INNISFIL CREEK DROUGHT MANAGEMENT
PLAN PILOT SUMMARY REPORT

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Innisfill Creek Drought Management Plan
Nottawasaga Valley Conservation Authority
Pilot Summary Report
30 Sept 2017

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EXECUTIVE SUMMARY

The Innisfil Creek watershed is considered a high priority area by the Nottawasaga Valley Conservation Authority (NVCA) due to water quality and quantity issues related to agriculture and urban development (NVCA 2006). Situated north of the Oak Ridges Moraine (ORM) and partially within the municipalities of Innisfil, Essa, Bradford West Gwillimbury, New Tecumseth, Adjala Tosorontio, and Mono; the area has experienced historical water abstraction shortages due to meteorological and agricultural related droughts with related negative socio-economic impacts. The knowledge and experience gained through the Provincial Water Budget Program under the Clean Water Act along with several local water resource management initiatives made the Innisfil Creek watershed an ideal location to pilot the development of a Drought Management Plan.

Water management is a coordinated effort between provincial representatives, conservation authorities, municipalities, and water users. In Ontario’s Low Water Response (OLWR) program, low water conditions are ranked from Level 1 to Level 3 based on a prolonged period of low flow and/or precipitation (Level 1 is the least severe and Level 3 is the most severe). Progression to a Level 3 low water condition indicates a failure of the water supply to meet demand which often is typically considered as drought conditions. Drought is identified as a “natural hazard” and “type of emergency” under the Emergency Management and Civil Protection Act (EMCPA). The EMCPA and its related regulations are overseen by Emergency Management Ontario (EMO) within the Ministry of Community Safety and Correctional Services (MCSCS). Within this regulatory framework the Ontario Ministry of Natural Resources and Forestry (MNRF) is responsible for the OLWR program, designed to meet the requirements of the EMCPA. Through the implementation of the OLWR program it has been recognized that the declaration of Level 3 conditions has been challenging as it is highly probable that there would be widespread social and economic impacts as a result. Considerations of the socio-economic impacts of potential drought management measures were therefore considered within the pilot project.

In general, as dry summer conditions persist, and soil water content becomes depleted, irrigation is required and water is withdrawn from the watercourses. At the same time, given the runoff driven nature of the Innisfil Creek watershed, baseflows quickly recede, resulting in low flow conditions. Therefore it is the combination of increased water demands with lowered streamflow conditions that result in water scarcity issues.

In 2007, ongoing demand on surface water abstraction together with climate variability in terms of timing and amount of precipitation contributed to persistent low water conditions and resultant surface water shortages in the Innisfil Creek watershed, and it was confirmed later that the shortages in 2007 reached unapproved Level 3 low water conditions. In response to the
In 2007, extreme low water conditions in the watershed and across Ontario during the summer of 2007, a provincial steering committee with representation from the Ontario Ministry of Natural Resources (MNR), the Ontario Ministry of Environment (MOE), Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), and Ontario Ministry of Municipal Affairs and Housing (MMAH) was established to evaluate the ability of local water users to achieve water use reductions, as shortages of water in some watersheds resulted in adverse socio-economic impacts and impacts to the aquatic ecosystem. Gaps and issues identified by conservation authorities like the NVCA, their water response teams, and water users were examined, and various recommendations and changes were made.

In 2009, an Integrated Water Resource Management Strategy (IWRMS) for the Innisfil Creek watershed was developed by local stakeholders; which in part has largely been adopted. Mitigation efforts and management strategies to combat low water conditions have been implemented in the Innisfil Creek watershed, largely due to the efforts of the Innisfil Creek Water Users Association (ICWUA) as established through the IWRMS. The strategy recommended a number of proactive activities among local irrigators, the NVCA and the Ontario Ministry of Environment and Climate Change (MOECC). The next steps and progression of the IWRMS recommended a focus on creating a more detailed understanding of the flow system, and ultimately to provide a more science-based road map to increased water reliability in the long term for all water users in the watershed.

