

Appendix A Water Availability Assessment



To:	Guy Bourgon, P.Eng. Town of Carleton Place	From:	Igor Iskra, Ph.D., P.Eng. Stantec Consulting Ltd.
File:	163401646	Date:	August 15, 2022

Reference: Water Availability Assessment for Carleton Place Water Treatment Plan

Introduction

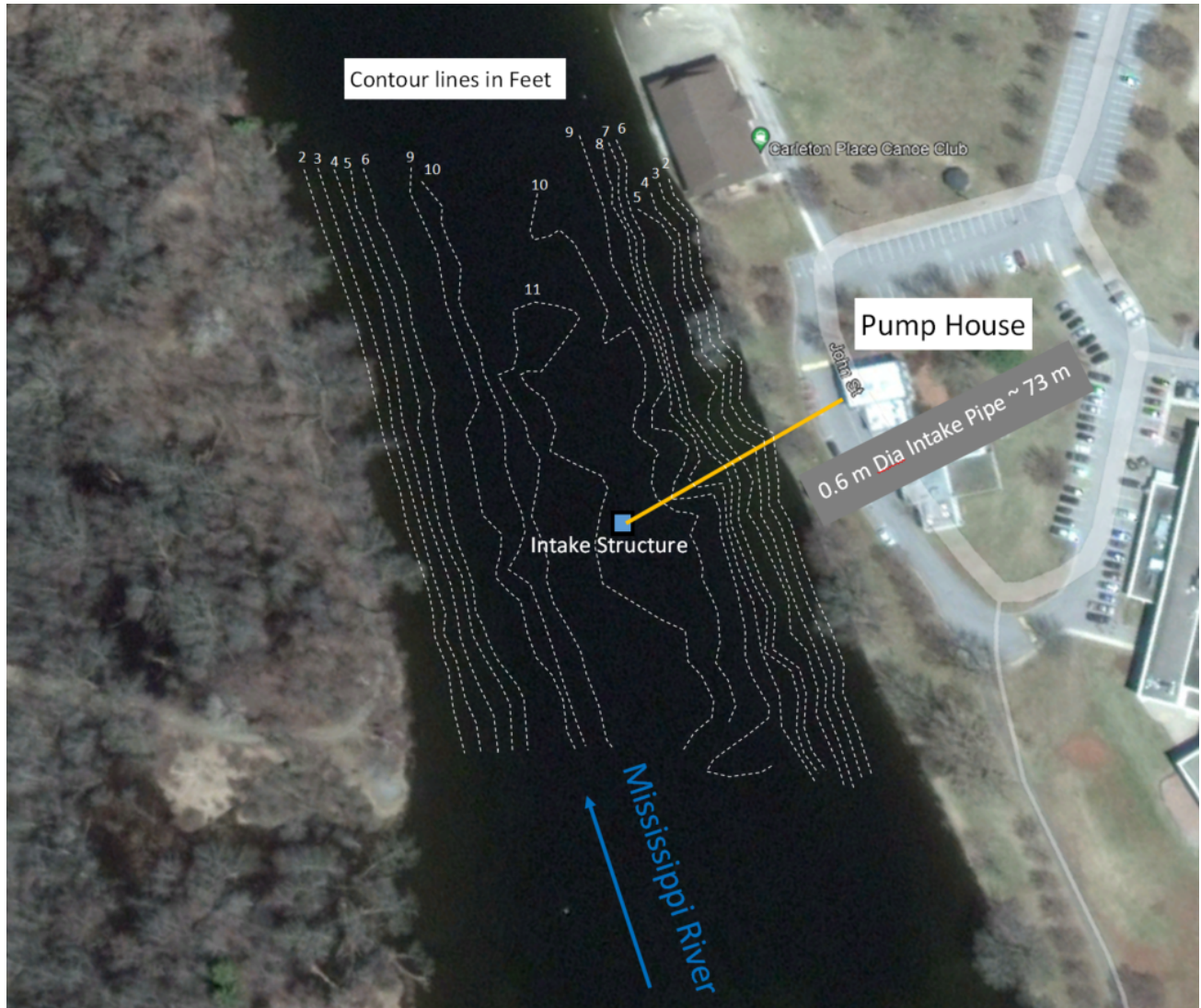
Stantec Consulting Ltd. has been retained by the Town of Carleton Place (the Town) to undertake a water availability assessment for the Carleton Place Water Treatment Plant (WTP). The objective is to assess water depth at the plant's water intake during historical low flow conditions and evaluate if the current location and freeboard above the intake crib is adequate to withstand low flow conditions. The assessment included examining lake elevation changes with an increase in maximum water taking rate during low flow conditions. This assessment is intended to support Phase 3 of the Environmental Assessment for the WTP Expansion Schedule C project that was identified as the preferred solution in the 2022 Water and Wastewater Master Plan.

The Carleton Place WTP is located in the Town of Carleton Place in the lower portion of Mississippi Lake on the Mississippi River. The Mississippi River is a tributary of the Ottawa River in Eastern Ontario. The Town of Carleton Place is situated in Lanark County (west of the City of Ottawa) and accessed by Provincial Highways #7 and #15. Carleton Place has a population of 12,517 (Canada Census 2021) with 5,876 private dwellings on 12.47 km² of land. The community provides municipal water and sewer services. The Mississippi River runs through the center of town and serves as both the source of water for municipal use, as well as the receiving watercourse for ultimate disposal of treated sewage effluent. The Mississippi River and Mississippi Lake are used for recreational purposes. Lakeshore development around Mississippi Lake is extensive with over 1,700 homes and cottages built along its shores with a recent trend of converting seasonal to permanent dwellings.

The Carleton Place WTP is located off John Street north of Lake Avenue West. Location of the WTP intake pipe in the Mississippi River is shown on **Figure 1**. The intake is located in a Mississippi River reach directly connected to the downstream section of Mississippi Lake.

Reference: Water Availability Assessment for Carleton Place Water Treatment Plan

Figure 1 Carleton Place Drinking Water Intake



WTP Water Taking

The Carleton Place WTP is operated under the Permit to Take Water No. 1310-9UHPPW issued by MECP on March 13, 2015. The maximum permit rated withdrawal rate of the plant is 12,000 m³/d (139 L/s). An operational benchmark of 7,700 m³/d, monitored by Ontario Clean Water Agency (OCWA), is applied for water use by-law considerations. Monthly daily average and daily maximum water takings in 2020 and 2021 are presented on **Figure 2** and **3**.

Reference: Water Availability Assessment for Carleton Place Water Treatment Plan

It is expected that the WTP will be expanded in future, and the maximum permitted withdrawal rate may increase to 20,700 m³/d (240 L/s).

