Memo: Revised Water Demand and Tier 2 Water Quantity Stress Assessment for the Irvine River Groundwater Assessment Area, November, 2014

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In the Grand River Tier 2 water quantity stress assessment, the Irvine River groundwater assessment area was evaluated as a "low" potential for stress under current conditions (AquaResource 2009b). When future water demands were applied to this assessment area the percent water demand increased to 10% and the assessment area was classified as having a "moderate" potential for stress (AquaResource 2009b). This assessment area includes the municipal water supply system for Centre Wellington which serves the communities of Fergus and Elora. Future water demands for the municipal system were estimated based on population projections and current water usage. A more detailed assessment of future water needs was not available during the study, as the municipality was at the preliminary stages of starting a water supply master plan. With the percent water demand at the threshold between "low" and "moderate" potential for stress and future water demands based on simple methodology, it was decided to review the findings of the Tier 2 Stress Assessment with updated water demand values before moving on to a Tier 3 Water Quantity Risk Assessment.

The Irvine River groundwater assessment area is in the northern part of the watershed, Figure 1. The assessment area is 359km^2 and includes the Irvine River, Carrol Creek and Swan Creek watersheds as well as local drainage to the Grand River from Shand Dam to Township Road 60 just downstream of Inverhaugh. The area is comprised of tight till with some glacial outwash and exposed bedrock. The assessment area is predominately used for agriculture. The communities of Fergus and Elora are serviced with a combined municipal system that is comprised of 9 supply wells that draw from bedrock aquifers.

This review of water demand values is only for the Irvine River groundwater assessment area and focuses on reducing uncertainty in both the current and estimated future water demand in the assessment area. Water supply and water reserve calculations were not changed from the 2009 Tier 2 Stress Assessment, and the groundwater flow model was not re-run for this update.