Subsequent research has been conducted in the Innisfil Creek watershed including, but not limited to: the analysis of monitoring data from climate stations, geological investigations, extensive fieldwork and data collection, ecological stream characterisation, and hydrological evaluations. The integrated data suggests that Innisfil Creek is largely a runoff-dominated system. Moreover, the surficial overburden is quite deep throughout the area (exceeding 200 m in some location), with the central portions of Innisfil Creek being characterized largely by surficial sands underlain by glaciolacustrine deposits. Although there is limited groundwater resources associated with these surficial sands, the underlying deposits create a regionally extensive and complex aquifer system.

Agriculture is the largest land use in the Innisfil Creek watershed with extensive sod, potato, carrot and onion crops typically irrigated. Wheat-corn-soybean rotations also predominate in this watershed however are not irrigated. In general, results of the socio-economic profiling illustrate that irrigation and agriculture in general appears to be in decline throughout the Innisfil Creek watershed. For the purposes of this Drought Management Plan, it was assumed that there is potentially 8,528 ha of land that is suitable for irrigation agriculture in the Innisfil Creek watershed. (This estimate was derived from land slope limitations associated with standard irrigation equipment used in the area). Based on the 2011 census of agriculture data, the total area
in agriculture declined by 25% from 1991 to 2011, while total irrigated land declined by 55%. It is also noted that the number of Permits to Take Waters (PTTWs) for agricultural irrigation has reduced by approximately a third since 2008. A major factor in this decline is thought to be the capital cost associated with purchasing a farm. Although the socio economic profile of the watershed suggests that there has been a shift away from agriculturally related economic activity over the past decade, there continues to be a significant amount of agricultural production that still relies heavily on surface water resources for irrigation.

Through watershed function analysis and evaluation of the low water drivers (e.g. statistically modelled precipitation and stream flow levels) it does not appear that agricultural related water withdrawals are increasing the frequency of Level 1 and Level 2 low water conditions. Rather, these more frequently occurring low water conditions are largely a product of climate variability alone. However, it is noted that water withdrawals do affect the frequency of the more extreme Level 3 flow conditions.

In addition to understanding and quantifying the hydrologic regime of the Innisfil Creek watershed, an integrated MikeSHE hydrologic model was developed and used as an assessment tool to understand the future state of the watershed. The population in the Innisfil Creek watershed region is experiencing a growth surge reflecting ongoing regional growth. Communities within the watershed, such as Cookstown, Beeton, and Tottenham have experienced rapid growth in new housing developments and land speculation, and although the local economy is still specialized in agriculture, it is becoming less so. As noted, an economic impact assessment was completed to investigate the economic implications of alternative water management scenarios on the Innisfil Creek watershed. This assessment included four primary water uses in the watershed: 1) agricultural irrigation and crop production, 2) golf course irrigation, and 3) residential water use, and 4) recreational fishing. Details on the economic impact assessment are provided in Appendix D of the Drought Management Plan. The results indicated the following:

1. The economic activity associated with agricultural production in the Innisfil Creek watershed is valued at approximately $35 million per year. It was found that total agricultural annual losses during a catastrophic drought (complete crop failure) can range from $23 to $31 million.

2. The analysis of revenue losses for Innisfil Creek watershed golf courses as a result of drought provides a useful indication of the potential losses relative to the losses estimated for irrigated crops. The “worst case” loss at one golf course amounts to a loss of 2.5% or $273,800. However, if golfers switch to other courses that are irrigated in the watershed, then the overall loss to the sector is likely negligible.
3. It is recognized that municipalities often enact water restrictions during times of drought that temporarily reduce water use. Should water restrictions result in a permanent reduction in water demand, municipalities would be required to raise water rates to offset reduced sales, resulting in a revenue neutral situation. Municipal water revenues would not be affected by a ban on water withdrawals.

4. The total value of watershed fishing to anglers is $13,200 to $26,200/year. Surface withdrawals may exacerbate an adverse impact of irrigation on fishing. Switching surface withdrawals to deep wells would mitigate any impact since the deep aquifer does not appear to be connected to stream base flow.