Figure 2 Raw Water Takings in 2020 (OCWA 2021)

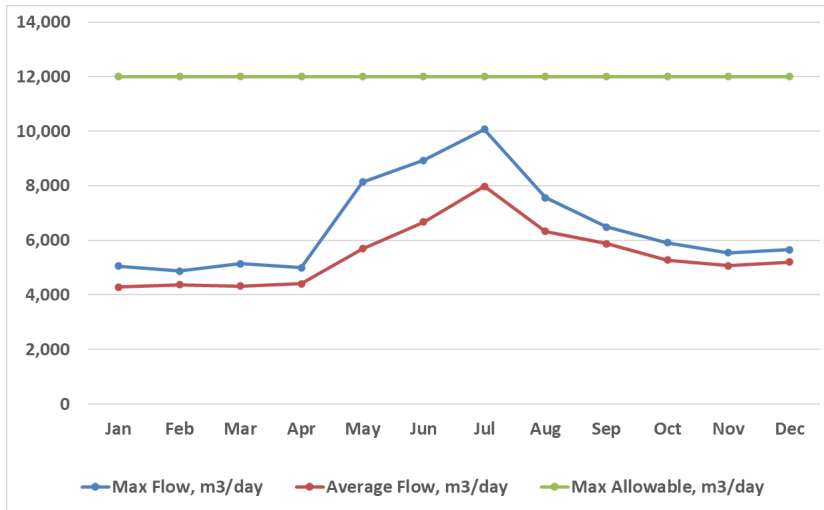
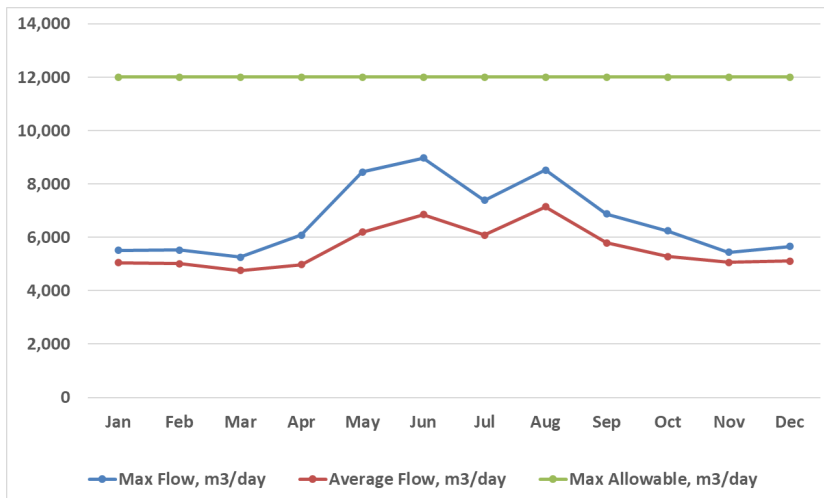


Figure 3 Raw Water Takings in 2021 (OCWA 2022)



Reference: Water Availability Assessment for Carleton Place Water Treatment Plan

Carleton Place Dam

Water levels in Mississippi Lake are controlled by the Carleton Place Dam, which is owned and operated by the Mississippi Valley Conservation Authority (MVCA). The dam is a concrete structure with five sluices containing a total of 48 stoplogs and a 75 m overflow weir. There are ten stoplogs stacked in each of the first three sluices and nine stoplogs in the last two sluices, with stoplogs being 0.25 m H x 0.25 m W x 4.25 m L. The weir elevation is 133.92 m above sea level (m asl) and the normal operating range for the dam is 133.93 m asl to 134.50 m asl (MNR 2020).

The dam is not intended for hydro-electric production, it maintains recreational levels in Mississippi Lake and provides some flood control benefits for Mississippi Lake and downstream municipalities (MNR 2020). Operation of the Carleton Place Dam is important for maintaining water levels in Mississippi Lake during low flow conditions. Additionally, the Carleton Place Dam is operated to reduce shoreline damage and maintain stable ice levels in Mississippi Lake.

MVCA has two water level stations on Mississippi Lake. One station is an automatic, real time gauge located around the mid-point of the lake at Sunset Lane and it has hourly water level records from 2002. Another water level station is located at the Carleton Place Dam is not automated with daily records from 2008. Water level data from both stations were evaluated in this assessment.

Mississippi Lake Hydrology

Mississippi Lake is one of the largest inland lakes in south-eastern Ontario and the last lake in the Mississippi River system. Mississippi Lake at the Carleton Place Dam has a watershed area of 2,876 km². Physical characteristics of Mississippi Lake at the Carleton Place Dam are presented in Table 1.

Reference: Water Availability Assessment for Carleton Place Water Treatment Plan

Table 1 Physical Characteristics of Mississippi Lake (MNR 2020)

Characteristics	Values
Elevation (m asl)	134.4
Surface Area (ha)	2,349
Maximum Depth (m)	52.7
Mean Depth (m)	9.2
Volume (m ³)	6.36 x 10 ⁷
Perimeter (km)	55.9
Total Storage Volume (ha. M)	3,787
Weir Elevation (m asl)	133.92

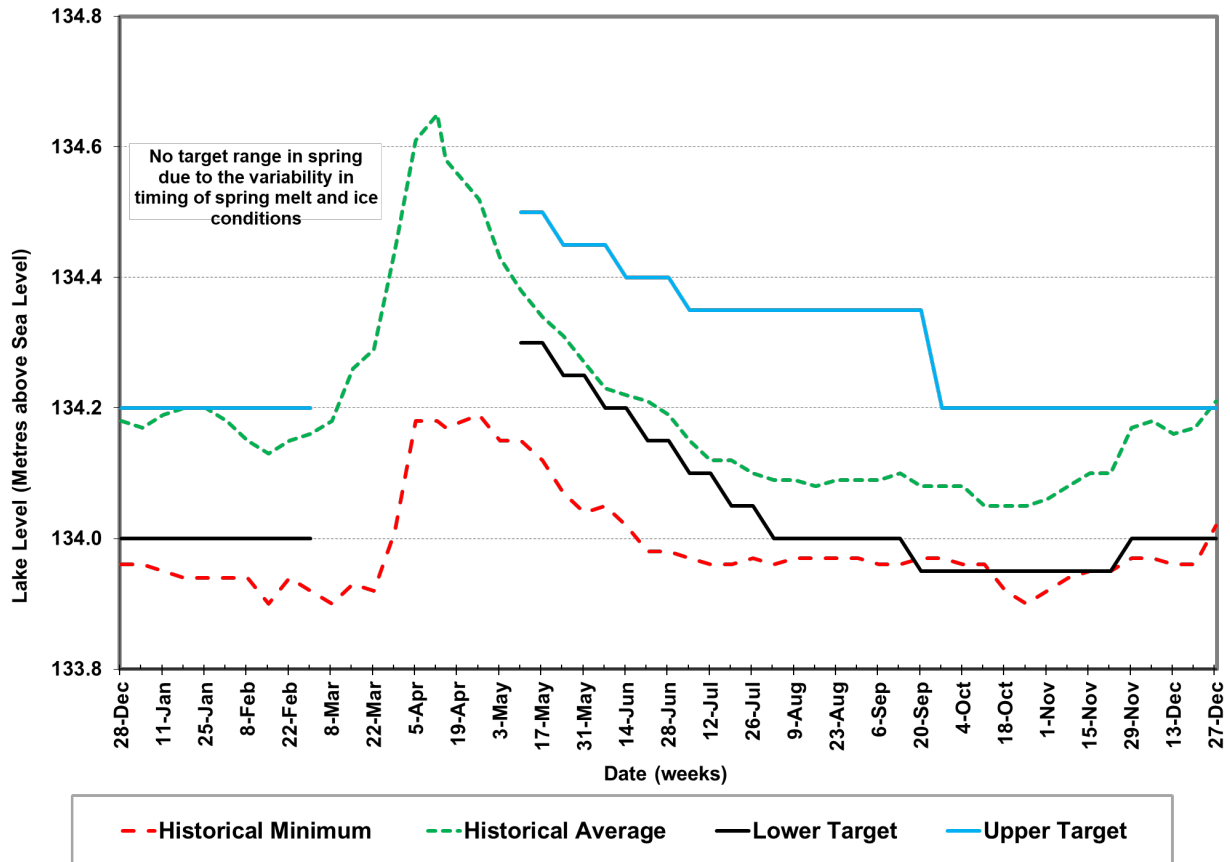
The Carleton Place Dam is operated to drawdown the lake to provide storage for the spring runoff. As snowmelt and spring rains occur, Mississippi Lake is gradually filled to reach the summer target levels for recreation and tourism. Water levels in the lake are monitored to ensure adequate storage and sufficient flows and levels are maintained to support spawning fish migration.

