present at both ends of the transects in both 2013 and 2014. During the 2011 survey, this area was inundated by a beaver dam which flooded areas near the channel. No beaver dam was observed in 2013 in 2014 whoever a beaver lodge was present.

18+500: Right transect seen from creek bank in 2013 (left) and 2014 (right).

18+500: Right transect, looking downstream in 2013 (left) and 2014 (right).

18+500: Left transect seen from creek bank in 2013 (left) and 2014 (right).

18+500: Left transect, looking upstream in 2013 (left) and 2014 (right).

18+500: Erosion on left bank approximately 50 m upstream from transect.

18+500: Beaver lodge on right side of river, looking downstream (2014).

3.13 19+000

This transect runs in a northeast-southeast orientation. In 2013, the left side of the creek consisted of bare areas, dead shrubs, and early stage grass regrowth near the creek. In 2014, this area was almost entirely grassed over, with a small amount (5%) of bare areas remaining. Dead shrubs did not recover. The left transect transitions to live short shrubs followed by tall shrubs with a high percentage of grass before becoming largely treed. This remained consistent between 2013 and 2014. Standing water was present at the end of the transect. The right side had a similar, although slightly larger, area consisting of dead shrubs, bare areas, and early stage grass regrowth in 2013. In 2014 this areas was entirely grassed over, although a dead trees and debris (logs, etc.) still covered a large area approximately half way down the transect. Beyond the dead shrubs a small area of short shrubs followed by a tree/shrub mixture was observed both years. At the end of the transect, the understory became sphagnum-dominated. Exposed inorganic soils were noted in 2013 immediately adjacent to the creek on the left side, however elsewhere organic soils were noted on the surface. In 2014, depositional soils were observed on both sides of the creek. On the left side, a mix of deposited sand, gravel, cobble and silt were observed above the organic soil. On the right side of the creek, a thin layer of silt was present above the organic soils along much of the transect. Deposited organic soils were also observed above the silt along the right transect at one location. An area of bank erosion was noted approximately 100 m upstream from the transect (photo below).

19+000: Left transect seen from near creek bank in 2013 (left) and 2014 (right).

19+000: Right transect seen from near creek bank in 2013 (left) and 2014 (right).

19+000: Erosion on left side of creek approximately 100 m upstream (2014).

3.14 19+500

This transect followed an east-west alignment. In 2013, the left side was bare along the creek, followed by a large area of mature dead trees which were largely bare beneath (80%). High water marks were visible on many of the tree trunks. Lots of trees and debris were on the ground, as it appeared the trees at this location acted as a catch/dam/strainer for dead vegetation floating down the creek. In 2014, this section appeared similar but a lush layer of grass was present throughout the majority of the area. There was no bare area along the creek edge in 2014. Dead trees did not recover. At the end of the transect, live trees with a sphagnum understory were encountered both years. The terrain on the right side of the creek was much flatter. In 2013, bare areas were observed near the creek channel, with a combination of dead shrubs and trees for the entire transect distance. Aquatic emergent vegetation was found at several locations on this side. In 2014, the same area was largely grassed over, but did still have some bare exposed sand areas. The dead shrubs and trees did not recover. Depositional inorganic soils (1-5 cm) were observed on both sides of the creek in 2013. In 2014, thick layers of fine to medium sand were measured on the right side near the creek (10-15 cm) while further from the creek, thinner layers of silty

sand (5 cm) were measured. On the left side in 2014, a mixture of deposited silty clay, silt and sandy silt was observed for the majority of the transect.

19+500: Right transect seen from near creek bank in 2013 (left) and 2014 (right).

19+500: Dead trees along right transect in 2013 (left) and 2014 (right).

19+500: Small channel on left transect in 2013 (left) and 2014 (right).

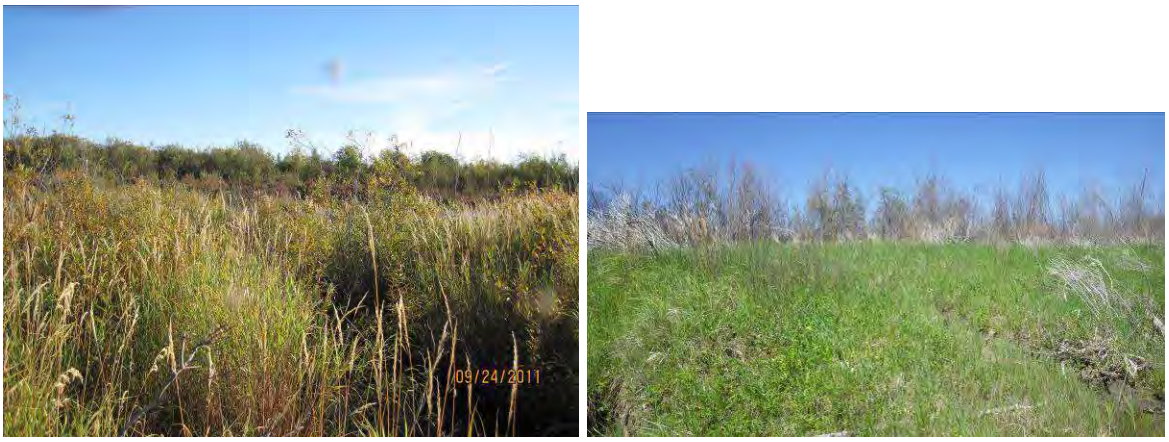
19+500: Dead trees along left transect in 2013 (left) and 2014 (right) (photos not from exactly same location).

19+500: High water mark on spruce trees on left transect in 2013.

3.15 20+000

This transect runs in a south-southwest to north-northeast direction and is just downstream from a sharp left turn in the creek. In 2013, the left side had a large bare area of cobble and gravel which extended for about half of the transect, followed by an area of dead shrub which was largely bare beneath. The entire area along the inside bend of the creek appears to have been inundated by high water, including the entire left transect. In 2014, most of the bare cobble areas were still exposed and all the dead shrubs remained dead. Grass was beginning to establish itself on the further half of the transect, however large bare areas remained near the creek in 2014. In 2013, the right side had a smaller bare area near the creek, followed by dead shrubs underlain by grass, then dead trees underlain by grass. In 2014, small bare areas remained near the creek, but grass had overtaken most of the transect including beneath the dead trees and shrubs. As the whole transect appears to have been inundated, deposited inorganic soils were observed on the surface throughout. In 2013, 1-5 cm of inorganics were measured above organic soils. In 2014, 3-13 cm of inorganics were measured above organic soils. On the left side in 2014, thick layers of sand, gravel and cobble were present near the creek, while mainly sand was present further along the transect. On the right side in 2014, silt overlaid organic soils for the length of the transect. An eroded bank was noted approximately 300 m upstream from the transect on the left side (outside bend of river).

* Due to camera malfunction in 2013, photos below are from 2011 and 2014 only.



20+000: Grass on right transect in 2011 (left) and 2014 (right). (Photos not from exact same location)

20+000: Looking downstream from right side of creek in 2011 (left) and 2014 (right). (Photos not from exact same location)

20+000: Trees along right transect seen in 2011 (left0 and 2014 (right). (Photos not from exact same location)

20+000: Bare area on left side of creek as seen from right bank (2014).

3.16 20+500

This transect was oriented in an east-west orientation at a strait stretch of creek shortly after a right turn. In 2013, both sides had bare areas with dead shrubs and a small proportion of grass. On the left side, live trees were encountered approximately half way along the transect. On the right side in 2013, the dead shrubs transitioned to a mixture of dead trees and dead shrubs. The entire right transect appears to have been inundated as all shrubs and trees were dead. In 2014, the entire left transect was covered in grass including beneath dead shrubs and trees. It appears as though live trees that were observed in 2013 died between 2013 and 2014 as no live trees were noted along the transect in 2014. The right side in 2014 was fully grassed over near the creek, but several bare patches were still present between 50 m and 100 m. In 2013, deposited inorganic soils were present above the organic soils throughout both sides of the transect in thicknesses varying from 1 cm to 13 cm. In 2014, similar depths of silt (<1 cm to >15 cm) were measured above organic soils on both sides of the creek.

* Due to camera malfunction in 2013, photos below are from 2011 and 2014 only.

20+500: Left transect from near creek bank in 20111 (left) and 2014 (right). (Photos not from exact same location)

20+500: Looking upstream from left bank in 2011 (left) and 2014 (right). (Photos not from exact same location)

20+500: Dead shrubs and grass along left transect (2014).

20+500: Dead trees and grass along left transect (2014).

3.17 21+000

This transect runs in an east-west direction at a gentle left turn in the creek. In 2013, the left side of the creek was comprised largely of dead shrubs, with bare areas near the creek channel and some dead trees near the end of the transect. In 2014, this area was covered by a thick layer of grass, while dead trees and shrubs did not recover. The high water mark can be seen on many of the mature dead spruce (see photo below). In 2013, the right side had a mixture of dead shrubs, grass, and bare patches for the first approximately 30 m. Beyond this was live shrubs and grass layer underlain by sphagnum which transitioned to trees approximately halfway along the transect at the end of a small clearing up the slope. In 2014, this transect had lots of grass near the creek, and then transitioned to an area of shrubs (1/2 dead) and then to an area of trees (1/2 dead). These trees appear to have died between 2013 and 2014 as these trees were live in 2013. In 2013, deposited inorganic soils above the organic soils were 6-13 cm thick on the left side and 4 cm thick on the right side near the creek. Peat was observed above the slope on the right side. In 2014, inorganic fine sand and silt was present along most of the transect including all of the left side and the first half of the right side. On the right side, organic soils (peat) was present starting at approximately 50 m. Thicknesses of inorganic soils above the organic soils in 2014 varied from 5 to 15 cm. An area of erosion and fallen trees was observed on left side of creek approximately 200 m upstream from the transect (photo below).

* Due to camera malfunction in 2013, photos below are from 2011 and 2014 only.

21+000: Right side of creek looking downstream in 2011 (left) and 2014 (right).

21+000: Right transect from near creek bank in 2011 (left) and 2014 (right). (Photos not from exact same location)

21+000: High water mark seen on dead spruce on left side of creek in 2014.

21+000: Erosion and fallen trees on left side of creek approximately 200 m upstream from transect 21+000 (2014).

3.18 21+500

This transect runs in a southwest-northeast orientation at a strait stretch of the creek. In 2013, the left side of the creek was dominated by dead shrubs for the first 32 m, followed by dead trees up to 57 m, followed by live spruce trees. The understory was bare for the first half of the left transect in 2013. In 2014, the area near the creek was a mixture of grass and shrubs (2/3 live), and then transitioned to an area of dead trees with a thick herbaceous groundcover. Trees were dead all the way to the end of the transect. These trees appear to have died between 2013 and 2014. The right side of the creek in 2013 had dead shrubs until 25 m, followed by live spruce trees which developed a sphagnum understory beyond 36 m. In 2014, dead shrubs were again seen for the first 23 m, although there was also a thick layer of grass growing beneath it. Beyond the dead shrubs, dead mature spruce trees were observed for the duration of the transect. These trees appear to have died between 2013 and 2014. In 2013, organic soil depths varied from 3 to >17 cm, with much of the area overlain by inorganic soils of 3 to 7 cm. In 2014, >13 cm of silt was observed in the area with dead shrubs on the left side, while on the right side, >15 cm of fine sand was observed. Within the mature trees, 3-8 cm of deposited silt was observed above organic soils in 2014.

* Due to camera malfunction in 2013, photos below are from 2011 and 2014 only.

21+500: Left side of creek looking upstream in 2011 (left) and 2014 (right).

21+500: Right side of creek in 2014 looking upstream (left) and downstream (right).

21+500: Right side of creek as seen from left side in 2014. Note high water mark on trees.

21+500: Dead spruce trees showing high water mark and a herbaceous understory on left transect in

2014.

3.19 22+000

This transect runs in a southwest-northeast direction at a relatively treed stretch of the creek. In 2013, the first approximately 13-18 m on both sides of the creek were dominated by dead shrubs, but also had bare areas and grass. Beyond the dead shrubs were live mature trees on the left and a mixture of dead and live mature trees on the right. Both sides end in a forested area with sphagnum understory. In 2014, dead shrubs were still present along the creek, but were less visible as many had fallen to the ground and thick layer of grass now existed. Within the trees, the first 26-43 m were dead, followed by live trees transitioning into bog. High water marks were visible on the mature spruce well away from the creek. A small proportion of shrubs were also present on the left side. In 2013, inorganic soils overlaid organic soils along most of the transect with the exception of the sphagnum areas near the end on each side. Depths ranged from >13 cm near the creek to 5-6 cm in the trees. In 2014, 3-5 cm of silt overlaid most of the transect with a thick layer of sand (>13 cm) also found on the left side near the creek (beneath silt). Peat was again observed at the surface at the end of the transects. An area of erosion and fallen trees on the right bank approximately 230 m downstream from the transect.