Alternate sources of irrigation water (e.g., dugout ponds, online reservoirs, groundwater wells) were among those identified as potential Water Management Scenarios. The initial economic feasibility assessment indicated that the construction of dugout ponds and online reservoirs do not generate a positive rate of return (-5% and -3%, respectively). However, changing sources from surface to groundwater sources, via groundwater wells could result in a positive rate of return (10%), assuming that water restrictions were put into place 5 days into a Level 3 low water condition. Given this assumption, transitioning to groundwater supplies may not return the anticipated economic results. However, the water supply security associated with groundwater wells may be desirable by irrigators.

It is now accepted that climate change is occurring and will continue to occur into the future (IPCC 2013). Temperatures will warm, growing seasons will be extended, and precipitation patterns will shift. Climate change introduces a significant amount of uncertainty. There is substantial potential for hydrological change in the Innisfil Creek watershed as a result of climate change. Future climate will influence the hydrologic regime with a reduced snowpack, more rain, and warmer temperatures predicted. Irrigation demand models show that annual irrigation is predicted to increase in all future climate scenarios. Existing irrigation, simulated to be approximately 470,000 m³/year, can be expected to increase by a minimum of 40% to 650,000 m³/year, or a maximum of 90% to 890,000 m³/year. This assumes the same area of cropland is irrigated in the future as was irrigated in 2012. Even for the most optimistic future climate scenario, it is not likely that surface water within the Innisfil Creek watershed can support an irrigation demand increase of 40%.

This increase in irrigation demand, coupled with reduced streamflow conditions will increase the frequency of Level 3 low water conditions by up to 180%. When evaluating the water use scenarios under a changed climate, it is apparent that the most significant factor resulting in an increase in low water days is not the water use scenarios themselves, but the expected change in climate. This change will not occur immediately, but will require constant adaptation to a gradually warming climate. If the most extreme climate projection occurs, what is now
considered to be extreme low flow would become the new normal. This modification to the hydrologic regime of Innisfil Creek is so significant that without substantial adaptation measures the creek may not be considered a reliable source of water to meet irrigation demands.

It is the objective of the Ministry of Natural Resources and Forestry (MNRF), managers of OLWR program, to ensure that provincial and local authorities, such as the NVCA, are prepared in the event of persistent low water conditions. Accordingly, the objective of this pilot Drought Management Plan was to incorporate new and innovative ways to proactively approach low water conditions. It was recognized from the outset that a critical aspect of meeting the stated objective is the need to ensure that the final deliverable be a locally developed and agreed upon plan. It was also understood that for a Drought Management Plan to be effective in the long term, the local water users must have a sense of ownership of the Drought Management Plan. As such, a considerable portion of the project was devoted to public consultation and gathering feedback from the water users in the Innisfil Creek watershed.

The stakeholder group in the Innisfil Creek watershed is a diverse and broad group; therefore, an effective drought management strategy must provide an overall framework that can accommodate a variety of specific circumstances and needs. The issue of water security requires a collaborative approach for success. A key consideration is the degree of control or influence that the stakeholders have over the future of their water supply. Therefore, the recommended Drought Management Plan options were chosen because they are measures that potentially could be implemented by actors within the agricultural sector, alone, or in partnership with other stakeholders in the watershed or externally; not included are options that depend entirely on external actors for their success.

As intended, the more detailed understanding of the flow system obtained through this pilot project has provided a more science-based road map to increased water reliability in the long term for all water users in the watershed. Many of the short-term drought management actions are consistent with those of the existing IWRM’s, but the actions can now be taken with a substantially enhanced understanding of the flow system and the expected impacts of climate change on this system.

The Drought Management Plan aims to shift the drought response in Innisfil Creek from a reactive approach to a proactive approach through a robust, locally driven process that is designed to orchestrate action when drought-like conditions occur and/or minimize the potential for low water conditions to occur from human-induced water taken, when possible. This undertaking coupled a more detailed understanding of the flow system at a watershed scale with the socio-economic drivers in the Innisfil Creek watershed. This knowledge supplies the
foundation to build a road map to increase water reliability for all water users in the watershed including the ecosystem.

**Key Outcomes**

Further implementing and improving upon the existing IWRMS using a science-based road map to increased water security in the long term for all water users in the watershed.