During low flow months, the water levels in Mississippi Lake are also maintained by the Crotch Lake Dam operation. From late June through early October, Crotch Lake is drawn down to provide flows in the lower portion of the river. Under normal conditions, approximately 60% of the flow in the Mississippi river comes from Crotch Lake. During the droughts of 2001 and 2002, 100% of the flow in the river below Crotch Lake came from Crotch Lake as all other tributaries had virtually dried up (MNR 2020). Throughout the fall, as Mississippi Lake is drawn down, Crotch Lake is filled again while still maintaining at least a minimum average flow of 5 m³/s downstream of the dam. From January through March Crotch Lake is drawn down to perform low flow augmentation function over the remainder of the winter months and to maximize storage in the lake for spring.

Historical weekly average water levels in Mississippi Lake and their upper and lower targets are presented on **Figure 4**. The winter minimum target water level is 134.0 m asl and the fall minimum target water level is 133.95 m asl. The weir elevation is 133.92 m asl.

Reference: Water Availability Assessment for Carleton Place Water Treatment Plan

Figure 4 Mississippi Lake Water Levels and Operating Rule Targets



Historical water levels in Mississippi Lake and the Carleton Place Dam are presented on **Figure 5**. During dry seasons water levels at both gauges are very similar as the dam controls water levels in the lake. The lowest observed water level in Mississippi Lake was 133.92 m asl on October 23, 2017.

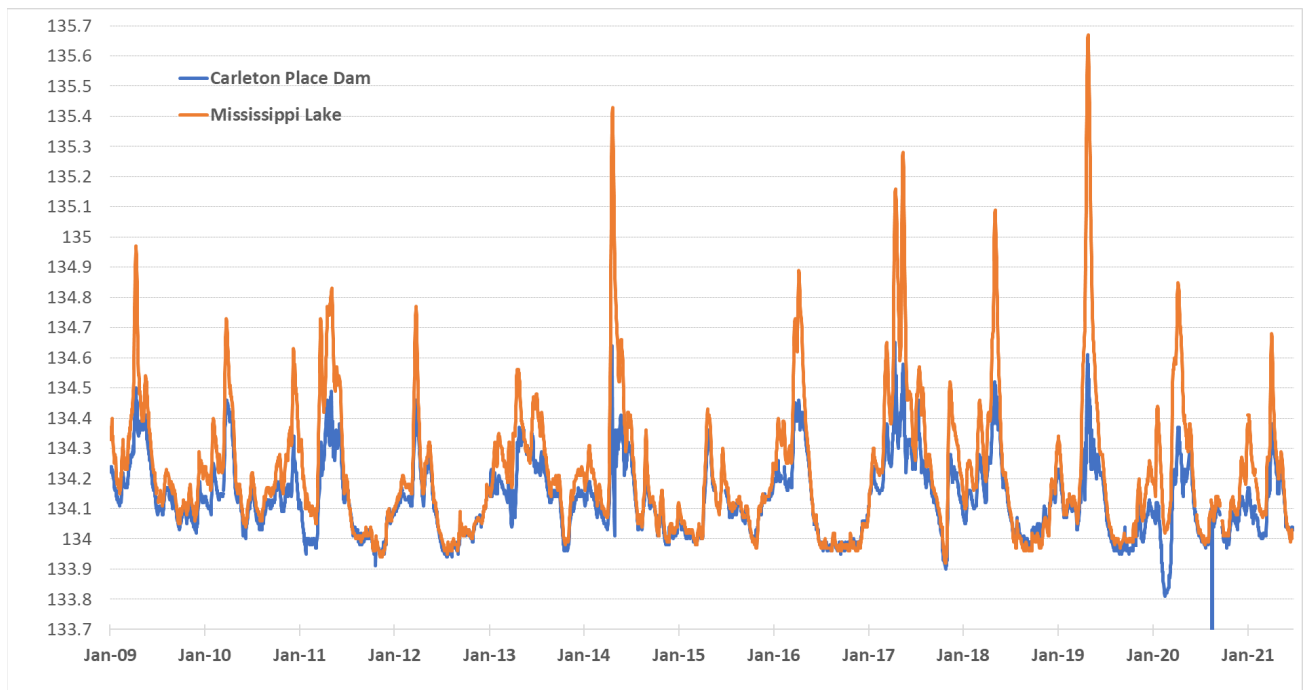
The lowest observed water level at the Carleton Place Dam was 133.81 m asl on February 17, 2020.

An instantaneous single day 2 m water level drop was recorded at the dam on August 17, 2020. This measurement is suspect as no water level drop was recorded at the Mississippi Lake gauge on the same day and it is unrealistic to have such a short lived drop in a lake of this size. Therefore, this measurement was considered an anomaly in this analysis. It was confirmed with the Town (email from Guy Bourgon on April 6, 2022) that no significant water level drops were observed on that day.

Reference: Water Availability Assessment for Carleton Place Water Treatment Plan

For the purpose of this water availability assessment the lowest observed water level of 133.81 m at the Carleton Place Dam was used.

Figure 5 Historical Daily Water Levels from 2009 to 2021 in Mississippi Lake and at the Carleton Place Dam



Mississippi River Flows

The Water Survey of Canada (WSC) has a flow station about 6 km downstream of the Carleton Place Dam at Appleton (station ID 02KF006). Flows at Appleton station have been monitored since 1918. This station is located approximately 5 km downstream from the Carleton Place WWTP outfall. The Carleton Place Dam provides flow attenuation for the downstream section of the Mississippi River. The lowest flows on record in Appleton were observed in August 2016, with 7-day average minimum flow of 2.2 m³/s.

Instantaneous lowest water levels in Mississippi Lake and at the Carleton Dam in the driest year on record (2016) were correspondingly 133.95 m asl and 133.96 m asl.

