Water Crossing 1 – Tributary to Sheldrake Lake

The watercourse at the proposed crossing is a tributary between Upper Sheldrake Lake and Sheldrake Lake. The system collects surface flows from an area north of the existing Highway 103. The watershed for this water crossing is undeveloped as observed from aerial photography and property mapping.

At Highway 103 there is an existing 1800 mm diameter concrete culvert. This culvert will require an extension to accommodate the construction of a ramp from the proposed Highway 113. The existing culvert is in excellent shape and the ordinary high water mark appears to be only a little over half way up the culvert. The stream in the vicinity of the extension is approximately 10 m wide immediately upstream of the culvert. Large boulders are present at the inlet of the culvert, preceded by a pool and a defined channel. The predominant particle size upstream is boulder and the depth ranges from 25 mm in the riffles to greater than half a metre in the pool. The water shed is well vegetated with mixed forest.

Water Crossing 1 Tributary to Sheldrake Lake Basin Characteristics Upstream of Proposed Crossing	
Parameter	**Value**
Drainage Area	1.65 km^2
Drainage Length [Channel Length]	3.0 km [2.6 km (including lake)]
Average Basin Slope	2.0 %
Approximate Slope at Crossing Location	< 0.5 %
% Lakes	15.2 %
Estimated 1:2 Year Flow	1.01 m^3/s
Estimated 1:100 Year Flow	1.93 m^3/s

Water Crossing 2 - Tributary between Maple Lake and Fraser Lake

This water course is within the water shed of a large lake system that includes Cox' Lake, Flat Lake, Long Lake and Maple Lake. The tributary then discharges into Fraser Lake. A portion of this watershed includes residential development. It also includes small pockets of commercial establishments. The watercourse flows from the northwest of the proposed Highway 113 from Maple Lake into Fraser Lake.

Channel at the proposed highway

The watercourse is greater than 20 m wide at the approximate location of the highway crossing. The water had over topped the banks and was flooding the adjacent forested area. The water depth could not be estimated due to the width, darkness and depth of water in the stream. The visible stream bed was made up of predominantly boulder sized particles. There were no apparent pool/riffles along the watercourse.

The watershed in the area of the watercourse was mostly treed and moderately sloped. The large lakes directly up and downstream of the crossing directly affect the character of the stream.

Water Crossing 2 **Tributary between Maple Lake and Fraser Lake** **Basin Characteristics Upstream of Proposed Crossing**	
Parameter	**Value**
Drainage Area	20.0 km^2
Drainage Length [Channel Length]	9.2 km 8.5 [km]
Average Basin Slope	0.9 %
Approximate Slope at Crossing Location	<0.5 %
% Lakes	9.3 %
Estimated 1:2 Year Flow	5.0 m^3/s
Estimated 1:100 Year Flow	23.6 m^3/s

Water Crossings 3A, 3A2, 3B and 3C – Fishers Brook

Fishers Brook crosses the proposed highway at three locations at 3A, 3B and 3C. After crossing the proposed alignment at 3A, the stream flows into Frasers Lake. The water shed is predominantly undeveloped, but there is some residential development upstream of crossing 3C. Several large wetlands are part of the stream network.

Crossing 3A

Fishers Brook at 3A flows from the north at the proposed crossing of the 113. The channel width at 3A ranges up to 10 m and the channel bottom is comprised of mostly boulder sized rocks, with gravel and sand in pooled areas.

The terrain is moderate to steep with treed and vegetated banks. There are several fallen trees over the stream providing cover and several pool/riffle/run arrangements. The channel bank material and channel alignment north of the crossings do not indicate meander potential.

The following table presents the basin characteristics for the crossing obtained from 1:10,000 scale mapping.