**Short Term**
- Expanding stakeholder representation
- Increasing capacity of the stakeholders
- Development of a renewed communication strategy
- Increasing coordination to reach larger audiences

**Long Term**
- Shifting from surface water centric to utilizing groundwater wells as a source of irrigation water would result in a more secure water supply for seasonal water users, and would result in a more reliable supply of streamflow for ecological needs.
- Upscale efforts to implement and support new technologies and science-based understanding of the water supply in the Innisfil Creek watershed
- Adapting to climate change, including changing precipitation patterns, warmer weather, reduced snowpack, a longer growing season, and increased evapotranspiration, which may include investigating alternative crops that are more resilient to water shortages.
1 INTRODUCTION

This document is intended to serve as a concise summary of the objectives, approach and outcomes detailed in the main technical report entitled “Innisfil Creek Drought Management Plan Pilot” (Matrix Solution and BluMetric Environmental, 2017). This summary highlights information presented throughout each chapter in the main technical report: general watershed description, watershed function, low water drivers, the drought management planning process, evaluation of water use scenarios including hydrologic, aquatic and economic impacts, and future climate scenarios. It also focuses on the key material used to support the drought management plan and recommended short and long term actions that could be taken. The reader is encouraged to refer to the main technical report for specific and additional analysis and information including maps and figures and a comprehensive list of references.

2 WATERSHED CHARACTERIZATION

The Innisfil Creek watershed is approximately 490 km² in size and consists of five main subwatersheds: Bailey, Beeton, Cookstown, Innisfil, and Penville. The watershed has a primarily rural agricultural coverage, and low forest cover (MAP 1). Understanding the flow of water in and out of the system is important to help manage water supply and predict where there may be shortages. Water entering the system, does so via precipitation, and monitoring records from stations around the watershed shows annual precipitation ranges from 789 to 912 mm/year. As per a generalized water budget, this water moves within the watershed either via evapotranspiration, surface runoff, or stored in the ground. In the Innisfil Creek watershed, evapotranspiration was found to be 550 to 600 mm/year and would consume approximately two thirds of the annual precipitation (MNR, 1984). The remainder of the water balance is attributable to surface runoff or groundwater storage.

Land cover is an important factor affecting the overall water balance of a watershed by altering this runoff, infiltration and the potential for evapotranspiration. In the Innisfil Creek watershed, agricultural land use activities are the most prevalent. Agricultural land cover consist primarily of row crops and undifferentiated agricultural and roughland areas. Collectively, the proportion of land use in the water shed is approximately distributed as 75% Agriculture, 14% Forests, 7% Wetlands, and 3% Built Up Urban, and 1% Extraction (MAP 2). The top four irrigated crops grown in the Innisfil Creek watershed are potato, turf, onion, and cabbage. Irrigation occurs typically where the slope of the land is not greater than 1% due to restrictions on typical equipment in the area. Using this criterion, there is potentially 8,528 ha of land that is suitable for irrigation agriculture in the Innisfil Creek watershed. MAP 3 shows where the potential irrigable land is located.
The Water Survey of Canada (WSC) and the NVCA operates stream gauges throughout the Innisfil Creek watershed. Four stream gauges operated by the WSC and four stream gauges operated by NVCA are located near the Innisfil Creek watershed. (MAP 4). All stream gauges are located within the boundaries of Innisfil Creek watershed, with the exception of Nottawasaga River near Alliston, which is located approximately 1 km downstream from the watershed boundary (Station ID 02ED101). Compared to the gauges on Innisfil Creek, the most notable difference is the relatively high amount of streamflow generated during the summer months in the Nottawasaga River. This difference is indicative of Innisfil Creek being a runoff-dominated system, compared to the baseflow-driven system of the Nottawasaga River.