Discussion

The J.L. Richards and Associated Limited Drawings dated August 1997 were used in this assessment (**Attachment A**). No recent survey of the intake crib was available. The low lift pump floor elevation of 136.454 m asl was used as a reference point.

Reference: Water Availability Assessment for Carleton Place Water Treatment Plan

Schematic intake structure is shown on **Figure 6**. River bed elevation at water intake derived from MVCA recent survey is 131 m. The top of intake structure is located 1.07 m above the river bottom. The water depth at average water level is 3.2 m, and water depth during the lowest observed water level is 2.81 m. Therefore, freeboard between the top of the intake structure and the lowest historical observed water level is 1.74 m. Based on bathymetry information and volumetric characteristics of the lake, a drop of water level in Mississippi Lake of 1 cm corresponds to an estimated reduction in lake volume of 234,900 m³, which is 11 days of constant water pumping at the maximum rate of 20,700 m³/day. Shoreline damage and recreational uses will be impacted by low flow conditions much sooner than water availability for the intake structure. Mississippi Lake has a very large operational volume (tens of millions of cubic meters) to withdraw before water level will reach the top of crib elevation.

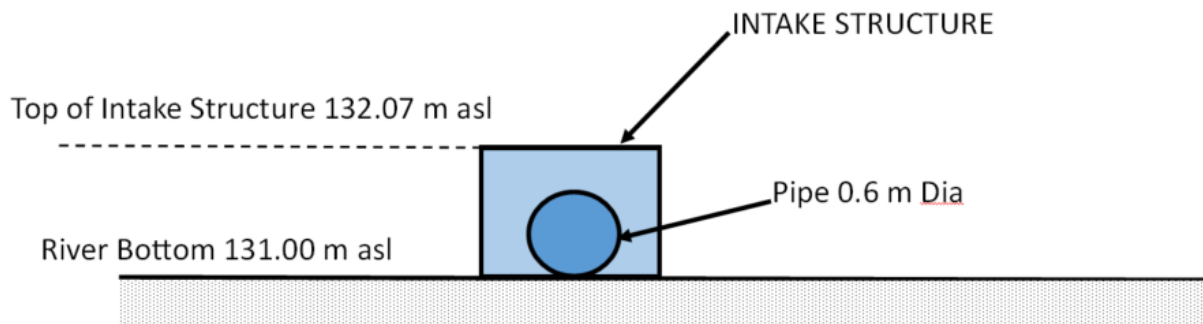
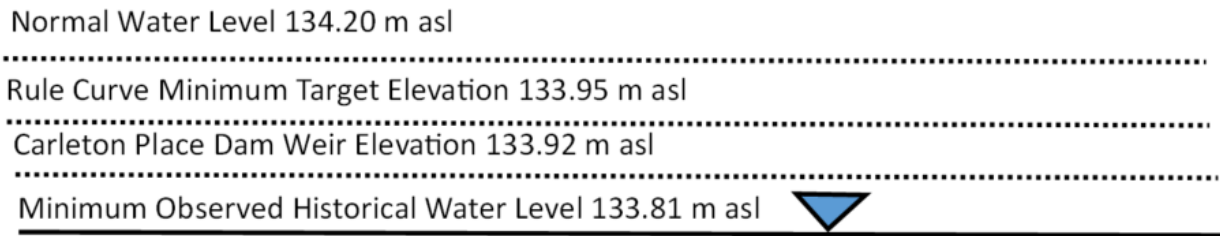
Therefore, it was concluded, that an increase in water taking from the current 12,000 m³/day to 20,700 m³/day will not substantially impact water levels in Mississippi Lake and it is unlikely that the intake crib will be exposed at this water pumping rate. The lake water level is regulated by the Mississippi Dam and it is unlikely that the lake water level will drop below the dam rule curve targets and the weir elevation. As per communication with the Town (email from Guy Bourgon of April 6, 2022) no intake exposure or water availability issues have been reported in the past.

Various climate change scenarios and their impact on flows and water levels in the Mississippi River were evaluated in MVCA (2015). The study concluded that future stream flows will become considerably more variable and erratic specifically in the spring and summer low flow seasons which may result in increased flood risk and more severe low flow conditions. Water levels in the lakes are less susceptible to climate change as lakes are regulated by dams and rule curve changes can be used to adapt to future changes. One of the suggestions in the MVCA report was made to reduce the extent of lake drawdown prior to spring melt which will improve water level regulations during summer months. The current rule curve addresses water level fluctuations in the lake and water depth at the intake structure. Future changes to the Mississippi Lake rule curve targets (if any) will need to take into account the water intake structure of the town.

The intake is located upstream of the Carlton Place Dam and a dam failure would result in water availability issues, including exposure of the Carleton Place water treatment plant intake. The Master Plan includes mitigation measures for lack of water due to climate change. In the Environmental Study Report (ESR), Stantec will recommend that the Town update its emergency response plan in the event that river source water is not available.

Reference: Water Availability Assessment for Carleton Place Water Treatment Plan

Figure 6 Intake Structure



Conclusion

This assessment evaluated design of the water intake structure, bathymetry around the intake and historical water levels in the middle and lower portion of Mississippi Lake.

It was concluded that from a water availability perspective it is unlikely there will be issues with insufficient water supply or exposed water intake. The lowest recorded lake water level was 133.81 m asl, corresponding to a 1.74 m water depth above the top of the crib. The lake water level is regulated by the Carleton Place Dam and it is unlikely that the lake water level will drop below the dam rule curve targets and the weir elevation. This conclusion is also supported by historical operation of the WTP.

August 15, 2022

Guy Bourgon, P.Eng.


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Reference: Water Availability Assessment for Carleton Place Water Treatment Plan

Closure

We trust this information is satisfactory for your purposes. If you have any questions, please contact the undersigned.

Stantec Consulting Ltd.

 Digitally signed
by Iskra, Igor
Date: 2022.08.15
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Attachment: A - Intake Structure Design

Attachment: B – Comments and Proponent Responses

References

Ministry of Natural Resources and Forestry (MNRF). 2020. Mississippi River. Water Management Plan. Final Report. Amended October 2020.

