MEMO TO: Tim Robertson Division Manager Wastewater Services

FROM: Hugh Whiteley P. Eng.

DATE: May 10 2021

RE: **UNEXPLAINED INCREASE IN GUELPH WRRF FLOWS FROM 2013 to 2020**

This memo identifies a trend in the observed annual-mean effluent flows at the Guelph WRRF in the period 2013 through 2020 which requires explanation. Fig 1 shows that from 2013 to 2020 effluent flowrates were increasing while water-system supply flowrates were rising only slightly or steady.

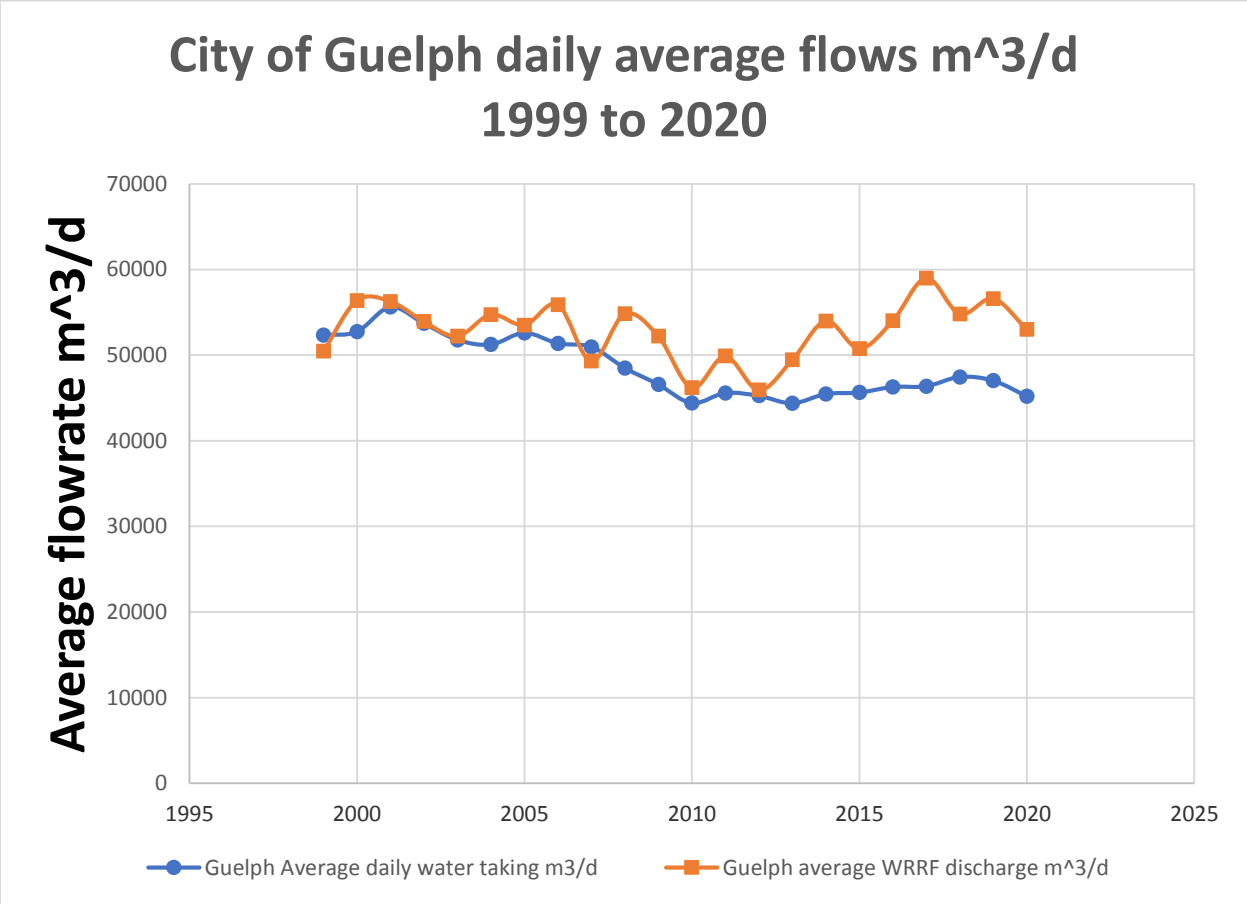

FIGURE 1 Annual average daily flows for City of Guelph Supply and WRRF effluent

Figures 2 and 3 illustrate the patterns in annual average per capita daily flow volumes for water supply and for WRRF effluent for the City of Guelph system and for the ROW system servicing