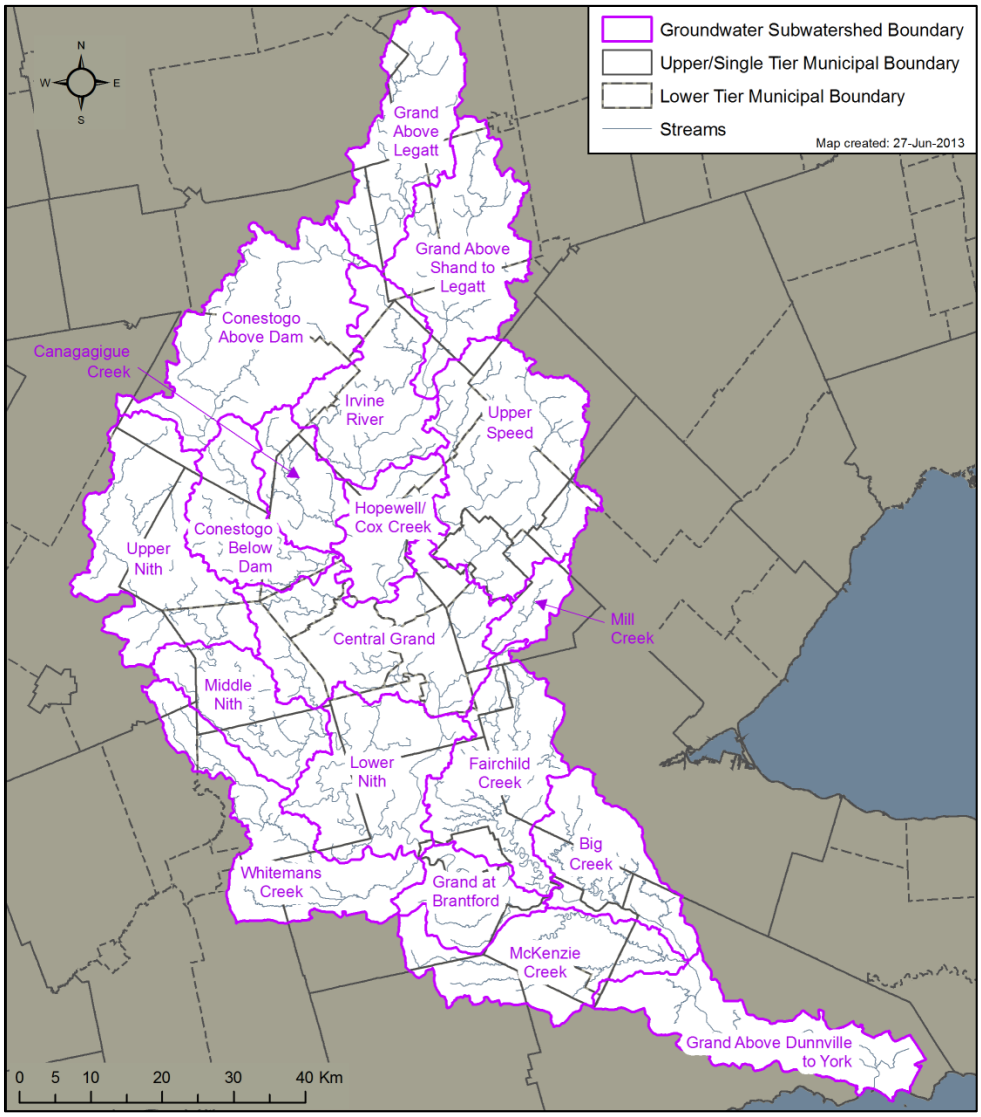

Figure 1: Map showing the groundwater assessment areas in the Grand River watershed

Revised Water Demand

Water demand in the Irvine River Assessment Area in the 2009 stress assessment report had about 20% of the total demand estimated based on maximum permitted water takings with the other 80% based on actual water use numbers. By using the WTRS values from 2009 to 2012 all permitted water takings now have actual water use values attached to them.

Updated values based on actual water use were very similar to the water demand used in the 2009 assessment report. Both values are given in Table 1. The number and types of PTTW also did not change from the 2009 assessment report to the revised values given in this update. The amount of water used for livestock watering and rural domestic was not updated and accounts for approximately

22% of the water demand in the assessment area. Municipal water use was the largest water use with 73% of the total demand. Commercial and industrial uses accounted for 5% of the total demand, while groundwater remediation accounted for less than 1%.

Table 1: Revised monthly water demand in (L/s) for the Irvine River assessment area

Water Demand Estimate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave	Max
2009 Stress Assessment Report Water Demand														
Reported	60	64	63	73	71	74	67	64	67	67	65	64		
Estimated	14	14	14	14	14	15	15	15	15	14	14	14		
Total	74	78	77	87	85	89	83	79	82	81	79	78	81	89
Revised Water Demand														
Municipal	55	58	56	54	59	57	63	56	59	61	53	56		
Non-Municipal	1	1	1	2	6	9	9	8	6	4	3	1		
Rural/Livestock	17	17	17	17	17	17	17	17	17	17	17	17		
Total	73	76	74	74	82	83	89	81	82	82	73	74	**79**	**89**

Future Water Demand

In the 2009 stress assessment the Irvine River assessment area was classified as a "moderate" potential for stress under future conditions only. Future water use is based on forecast increased water use from municipal sources only. For the 2009 stress assessment water demand for the Irvine River assessment area was projected to increase by 73 L/s by 2031. This value was based on an assessment of current per capita water use within Fergus and Elora, and forecast population projections to 2031. Since the time of the original study Centre Wellington has started work on long term water supply planning. Part of long term water supply planning is to forecast water needs into the future.

Estimates of future water needs were attained from the township and include projected water demands for both average day pumping and maximum day pumping needs. Based on the projections from the township the water supply system is expected to need 64 L/s additional capacity on an average day basis and 75 L/s to meet peak day demands. Average day demands were applied to the average monthly water use estimate, while maximum day demands were applied to the maximum monthly water use estimate. Water use for municipal systems typically peaks in the summer months when outdoor water use is highest so applying peak use to the maximum month (July) makes sense.

Table 2: Future water demand in (L/s) for the Irvine River assessment area

Water Demand Estimate	Future Additional		Future Total	
	Average	Maximum	Average	Maximum
2009 Stress Assessment	73	73	154	162
Revised Water Demand	64	75	**146**	**167**

Groundwater Stress Assessment

Percent Water Demand for groundwater in the Irvine River groundwater assessment area was calculated using estimates of groundwater supply, groundwater reserve, and consumptive demand. Estimates of groundwater supply and reserve have not been changed from the original stress assessment as part of this update. Explanations of how they were calculated can be found in Section 3.3.3 of the stress assessment report (AquaResource 2009b).