* Due to camera malfunction in 2013, photos below are from 2011 and 2014 only.

22+000: Mature spruce trees and herbaceous understory in 2011 (left) and 2014 (right). Note high water mark in 2014. (Photos not from exact same location)

22+000: Right side of creek, looking downstream in 2014.

22+000: Dead trees on right side of creek, as seen from creek bank in 2014.

22+000: Erosion and fallen trees on the right bank approximately 230 m downstream from 22+000 (2014).

3.20 22+500

This transect runs in an east-west direction at a left bend in the creek just downstream from a small rapid. The creek is particularly wide at the transect location. In 2013, the left side had a large bare area of gravel and sand adjacent to the creek. Beyond this, dead trees with a mainly bare understory were observed until near the end of the transect. The last 27 m of the transect had live trees and a few shrubs. In 2014, the same bare area was observed along the creek, although this time it had a small (5%) amount of grass. Beyond the bare area, dead trees were observed until the end of the transect. The trees at the end of the

transect that were alive in 2013 appear to have died by 2014. The understory of this area was almost entirely grass. Large piles of debris (trees, sticks, etc.) were captured by trees on the left transect during high water (see photo below). The right side in 2013 had an area of dead trees with bare understory immediately adjacent to the creek for about 20 m, followed by live mature trees for the remainder of the transect. In 2014, a similar extent of dead trees was observed, although this time there was a 50% understory of herbaceous plants. The remainder of the transect was comprised of live trees. Organic soils in 2013 were beneath a 5-9 cm layer of inorganic soil deposition, with the exception of near the ends of transects. In 2014, 3-13 cm of silt was on the surface at most locations.

* Due to camera malfunction in 2013, photos below are from 2011 and 2014 only.

22+500: Mature spruce trees and herbaceous understory in 2011 (left) and 2014 (right). Note high water mark in 2014. (Photos not from exact same location)

22+500: Bare area on left side, looking downstream in 2014.

22+500: Dead trees, accumulated debris and grass on left transect in 2014.

22+500: Debris on rock in creek, as seen from left bank in 2014 (flow going left).

22+500: Dead trees and grass on right side, as seen from near creek bank in 2014.

3.21 23+000

This transect runs in a southwest-northeast direction. In 2013, dead shrubs were observed on both sides of the creek, with dead trees also present beyond the dead shrubs on the right side. The dead zones were approximately 30 m on both sides and were largely underlain by deposited bare exposed soils. Beyond the dead zone, live trees covered approximately half of the transect on each side. In 2014, the areas closest to the creek on each side were covered with thick grass. Dead shrubs were still present amongst the grass. Beyond the dead shrubs, dead trees were observed. An area of trees on the left side that was alive in 2013

was dead in 2014. Live trees were still present at the end of the transect on both sides. In 2013, organic soils were beneath 5-9 cm of inorganic deposition at test holes near the creek, while peat was observed on the surface further along the transect on each side of the creek. In 2014, 3-5 cm of silt was measured above organic soils near the creek, while peat was again observed near the end of the transect on each side.

* Due to camera malfunction in 2013, photos below are from 2011 and 2014 only.

23+000: Mature spruce trees and herbaceous understory in 2011 (left) and 2014 (right). Note high water mark in 2014. (Photos not from exact same location)

23+000: Grass and dead trees, looking downstream from right bank in 2014.

23+000: Dead trees and grass on left transect as seen from near creek bank in 2014.

23+000: Silt deposition above organic soil on the left side of the creek in 2014.

3.22 23+500

This transect runs in a north-south orientation near a sharp left bend in the river. During emergency channel operation, it appears water immersed the inside bend of the river including the entire left transect. In 2013, all vegetation on the left side of the river was dead. Dead shrubs were present from the creek bank to 50 m, while dead trees were present from 50 m to 100 m. The understory was bare for the entire left side transect. On the right side in 2013, dead trees were observed adjacent to the creek bank for the first 21 m. The understory was bare close to the creek, while a herbaceous understory was present starting at 9 m for the remainder of the transect. The remainder of the right side transect consisted of live trees with a sphagnum understory. In 2014, all the shrubs and trees on the left transect were still dead. Thick grass was present close to the creek around the dead shrubs, while a herbaceous layer was present beneath the dead trees. On the right side in 2014, grass cover was present near the creek along with a small proportion of new young shrubs. The extent of dead trees was similar as was observed in 2013, and live mature trees were again present for the majority of the transect. In 2013, 6 to >20 cm of inorganic soil was measured above organic soils, with the thickest layer of deposition being along the left transect. Only a narrow area of deposition was noted on the left side with organic soils at the surface for the majority of

the transect. In 2014, 3 to >10 cm of silt was measured above organic soils near the creek, but silt was again observed along the full length of the left transect. An area of erosion and fallen trees on the left side of the creek and deposition on the right side of the creek was observed approximately 175 m upstream from the transect.

* Due to camera malfunctions in 2011 and 2013, photos below are from 2014 only.

23+500: Looking downstream from left bank (2014).

23+500: Grass and dead trees on left transect, as seen from shore (2014).

23+500: Dead trees on left transect, with herbaceous ground layer and accumulated debris on upstream side of trees. Note high water mark on tree trunks (2014).

23+500: Bog at end of right transect. Typical of what was seen at the end of many transects (2014).

23+500: Erosion and fallen trees on left (left) and deposition on right (right) approximately 175 m upstream from transect (2014).

3.23 24+000

This transect runs in an east-west orientation immediately upstream from a sharp S-turn in the creek. In 2013, the left bank was a steep eroded bank. At the top of the bank was a mixture of deciduous shrubs and trees for the duration of the transect. At 61 m, where the transect approached the river bank further down stream, the trees and shrubs were dead. On the right side of the river in 2013, the slope was much gentler, and the ground were largely wet and muddy. The creek appears to have flooded the full length of the right transect. Dead trees and shrubs dominated the first 68 m of the transect. The understory of that section was largely bare, but with increasing concentrations of grass as the transect progressed away from the creek. Live trees were present from 68 m to the end of the transect. In 2014, the steeply eroded bank on the left side appeared unchanged. A similar composition of shrubs and trees was recorded for the remainder of the transect although the bare areas noted in 2013 near the end of the transect were now covered with a herbaceous layer of vegetation. In 2014, the right transect was mainly grassed over. Some areas had stagnant water and emergent aquatic plants were growing (*typha* spp.) Trees remained dead, although it appears that some of the shrubs further from the creek had recovered. In 2013, deposited

inorganic sediments varied from 8 to 13 cm above the organic soils along the right transect and near the creek along the left transect. Organic soils were on the surface at the majority of the left transect. In 2014, a similar pattern was observed with relatively small amounts of deposited silt near the creek on the left side and a thicker layer of silt on the right transect. Many areas were too wet to assess soil content.

High water levels forged new creek channels immediately downstream from the transect, essentially short-cutting the previous meandering route. While water continues to pass though the previous channel, it appears the majority of water now goes through the new channels, particularly during low water conditions.

24+000: Looking across creek at left transect from right bank in 2013 (left) and 2014 (right).

24+000: Dead trees on right transect in 2013 (left) and 2014 (right) (photos not from exactly the same location).

24+000: Looking upstream from left bank in 2013 (left) and 2014 (right).

24+000: Looking downstream from left bank in 2013 (left) and 2014 (right). Original channel is to the right, while new channel is on left (2014 photo).

24+000: Erosion immediately downstream from transect where near channels were created (2104)

3.24 24+500

This transect is oriented in an east-west direction downstream from the S-turn in the creek where new channels were created during high water. In 2013, the left side of the river was composed of dense dead

shrubs with a bare understory until 34 m where a layer of live shrubs began. Beyond this, the vegetation became largely treed with a sphagnum understory. Effects from high water appear to end approximately 20 m from the creek bank. On the right side, bare areas with dead shrubs and trees span the entire transect in 2013. This side of the creek is lower and was clearly immersed by high water for its entire length. In 2014, the left side was unchanged other than the 90% grass cover near the creek where it was previously bare. The right side in 2014 showed a similar pattern. Dead shrubs and trees did not recover, but the understory was largely covered by grass near the creek and more herbaceous species within the dead trees further away from the creek. Soils in 2013 showed thick layers of inorganic deposition near the creek. 14-15 cm deep inorganics were measured above organics on the left side while >19 cm of inorganics were measure on the left side near the creek. Thinner inorganic layers were noted further from the creek on both sides. In 2014, 5 cm of silt was measured near the creek on both sides, while >15 cm of silt was present further along the right transect. Peat was observed at the end of the left transect which was unchanged between 2013 and 2014. An area of erosion and deadfall was observed approximately 190 m downstream from the transect (see photos below).

24+500: Left bank, looking downstream in 2013 (left) and 2014 (right).

24+500: Right transect seen from near creek bank in 2013 (left) and 2014 (right).

24+500: Along right transect, looking downstream in 2013 (left) and 2014 (right).

24+500: Erosion and deadfall on left (left) and right (right) of creek approximately 190 m downstream from transect.

3.25 25+000

This transect is oriented in a northwest-southeast direction. In 2013, the left side of the creek had a steep

bank which appears to have slumped (see photo below). At the top of the slope were shrubs which were followed by deciduous trees and then coniferous trees. The right side in 2013 was less steep and had dead shrubs and a bare understory until 36 m. Much of the area consisted of exposed cobbles, gravel and sand. Beyond this was a mixture of live trees and shrubs. In 2014, the slumped bank was still present and had minimally more vegetation on it. Above the slope, a similar composition of shrubs and trees was observed. The right side in 2014 still had a bare cobble area adjacent to the creek although patches of grass had grown in a few locations. Beyond the cobble, thick grass was growing within the dead shrubs until near the end of the transect where the transect leaves the dead zone and live trees and shrubs are encountered. A fair bit of debris (logs, branches) was deposited within the dead shrub area. In 2013, 1 to 4 cm of inorganic soil overlaid organic soils near the creek, except for the large areas of coble which were deeper. Organic soils were present on the surface further from the creek on both sides. In 2014, the bank slump on the left side was identified as being mainly silt. Above the bank, trace silt was present above organic soils. On the right side in 2014, 10 cm of silty organic soil was observed above silt within the grassy area with dead shrubs. Peat was present at the end of the right transect. An area with cobble and gravel deposition was observed approximately 200 m upstream from the transect at a sharp bend in the creek (photo below).

25+000: Bank slump on left side of creek, looking upstream in 2013 (left) and 2014 (right).

25+000: Cobble area on right side of creek in 2013 (left) and 2014 (right) (photos not from exact same location).

25+000: Dead trees along right transect in 2013 (left) and 2014 (right) (photos not from exact same location).

25+000: Areas with cobble and gravel deposition approximately 200 m upstream from transect (2014).

3.26 25+500

This transect was oriented in an east-west direction at a left turn in the creek. In 2013, the left side of the creek had a very gentle slope and consisted of dead shrubs and a largely bare understory for the entire left-side transect. The entire left transect had clearly been inundated during high water. The right side of the creek has a steeper bank. In 2013, it had a thin layer of dead shrubs with a bare understory, followed by a progression of live shrubs followed by trees with a sphagnum understory starting at 54 m. In 2014, the left side had been completed vegetated over with mainly grass, but also herbaceous species further from the creek. None of the dead shrubs recovered. On the right side in 2014, the thin strip with dead shrubs now had a thick layer of vegetation growing beneath it. Above the bank, a similar composition of shrubs, and trees was observed. Soils in 2013 had 1 to 4 cm of inorganics above organic soils near the creek and along the left transect. In 2014, 5 to 8 cm of silt was observed at the surface on the left side. At one location, beneath the silt was 3 cm of organic soil followed by further silt. On the right bank, 10 cm of organic soil was measured above a layer of silt. An area of erosion was observed at an outside bend in the creek approximately 175 m upstream from the transect (photo below).

25+500: Right side of creek, looking downstream in 2013 (left) and 2014 (right).

25+500: Left transect in 2013 (left) and 2014 (right).

25+500: Left transect in 2013 (left) and 2014 (right).