Cambridge Kitchener and Waterloo. The ROW data for WRRF effluent is the combined flow from the five WRRF's at Galt, Hespeler, Preston, Kitchener and Waterloo.

The observed values of per capita supply and return flows (WWTP flows) for Guelph and for the ROW are shown in Figure 2 for the period 1999-2019. The difference in per capita flows between the Guelph System (always larger) and the ROW is shown in Figure 3.

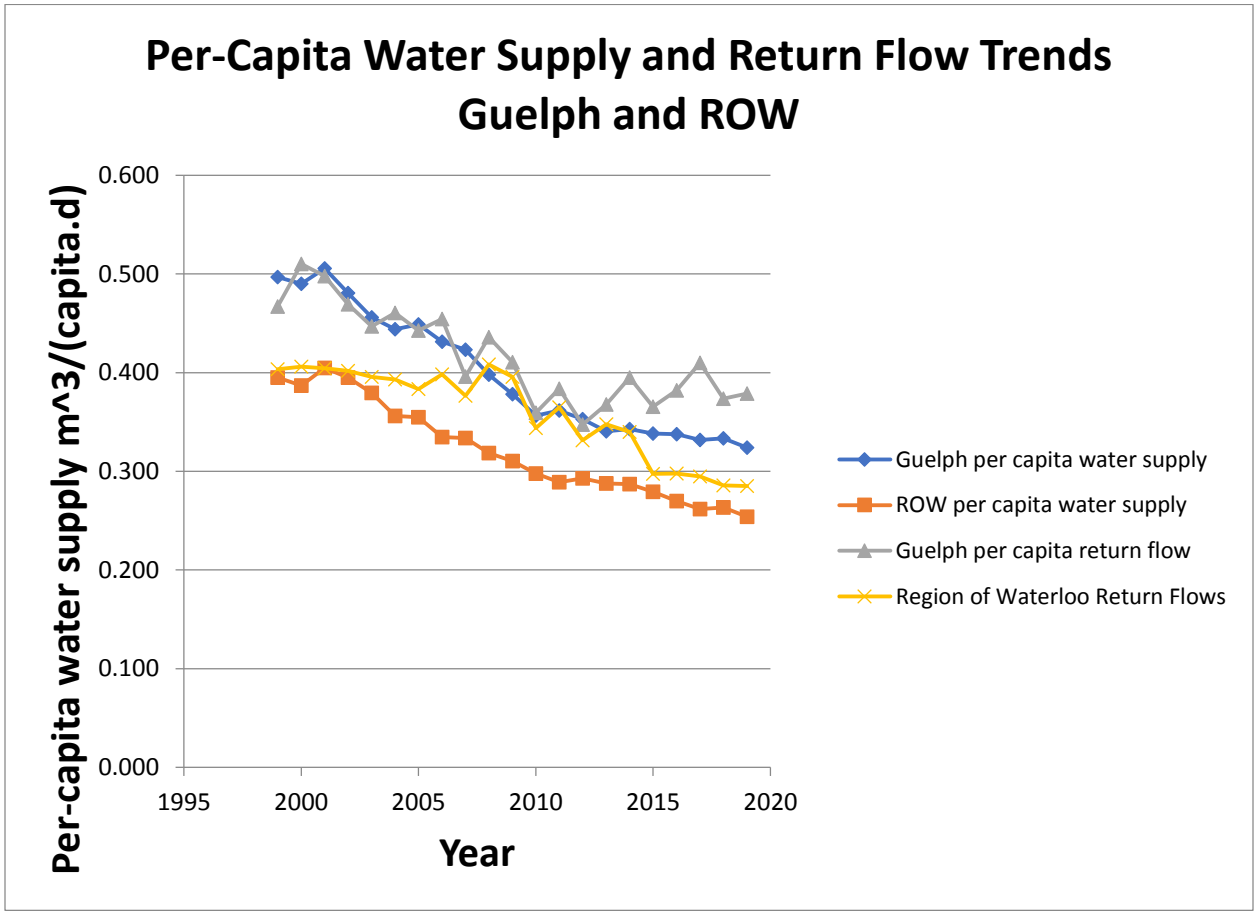

FIGURE 2 Per capita average annual daily flows for City of Guelph and ROW 1999-2019