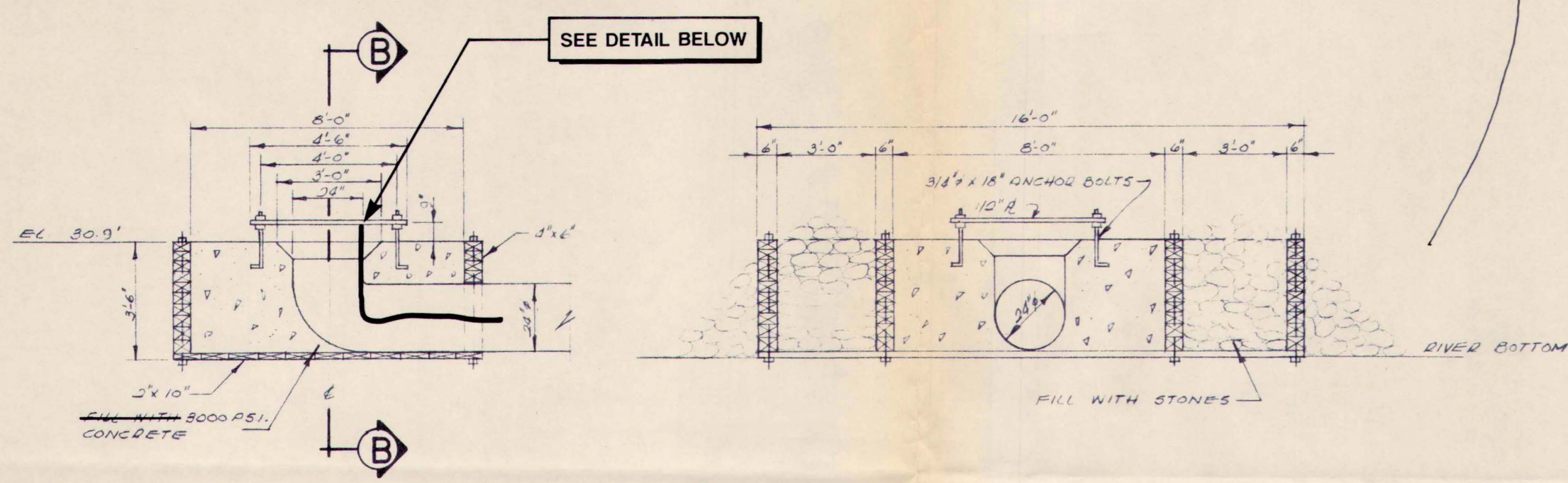
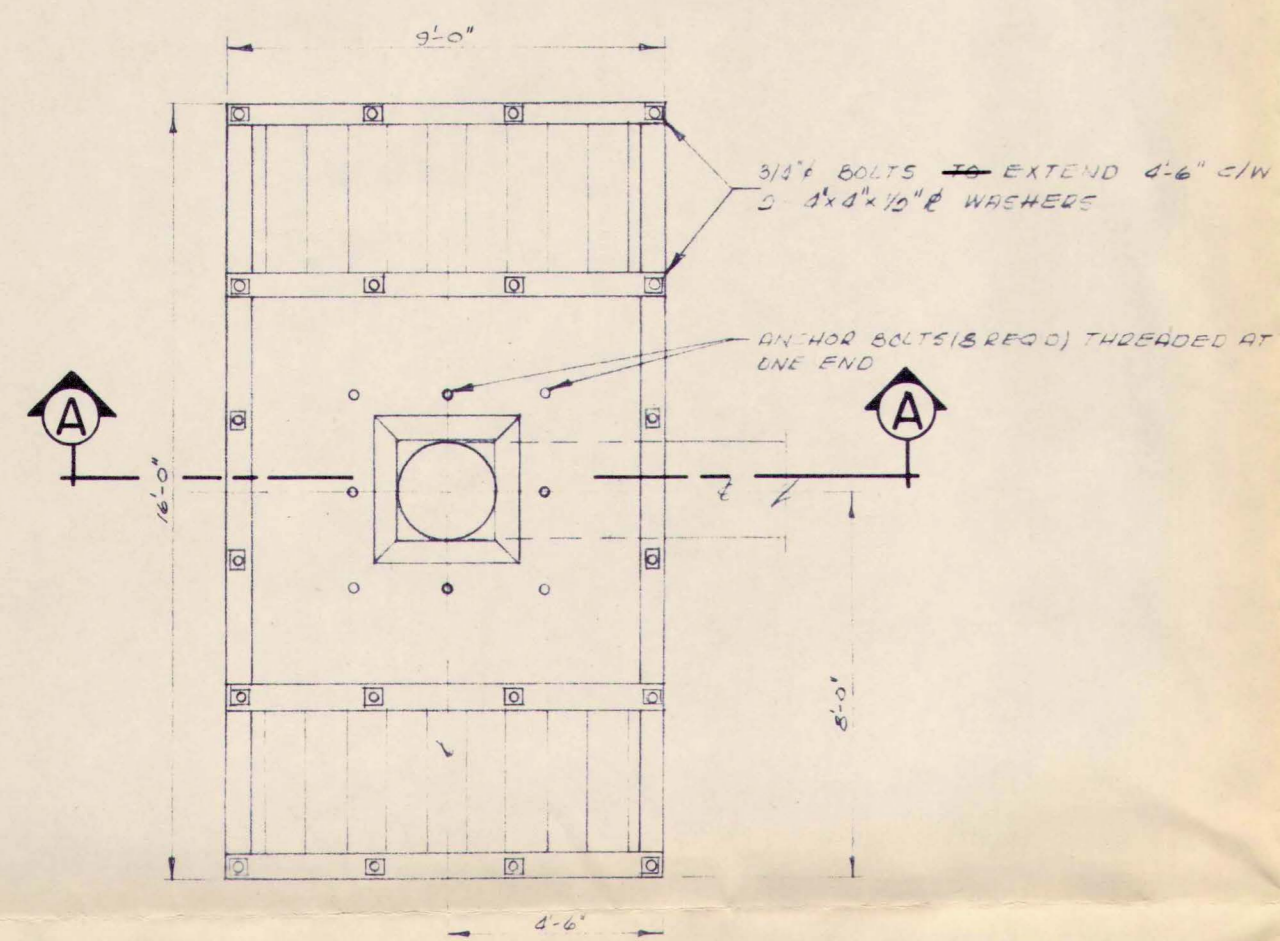
Mississippi Valley Conservation Authority (MVCA). 2015. Climate Change Implications for Small Waterpower Facilities – A Watershed Perspective. Natural Resources Canada Project – AP223. December 2015.

Ontario Clean Water Agency (OCWA). 2021. Carleton Place Drinking Water System. Annual Water Report for 2020.