25+500: Area of erosion on left side of creek approximately 175 m upstream from transect (2014).

3.27 26+000

This transect runs in a east-northeast to west-southwest direction at an S-turn in the river. The left transect approximately paralleled the river and had very little topography. In 2013, the ground cover was entirely

comprised of dead shrubs and bare understory, with a small percentage of grass. The right side of the creek in 2013 had a similar area of dead shrub and bare understory adjacent to the creek until the transect went up the slope and a dense shrub coverage was encountered seemingly above the high water mark. Due to the winding nature of the creek at this point, this transect approaches the creek again near its end. In this area, dead shrubs and trees and a bare understory were again encountered. In 2014, there was a 3 m area adjacent to the creek on the left side which was still bare, but otherwise the remainder of the left transect was 100% covered by grass, None of the dead shrubs recovered. On the right side in 2014, areas near the creek both at the beginning and end of the transect (which were previously bare) were largely covered by grass. In 2013, a thin inorganic soil layer was observed above organic soils on the left side. On the right side, 4-13 cm of inorganic soils were present above the organic soils. In 2014, the small bare area adjacent to the creek was composed of 5 cm of silt above gravel. On the right bank in 2014 a silty organic soil was noted. An area of erosion on the left bank approximately 250 m upstream from transect was observed (photo below).

26+000: Right transect in 2013 (left) and 2014 (right).

26+000: Left transect in 2013 (left) and 2014 (right).

26+000: Bare area adjacent to creek on left side, looking upstream.

26+000: Area of erosion on left bank approximately 250 m upstream from transect.

3.28 26+500

This transect runs in a south-southeast to north-northwest direction and is situated between two bends in the creek. In 2013, the left side, which is fairly low and flat, was comprised entirely of dead shrubs and trees with a small amount of grass, but the understory was largely bare. The right side was also largely bare adjacent to the creek, but with a slightly higher coverage of grass. Dead shrubs were found until 59

m where the transect entered 100% live trees. In 2014, none of the dead shrubs or trees recovered. The first half of the left transect was fully grassed over while a more herbaceous layer was present further along the transect closer to the dead trees. The right side in 2014 was fully grass-covered near the creek with a more herbaceous groundcover seen within the dead shrubs. Some accumulated debris (branches) was also noted on the right side. Soils in 2013 had 2-5 cm of inorganic deposition above organic soils near the creek, and throughout the left transect. Organic soils were observed on the surface on the right side after the first 20 m. In 2014, 15 cm of sandy silt was measured above organic soils near the creek on the left side, while organic soil was noted on the right side of the creek. An area of erosion was noted on the on right side approximately 175 m downstream from transect (photo below).

26+500: Right transect from shore in 2013 (left) and 2014 (right).

26+500: Within dead shrubs on right transect in 2013 (left) and 2014 (right).

26+500: Accumulated debris on right transect (2014).

26+500: Left transect in 2013 (left) and 2014 (right).

26+500: Trees near end of left transect in 2013 (left) and 2014 (right).

26+500: Erosion on right side of creek approximately 175 m downstream from transect (2014).

3.29 27+000

This transect runs in an east-west direction at a left turn in the creek. The inside bend (left side) is low in elevation, while a distinct bank was present on the right side at approximately 20 m from the creek bank. In 2013, the left side of the river was composed of mainly dead shrubs with a smaller portion of grass and a largely bare understory. At 77 m the transect entered live mature trees. On the right side in 2013, a similar composition of dead shrubs, grass and bare understory was encountered adjacent to the creek. At 42 m (base of slope), the transect transitioned to shrubs and at 58 m, there was a mixture of shrubs and trees. In 2014, the lower lying areas which were largely bare were now covered with a thick layer of grass. Dead shrubs did not recover. Organic soils near the creek in 2013 were overlain with 2-3 cm of inorganic deposition at the low areas near the creek, while organic soils were observed on the surface up the bank on the right side. In 2014, 1 cm of silt was measured above >13 cm of fine gravel near the creek on the left side, while 1 cm of silt was measured above organic soils on the right side (near the creek). Erosion was noted at locations 100 m to 200 m downstream from the transect along the outside bend of the creek (photos below).

27+000: Right transect in 2013 (left) and 2014 (right).

27+000: Left transect in 2013 (left) and 2014 (right).

27+000: Near end of left transect in 2013 (left) and 2014 (right).

27+000: Eroded right bank approximately 100 m downstream (left) and 200 m downstream (right) from transect (2014 photos).

3.30 27+500

This transect runs in an east-west direction just downstream from a sharp right-hand bend in the creek. The inside bend of the river (right side) was lower in elevation, while there was a distinct bank on the left side near the creek. In 2013, the left side of the river had an area of dead shrubs with some grass but was largely bare until the slope increased at 34 m. Above the slope was a mixture of thick shrubs and trees until 59 m where 100% trees were encountered along with a sphagnum understory. The right side in 2013 had a larger flat area which was largely bare (cobble, sand) until 25 m. Beyond this, an area of dead shrubs with grass and bare understory transitions to an area of largely trees at 51 m, and then back to shrubs at 92 m. In 2014, the left side was covered with a thick layer of grass up to the slope. Dead shrubs did not recover. Up the slope appears to be outside of the high water impact zone and therefore appears that little changed between 2013 and 2014. On the right side in 2014, the cobble/sand area was largely still bare for about 6 m from the creek. Beyond that, grass covered the ground and grew through the dead shrubs. A similar composition of live shrubs and trees was observed beyond 50 m along the right transect. In 2013, a thin layer (1 cm) of inorganic soil was present above organic soil on the left side of the creek, while a thicker layer (3-5 cm) was present on the right side aside from the cobble area which was much thicker. In 2014, 6 cm of silt was measured above organic soil on the left side, while >15 cm of sand and gravel was measured near the creek on the right side and sandy silt was identified further from the creek.

27+500: Left transect in 2013 (left) and 2014 (right).

27+500: Left transect, looking downstream in 2013 (left) and 2014 (right).

27+500: Right transect in 2013 (left) and 2014 (right) (photo not from exactly same location).

3.31 28+000

This transect runs in an east-southeast to north-northwest direction at a right-hand bend in the creek. The

right side is a large open area with low elevation, while the left side is sloped near the creek bank. On the left side in 2013, a small bare/grass patch adjacent to the creek transitioned to shrubs and then to trees. On the right side of the creek, a large (60 m) bare area with some grass leads to a band of shrubs, followed by trees up a gentle slope. In 2014 on the left side, aside from some erosion immediately at the water's edge, the ground was covered with thick grass up the slope. Shrubs and trees above the slope were beyond the impacted area and are therefore not changed. The right side in 2014 had a 4 m area adjacent to the creek which was still mostly bare, but the remainder of the open area was covered with grass. A similar composition of shrubs and trees was noted beyond the open area. Soils in 2013 were organic at the surface on the left, and a mixture of gravel, sand and silt on the right side. In 2014, 1 cm of silt was observed above organic soil on the left, while gravel, sand and silt were again noted on the right side of the creek.

28+000: Right transect from near creek bank in 2013 (left) and 2014 (right).

28+000: Looking downstream from left bank in 2013 (left) and 2014 (right) (photos not from exact same location).

28+000: Erosion on left bank, looking downstream (2014).

28+000: Erosion on left bank, looking upstream (2014).

TABLE

TABLE 1
RESULTS OF VEGETATION COVER SURVEY

Station	Sub-Section	Bank *1	Transect Orientation	Cover Type	Start (m)	End (m)	Organic Layer (cm)
13+000	A	Left	Northeast	River	0	16	-
				Grass 90%; Bare 10%; Shrub (dead) 5%	16	60	>12
				Grass 100%; Shrub (dead) 15%	60	100	>12
	B	Right	Southwest	River	0	16	-
				Grass 50%; Bare 50%	16	18	20
				Grass 100%; Shrub (dead) 5%	18	58	>12
				Grass 50%; Shrub (regrowth) 50%	58	78	-
				Shrubs (mainly dead) 90%; Grass 75%	78	87	>12
				Grass 100%; Shrub (dead, standing) 75%	87	100	-
13+500	A	Left	Northwest	River	0	20	-
				Grass 100%; Shrub (dead) 10%	20	39	20 (above till)
				Grass 100%; Shrub (dead) 50%	39	44	>20
				Grass 100%; Shrub (tall, 90% dead) 75%	44	58	>20
				Grass 100%; Shrub (tall, 50% dead) 50%; Trees (dead) 25%	58	84	-
				Grass 100%; Shrub (tall) 90%	84	100	2 (above silty clay)
	B	Right	Southeast	River	0	20	-
				Grass 50%; Bare 50%	20	21	4 (above clay with gravel)
				Grass 100%; Shrub (dead) 5%;	21	34	-
				Grass 100%; Shrub (dead) 25%; Tree (dead) 10%	34	49	-
				Grass 100%; Shrub (dead) 20%; Tree (dead) 5% (marshy)	49	92	-
				Grass (typha) 40%; Shrub (dead) 40% (deeper water)	92	100	-
14+000	A	Left	Northwest	River	0	13	-
				Grass 100%	13	23	1 (above fine silty clay)
				Grass 90%; Shrubs (mostly dead) 60%	23	27	-
				Grass 100%; Shrubs 40%; Trees (dead) 5%	27	37	1 (above clay with silt and fine sand)

				Grass (typha) 100%; Shrubs 70% (wet)	37	52	-
				Grass 50%; Open Water 50%; Shrubs 20%	52	82	-
				Shrubs 80% (wet)	82	100	-
	B	Right	Southeast	River	0	13	
				Grass 95%; Bare 5%; Shrubs (dead) 5%	13	20	3 (above sandy clay)
				Grass 95%; Bare 5%; Shrubs (dead) 25%	20	28	-
				Shrubs (short) 100%	28	33	4 (above clay with rocks)
				Trees 50%; Shrubs 50%	33	46	-
				Shrubs (short) 100%; Trees 80%	46	78	-
				Trees 80%; Shrubs (short) 75%	78	100	-
14+500	A	Left	Northwest	River	0	8	-
				Grass 95%; Bare 5%	8	15	15 (above fine silty clay)
				Grass 75%; Bare 25%; Shrubs (dead) 25%	15	17	5 (above clay)
				Shrubs (short) 100%; Trees 40%	17	30	-
				Trees 75%, Shrubs 25%	30	50	<1 (above silty clay with sand)
				Trees 100%; Shrubs (short) 100%	50	100	-
	B	Right	Southeast	River	0	8	-
				Grass 60%; Bare 40%	8	18	mix of cobble and 3 cm org soil (above sand)
				Grass 90%; Shrubs (dead) 50%	18	20	-
				Shrubs 95%; Trees 5%	20	28	-
				Shrubs (tall) 50%; Trees 5% (100% herbaceous understory)	28	46	8
				Trees 100% (100% herbaceous understory)	46	69	-
				Trees 70%; Shrubs 30% (100% herbaceous understory)	69	100	-
15+000	A	Left	Northwest	River	0	10	-
				Bare 100%	10	24	0
				Grass 100%; Shrubs (dead) 60%; Trees (dead) 5%	24	44	-
				Shrubs 100%	44	65	9 (above clayey silt)
				Trees 100%; Shrubs 25% (100% herbaceous understory)	65	100	-
	B	Right	Southeast	River	0	10	-
				Bare 100%	10	12	0

				Trees 50%; Shrubs 50% (75% short shrub understory, 25% deadfall)	12	18	-
				Shrubs (tall) 75%; Trees 25% (100% herbaceous understory)	18	41	-
				Trees 25%; Shrubs 25% (100% herbaceous understory with sphagnum)	41	100	-
15+500	A	Left	Northwest	River	0	7	-
				Grass 95%; Shrubs (dead) 25%; Bare 5%	7	17	8 (above clayey soil)
				Shrubs 75%; Bare 25%	17	21	exposed clayey silt with negligible organics
				Trees (jack pine) 100% (75% short shrub understory)	21	55	-
				Shrubs (tall) 75%; Trees 25% (100% short shrub understory)	55	100	-
	B	Right	Southeast	River	0	7	-
				Grass 100%; Shrubs (dead) 20%	7	24	18 (above clayey silt)
				Shrubs 50%; Trees (dead) 40% (80% short shrub understory)	24	26	3 (above silty clay)
				Trees 80%; Shrubs 20% (understory 100% short shrubs)	26	40	-
				Shrubs (tall) 90%; Trees (spruce) 10% (short shrub and sphagnum understory)	40	100	-
16+000	A	Left	Northwest	River	0	9	-
				Bare (inorganics) 100%	9	10	0
				Grass 100%; Shrubs (dead) 15%	10	26	4 (above clay with rocks)
				Trees 95% (jack pine); Shrubs 5% (100% short shrub understory)	26	44	-
				Shrubs (tall) 100% (100% short shrub understory)	44	81	-
				Trees 100% (mainly jack pine) (100% short shrub understory)	81	100	-
	B	Right	Southeast	River	0	9	-
				Grass 75%; Shrubs (dead) 40%; Bare 25%	9	29	0
				Shrubs 80%; Trees 10%	29	49	5 (above clay)
				Shrubs (tall) 95%; Trees 5% (100% short shrub understory)	49	100	-
16+500	A	Left	North-Northwest	River	0	10	-
				Grass 100%; Shrubs (dead) 75%	10	28	15 (above clayey silt)

