



G R E E R
G A L L O W A Y
C O N S U L T I N G
E N G I N E E R S

November 22, 2022

Municipality of Magnetawan
P.O. Box 70, 4304 Hwy 520
Magnetawan, ON
P0A 1P0

Attention: Mr. Scott Edwards, Public Works Superintendent

Re: Poverty Bay Road Culvert Replacement

As requested by the Township of Magnetawan, the Greer Galloway Group has completed an as-built survey of the Poverty Bay Road Culvert replacement project. This letter is in response to homeowners concerns regarding the culvert inverts, potential flow rates through the new culvert, and design parameters contained in the Canadian Highway Bridge Design Code (CHBDC).

Watershed Characteristics

West Poverty Bay acts as an equalization basin for the Magnetawan river system. The Magnetawan river is a controlled water system meaning the water levels within the system are regulated through the use of control structures. The two structures upstream of West Poverty Bay, located at Knoepfli Falls & Old Mill Bay, regulate the amount of water exiting Ahmic Lake and accordingly the amount of water entering the section of river encompassing West Poverty Bay.

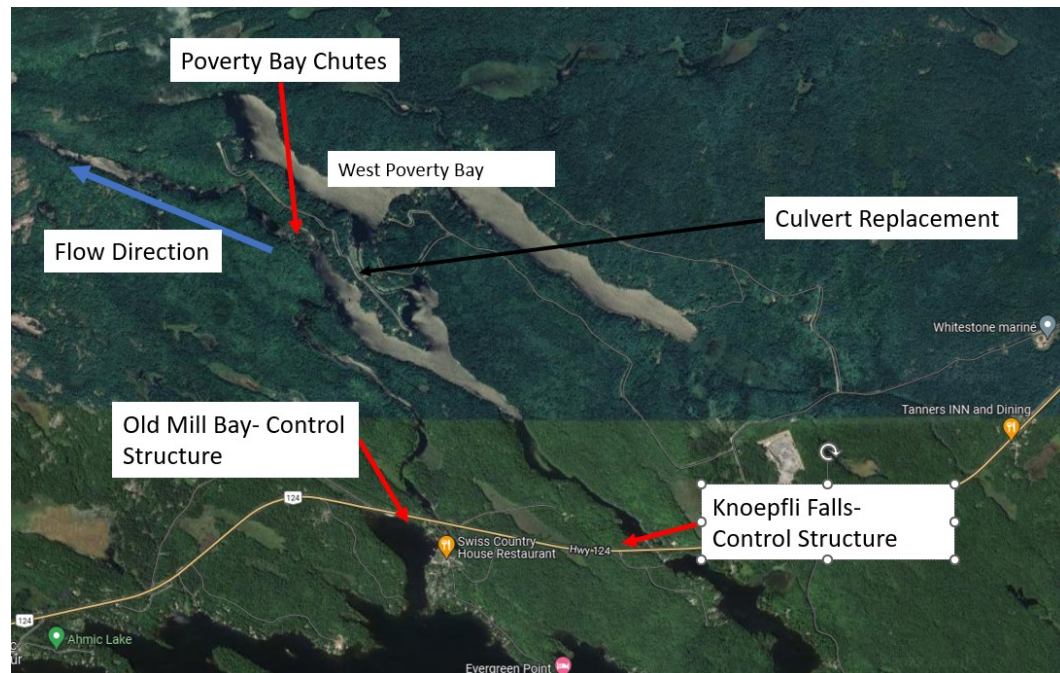


Figure #1: Watershed system around West Poverty Bay

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The Government of Canada maintains a real-time hydrometric data logger at Ahmic Harbor (02EA019- AHMIC LAKE) on Ahmic Lake. Below is a graph detailing the changes in water elevations from 2021-03-01 to 2022-11-01 (Blue is 2021, Green 2022). Of particular relevance for this letter is the change in water elevation from 2022-04-11 to 2022-11-17. During this time period, the water elevation dropped in Ahmic Lake by 535 mm. The downstream river level changes seasonally and yearly depending on a number of factors including rainfall within the watershed, yearly snowpack, recreational user needs, power production and minimum / maximum flow requirements. The Township is not responsible for the operation of the watershed and its control structures.