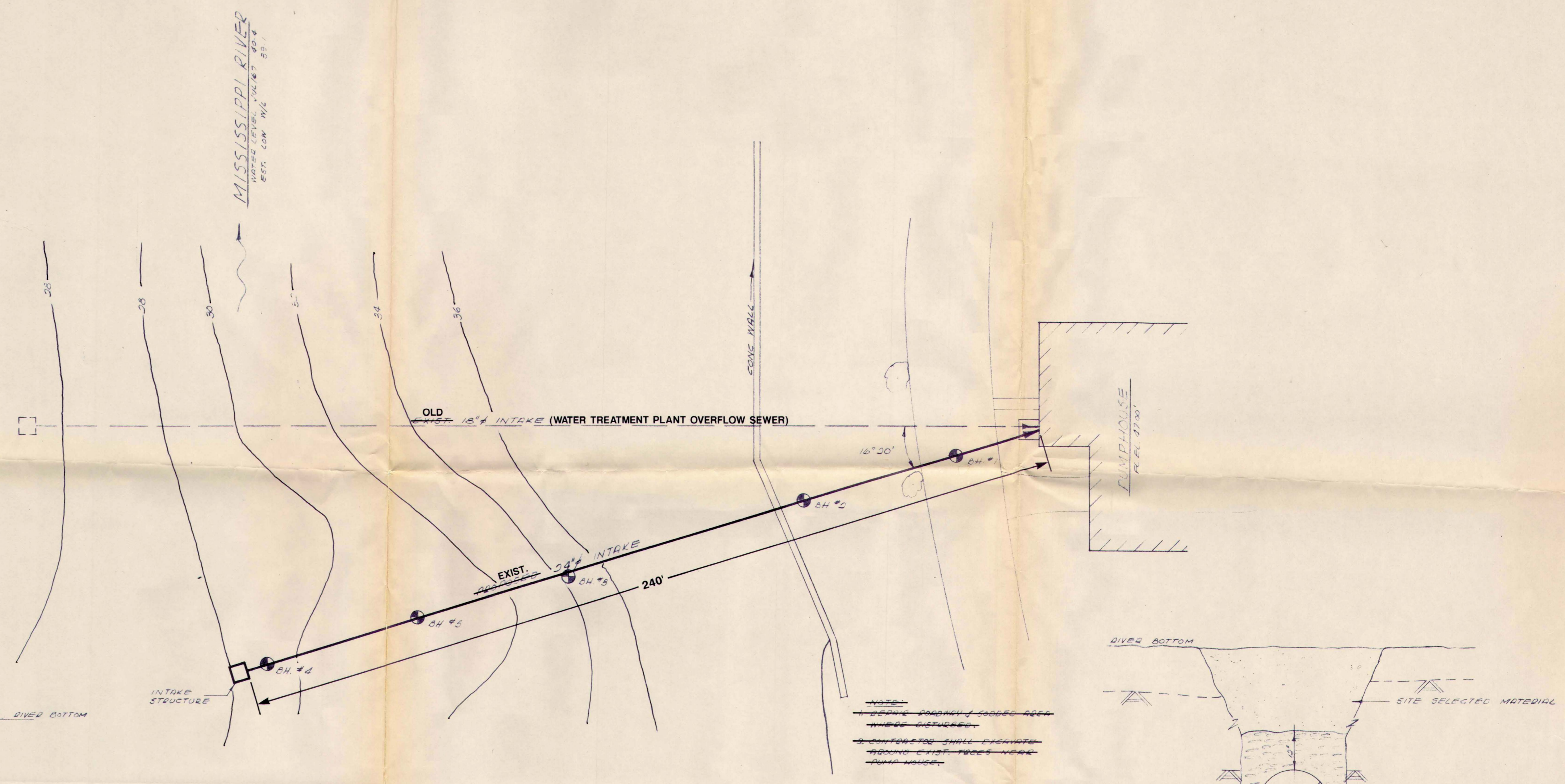
Ontario Clean Water Agency (OCWA). 2022. Carleton Place Drinking Water System. Annual Water Report for 2021.