				Grass 100%; Shrubs and trees (dead) 90%	28	80	2 (above silty clay)
				Shrubs (short) 100%	80	84	-
				Trees (jack pine) 60%; Shrubs (40%) (100% short shrub understory)	84	100	-
	B	Right	South-Southeast	River	0	10	-
				Bare (cobble) 100%	10	12	0
				Shrubs (dead) 100%; Grass 90%; Bare 10%	12	17	5 cm of clayey silt with gravel and sand above 10 cm of organic soil, then cobble
				Shrubs (short) 100%	17	19	-
				Shrubs (tall) 100% (10% short shrub understory)	19	45	-
				Trees 75%; Shrubs 20% (100% short shrub understory)	45	100	-
17+000	A	Left	Northwest	River	0	15	-
				Grass 100%; Shrubs (dead) 10%	15	21	3 (above sandy silt)
				Grass 50%; Shrubs (dead) 50%; Bare 25%	21	25	clay with silt soil
				Shrubs (short) 100%	25	44	-
				Shrubs (tall) 80%; Trees 20% (100% short shrub understory)	44	100	-
	B	Right	Southeast	River	0	15	-
				Grass 50%; Bare (cobble with sand) 50%; Shrubs (dead) 40%	15	29	trace org., 1 cm silt, then coarse sand and gravel
				Grass 100%; Shrubs (dead) 80%	29	39	5 silt with fine sand, then 15 organic, then cobble
				Shrub (tall) 95%; Trees 5% (100% herbaceous understory)	39	66	10 above silty clay
				Shrub (tall) 65%; Trees 35%	66	83	>15 (wet at 13)
				Trees 50%; Shrubs 50%	83	100	organic peat, wet at 3 cm
17+500	A	Left	West-Northwest	River	0	12	-
				Grass 90%; Bare 10%; Shrub (dead) 20%	12	19	3 cm coarse sand, then >13 cm org. peat
				Grass 60%; Bare 40%; Shrubs (dead) 20%	19	21	15 cm sand and gravel, then org. peat
				Bare 75%; Shrubs (dead) 40%; Grass 10%	21	34	15 cm sand and gravel, then org. peat

				Grass 100%; Shrubs (dead) 40%; Deadfall logs 10%	34	74	3 cm deposited silt, then 20 cm organics, then silt
				Trees 60%; (100% herbaceous understory)	74	100	1 cm silt, then 5 cm org. peat, then cobble and coarse sand
	B	Right	East-Southeast	River	0	12	-
				Grass 100%; Shrubs (dead) 25%	12	15	15 (peat), then clayey silt
				Bare 60%; Shrubs (dead) 40%, Grass 25%	15	19	5 cm silt, then 8 cm org. peat, then clayey silt
				Shrubs (short) 100%	19	20	1 cm silt, then 5 cm organics, then 9 cm clayey silt, then silty clay
				Shrubs 85%; Trees 15%	20	60	15 cm peat, then silty fine sand
				Trees 40%; Shrubs 40% (sphagnum understory)	60	100	-
18+000	A	Left	Northeast	River	0	9	-
				Bare (cobble) 95%; Shrubs (dead) 10%; Grass 5%	9	25	sand, gravel, cobble with areas showing trace organic deposition
				Grass 95%; Shrubs (dead) 20%; Bare 5%	25	37	3 cm peat, then silt
				Shrubs (dead) 60%; Bare 40%; Grass 25%	37	43	5 cm silt, then 8 cm org. peat, then clayey silt
				Shrubs 100% (100% herbaceous understory)	43	49	0.5 cm silt above 6 cm of peat, then clayey silt
				Shrubs (tall) 95%	49	74	trace silt above 5 cm of peat, then silt with trace clay
				Trees 95%; Shrubs (tall) 5%	74	100	15 cm organic soil above then silt with trace sand
	B	Right	Southwest	River	0	9	-
				Grass 100%; Shrubs (dead) 50%	9	19	0.5 cm peat, then 4 cm silt, then peat
				Shrubs 100%	19	27	13 cm peat above silt with fine sand
				Shrubs (tall) 80%; Trees 20%	27	41	>18 cm peat
				Trees 50%; Shrubs 40%	41	97	
				Trees 90%; Shrubs 10%	97	100	peat
18+500	A	Left	Northwest	River	0	11	-

				Grass 95%; Shrubs (dead) 25%; Bare 5%	11	18	1 cm silt deposition, then 13 cm peat, then clayey silt
				Shrubs 90%; Trees 10%	18	36	6 cm organic soil above silt with trace clay
				Shrubs (tall) 100%	36	100	18 cm peat
	B	Right	Southeast	River	0	11	-
				Grass 95%; Shrubs (dead) 40%; Bare 5%	11	70	13 cm sand, then peat (near creek); 8 cm silt, then peat approx. 30 m from creek
				Shrubs (dead) 90% (75% herbaceous understory)	70	75	1 cm silt, then >20 cm org. peat
				Shrubs 80%; Trees 20% (grassy understory)	75	89	3 cm peat above silt with trace clay and sand
				Grass 100%; Shrubs 75% (wet)	89	100	peat
19+000	A	Left	Southwest	River	0	6	-
				Grass 95%; Shrubs (dead) 25%; Bare 5%	6	23	3 cm of sand with trace gravel and cobble above org. peat
				Grass 100%; Shrubs (dead) 40%	23	37	-
				Grass 75%; Shrubs 25%	37	42	10 cm silt at surface, then 13 cm organics, then stones
				Shrubs (tall) 90%; Trees 10%	42	100	-
	B	Right	Northeast	River	0	6	-
				Grass 100%; Shrubs (dead) 40%	6	26	1 cm organics, then 2 cm silt, then peat
				Grass 100%; Shrubs (dead, standing) 40%; deadfall	26	58	1 cm silt above >15 cm peat
				Shrubs (short) 60%; Grass 40%; deadfall	58	63	-
				Trees 75%; Shrubs 25% (100% herbaceous understory)	63	87	-
				Shrubs 80%; Trees 20%	87	100	-
19+500	A	Left	East	River	0	10	-
				Grass 100%; Shrubs (dead) 5%	10	19	organic silty clay
				Grass 90%; Trees (dead) 80%; Shrubs (short) 10%	19	91	5 cm silt, 5 cm sandy silt, then peat
				Shrubs 85%; Trees 15% (sphagnum understory)	91	100	-
	B	Right	West	River	0	10	-

				Grass 95%; Shrubs (dead) 10%; Bare (sand) 5%	10	34	15 cm fine-medium sand above roots near creek, then 10 cm sand above organics further from creek
				Grass 90%; Trees (dead) 80%	34	100	5 cm silty sand, 3 cm of peat, then fine sand
20+000	A	Left	South-Southwest	River	0	10	-
				Bare 100%; Shrubs (dead) 5%	10	39	sand, gravel, cobble
				Grass 90%; Shrubs (dead) 25%; Bare 10%	39	100	13 cm of sand above organics
	B	Right	North-Northeast	River	0	10	-
				Grass 95%; Shrubs (dead) 20%; Bare 5%	10	28	3 cm silt with organics, 5 cm silt, then organics
				Grass 100%; Shrubs (tall, dead) 95%; Trees (dead) 5%	28	100	8 cm silt, then organics
20+500	A	Left	West	River	0	6	-
				Grass 100%; Shrubs (dead) 20%	6	29	fine layer of silt above organic soil
				Grass 100%; Shrubs (dead) 100%	29	42	>15 cm silt
				Grass 100%; Trees (dead) 100%	42	100	8 cm silt above peat
	B	Right	East	River	0	6	-
				Grass 100%; Shrubs (dead) 5%	6	25	5 cm silt above peat
				Grass 100%; Shrubs (dead) 40%	25	47	13 cm silt above peat
				Grass 90%; Shrubs (dead) 90%; Bare 10%	47	100	6 cm silt above peat
21+000	A	Left	West	River	0	11	-
				Grass 100%; Shrubs (dead) 20%	11	43	5 cm fine sand above organic soil
				Grass 100%; Trees (dead) 45%; Shrubs 45%	43	100	15 cm of silt above peat
	B	Right	East	River	0	11	-
				Grass 100%; Shrubs (dead) 20%	11	25	8 cm silt above peat
				Shrubs (1/2 dead) 100%	25	53	8 cm silt above peat
				Trees (1/2 dead) 100%	53	100	peat
21+500	A	Left	Southwest	River	0	11	-
				Grass 50%; Shrubs (1/3 dead) 70%	11	26	>13 cm silt
				Trees (dead) 75% (100% herbaceous understory)	26	100	3 cm silt above peat

	B	Right	Northeast	River	0	11	-
				Grass 100%; Shrubs (dead) 75%	11	23	>15 cm fine sand
				Trees (dead) 100%; Grass 50% (herbaceous understory)	23	100	8 cm silt above organic soil
22+000	A	Left	Southwest	River	0	10	-
				Grass 100%; Shrubs (dead) 40%	10	26	3 cm silt above >13 cm sand
				Trees (dead) 100%; Shrubs (1/2 dead) 20%	26	69	5 cm silt above peat
				Trees 100%; Shrubs 10% (sphagnum understory)	69	100	peat
	B	Right	Northeast	River	0	10	-
				Grass 100%; Shrubs (dead) 10%	10	22	5 cm silt above peat
				Grass 100%; Trees (dead) 80%	22	48	5 cm silt above peat
				Trees 100% (100% herbaceous understory)	48	100	peat with trace silt
22+500	A	Left	West	River	0	22	-
				Bare 95%; Grass 5%	22	35	3 cm silt above sand/gravel
				Grass 95%; Trees (dead) 75%; Bare 5%	35	100	13 cm silt above peat
	B	Right	East	River	0	22	-
				Grass 100%; Shrubs (dead) 40%	22	29	3 cm silt above peat
				Trees (dead) 100%; Grass 50% (herbaceous understory)	29	42	-
				Trees 100%; Shrubs 40% (herbaceous and sphagnum understory)	42	100	-
23+000	A	Left	Southwest	River	0	20	-
				Grass 100%; Shrubs (dead) 50%	20	25	3 cm silt above organic soil
				Trees (dead) 75%; Shrubs (dead) 25% (100% herbaceous understory)	25	50	3 cm silt above organic soil
				Trees (dead) 90% (75% herbaceous understory)	50	78	peat
				Trees 100% (75% herbaceous understory)	78	100	peat
	B	Right	Northeast	River	0	20	-
				Grass 100%; Shrubs (dead) 50%	20	31	5 cm silt above organic soil
				Trees (dead) 75% (100% herbaceous understory)	31	45	-
				Trees 100%; Shrubs 25% (100% herbaceous understory)	45	100	peat
23+500	A	Left	South	River	0	6	-
				Grass 95%; Shrubs (dead) 40%	6	46	>10 cm silt