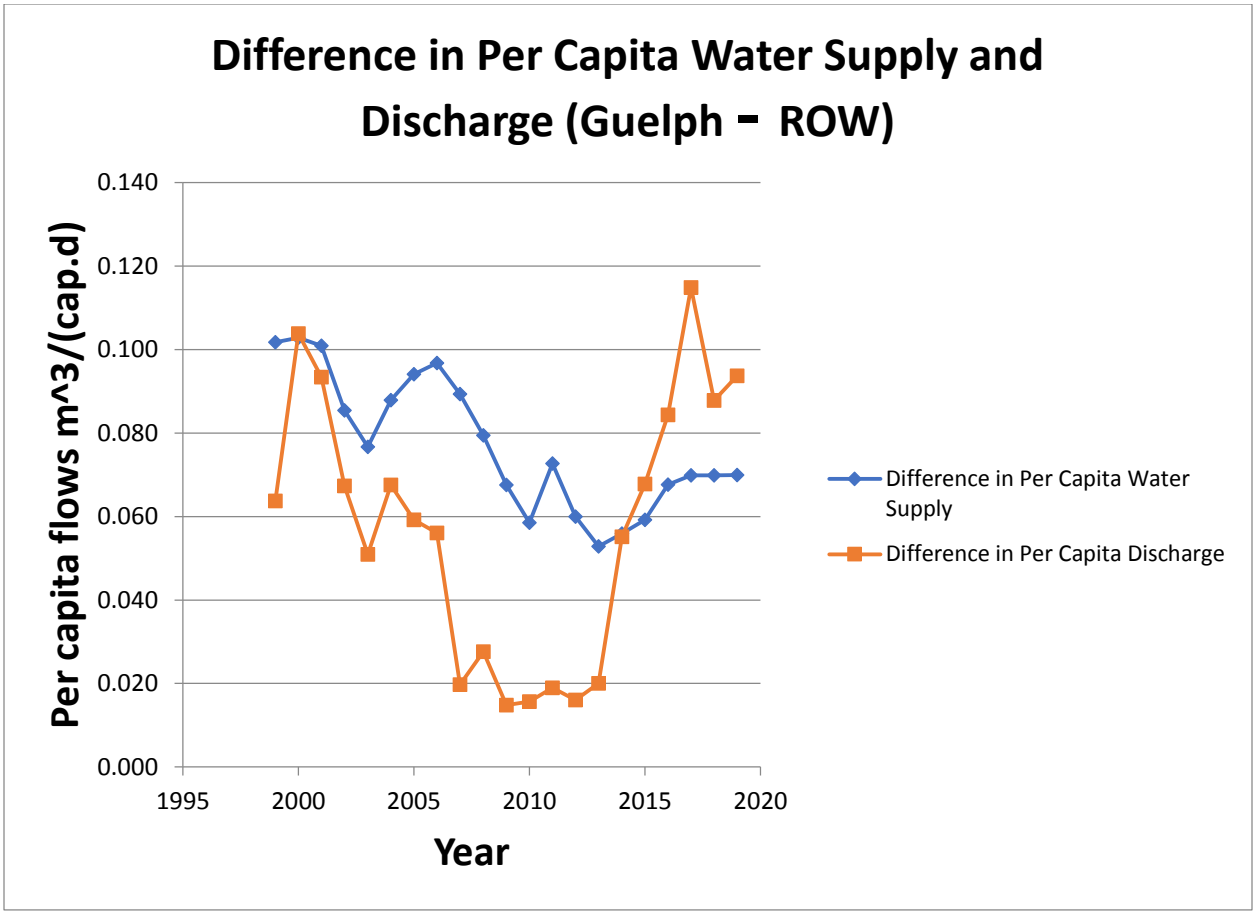

FIGURE 3 Difference in per capita daily flows (City of Guelph - ROW) 1999-2019

Between 1999 and 2012 the difference between Guelph and ROW in per capita water supply and the per capita effluent daily flow volumes was trending downward. Beginning in 2013 this trend was reversed and the difference between Guelph and ROW began increasing. The increase in per capita water supply of Guelph compared to ROW was slight. However, the increase in difference in per capta effluent volumes was much larger and by 2019 the difference was greater than it had been 20 years earlier.

The most obvious possible explanation for the observed increase in both absolute values of effluent flowrates and in difference in per capita flowrates between Guelph and ROW is that Inflow and Infiltration flow volumes has been increasing in the Guelph system, but not in the ROW system between 2013 and 2019.

I have used baseflow separation to establish the monthly pattern of baseflow at the Blue Springs Creek gauging station 02GA031. Blue Springs Creek has a very high Base Flow Index with about 75 % of the streamflow being baseflow. The pattern of baseflow of Blue Springs Creek represents the seasonal pattern of groundwater levels and is thus a good indicator of the

pattern on Inflow and Infiltration into the Guelph sanitary sewer system since watertable -level patterns govern I & I flowrates.

I have estimated Inflow and Infiltration for the Guelph WRRF by using a proportioning factor applied to the observed baseflow in Blue Springs Creek. I have assumed that (Observed WRRF Effluent - I & I) rates should be less than Water Supply rates since a portion of the water supplied is used in landscaping and product production and does not form part of the sanitary sewer return flow. Applying this principle I selected proportioning factors for each year that produced parallel curves for water supply and WRRF (Q – I & I).