Attachment A

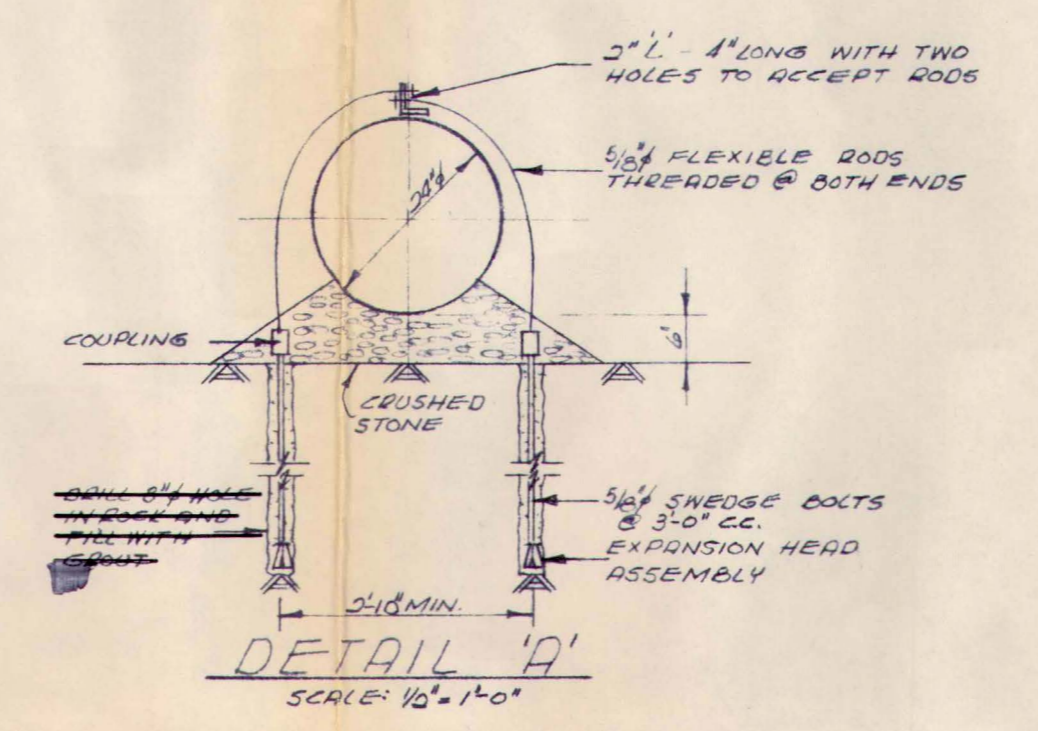
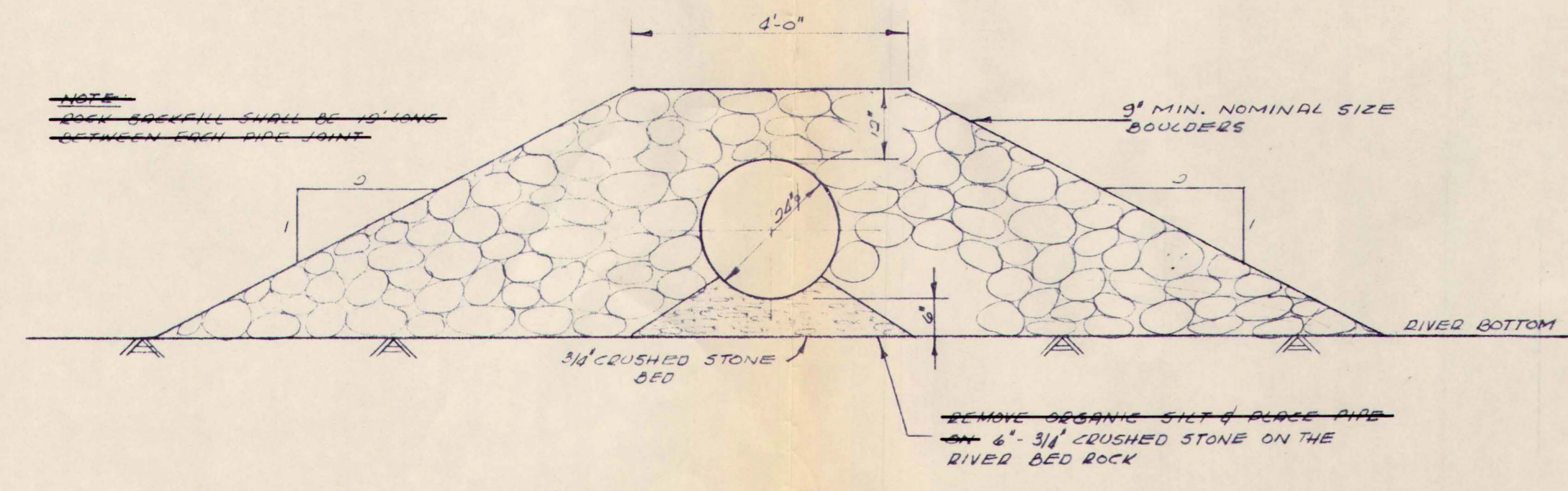
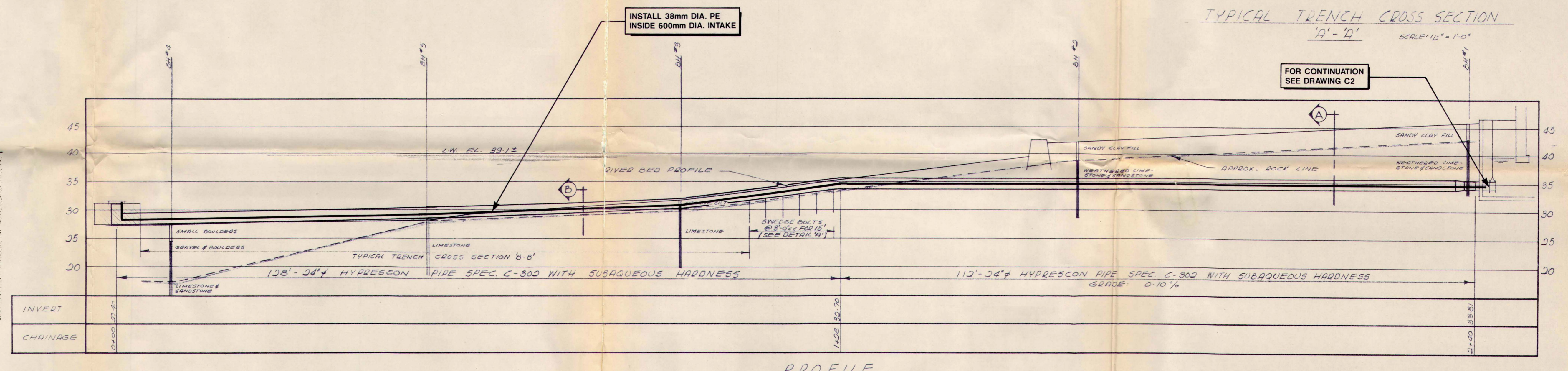
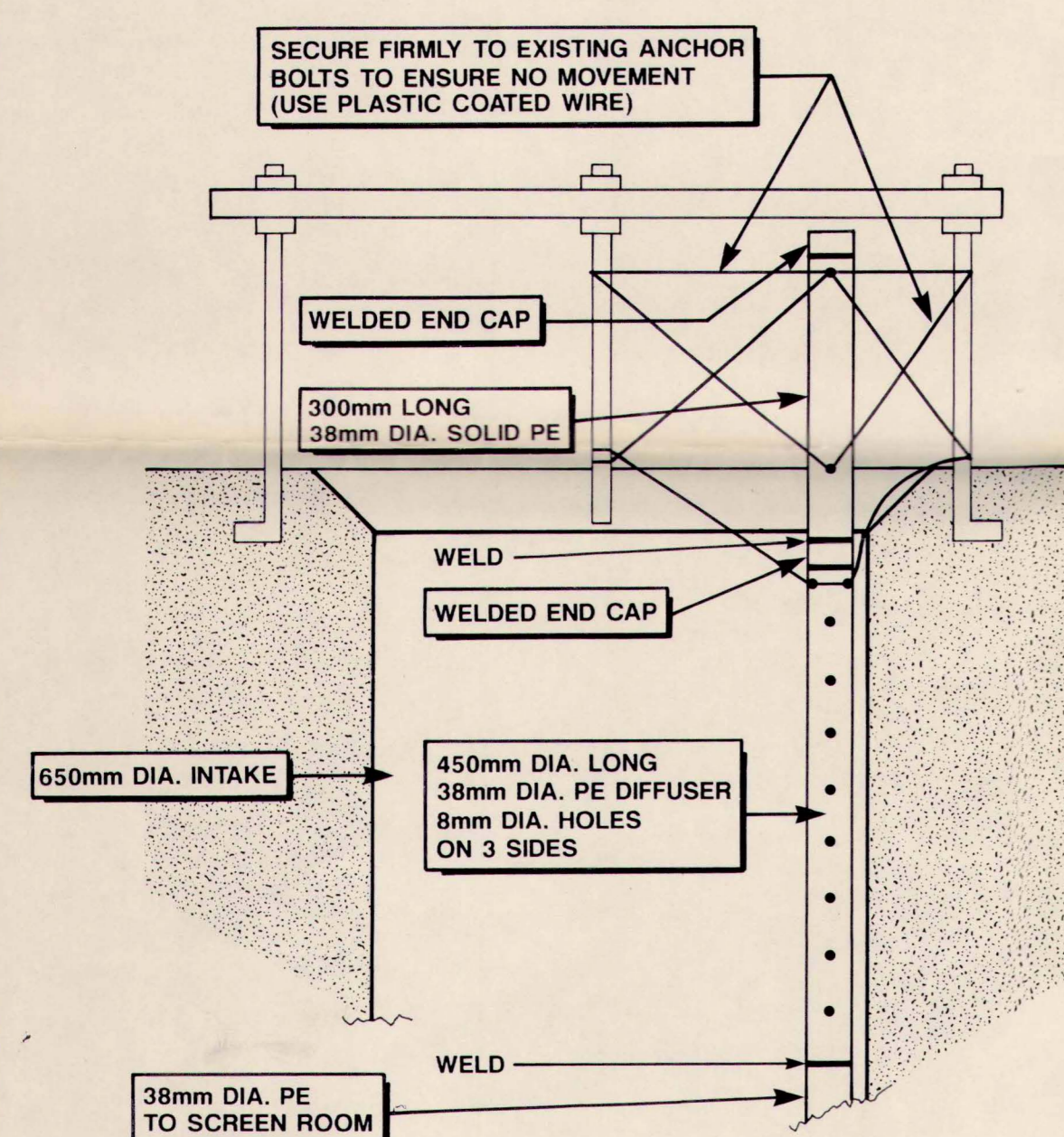
Intake Structure Design



DETAILS OF INTAKE STRUCTURE
SCALE: 1/2" = 1'-0"



TYPICAL TRENCH CROSS SECTION
SCALE: 1/2" = 1'-0"



CORPORATION OF THE TOWN OF CARLETON PLACE	
PROJECT: WATER TREATMENT PLANT MINOR MODIFICATIONS	
DRAWING: ZEBRA MUSSEL CONTROL - 2	
DESIGN: B.H.	DATE: AUGUST 1997
DRAWN: T.O.B.	SCALE: AS SHOWN
CHECKED: R.C.	DWG. NO.: 14937-02-C3
JOB NO.: 14937-02	J.L. Richards & Associates Limited Consulting Engineers, Architects & Planners