				Trees (dead) 100% (90% herbaceous understory)	46	100	3 cm of silt above organic soil
	B	Right	North	River	0	6	-
				Grass 90%; Shrubs (dead) 25%; Bare 10%; Shrubs 5%	6	16	13 cm organic soil above silt
				Trees 75%; Shrubs 10% (75% herbaceous understory)	16	20	-
				Trees 100% (sphagnum understory)	20	39	peat
				Trees 90%; Shrubs 40% (sphagnum understory)	39	100	peat
24+000	A	Left	West	River	0	12	
				Bare 100%	12	13	silt with gravel
				Shrubs 90%; Trees 10%	13	29	0.5 cm silt over organic soil
				Shrubs (tall) 50%; Trees 30% (100% herbaceous understory)	29	58	-
				Trees 80%; Shrubs 15% (100% herbaceous understory)	58	100	-
	B	Right	East	River	0	12	-
				Grass 100%; Shrubs (dead) 75%; Trees (dead) 10%	12	50	10 cm of silt above organic soils
				Grass 100%; Trees (dead) 90%; Shrubs 25% (wet ground)	50	66	-
				Trees 100%; Grass 50%; Shrubs 50%	66	100	-
24+500	A	Left	West	River	0	15	-
				Grass 90%; Shrubs (dead; on ground) 75%	15	23	5 cm silt above organic soil
				Grass 90%; Shrubs (dead; standing) 75%	23	33	5 cm silt above organic soil
				Shrubs 100% (100% herbaceous understory)	33	41	-
				Trees 100% (100% herbaceous understory)	41	60	-
				Shrubs (tall) 95%; Trees 5% (sphagnum understory)	60	100	peat
	B	Right	East	River	0	15	-
				Grass 75%; Shrubs (dead) 25%; Trees (dead) 5% (25% herbaceous understory)	15	28	5 cm silt above organic soil
				Shrubs (dead) 100%; Grass 50% (50% herbaceous understory)	28	64	>15 cm silt with organics
				Trees (dead) 100%; Grass 50% (50% herbaceous understory)	64	100	
25+000	A	Left	Northwest	River	0	11	-
				Bare 95% (5% herbaceous shrubs)	11	13	silt

				Shrubs 25% (75% herbaceous shrubs)	13	17	-
				Shrubs 75%; Trees 10% (100% herbaceous understory)	17	26	trace silt above organic soil
				Trees (dead) 50%; Shrubs (tall) 50% (100% herbaceous understory)	26	44	-
				Trees 95%; Shrubs 5% (sphagnum understory)	44	58	peat
				Trees 100%; Shrubs 25% (sphagnum understory)	58	100	peat
	B	Right	Southeast	River	0	11	-
				Bare 100%	11	20	cobble
				Grass 100%; Shrubs (dead) 20%	20	38	10 cm silty organic soil above silt
				Grass 100%; Shrubs (dead) 20%	38	83	10 cm silty organic soil above silt
				Trees 50%; Shrubs 50% (sphagnum understory)	83	100	peat
25+500	A	Left	West	River	0	10	-
				Grass 100%; Shrubs (dead) 30%	10	37	5 cm silt above organic soil
				Shrubs (dead) 90%; Grass 50% (50% herbaceous understory)	37	100	8 cm silt, then 3 cm organic soil, then silt
	B	Right	East	River	0	10	-
				Shrubs (dead) 50%; Grass 50% (50% herbaceous understory)	10	18	10 cm organic soil above silt
				Shrubs 100% (100% herbaceous understory)	18	36	-
				Trees 50%; Shrubs 50%	36	53	-
				Shrubs (tall) 90%; Trees 10% (sphagnum understory)	53	100	-
26+000	A	Left	East-Northeast	River	0	7	-
				Bare 100%	7	10	5 cm silt above gravel
				Grass 100%; Shrubs (dead) 20%	10	75	-
				Grass 100%; Shrubs (dead) 65%	75	100	-
	B	Right	West-Southwest	River	0	7	-
				Grass 70%; Shrubs (dead) 50% (20% herbaceous understory)	7	19	silty organic soil
				Shrubs 95%; Trees 5%	19	62	-
				Shrubs (dead) 80%; Grass 80% (20% herbaceous understory)	62	100	-
26+500	A	Left	South-	River	0	8	-

			Southeast	Grass 100%; Shrubs (dead) 20%	8	51	15 cm sandy silt above organic soil
				Shrubs (dead) 50% (100% herbaceous understory)	51	75	-
				Trees (dead) 70% (100% herbaceous understory)	75	100	-
	B	Right	North-Northwest	River	0	8	-
				Grass 100%; Shrubs (dead) 20%	8	34	organic soil
				Shrubs (dead) 100%; Grass 50% (50% herbaceous understory)	34	50	peat
				Shrubs (tall) 100% (100% herbaceous understory)	50	79	-
				Trees 80%; Shrubs (tall) 20% (herbaceous understory)	79	100	-
27+000	A	Left	West	River	0	12	-
				Grass 95%; Shrubs (dead) 30%; Bare 5%	12	27	1 cm silt above >13 cm fine gravel
				Grass 95%; Trees (dead) 75%	27	73	-
				Trees (dead) 100% (75% herbaceous understory)	73	84	-
				Trees 95%; Shrubs (tall) 5% (100% herbaceous understory)	84	100	-
	B	Right	East	River	0	12	-
				Grass 100%; Shrubs (dead) 40%	12	37	1 cm silt above organic soil
				Shrubs 100% (100% herbaceous understory)	37	50	-
				Trees 50%; Shrubs (tall) 50% (100% herbaceous understory)	50	75	-
				Trees 50%; Shrubs (tall) 50% (sphagnum understory)	75	100	-
27+500	A	Left	West	River	0	13	
				Grass 100%; Trees (dead) 5%	13	26	6 cm silt above organic soil
				Shrubs 80%; Trees 20% (herbaceous understory)	26	61	> 13 cm organic soil
				Trees 80%; Shrubs 20%	61	100	very wet
	B	Right	East	River	0	13	-
				Bare 95%; Grass 5%	13	19	>15 cm sand and gravel
				Grass 100%; Shrubs (dead) 5%	19	46	sandy silt
				Shrubs 70%; Trees 30%	46	100	-
28+000	A	Left	East-	River	0	10	-

			Southeast	Grass 100%	10	14	1 cm silt above organic soil
				Shrubs 100%	14	34	-
				Trees 50%; Shrubs 50%	34	65	-
				Trees 100% (sphagnum understory)	65	100	peat
	B	Right	West-Northwest	River	0	10	-
				Bare 75%; Grass 25%	10	14	stones, gravel and silt
				Grass 95%; Bare 5%	14	62	-
				Trees 100%; Shrubs 100%	62	100	-

*[1] Note: Bank left or bank right is based on facing downstream.

FIGURES

APPENDICES

DRAFT

APPENDIX A3

TASK 16 – BUFFALO CREEK TOPOGRAPHIC SURVEYS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 16**

REPORT DATE: July 15, 2013

BY: Jordan Kiez

POSITION TITLE: GIS Technologist

Buffalo Creek Topographic Survey
July 3, 2013

Weather:

- Clear and sunny, winds calm
- Temperature between 25°C and 30°C
- Very hot working conditions

Day 1 Cross Sections

- Two separate GIS crews were established to reproduce the GIS transect survey work that was conducted along Buffalo Creek prior to operation of the Reach 1 Emergency Outlet Channel.
- Crew 1 consisted of Jordan Kiez, Andrew Chan and Dan Bigelow, while Crew 2 consisted of Andre Laframboise, Turk Scatliff and Cory Zimberg-Collins.
- Dan Leitch and Nadine Hanneson also worked along side us, but working on separate environmental studies.
- Before Crew 2 departed from the Big Rock Camp, they set up a Static GPS Occupation over a newly establish control point. The GPS collected Static data the entire day.
- After the base was set up, Taiga's sub-contracted helicopter and pilot (Cory) transported Crew 2 and the environmental crew to their starting station (Stn. 13+000).
- Two rental canoes were then slung to station 13+000.
- While Crew 2 and the environmental crew were setting up and being ferried to their starting station, GIS Crew 1 drove to the Dauphin River air strip to established a new control point (4ft rebar) and set up a GPS over this point to collected static data for the entire day.
- Crew 1 and all of their gear were picked up by Taiga at the air strip and taken to heli-pad #7. No slinging was involved because we had a collapsed Zodiac that fit inside the cab of the helicopter.
- After Crew 1 was dropped off, Taiga returned to Big Rock Camp and waited for the end of day to come pick us up.

- Once everybody was dropped off, Crew 2 started on section 13+000, while Crew 1 started on station 21+000
- Crew 1 completed sections on stations 21+000, 21+500, 22+000, and 22+500.
- Crew 2 completed sections on stations 13+000, 13+500, and started on section 14+000
- Crew 1 was picked up by Taiga and transported to the Dauphin River air strip to recover the static logger station and drive back to Big Rock Camp.
- The remaining staff were picked up and returned with the helicopter to Big Rock Camp.
- All of the boats remained at site.

July 4, 2013

Day 2 Cross Sections

- Same procedure as the day prior for the start of the day; Crew 2 set up and logged static GPS data and then were transported to the section that they left on the day before.
- While Crew 2 was setting up and getting transported to site, Crew 1 drove to Dauphin River Air Strip and set up the GPS static logger.
- Crew 1 was then taken to the section where they left off, and started to work downstream
- Crew 1 completed sections on stations 23+000, 23+500, 24+000, 24+500, and started on section 25+000
- Crew 2 completed sections on stations 14+000, 14+500, 15+000, and section 15+500

July 5, 2013

Day 3 Cross Sections

- Same procedure as the day prior for the start of the day; Crew 2 set up and logged static GPS data and then were transported the section that they left on the day before.
- While Crew 2 was setting up and getting transported to site, Crew 1 drove to Dauphin River Air Strip and set up the GPS static logger.
- Crew 1 was then taken to the section where they left off, and started to work downstream
- Crew 1 completed sections on stations 25+000, 25+500, 26+000, 26+500, 27+000 and started on section 27+500
- Crew 2 completed sections on stations 16+000, 16+500, 17+000 and section 17+500
- ***GPS for Crew 1 did not log static in the field, all sections done on this day needed to have the GPS Static logs redone***

July 6, 2013

Day 4 Cross Sections

- Same procedure as the day prior for the start of the day, Crew 2 set up and logged static GPS data and then got taken to the section that they left on the day before.
- While Crew 2 was setting up and getting transported to site, Crew 1 drove to Dauphin River Air Strip and set up the GPS static logger.
- Crew 1 was then taken to section 27+500. After the section was completed the Zodiac was slung to station 20+000 to split up the remaining sections.
- Crew 1 completed sections at 20+000 and 20+500 and then made there way downstream to redo static logs at station 25+000 and 25+000.
- Crew 2 completed sections on stations 18+000, 18+500, 19+000, and section 19+500

Day 5 Cross Sections

- All sections had been completed, only 3 sections need the GPS static logs to be redone.
- Crew 2 set up on the same known point that they have been setting up on the previous days, and then was taken to where Crew 1 was picked up the day before.
- Crew 1 went to Dauphin River Air Strip and setup on the known point, then was taken to the section where they were picked up the day before.
- Both Crews 1 and 2 worked along side each other for the rest of the remaining sections.
- Static logs were redone on sections 26+000, 26+500, and 27+000
- After the last section was finished, both crews were lifted to Dauphin River Air Strip with the deflated Zodiac, then the helicopter slung the canoe back to Big Rock Camp

Photos

13+000 Downstream

13+000 Right Bank Cut Line

13+000 Upstream

13+000 Left Bank Cut Line

13+500 Downstream

13+500 Right Bank Cut Line

13+500 Upstream

13+500 Left Bank Cut Line

14+000 Downstream

14+000 Right Bank Cut Line

14+000 Upstream

14+000 Left Bank Cut Line

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Section 16+500 Upstream

Section 16+500 Left Bank Cut Line

Section 17+000 Downstream

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23+500 North Cut

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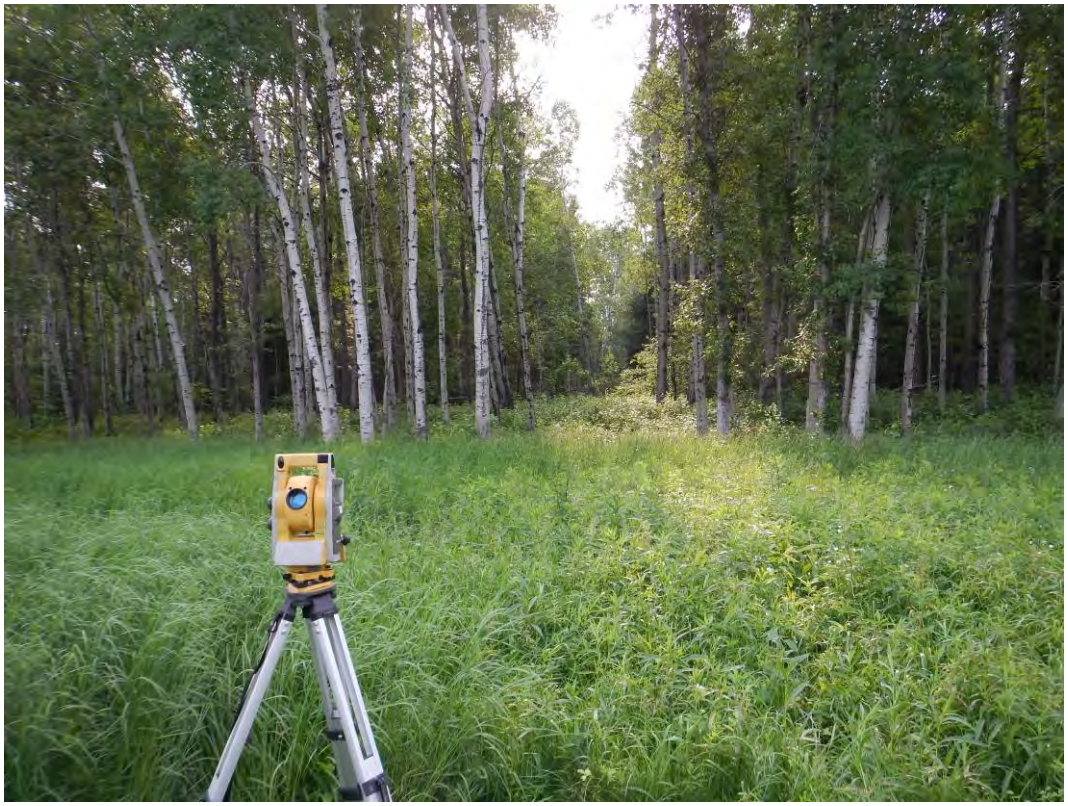
27+000 West Cut 1