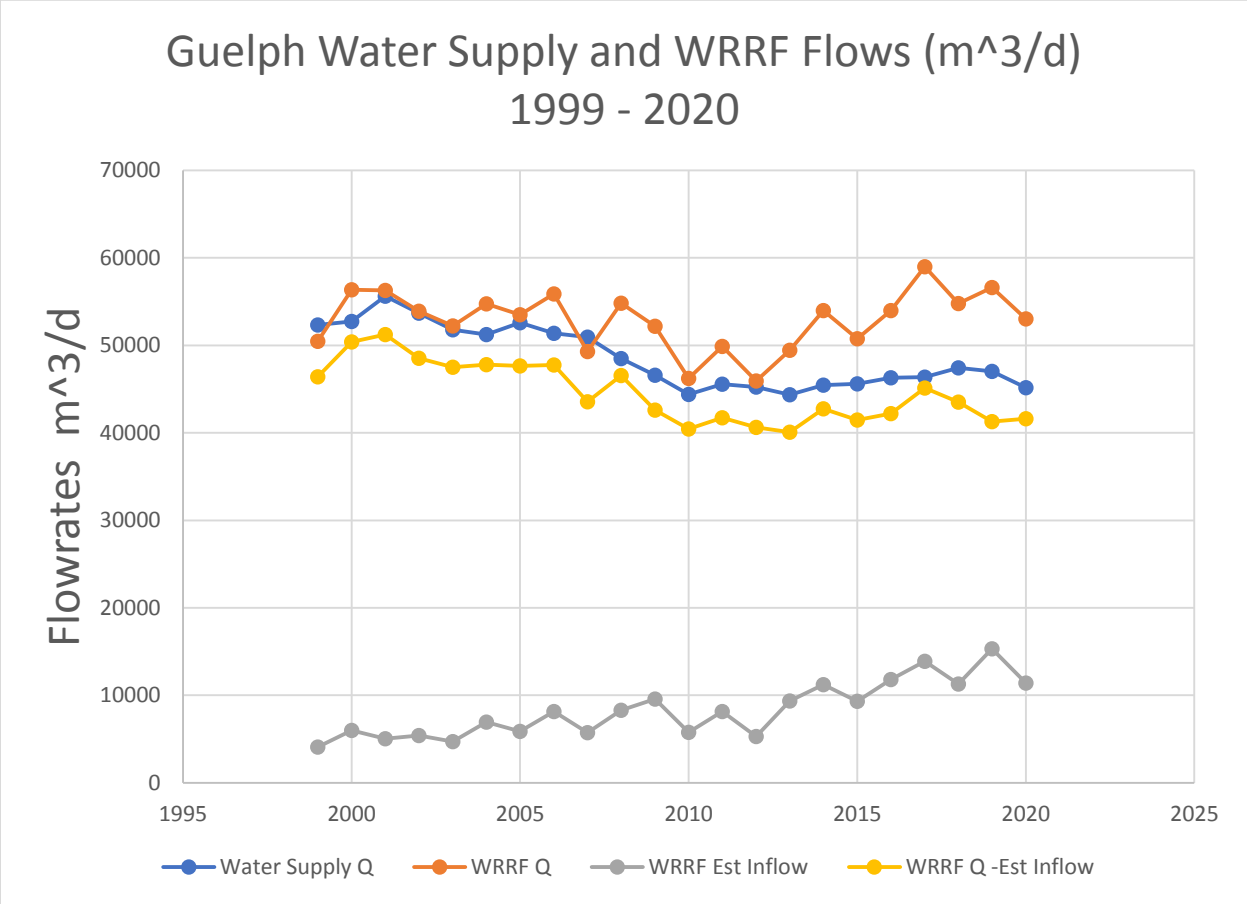

FIGURE 4 Annual mean daily rates of water supply and WRRF effluent (Q - I & I) 1999-2020

In addition to the results for annual mean estimates of Inflow and Infiltration I did the same calculations for monthly flowrates for the years 2019 and 2020. The results for the monthly calculations are shown in Figure 5. The monthly pattern is consistent with the assumed relationship between water supply rate and (Q -I & I) for WRRF effluent.