Attachment B
Comments and Proponent Responses

COMMENTS AND PROPONENT RESPONSES

Comment No.	Item	MVCA Comments – Received May 5, 2022	Response
MVCA - 1	Introduction	<p>Report Text: The intake is located in the downstream section of Mississippi Lake.</p> <p>Comment: The intake is located in the Mississippi River</p>	Text was revised to “The intake is located in a Mississippi River reach directly connected to the downstream section of Mississippi Lake”.
MVCA-2	Mississippi Lake Hydrology	<p>Report Text: Figure 5 Historical Daily Water Levels from 2009 to 2021 in Mississippi Lake and at the Carleton Place Dam</p> <p>Comment: Only 11 years of historical data is plotted; full record shows even more pronounced decreasing trend in low lake levels.</p>	<p>13 years of historical data is plotted on Figure 5. Water level data at the Carleton Place Dam is only available from January 2009. Stantec pulled available data from the MVCA website https://mvc.on.ca/water-levels/ .</p> <p>Water level data at Mississippi Lake is available for a longer period, however, Figure 5 presents the period of records when both stations are reporting.</p>
MVCA-3	Mississippi River Flows	<p>Report Text: Table 3.1</p> <p>Comment: Table not found</p>	It was a typo, reference was removed. .
MVCA-4	Discussion	<p>Report Text: Schematic intake structure is shown on Figure 6. The top of intake structure is located 1.07 m above the river bottom. The water depth at average water level is 3.72 m, and water depth during the lowest observed water level is 3.33 m. Therefore, freeboard between the top of the intake structure and the lowest historical observed water level is 2.26 m.</p> <p>Comment: MVCA bathymetric data suggests river bed elevation at water intake to be close to 131.0 masl, 0.5 m higher than Stantec data (130.5 masl). This would reduce freeboard by ~0.5 m</p>	<p>Elevation of the intake structure and bathymetry around the intake were obtained from design drawings and bathymetry maps available to Stantec. The report and figures were updated with the new bed elevation of 131 m provided by MVCA.</p> <p>Considering the new MVCA bathymetry information the freeboard will be reduced by 0.52 m from 2.26 m to 1.74 m. Freeboard of 1.74 m is still sufficient for the existing intake as a drop of water level in Mississippi Lake of 1 cm corresponds to an estimated reduction in lake volume of 234,900 m³.</p>
MVCA-5	Discussion	<p>Report Text: Therefore, it was concluded, that an increase in water taking from the current 12,000 m³/day to 20,700 m³ /day will not substantially impact water levels in Mississippi Lake and it is unlikely that the intake crib will be exposed at this water pumping rate. The lake water level is regulated by the Mississippi Dam and it is unlikely that the lake water level will drop below the dam rule curve targets and the weir elevation. As per communication with the WTP operator (email from Guy Bourgon of April 6, 2022) no intake exposure or water availability issues have been reported in the past.</p> <p>Comment: An extraction rate of 20,700 m³/d is roughly equal to 0.24 m³/s, which is a significant amount (>10%) of historic low flows observed at Appleton. -How would this impact river assimilative capacity, with respect to downstream WWTPs in Carleton Place, Almonte? -How will this affect low water levels downstream?</p>	<p>Proposed increase in water taking is not expected materially to impact downstream assimilative capacity or downstream water levels because most of the increased water taking (about 87%) at the Water Treatment Plant will return back to the river at the WWTP outfall. Consumptive loss is approximately 13% and that is mostly outdoor water use which partially returns to the river through runoff and groundwater discharge. The Town intends to limit lawn watering and other outdoor water use during extended drought conditions.</p> <p>Also, the proposed increased water takings are from a river reach directly connected to Mississippi Lake which has a volume of 6.36 x 10⁷ m³ and outflow from the dam is regulated by an operating rule curve. During low flow conditions, the outflow from the dam will still be maintained regardless of WTP operation.</p>

COMMENTS AND PROPONENT RESPONSES

Comment No.	Item	MVCA Comments – Received May 5, 2022	Response
		The lake water level is regulated by the Carleton Place Dam (owned and operated by MVCA).	
MVCA-6	Discussion	<p>Report Text: Water levels in the lakes are less susceptible to climate change as lakes are regulated by dams and rule curve changes can be used to adapt to future changes.</p> <p>Comment: Mississippi Lake levels show a decreasing trend at a rate of 1.5 cm/decade. This trend is more pronounced during the summer months (3-10 cm/decade).</p>	<p>Comment acknowledged.</p> <p>Various climate change scenarios and their impact on flows and water levels in the Mississippi River were evaluated in MVCA (2015). One of the suggestions in the MVCA report was to reduce the extent of lake drawdown prior to spring melt which will improve water level regulations during summer months. In future, the rule curve targets may need to be updated in order to address variability and uncertainty in water level fluctuations.</p>
MVCA-7	Conclusion	<p>Report Text: It was concluded that from a water availability perspective it is unlikely there will be issues with insufficient water supply or exposed water intake.</p> <p>Comment: MVCA concerns are primarily related to the impacts of increased water taking on downstream water quantity and quality, particularly during low flow/drought conditions (see previous comments).</p>	Please see MVCA-5
MVCA-8	Conclusion	<p>Report Text: The lake water level is regulated by the Carleton Place Dam and it is unlikely that the lake water level will drop below the dam rule curve targets and the weir elevation.</p> <p>Comment: Has the water availability study considered the hypothetical scenario of dam failure?</p>	No, the water availability study did not consider the hypothetical scenario of dam failure.

ADDITIONAL COMMENTS

Comment No.	Item	MVCA Comments – Received July 8, 2022	Response
MVCA – 9	Mississippi Lake Hydrology	<p>Response to MVCA-2: Water level data at Mississippi Lake is available for a longer period, however, Figure 5 presents the period of records when both stations are reporting</p> <p>Comment: Why limit analysis to just when both stations have data? To assess long term trends, using a longer record from Mississippi Lake would provide a more comprehensive historical analysis.</p>	The purpose of the figure was to compare data from both stations to see how they correlate. Based on discussion in a meeting with MVCA on July 26, 2022, no further action required.
MVCA-10	Mississippi Lake Hydrology	<p>Response to MVCA-8: The water availability study did not consider the hypothetical scenario of dam failure</p> <p>Comment: The intake for the Carleton Place Water Treatment Plant is located upstream of the Carleton Place Water Control Structure. In the event of a dam failure, there</p>	Based on discussion in a meeting with MVCA on July 26, 2022, Stantec included an acknowledgement in the report that the intake is upstream of the dam and a dam failure would result in water availability issues, including exposure of the Carleton Place water treatment plant intake. The Master Plan includes mitigation measures for lack of water due to climate change. In the ESR, we will recommend that the Town update its emergency response plan in the event that river source water is not available.

COMMENTS AND PROPONENT RESPONSES

Comment No.	Item	MVCA Comments – Received July 8, 2022	Response
		would be potential for intake exposure and water availability issues. The Master Plan should acknowledge this fact and develop appropriate emergency/mitigation procedures.	