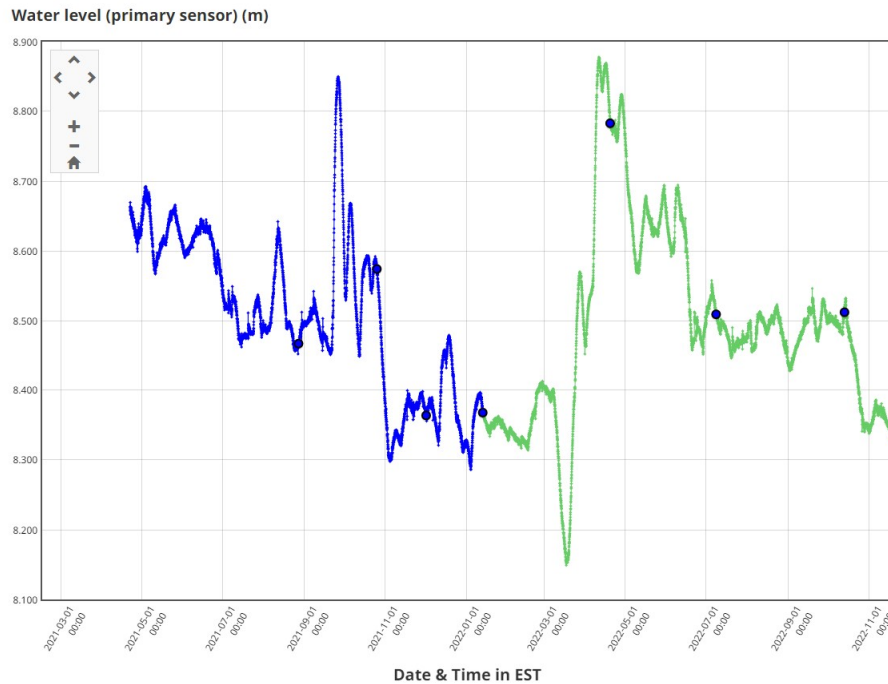


Figure #2- Water levels on Ahmic Lake

Source: https://wateroffice.ec.gc.ca/report/real_time_e.html?stn=02EA019

An additional contributing factor for water levels is the beaver activity in the area of the culvert. During the design period, it was identified that beavers were present with a lodge and feed bed next to the project location. At the time of the final inspection, it was noted that a beaver dam had been constructed across the newly installed culvert. Currently this beaver dam is restricting flow through the culvert.



Figure 3 - Culvert Facing Northwest – Beaver dam obstruction

West Poverty Bay Culvert Replacement

Greer Galloway was retained by the Township of Magnetawan for the design and contract administration of the West Poverty Bay Culvert replacement. This culvert was identified for replacement by the Township's biannual OSIM inspection (structural assessment report completed by an engineer).

As per the guidelines of the Municipal Class Environmental Assessment (MCEA), the design process for the culvert replacement was initiated. As part of this process, there were several possibilities reviewed for replacement structures. This included a hydraulic analysis of potential culvert replacement options, cost implications, product availability, life cycle costing and a geotechnical report. It was determined early in the design process that the project scope was consistent with a Schedule A+ environmental assessment and no further studies were required.

Once a preferred design option was selected with input from Township staff, local regulatory authorities (DFO and the local MNRF office) were contacted regarding the project. There were no further requirements noted by these entities.

The original culvert was a 6500 mm wide x 3600 mm tall elliptical CSP structural steel plate. The existing inverts for this culvert were as follows:

NW Invert: 271.17 m

SE Invert: 271.15 m



Figure 4 – Existing CSP Elliptical Culvert

The culvert installed as part of this design was a 6450 mm wide x 3910 mm tall polymer coated CSP ellipse culvert with the following inverts.

NW Invert: 270.871 m

SE Invert: 270.864 m



Figure 5 – New Polymer-Coated CSP Ellipse Culvert

A higher, or taller, culvert was selected based on the available products that best matched the original culvert. Since this new culvert had a greater height, it was embedded approximately 275 mm lower than the existing culvert to achieve similar hydraulics. It should be noted that homeowners on West Poverty Bay may have documented significant water level changes during construction. This may have occurred due to the fact that only two small culverts were used as a temporary flow bypass during the construction period.

The existing and proposed culverts were modeled at different flow rates and associated headwater elevations as shown in the below figures:

Headwater Elevation (m)	Total Discharge (cms)	Existing Discharge (cms)	Roadway Discharge (cms)	Iterations
271.41	0.20	0.20	0.00	1
271.58	0.68	0.68	0.00	1
271.66	1.00	1.00	0.00	1
271.79	1.64	1.64	0.00	1
271.86	2.12	2.12	0.00	1
271.93	2.60	2.60	0.00	1
272.00	3.08	3.08	0.00	1
272.05	3.56	3.56	0.00	1
272.11	4.04	4.04	0.00	1
272.16	4.52	4.52	0.00	1
272.21	5.00	5.00	0.00	1
274.83	48.19	48.19	0.00	Overtopping

Figure 6 – Existing Culvert Flow Rates Based on Headwater Elevations

Headwater Elevation (m)	Total Discharge (cms)	Installed Discharge (cms)	Roadway Discharge (cms)	Iterations
271.34	0.20	0.20	0.00	1
271.50	0.68	0.68	0.00	1
271.58	1.00	1.00	0.00	1
271.71	1.64	1.64	0.00	1
271.79	2.12	2.12	0.00	1
271.86	2.60	2.60	0.00	1
271.93	3.08	3.08	0.00	1
271.99	3.56	3.56	0.00	1
272.05	4.04	4.04	0.00	1
272.11	4.52	4.52	0.00	1
272.16	5.00	5.00	0.00	1
274.83	50.70	50.70	0.00	Overtopping

Figure 7 – Proposed Culvert Flow Rates Based on Headwater Elevations

As shown above, the new culvert has the same hydraulic capacity as the original culvert. Any minor differences in headwater elevations or total discharge are inconsequential with respect to the culvert flows.

Conclusions

- The hydraulic performance of both culverts is similar, and the installation was effectively “like for like”. The replacement of this culvert will have had negligible impacts on the lake levels of West Poverty Bay. The water levels within the Magnetawan river system are currently controlled by both manmade and natural structures, and West Poverty Bay is an equalization basin.
- The new culvert was placed 275 mm lower to better match the hydraulics of the existing culvert.
- Based on a comparison of the original culvert conditions and as-built elevations, it is the opinion of Greer Galloway that the new culvert does not impede the passage of fish.

Best regards,

**GREER GALLOWAY
CONSULTING ENGINEERS**



Kevin Hawley, P.Eng.
Project Manager