Water that is not transferred into either evapotranspiration or surface runoff is stored in the ground. The underlying surficial geology of the land in the watershed was simplified into six classes: clay, fluvial and organic deposits, gravel, Kettleby Till, Newmarket Till, and sand (MAP 5). Overburden is quite deep throughout the area, with depth to bedrock exceeding 200 m in some locations. As part of an Ontario Geological Survey three dimensional (3D) mapping project of Quaternary deposits in the southern part of the County of Simcoe, extensive fieldwork and data collection has been completed (referred to as south Simcoe County; Bajc and Rainsford 2010, 2011; Bajc et al. 2012; Mulligan 2013). It was found that while surficial sands are present throughout the central portion of Innisfil Creek; these are thin deposits, which are underlain by thick glaciolacustrine deposits. There is limited groundwater resources associated with these surficial sands; shallow groundwater wells or dugout ponds would likely be insufficient to meet irrigation needs. However, there is evidence for a viable aquifer beneath these surficial sands that appears to be able to support large scale withdrawals and groundwater in the Innisfil Creek watershed is primarily hosted within these aquifers comprised of (glacio) fluvial sands and gravels at the base of the Laurentian Valley and Quaternary channels, sand packages contained within the Thorncliffe Formation. These deposits create a regionally extensive and complex aquifer system.

In Ontario, water management is a coordinated effort between provincial representatives, municipalities, conservation authorities, and water users through the Ontario Low Water Response program (MNR 2010). The OLWR program was implemented to help meet the requirements of emergency preparedness under the Emergency Management and Civil Protection Act (EMCPA). The EMCPA and its related regulations are overseen by Emergency Management Ontario (EMO) within the Ministry of Community Safety and Correctional Services (MCSCS). The low water condition of a watershed can be defined as being in one of three levels, which are shown in Table 1. A water response is undertaken when watershed conditions changes from one level (or no level) to another, with water supply problems defined as those with significant social, environmental and economic impacts.
Table 1: **Ontario Low Water Response Indicators in the Innisfil Creek Watershed**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Precipitation (3 Month or 18 Month)</th>
<th>Streamflows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Level 1 - Potential water supply problems</td>
<td>&lt;80% of average</td>
<td>0.405 m³/s (&lt; 70% of lowest average summer month flow)</td>
</tr>
<tr>
<td>Level 2 - Minor problems, potential major supply problems</td>
<td>&lt;60% of average</td>
<td>0.29 m³/s (&lt; 50% of lowest average summer month flow)</td>
</tr>
<tr>
<td>Level 3 Supply fails to meet usual demand, social and economic impact</td>
<td>&lt;40% of average</td>
<td>0.174 m³/s (&lt; 30% of lowest average summer month flow)</td>
</tr>
</tbody>
</table>

Each condition is accompanied with a response: Level 1 (conservation), Level 2 (conservation, restriction), and Level 3 (conservation, restriction, and regulation; MNR 2010). Level 1 is the first indication of a potential water supply problem, while Level 2 indicates a potentially serious water supply problem. Level 3 provides indication that there is a failure in the water supply to meet demand (MNR 2010). Level 3 conditions may include mandatory water restrictions, which can have widespread social and economic impacts. These restrictions impact Permit to Take Water (PTTW) users. Furthermore, although streamflow and precipitation indicators can suggest a Level 3 condition is being experienced, the Low Water Team may not declare a Level 3. Reasons for not declaring a Level 3 may include a lack of understanding of the socio-economic consequences of declaring a Level 3; uncertainty regarding whether water restrictions may alleviate the low water situation; or when in a year the low water condition is experienced (summer vs late fall). Accordingly, the economic implications of alternative water management scenarios on the Innisfil Creek watershed were evaluated.

**Water Use Assessment**

A water use assessment was designed and completed to improve the understanding of permitted water takings, and to determine water use trends for the purpose of developing realistic alternative water demand scenarios for drought management in the watershed. Water use was assessed based on the permitted versus non-permitted takings, and groundwater versus surface water takings. Historical water use data reported in the tiered water budget and water quantity stress assessments undertaken as part of the Clean Water Act requirements were reviewed in the assessment, although it is noted that the assessment were completed on different scales. Therefore, the historical water use data is not necessarily directly comparable to the current water use assessment. However, it can provide insight on water taking trends. Additionally, a water use survey of all active non-municipal PTTW was completed in the summer of 2008. This was a parallel study driven by adverse climate and water resource conditions, along with experiences relating to the implementation of the Ontario Low Water Response in 2007. The reported experiences during dry summers, such as occurred in 2007, demonstrated that intensive use of
surface water resources in Innisfil Creek and its tributaries was not sustainable. The 2008 study led to the adoption of a locally designed IWRMS for the Innisfil Creek watershed.