Water Crossing 3A Fishers Brook Basin Characteristics Upstream of Proposed Crossing	
Parameter	**Value**
Drainage Area	3.15 km^2
Drainage Length [Channel Length]	4.86 km [4.79 km]
Average Basin Slope	1.1 %
Approximate Slope at Crossing Location	0.43 %
% Lakes	0.5 %
Estimated 1:2 Year Flow	3.99 m^3/s
Estimated 1:100 Year Flow	7.13 m^3/s

Crossing 3A2

The tributary to Fishers Brook at 3A2 flows from the southeast at the proposed 113 crossing. The channel width ranges up to 10 m and the channel bottom is comprised of mostly boulder sized rocks, with gravel and sand in pooled areas.

The watershed in the immediate vicinity of the proposed crossing is treed and very steeply sloped. Outside of the immediate area of the crossing, the terrain is essentially an area in the process of re-growth after fire damage. The slope of the stream is very steep.

The following table presents the basin characteristics for the crossing obtained from 1:10,000 scale mapping.

Water Crossing 3A2 Fishers Brook Tributary Basin Characteristics Upstream of Proposed Crossing	
Parameter	**Value**
Drainage Area	0.12 km^2
Drainage Length [Channel Length]	0.58 km [0.15 km]
Average Basin Slope	4.8 %
Approximate Slope at Crossing Location	5.9 %
% Lakes	0 %
Estimated 1:2 Year Flow	0.25 m^3/s
Estimated 1:100 Year Flow	0.53 m^3/s

Crossing 3B

Fishers Brook flows from the northeast as it crosses the proposed Highway 113 at 3B. The channel width at 3B is greater than 15 m and is essentially ponded in the area of the proposed crossing. There is a defined channel downstream. The character of the stream at the crossing is affected by the large wetland at the downstream end. The channel is approximately 1 m deep and very dark. The stable particle size was not visible during the field visit. The channel and the terrain are very flat. AS depicted in the adjacent photo,

the stream banks are vegetated with trees. Similar to the watershed for Crossing 3A2, the watershed includes areas of re- growth from a historic fire in the area.

The following table presents the basin characteristics for the crossing obtained from 1:10,000 scale mapping.

Water Crossing 3B Fishers Brook Basin Characteristics Upstream of Proposed Crossing	
Parameter	**Value**
Drainage Area	1.51 km^2
Drainage Length [Channel Length]	3.10 km [3.03 km]
Average Basin Slope	0.8 %
Approximate Slope at Crossing Location	< 0.5 %
% Lakes	0 %
Estimated 1:2 Year Flow	2.14 m^3/s
Estimated 1:100 Year Flow	3.97 m^3/s

Crossing 3C

Crossing 3C is a ponded area, approximately 15 m wide, bordered by wetland. Although the observed flow was very low, the apparent flow from mapping is from the north across

the proposed 113. The channel bottom was not visible during the field visit and therefore depth and stable particle size were not ascertained.

The watershed in the immediate vicinity of the proposed crossing is marshy and grassed. A strip of trees outlines the marshy area. The terrain is fairly flat.

The following table presents the basin characteristics for the crossing obtained from 1:10,000 scale mapping.

Water Crossing 3C Fishers Brook Basin Characteristics Upstream of Proposed Crossing	
Parameter	**Value**
Drainage Area	1.24 km^2
Drainage Length [Channel Length]	2.46 km [2.39 km]
Average Basin Slope	1.0 %
Approximate Slope at Crossing Location	< 0.5 %
% Lakes	1.2 %
Estimated 1:2 Year Flow	2.48 m^3/s
Estimated 1:100 Year Flow	4.82 m^3/s

Water Crossing 4 – Stillwater Run

This water course is within the water shed of a large lake system that includes Ash Lake, Long Lake, and Morton's Lake. Stillwater Run then flows overland and discharges into Stillwater Lake and eventually joins the outlet of Fraser Lake. The tributary then discharges into Fraser Lake. A portion of this watershed includes residential development surrounding Long Lake and Mortons Lake. The watercourse flows from the north of the proposed Highway 113.