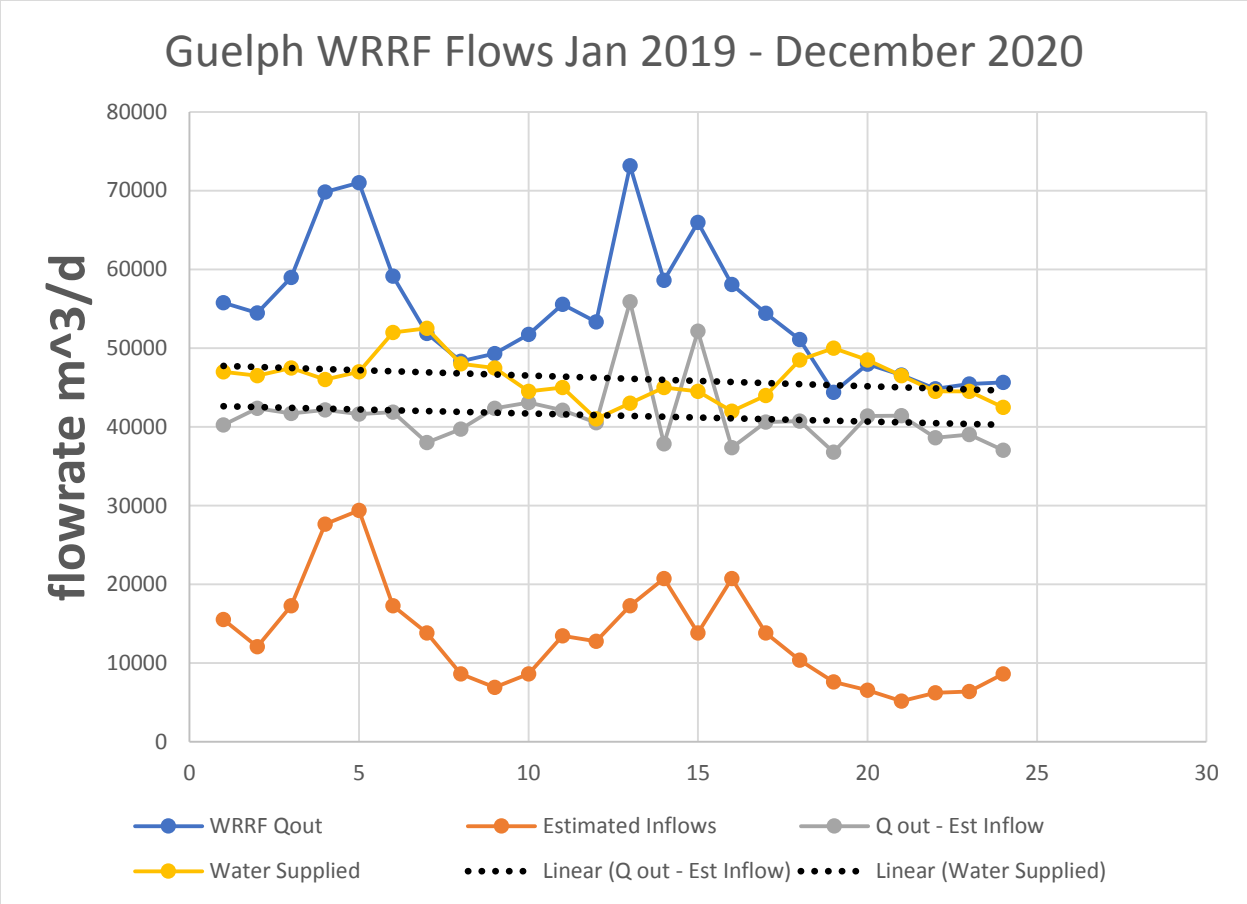

FIGURE 5 Monthly mean daily rates of water supply and WRRF effluent (Q - I & I) 2019-2020

Conclusions

The estimates of Inflow & Infiltration to the Guelph WRRF, based on using Blue Springs Creek baseflow as a predictor of flow pattern, appear reasonable and show an annual rate of increase in I & I flows from 1999 to 2012 of 2 %/y. This annual rate of increase jumps to 12 % per year for the period 2013- 2020.

This increase in rate of increase is not due increase in wet years since the Blue Springs Creek baseflow increased only slightly faster from 2013 to 2020 than it had for 1999 to 2012 (3 %/y compared to 2 %/y).

As a result of this rapid rate of increase in Inflow & Infiltration the average annual rate of I & I in Guelph has about doubled in the last eight years rising from about 7,000 m^3/d to about 13,000 m^3/d.

This increase in I & I in Guelph is responsible for the increase in per capita WRRF flows for the period 2013 to 2020. Without this increase in I & I per capita WRRF flows would have continued

to decline from 2013 to 2020, matching the pattern of declining per capita WRRF flows in the Region of Waterloo for his period. If the pattern of I & I flows had not shown the rapid increase from 2013 to 2020 but remained in the pre 2013 pattern the per capita flows for Guelph would be 0 .31 m^3/(capita . d) rather than 0.35 m^3/(capita . d)

The unexplained increase in I & I for the Guelph WRRF is large enough to strongly influence the timing of new facilities needed to handle increasing flows and the increase creates additional operational stress on the system by increasing the frequency of high-flow months.

Recommendation

An investigation of the causes for the apparent rapid rate of increase in I & I for the Guelph WRRF system should be launched immediately. The investigation should be completed before the completion of the Master Plan update and the results of the investigation used in preparing the contents of the Master Plan Update.

The investigation should include:

- Confirmation studies to confirm that an increase in I & I has occurred and is still occurring
- Inspection of the system to identify locations where I & I is occurring and establish priority listing for possible remediation
- Determine feasibility of measures to reduce I and I and the cost of alternatives
- Compare the costs and benefits for various levels of reduction of I and I to determine a business case for a recommend program of expenditures to reduce I and I.