In addition to historical data from previous studies, the PTTW program database for 2011, 2012, and 2013 was used to complete the assessment on actual water demands. Only permits representing sustained water takings, both surface water and groundwater, were used in the assessment; temporary permits such as dewatering and construction were not included. The source of withdrawn water is variable based on the sector responsible for withdrawals. Forty-six active permits were listed, 36 were linked to seasonal irrigation, 3 of which were associated with golf courses in the watershed. For example, 6 of the 33 permits for agricultural irrigation draw on groundwater from either a well or dugout pond; the rest are surface water takings. In addition, there were five municipal water supply permits associated with seven water systems drawing on groundwater: Churchill, Tottenham, Colgan, Palgrave, and Cookstown (decommissioned in April 2013). The remaining permits include two communal water supply permits, three commercial permits for golf courses captured above, and one additional commercial business water supply permit.

The withdrawals associated with municipal water supply, all of which are groundwater sources, comprise a majority of the annual water demand within the Innisfil Creek watershed. Alternatively, withdrawals associated with agricultural irrigation in 2012 were predominantly sourced from surface water (88% of total). This is reflective of surface water withdrawals being the most economically feasible source of water, from the perspective of infrastructure costs. Water withdrawals for 2012, and their breakdown by sector and source, are graphically represented on Figure 1. Surface water withdrawals typically occur between April and October as was the case in 2012, and agriculture represents approximately 87% of the surface water takings while commercial surface water takings represent the remaining 13%. 
The NVCA completed a field-based agricultural resource inventory of the Innisfil Creek watershed in the summer of 2014. This inventory and subsequent report provides the most recent data set in terms of crop distribution and irrigation locations within the watershed and is therefore the primary source of information for this assessment. Local irrigators reported that due to the primary type of irrigation equipment used in the watershed (i.e., centre pivot, stationary gun, and travelling gun) that irrigation occurs typically where the slope of the land is not greater than 1%. Using this criteria, there is potentially 8,528 ha of land that is suitable for irrigation agriculture in the Innisfil Creek watershed. MAP 3 shows where the potential irrigable land is located. This map may under or over estimate the total irrigable land slightly depending on the digital elevation model used; however, it is a reasonable first approximation.

Irrigation and agriculture in general appears to be in decline throughout the Innisfil Creek watershed. From 2011, 2012 and 2013, there were a total of 33 individual PTTWs for agricultural irrigation owned by 17 individuals or corporations. The number of PTTWs has been reduced by approximately a third since 2008. Total farmed area has declined by 25% from 1991 to 2011, while irrigated land has declined by 55%. A major factor in this decline is thought to be the capital cost associated with purchasing a farm. With the estimated value of farms exceeding $2,000,000, the economic viability of a new operation is questionable.
The Socio Economic Profile of the Innisfil Creek Watershed is documented in detail in Appendix B of the Drought Management Plan. Although the local economy is still specialized in agriculture, it is becoming less so. According to the 2011 census, agricultural jobs declined 21% between 2006 and 2011. The number of farms declined by 26% from 410 to 304 farms between 1991 and 2011, while total farmland area fell 25% from 32,325 hectares to 24,003 hectares, the highest rate of loss of any subwatershed in the Nottawasaga watershed.

Summary of Water Use Scenario Evaluation
Low water conditions can naturally occur, or they can result from activities such as direct water abstraction from a creek or stream. The naturally occurring low water conditions are typically due to meteorological drought such as below average precipitation rates or reduced groundwater discharge to a creek or stream due to lowered static water levels in a discharge driven system. As dry summer conditions persist, and soil water content becomes depleted, irrigation is required and water is withdrawn from the watercourses. At the same time, given the runoff-driven nature of the Innisfil Creek watershed, base flows quickly recede, resulting in low flow conditions. The combination of increased water demands with lowered streamflow conditions results in water availability issues. Current climate change projections indicate that the frequency of naturally occurring low water conditions to exist in this area will increase. Based on the current assessment, it does not appear that water withdrawals are increasing the frequency of Level 1 and Level 2 low water conditions. These more frequently occurring low water conditions are largely a product of climate variability alone. However, water withdrawals do affect the frequency of the more extreme Level 3 flow conditions.