Channel at the proposed highway

The watercourse width varies in the area of the proposed crossing from about 1 m wide as depicted in the adjacent photo where the stream is defined to greater that 20 m wide in a flooded area as evident in the photo below. The area in the vicinity of the watercourse was clear cut and the topography is generally flat. The water depth was approximately 1 m deep in the defined channel. The stable particle was cobble/boulder. There were apparent pool/riffle/runs along the watercourse.

The following table presents the basin characteristics for the crossing obtained from 1:10,000 scale mapping.

Water Crossing 4 Stillwater Run Basin Characteristics Upstream of Proposed Crossing	
Parameter	**Value**
Drainage Area	2,52 km^2
Drainage Length [Channel Length]	4.66 km [4.30 km]
Average Basin Slope	0.7 %
Approximate Slope at Crossing Location	0.5 %
% Lakes	17.1 %
Estimated 1:2 Year Flow	6.65 m^3/s
Estimated 1:100 Year Flow	12.25 m^3/s

Water Crossing 5 – Outlet of Ragged Lake

This water course is within the water shed of Ragged Lake and Lewis Lake. The outlet of Ragged Lake crosses the proposed 113 from the north and eventually flows to Stillwater Run. This watershed is mostly developed with residential properties around Ragged Lake and Lewis Lake.

Crossing at 5

The watercourse at crossing 5 flows from the north across the proposed alignment for Highway 113. At the approximate crossing location, the channel varies from 1 m wide at the defined channel to 10 m wide at a pool. Beyond the pool on the downstream side, there is a wetland. The water depth ranges from a few centimetres in the riffle to > 1m in the pool. The stable particle varies from boulder sized in the channel to gravel sized in the pool. The slope of the channel is fairly flat and the terrain varies from shallow to the west of the stream and steep on the east. The watershed is mainly treed in the vicinity of the crossing.

The following table presents the basin characteristics for the crossing obtained from 1:10,000 scale mapping.

Water Crossing 5 **Outlet of Ragged Lake** **Basin Characteristics Upstream of Proposed Crossing**	
Parameter	**Value**
Drainage Area	2.60 km^2
Drainage Length [Channel Length]	3.8 km [3.5 km]
Average Basin Slope	0.8 %
Approximate Slope at Crossing Location	< 0.5 %
% Lakes	18.4 %
Estimated 1:2 Year Flow	7.74 m^3/s
Estimated 1:100 Year Flow	14.0 m^3/s

Crossing at 5A

The tributary to the outlet of Ragged Lake flows from the southeast across the proposed Highway 113 where it joins the Outlet of Ragged Lake. The channel varies from less than 1 m wide at the defined channel to 1.5 m wide in the pool. Similar to crossing 5, the tributary to the outlet of Ragged Lake flows into a wetland on the downstream side. The water depth ranges from a few centimetres in the riffle to about 30 cm in the pool. The stable particle varies from boulder sized in the channel to gravel sized in the pool. The slope of the channel is fairly steep. The terrain is vegetated with trees and fairly steep on both banks of the stream.

The following table presents the basin characteristics for the crossing obtained from 1:10,000 scale mapping.

Water Crossing 5A Outlet of Ragged Lake Tributary Basin Characteristics Upstream of Proposed Crossing	
Parameter	**Value**
Drainage Area	0.16 km^2
Drainage Length [Channel Length]	0.37 km [0.37 km]
Average Basin Slope	4.3 %
Approximate Slope at Crossing Location	5.6 %
% Lakes	0 %
Estimated 1:2 Year Flow	0.19 m^3/s
Estimated 1:100 Year Flow	0.36 m^3/s

Water Crossing 6 – Black Duck Brook

This water course flows southeast across the proposed highway alignment and eventually into Kearney Lake. This watershed is predominantly residentially developed with single family dwellings.

Channel at the proposed highway

The watercourse width varies in the area of the proposed crossing from about 2 m wide in the runs and up to 10m wide in the pools. The area in the vicinity of the watercourse is treed and the banks of the channel are steep. As the photographs indicate, several trees have fallen over the channel. The water depth ranges from 20 cm to 30 cm. The stable particle is cobble/boulder. There were apparent pool/riffle/runs along the watercourse.