27+000 West Cut 2

27+500 Downstream



27+000 East Cut

27+500 Upstream

27+500 West Cut

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APPENDIX A4

TASK 15 – DAUPHIN RIVER BATHYMETRIC SURVEYS

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 15**

REPORT DATE: 12 July 2013

BY: Kyle Perry

POSITION TITLE: Survey Technician

Dauphin River and Sturgeon Bay Bathymetric Survey
June 4-7 and July 22-23, 2013

Weather:

- Clear and sunny, winds calm
- Temperature between 23°C and 26°C

Transit to Lake St. Martin

- Kyle Perry and Corey Collins departed Winnipeg via ¾ Tonne Truck around 2pm Tuesday 04 June 2013.
- Arrived in Gypsumville around 8pm to meet with North/ South Consulting operator.
- Continued on to Bensons Big Rock camp.

Bathymetric Field Activities

Day 1 (June 5, 2013)

- Met with Johnny Peake (North/South) at 7am at Big Rock. Conducted a site Reconnaissance along the Dauphin River looking for a suitable boat launch. Once boat launch was determined KGS staff drove to the Dauphin River Air Strip to set up the GPS base on an existing control point.
- Sonar transducer and side scan was installed on North/ South Consulting's Jet boat and sonar survey commenced.
- Sonar work included:
    - The north and south banks, the centreline, and a criss-cross pattern heading upstream from the launch point towards big bend and approximately 1 km beyond. Also included the secondary channel at big bend.
    - Centreline of the channel from the boat launch to the confluence point Buffalo Creek.

Day 2 (July 6, 2013)

- Sonar work continued and includes the south bank and meandering between the banks from Launch point to the confluence with Buffalo Creek.

Day 3 (June 7, 2013)

- Attempted to complete the bathymetric survey of the north bank from the boat launch to buffalo creek however the boat hit a rock going through a particularly rough patch 3km west of buffalo creek and sonar transducer took was impacted resulting in a critical component malfunction. Repeated attempts to remedy the problem failed resulting in shutdown of bathymetric field activity until both the boat and the equipment could be repaired.
- Prior to returning to site to complete the work, a set of figures were produced which indicated the areas where the sonar work was completed during the June 4-7, 2013 (see Dauphin River Sonar Survey sheets 1 to 7).
- During bathymetric surveys along the north and south banks, videos with GIS locators were used to capture the riverbanks.

Return to site (July 22 and 23, 2013)

Weather:

- Clear and sunny, light winds
- Temperature between 25°C and 30°C

Transit to Dauphin River

- Kyle Perry drove truck up to Dauphin River and met Warren (North/South) onsite waiting with jet boat.
- Departed at 0500 hrs and drove to Dauphin River for bathymetric work.

Day 1 (July 22, 2013).

- Completed the North bank between the launch point established in June and Buffalo Creek.

Day 2 (July 23, 2013)

- Completed the north and south banks, the centreline, and a criss-cross pattern between the confluence with Buffalo Creek and the mouth of the Dauphin River at Sturgeon Bay.
- Completed a bathymetric survey of Sturgeon Bay.
- Video was captured along the north and south banks as well as along the shoreline at Sturgeon Bay; however, the GPS attachment may not have been working.

Photos

Photo 1. Sonar Mount from Back

Photo 2. Sonar Mount from side

Photo 3. Sonar Mount from side Close up

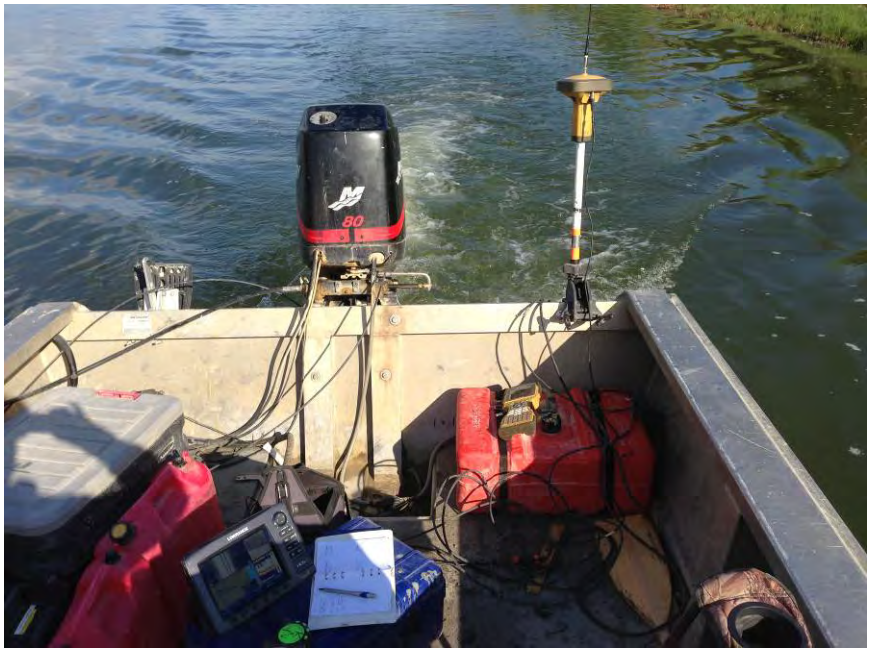

Photo 4. Sonar Mount in action

KGS GROUP CONSULTING ENGINEERS

Field Inspection Form

PROJECT: **Lake St. Martin Channel Monitoring - 2015**

CLIENT: **North/South Consultants Inc.**

CONTRACTOR:

FILE NO.: **13-0431-001 Task 18**

REPORT DATE: 02 July 2014 **BY:** Kyle Perry **POSITION TITLE:** Survey Technician

June 17 – 21, 2014 DAUPHIN RIVER SONAR

Weather:

- Over cast with light winds
- Temperature between 18°C and 23°C

Transit to Dauphin River

- Kyle Perry and Jim Hyde drove KGS truck up to DRFN and met Johnny Peake (North/South)
- Departed at 0630 hrs and drove to Dauphin River for bathymetric work.

Bathymetric Collection

- Tuesday 17 June 2014: Due to mobilization to Dauphin River, Sonar work was not started until 1200hrs. Work completed was all five lines from downstream of the rapids section to Sturgeon Bay. (Note: Tuesdays work was done in conjunction with NSC as they were conducting substrate mapping of the same work area)
- Wednesday 18 June 2014: Sonar work was started at 0700hrs. Work completed included cross-section style meandering sonar from downstream of the rapids section to Sturgeon Bay. (Note: This work was done in conjunction with NSC as they were substrate mapping the same work area and was finished at approx 1200hrs) Additional work this day included two river bank lines from Big Bend to just upstream of the rapids section
- Thursday 19 June 2014: Sonar work was started at 0700hrs. Work completed included Centreline and intermediate lines from Big Bend to upstream of the rapids. As well, as cross section style meandering from Big Bend to 6km downstream of Big Bend
- Friday 20 June 2014: Sonar work was started at 0700hrs. Work completed included detail of the mouth of Sturgeon Bay. (Note: This work was done in conjunction with NSC as they conducting substrate mapping of the same work area. Work was was finished at approx 1300hrs) Additional work completed this day included continuation of the cross-section style meandering from the previous day.
- Saturday 21 June 2014: Sonar work was started at 0700hrs. Work completed included;
    - Extra detail in a 400m section just downstream of the DRFN docks

    - Completion of the cross -style meandering up to the rapids section,
    - Capture of as much sonar data as possible through approximately 2km rough / rapids section
- River conditions: Typical Dauphin River conditions.

Transit Back to Winnipeg

- Kyle Perry Drove truck back to Winnipeg, June 21, 2014. Arrived back in city at 1900hrs

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APPENDIX B

DAUPHIN RIVER ICE RECONAISSANCE SURVEY PHOTOS

(PROVIDED ON CD)

DRAFT

APPENDIX C

FLOW METERING DETAILS

KGS GROUP CONSULTING ENGINEERS

Client:			
File No:	**13-0431-01**		
Project:	**13-0431-01**		
	Flow Metering - Buffalo Creek		
Sheet:	**1**	**of**	**1**
Date:	**28-Nov-13**	**By:**	**MH**
Checked:	**19-Mar-14**	**By:**	**GW**

Measurement

Info: Buffalo Creek
Date: 13-Nov-12
Time:
Station ID:
Site No.:

Crew Patrice Leclercq

Discharge Summary

Equipment: ADCP - RDI River Ray 600 without GPS
Metering Location: At logger

Transect	Start Bank	Total Q (m^3/s)	Delta Q %	Corrected Q for Bed Movement (m^3/s)
000	Right	45.82	-0.49	-
001	Left	45.56	-1.06	-
002	Left	46.76	1.55	-

Average (m^3/s): 46.05 -
St. Dev. (m^3/s): 0.63 -
St. Dev. / avg: 0.014 -

Upstream Water Level: n/a m
Downstream Water Level: n/a m

Gauge: n/a

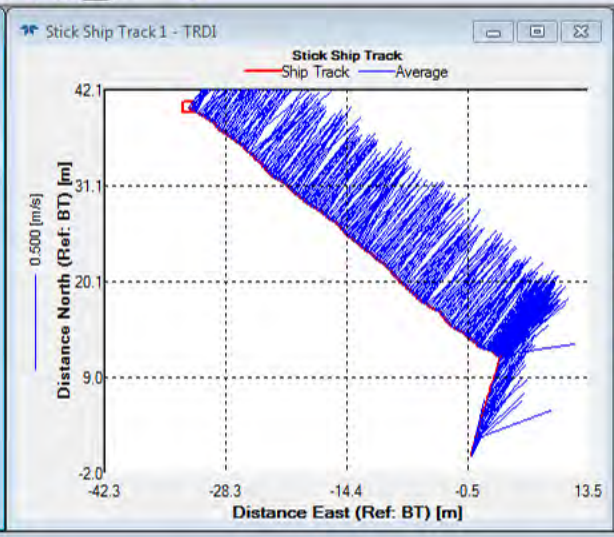
Note: Measurement did not include a loop test to correct for a potential moving bed.