Table 3 Revised Groundwater Stress Assessment Irvine River assessment area

Scenario	Groundwater Supply (L/s)			Groundwater Reserve (L/s)	Demand (L/s)		Percent Water Demand	
	Recharge	Flow In	Supply		Average Annual	Maximum Monthly	Average Annual	Max Monthly
Moderate Threshold							10%	25%
Current Demands	1595	58	1653	125	79	89	5.1%	5.8%
Future Demands	1595	58	1653	125	143	164	9.3%	11%

The revised current water demand values resulted in no change to the current demands stress assessment. The Irvine River assessment area remains classified as having a “low” potential for stress under current demands.

The revised future demands values resulted in a slight reduction in the average annual percent water demand from 10% to 9.3%. This reduction changes the potential for stress classification from “moderate” to “low”, but with the value so close to the “moderate” threshold of 10% further discussion on uncertainty and sensitivity is required. There was no change to the maximum monthly percent water demand.

Uncertainty

While the stress classification is based on the best estimates of consumptive water demand, water supply, and water reserve, there is uncertainty with these estimates that may affect the classification. The Technical Rules require that each subwatershed be labeled with having a Low or High uncertainty in regards to the Stress Assessment classification assigned to each subwatershed.

A sensitivity analysis was conducted, similar to the one in the original report, using the revised values for water demand as calculated above. In the sensitivity analysis, there are six scenarios where estimated current consumptive demand, future demand and groundwater recharge for each subwatershed are increased and decreased by 25%. The sensitivity scenarios are completed for both the annual and maximum monthly demand conditions.

Table 4 summarizes the results of the sensitivity analysis for the groundwater stress assessment under average annual and maximum monthly conditions for both current and future estimated demand.

Table 4 Groundwater Sensitivity Analysis

Scenario	Current		Future	
	Average Annual	Max Monthly	Average Annual	Max Monthly
Revised Future Water Demand	5.1%	5.8%	9.3%	11.0%
125% Estimated Water Demand	5.4%	6.1%	9.6%	11.0%
75% Estimated Water Demand	4.9%	5.6%	9.1%	10.5%
125% Future Demand	--	--	**10.4%**	10.6%
75% Future Demand	--	--	8.3%	8.1%
125% Recharge	4.1%	4.6%	7.4%	8.5%
75% Recharge	7.0%	7.9%	**12.6%**	14.6%

The results in Table 4 show that the results are not sensitive to estimated water demand in the future scenarios. This value only includes livestock watering and rural domestic water use and accounts for 22% of the current water use and approximately 10% in the future scenarios. Percent water demand is slightly more sensitive to future demand with a change of about 1% with a 25% change in future water use based on average annual use. Percent water demand values are most sensitive to changes in recharge in this assessment area. A 25% change in the amount of recharge resulted in a 3% change in average annual percent water demand.

Only two of the scenarios resulted in a percent water demand above the threshold of 10%; a 25% increase in future average day water demand and a 25% reduction in recharge with future water demand. An increase in the future estimated water demand of 25% to 80 L/s for average day demand resulted in a percent water demand of 10.4%, but an increase of this much is unlikely given trends for lower per capita water use. It is more likely that average use in the future will be less than the estimate given by the municipality because of more efficient appliances and changing water values. A 25% reduction in recharge resulted in a percent water demand of 12.6% under the future demand scenario. There is confidence in the current recharge values used as they represent a long term average (time period) and were calculated with a model calibrated over a long time period and confirmed with the regional groundwater model. Therefore it is unlikely that they are overestimated by 25%, but it is recommended that any future studies in this area pay particular focus to recharge estimates to further reduce uncertainty.

Conclusion

The revised water demand and percent water demand assessment shows reduced uncertainty in both current and future conditions. For the current condition, the only estimated water use was from unmeasured rural domestic and livestock watering. All permitted water uses were accounted for with multiple years of reported water use data available. Future water use estimates were also refined with values supplied by the municipality from updated water demand planning activities. The inclusion of a separate estimate for average use compared to peak demand is more indicative of current water demand planning, further reducing uncertainty.

Current and future percent water demand values are below the threshold for moderate potential for stress, but the future average annual percent water demand is very close to the 10% threshold. Percent water demand calculations are slightly sensitive to future water use, but are more sensitive to changes in recharge estimates. Based on the sensitivity analysis, a reduction in recharge or a large increase is future water use would bring values above the threshold triggering a need for a Tier 3 Risk Assessment.

Additional studies of water demand and availability in this assessment area should focus on recharge and connections between surface recharge and the bedrock aquifer, where most of the water for the municipal supply is drawn from.

References

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