The following table presents the basin characteristics for the crossing obtained from 1:10,000 scale mapping.

Water Crossing 6 **Black Duck Brook** **Basin Characteristics Upstream of Proposed Crossing**	
Parameter	**Value**
Drainage Area	2.74 km^2
Drainage Length [Channel Length]	2.97 km [2.63 km]
Average Basin Slope	2.2 %
Approximate Slope at Crossing Location	4.3 %
% Lakes	2.2 %
Estimated 1:2 Year Flow	12.8 m^3/s
Estimated 1:100 Year Flow	25.1 m^3/s

A drainage course was observed during field work within the watershed of Black Duck Brook. It is believed to be a seasonal drainage area. It is depicted in the above-right photograph.

Watercourse 7- Tributary to Kearney Run

The watercourse at the proposed crossing is a tributary to Kearney Run which flows into Kearney Lake. Kearney Run is a channel between Kearney Lake and Papermill Lake. The system collects surface flows from an area north of the proposed Highway 113. The watershed for this water crossing is essentially undeveloped as observed from aerial photography and property mapping. There is some commercial development in the northeast edge of the boundary. The watershed is bordered by Kearney Lake Road to the west and Bluewater Road to the North.

Channel at the proposed highway
Upstream of the approximate crossing location is a ponded area that is approximately 40 m long and 20 m wide. The watercourse width in the area of the proposed crossing is about 2 m wide. The area in the vicinity of the watercourse is treed and the banks on the south east side of the channel are steep and the northwest side are moderate. As the photograph to the left indicates, several trees have fallen over the channel. The water depth ranges from 2 cm to 20 cm. The stable particle is cobble/boulder. There were apparent pool/riffle/runs along the watercourse.

The following table presents the basin characteristics for the crossing obtained from 1:10,000 scale mapping

Water Crossing 7 Tributary to Kearney Run Basin Characteristics Upstream of Proposed Crossing	
Parameter	**Value**
Drainage Area	0.67 km^2
Drainage Length [Channel Length]	1.1 km [0.58 km]
Average Basin Slope	1.5 %
Approximate Slope at Crossing Location	0.8 %
% Lakes	0 %
Estimated 1:2 Year Flow	0.52 m^3/s
Estimated 1:100 Year Flow	0.97 m^3/s

Watercourse 8 - Tributary to Papermill Lake

The proposed crossing is over a tributary to Papermill Lake. The tributary collects water collects surface flows from an area northwest of the existing Highway 102. The watershed for this water crossing is currently undeveloped with the exception of some commercial developments on the northwest boundary. There is also a tributary to this watercourse that will also require a crossing (8A)

Upstream of the crossing is a large wetland as depicted in the attached photo. The channel currently flows under the existing Highway 102 through a 900 mm diameter concrete culvert. Downstream of the highway the channel flows into another wetland. The existing concrete culvert is in excellent condition and the high water mark appears to be approximately half way up the culvert. There is a pool upstream of the culvert and a meandering stream through the wetland. The immediate watershed is fairly flat and is vegetated with grasses.

As discussed above, a second channel flows along Highway 102 and into the wetland that eventually flows into this watercourse. It is a very small channel that takes ditch flow from the high point on Highway 101 and discharges into water crossing 8. It is only 1 to 2 m wide and less than 0.5 m deep.

The following table presents the basin characteristics for the crossing obtained from 1:10,000 scale mapping.

Water Crossing 8 Tributary to Papermill Lake Basin Characteristics Upstream of Proposed Crossing	
Parameter	**Value**
Drainage Area	1.15 km^2
Drainage Length [Channel Length]	1.64 km [1.54 km]
Average Basin Slope	1.5 %
Approximate Slope at Crossing Location	0.8 %
% Lakes	0 %
Estimated 1:2 Year Flow	0.89 m^3/s

Water Crossing 8 **Tributary to Papermill Lake** **Basin Characteristics Upstream of Proposed Crossing**	
Estimated 1:100 Year Flow	1.66 m^3/s