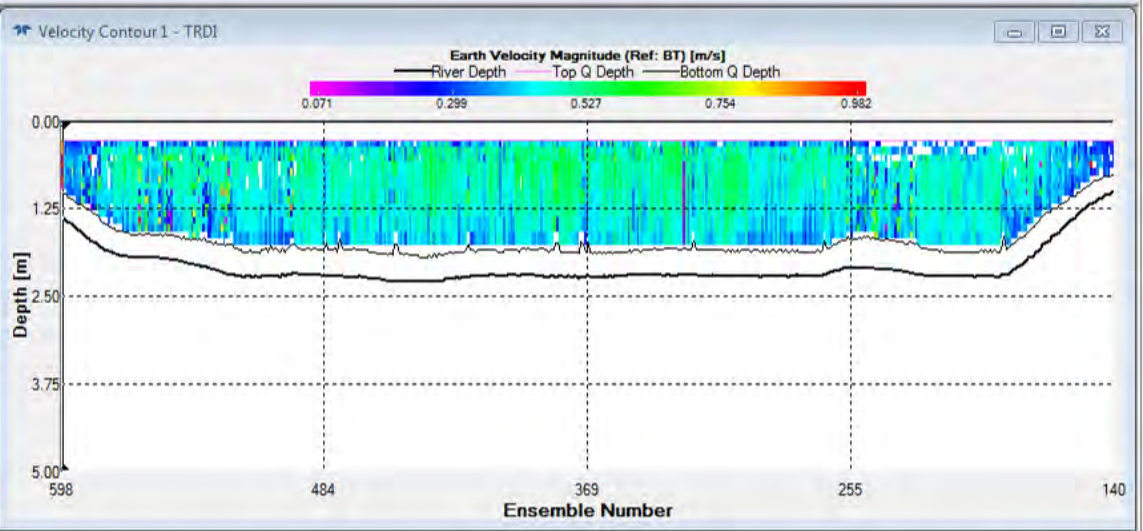
Final Discharge: 46.0 m^3/s
1626 ft^3/s

File Configure View Acquire Playback Window Help

MeasurementCtrl - TRDI

- r1_0.mmt
- Site Information
- Site Discharge
  - Transect 000
    - r1_0_000_12-11-13.PD0
    - Field Configuration
    - **Playback Configuration**
  - Transect 001
  - Transect 002
  - Discharge Summary
- QA/QC
  - Compass Calibration
- Collect Data





Discharge Summary - TRDI

Transect	Start Bank	# Ens.	Start Time	Total Q m³/s	Delta Q %	Top Q m³/s	Meas. Q m³/s	Bottom Q m³/s	Left Q m³/s	Left Dist. m	Right Q m³/s	Right Dist. m	Width m	Total Area m²	Q/Area m/s	Boat Speed m/s	Flow Speed m/s	Flow Dir. °	End Time	Durat s
r1000	Right	459	23:13:18	45.822	-0.48	6.757	31.001	7.232	0.602	3.00	0.230	2.00	56.72	109.97	0.417	0.202	0.435	38.15	23:18:33	315.
r1001	Left	386	23:18:47	45.556	-1.06	6.598	30.752	7.052	0.285	3.00	0.868	3.00	55.34	108.12	0.421	0.203	0.430	36.70	23:23:03	256.
r1002	Left	377	23:28:14	46.758	1.55	6.938	31.817	7.286	0.222	3.00	0.496	3.00	58.03	110.28	0.424	0.207	0.439	37.42	23:32:31	256.
Average		407		46.045	-0.00	6.764	31.190	7.190	0.370	3.00	0.531	2.67	56.70	109.46	0.421	0.204	0.435			
Std Dev.		45		0.631	1.37	0.170	0.557	0.123	0.204	0.00	0.320	0.58	1.35	1.17	0.004	0.003	0.005			
Std./| Avg.|		0.11		0.01	0.00	0.03	0.02	0.02	0.55	0.00	0.60	0.22	0.02	0.01	0.01	0.01	0.01			

KGS GROUP CONSULTING ENGINEERS

Client:	**MIT**		
File No:	**11-0300-08 - 1000.5**		
Project:	**2011 Flood Assistance**		
	Flow Metering - Assiniboine River		
Sheet:	**1**	**of**	**1**
Date:	**27-Nov-13**	**By:**	**MH**
Checked:	**19-Mar-14**	**By:**	**GW**

Measurement

Info: Buffalo Creek
Date: 14-May-13
Time: 10:30:00 AM
Station ID:
Site No.:

Crew Garrett Wellwood
Patrice Leclrecq

Discharge Summary

Equipment: ADCP - RDI River Ray 600 without GPS
Metering Location: At logger

Transect	Start Bank	Total Q (m^3/s)	Delta Q %	Corrected Q for Bed Movement (m^3/s)
000	Left	9.49	0.27	-
001	Right	9.51	0.50	-
004	Left	9.35	-1.21	-
005	Right	9.50	0.43	-

Average (m^3/s):	9.46	-
St. Dev. (m^3/s):	0.08	-
St. Dev. / avg:	0.008	-

Upstream Water Level: 221.55 m
Downstream Water Level: 221.55 m

Gauge: 1.27 m

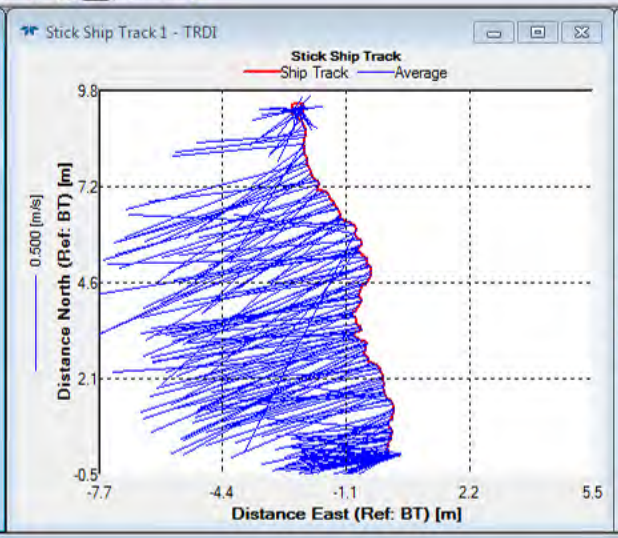
Note: Measurement did not include a loop test to correct for a potential moving bed.

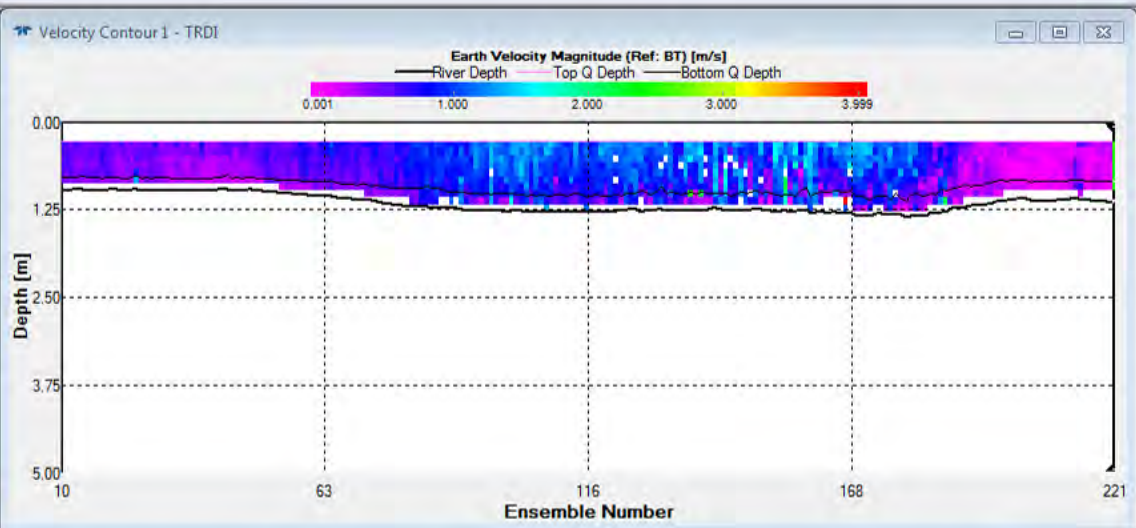
Final Discharge: 9.5 m^3/s
334 ft^3/s

File Configure View Acquire Playback Window Help

MeasurementCtrl - TRDI

spring 2013_0.mmt
- Site Information
- Site Discharge
  - [x] Transect 000
  - [x] Transect 001
  - [ ] Transect 002
  - [ ] Transect 003
  - [x] Transect 004
  - [x] Transect 005
  - [ ] Transect 006
  - Discharge Summary
- QA/QC
  - Compass Calibration
- Collect Data





Discharge Summary - TRDI

Transect	Start Bank	# Ens.	Start Time	Total Q m³/s	Delta Q %	Top Q m³/s	Meas. Q m³/s	Bottom Q m³/s	Left Q m³/s	Left Dist. m	Right Q m³/s	Right Dist. m	Width m	Total Area m²	Q/Area m/s	Bc
spring 2013000	Left	212	05:18:06	9.486	0.28	2.312	5.229	1.745	0.169	1.00	0.031	1.00	11.59	12.79	0.742	
spring 2013001	Right	237	05:21:39	9.507	0.50	2.341	5.239	1.803	0.089	1.00	0.035	1.00	11.96	13.01	0.731	
spring 2013004	Left	217	05:29:49	9.346	-1.21	2.300	5.220	1.722	0.072	1.00	0.032	1.00	12.11	13.27	0.704	
spring 2013005	Right	149	05:32:22	9.501	0.43	2.361	5.230	1.779	0.095	1.00	0.036	1.00	12.26	13.24	0.717	
Average		203		9.460	0.00	2.328	5.230	1.762	0.106	1.00	0.033	1.00	11.98	13.08	0.723	
Std Dev.		38		0.077	0.81	0.028	0.008	0.036	0.043	0.00	0.003	0.00	0.29	0.23	0.017	
Std./| Avg.|		0.19		0.01	0.00	0.01	0.00	0.02	0.40	0.00	0.08	0.00	0.02	0.02	0.02	

PHOTOS

Photo 1. BC-TM, flow metering location – looking upstream

Photo 2. BC-TM, flow metering location – looking downstream.

Photo 3: BC-TM, gauge board reading 1.3 m.

Photo 4: BC-TM, Turbidity and pressure logger install location, looking upstream.

Photo 5: BC-TM, Turbidity and pressure logger install location, looking downstream

KGS GROUP CONSULTING ENGINEERS

Client:	**MIT**		
File No:	**11-0300-08 - 1000.5**		
Project:	**13-0431-01**		
	Flow Metering - Buffalo Creek		
Sheet:	**1**	**of**	**1**
Date:	**27-Nov-13**	**By:**	**MH**
Checked:	**19-Mar-14**	**By:**	**GW**

Measurement

Info:	Buffalo Creek
Date:	14-Aug-13
Time:	1:30:00 PM
Station ID:	
Site No.:	

Crew Garrett Wellwood
Dan Leitch

Discharge Summary

Equipment: ADCP - RDI River Ray 600 without GPS
Metering Location: At logger

Transect	Start Bank	Total Q (m^3/s)	Delta Q %	Corrected Q for Bed Movement (m^3/s)
001	Left	0.99	-1.65	-
003	Left	1.03	2.55	-
005	Left	0.98	-2.35	-
008	Right	1.02	1.45	-

Average (m^3/s): 1.00
St. Dev. (m^3/s): 0.02
St. Dev. / avg: 0.024

Upstream Water Level: 220.93 m
Downstream Water Level: 220.93 m

Gauge: 0.64

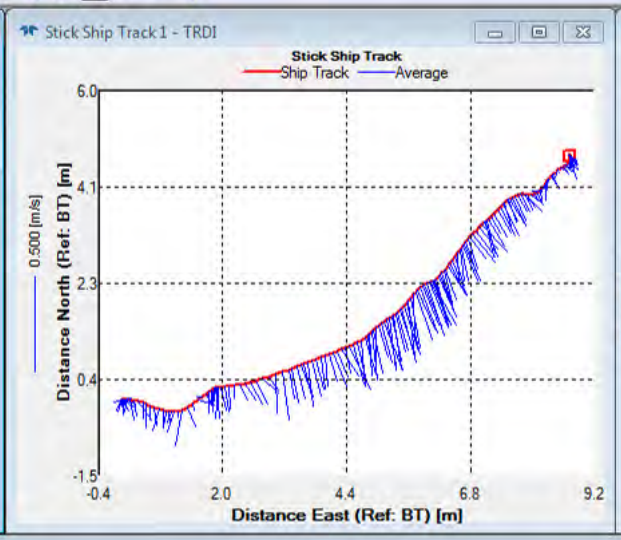
Note: Measurement did not include a loop test to correct for a potential moving bed.

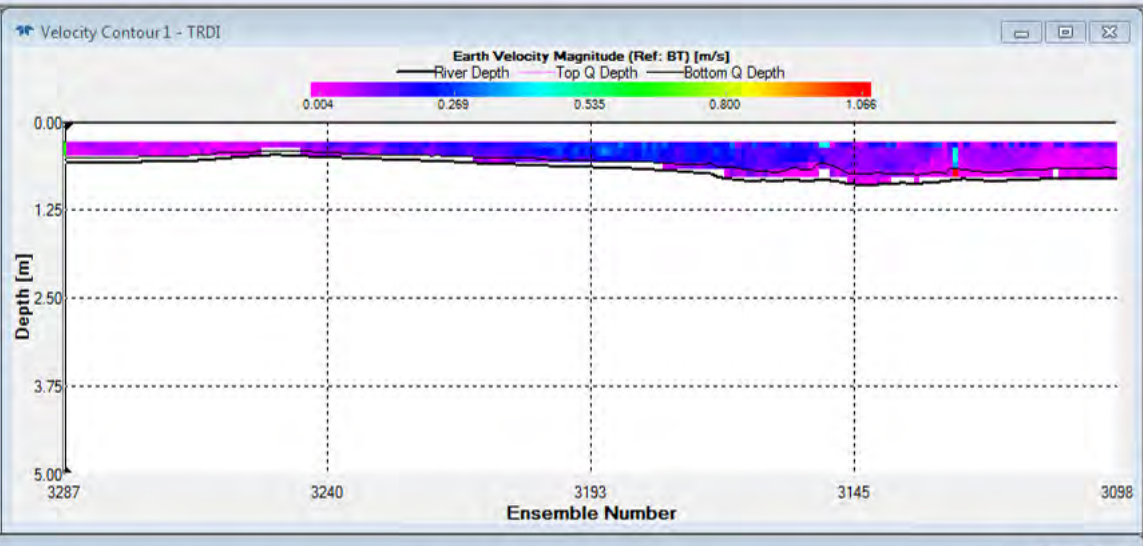
Final Discharge: 1.0 m^3/s
35 ft^3/s

File Configure View Acquire Playback Window Help

MeasurementCtrl - TRDI

- 01_0.mmt
  - Site Information
  - Site Discharge
    - Transect 000
    - Transect 001
    - Transect 002
    - Transect 003
    - Transect 004
    - Transect 005
    - Transect 006
    - Transect 007
    - Transect 008
    - Discharge Summary
  - Collect Data





Discharge Summary - TRDI

Transect	Start Bank	# Ens.	Start Time	Total Q m³/s	Delta Q %	Top Q m³/s	Meas. Q m³/s	Bottom Q m³/s	Left Q m³/s	Left Dist. m	Right Q m³/s	Right Dist. m	Width m	Total Area m²	Q/Area m/s	Boat Speed m/s	Flow Speed m/s	Flow Dir. °	End Time	Durat s
01005	Left	172	04:48:37	0.978	-4.62	0.424	0.371	0.176	0.004	0.30	0.002	0.40	10.49	6.98	0.140	0.119	0.122	168.18	04:50:09	92.3
01006	Right	179	04:50:18	1.054	2.81	0.455	0.371	0.219	0.004	0.30	0.005	0.40	10.61	7.11	0.148	0.112	0.133	163.51	04:51:56	97.7
01007	Left	171	04:54:42	1.052	2.69	0.452	0.387	0.202	0.003	0.30	0.007	0.40	10.77	7.10	0.148	0.119	0.115	167.14	04:56:20	98.3
01008	Right	190	04:56:33	1.016	-0.88	0.439	0.363	0.206	0.004	0.30	0.004	0.40	10.64	7.15	0.142	0.106	0.129	164.42	04:58:15	101.
Average		178		1.025	-0.00	0.442	0.373	0.201	0.004	0.30	0.005	0.40	10.63	7.08	0.145	0.114	0.125			
Std Dev.		9		0.036	3.52	0.014	0.010	0.018	0.000	0.00	0.002	0.00	0.11	0.07	0.004	0.006	0.008			
Std./| Avg.|		0.05		0.04	0.00	0.03	0.03	0.09	0.03	0.00	0.46	0.00	0.01	0.01	0.03	0.05	0.06			

PHOTOS

Photo 1. BC-TM, flow metering transect – looking upstream

Photo 2. BC-TM, flow metering location – looking upstream.

Photo 3: BC-TM, flow metering location – looking downstream.

Photo 4: BC-TM, Turbidity and pressure logger location, looking upstream.

Photo 5: BC-TM, Turbidity and pressure logger location, looking downstream

Photo 5: BC-TM, Turbidity logger and gauge board (gauge board 0.72 m)

KGS GROUP CONSULTING ENGINEERS

Client:	**MIT**		
File No:	**11-0300-08 - 1000.5**		
Project:	**13-0431-01**		
	Flow Metering - Buffalo Creek		
Sheet:	**1**	**of**	**1**
Date:	**27-Nov-13**	**By:**	**MH**
Checked:	**19-Mar-14**	**By:**	**GW**

Measurement

Info:	Buffalo Creek
Date:	16-Oct-13
Time:	1:20:00 PM
Station ID:	
Site No.:	

Crew Garrett Wellwood
Dan Leitch

Discharge Summary

Equipment: ADCP - RDI River Ray 600 without GPS
Metering Location: BC-TM

Transect	Start Bank	Total Q (m^3/s)	Delta Q %	Corrected Q for Bed Movement (m^3/s)
002	Right	0.70	4.63	-
003	Left	0.66	-0.64	-
004	Right	0.67	0.72	-
005	Left	0.63	-4.40	-

Average (m^3/s): 0.67
St. Dev. (m^3/s): 0.03
St. Dev. / avg: 0.040

Upstream Water Level: 220.93 m
Downstream Water Level: 220.93 m

Gauge: 0.64

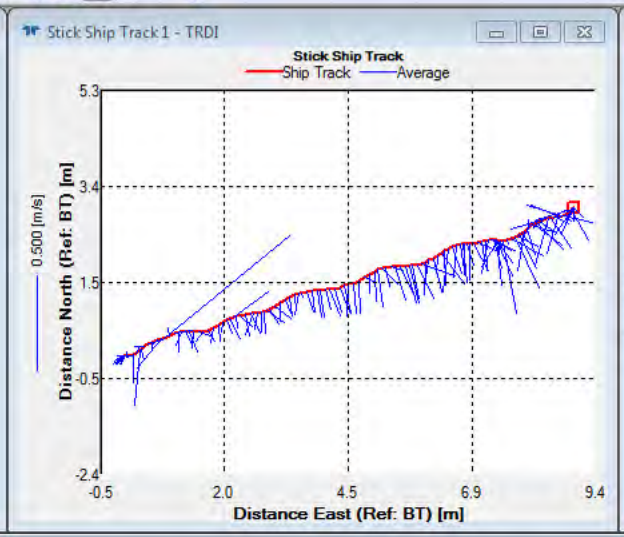
Note: Measurement did not include a loop test to correct for a potential moving bed.

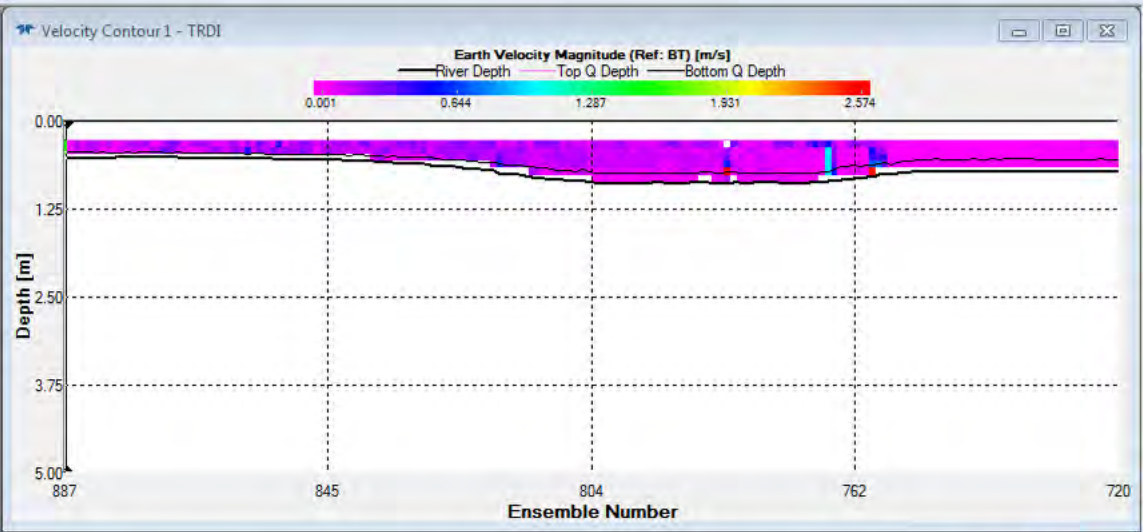
Final Discharge: 0.7 m^3/s
23 ft^3/s

File Configure View Acquire Playback Window Help

MeasurementCtrl - TRDI

pad18_0.mmt
- Site Information
- Site Discharge
  - Transect 000
  - Transect 001
  - Transect 002
  - Transect 003
  - Transect 004
  - Transect 005
  - Discharge Summary
- Collect Data





Discharge Summary - TRDI

Transect	Start Bank	# Ens.	Start Time	Total Q m³/s	Delta Q %	Top Q m³/s	Meas. Q m³/s	Bottom Q m³/s	Left Q m³/s	Left Dist. m	Right Q m³/s	Right Dist. m	Width m	Total Area m²	Q/Area m/s	Boat Speed m/s	Flow Speed m/s	Flow Dir. °	End Time	Durat s
pad18002	Right	168	18:45:03	0.698	4.92	0.289	0.257	0.131	0.015	1.00	0.006	0.50	10.92	7.40	0.094	0.109	0.081	165.14	18:46:33	90.(
pad18003	Left	149	18:46:49	0.660	-0.74	0.270	0.249	0.115	0.013	1.00	0.013	0.50	10.73	7.25	0.091	0.124	0.081	174.76	18:48:11	82.'
pad18004	Right	125	18:48:47	0.669	0.62	0.276	0.250	0.129	0.011	1.00	0.003	0.50	11.07	7.52	0.089	0.147	0.089	162.33	18:49:55	67.9
pad18005	Left	146	18:50:05	0.633	-4.80	0.273	0.233	0.118	0.010	1.00	-0.000	0.50	10.91	7.40	0.086	0.135	0.088	184.93	18:51:24	78.3
Average		147		0.665	-0.00	0.277	0.247	0.123	0.012	1.00	0.006	0.50	10.91	7.39	0.090	0.129	0.085			
Std Dev.		18		0.027	4.01	0.008	0.010	0.008	0.002	0.00	0.006	0.00	0.14	0.11	0.003	0.016	0.004			
Std./| Avg.|		0.12		0.04	0.00	0.03	0.04	0.06	0.18	0.00	1.00	0.00	0.01	0.01	0.04	0.13	0.05			

SITE PHOTOS

October 16, 2013 – Buffalo Creek staff gauge

October 16, 2013 – Buffalo Creek metering site (Flow Tracker)

October 16, 2013 – Buffalo Creek looking downstream of metering location

October 16, 2013 – Buffalo Creek looking upstream of metering location

October 16, 2013 – Buffalo Creek (adjacent to main channel), beaver dam downstream of BC-TM

October 16, 2013 – Buffalo Creek, beaver dam (main channel)

October 16, 2013 – Dauphin River, turbidity logger near shore in background

KGS GROUP CONSULTING ENGINEERS

Client:	**MIT**		
File No:	**11-0300-08 - 1000.5**		
Project:	**13-0431-01**		
	Flow Metering - Buffalo Creek		
Sheet:	**1**	**of**	**1**
Date:	**16-May-14**	**By:**	**GW**
Checked:		**By:**	

Measurement

Info:	Buffalo Creek
Date:	15-May-14
Time:	2:30:00 PM
Station ID:	BC-TM
Site No.:	001

Crew Garrett Wellwood
Dan Leitch

Discharge Summary

Equipment: ADCP - RDI River Ray 600 without GPS
Metering Location: BC-TM

Transect	Start Bank	Total Q (m^3/s)	Delta Q %	Corrected Q for Bed Movement (m^3/s)
000	Left	6.46	0.64	-
001	Right	6.18	-3.78	-
002	Left	6.37	-0.76	-
003	Right	6.67	3.91	-

Average (m^3/s): 6.42
St. Dev. (m^3/s): 0.20
St. Dev. / avg: 0.032

Upstream Water Level: 221.46 m
Downstream Water Level: 221.43 m

Gauge: 0.78

Note: Moving bed not observed. Measurement did not include a loop test to correct for a potential moving bed.

Final Discharge: 6.4 m^3/s
227 ft^3/s