An integrated surface and groundwater MIKE SHE model was developed to simulate surface water and groundwater resources. By applying a fully dynamic, physically based representation of all major processes of the hydrologic cycle and their interactions, reliable predictions can be generated to evaluate the significance of modelled irrigation withdrawals on the number of days with low water conditions. The primary output from the model is streamflow; however, it can also be used to quantify a number of other water budget parameters, such as groundwater recharge/discharge, groundwater levels, evapotranspiration, and soil water content.

A significant advantage of this approach is that the model is able to predict how irrigation demand will change with climate conditions, which is critical when evaluating drought conditions. Figure 2 shows the simulated impact of irrigation on streamflow by comparing model output (i.e., streamflow) for the 2007 summer season, between model simulations with crop irrigation and without. Figure 3 shows both the existing pumping and no-pumping scenarios over the summer season to illustrate the effect of irrigation on streamflow, and illustrates the impact of water withdrawals on the entire watershed by examining the range of flows for each month during the 1983-2012 simulation period, at the Innisfil near the Alliston gauge location. On
Figure 3, it is evident that the existing irrigation practices impacts the 99th and 75th exceedance flows during June, July, and August at Innisfil near Alliston. Water withdrawals are shown to impact the 99th and 75th percentile flows most significantly (i.e. impacts 99% and 75% of the streamflow data, respectively). As the agricultural sector will only irrigate when required by crops (i.e., when it is dry), low flows are impacted the most by the associated water withdrawals. This correlation of dry conditions increasing irrigation requirements, while also reducing the amount of streamflow available, can cause up to a 25% reduction in streamflow that is attributable to water withdrawals during extremely dry periods (represented by the 99th percentile flow).

![Graph](image.png)

**Figure 2:**  
Impact of Crop Irrigation on Simulated Streamflow at Innisfil Creek Outlet
While comparing flow values can be a useful metric to evaluate impacts from water withdrawals, an assessment more relevant to Drought Planning is the comparison of the number of days under a specific Low Water Response threshold as presented in Table 3 and discussed below.

**Economic Impacts**

The population in the Innisfil Creek watershed region is experiencing a growth surge reflecting ongoing regional growth. From 2006 to 2011, the Town of Bradford West Gwillimbury grew at 3 times the provincial rate and the Town of New Tecumseth, which includes Alliston, grew by 23% or almost four times the provincial average. In keeping with this rapid growth and bordered by large population centres, the Toronto/Barrie Highway 400 corridor and the Ontario Greenbelt, the watershed has seen intense land speculation and planning for new housing developments in communities such as Cookstown, Beeton, and Tottenham.
The economic implications of alternative water management scenarios on the Innisfil Creek watershed were evaluated for four primary water uses in the watershed: 1) agricultural irrigation and crop production, 2) golf course irrigation, and 3) residential water use, and 4) recreational fishing.

**Agricultural Irrigation**
The local economy is still specialized in agriculture; however it is becoming less so. In spite of the decline, the economic activity associated with agricultural production in the Innisfil Creek watershed is valued at approximately $35 million per year. Severe drought can restrict access to a water supply for irrigation, and will have an adverse effect on crop yield, crop value, and crop budget. Total agricultural annual losses during a catastrophic drought (complete crop failure) can range from $23 to $31 million. A significant portion of these losses would be associated with turf and potato production. These losses can be avoided during a severe drought if irrigation withdrawals can be sustained by local water resources.

**Golf Course Irrigation**
The analysis of golf courses consider impacts of drought on net golf course revenues. While it does not provide an accurate picture of likely revenue losses for Innisfil Creek watershed golf courses, it provides a useful indication of the potential losses relative to the losses estimated for irrigated crops. Economic losses will likely be caused by declining sales when a Level 3 drought occurs due to the initiation of a watering ban. It was found that the average annual loss of revenue for an affected golf course would be 12.7% (the loss on one 18-hole course). This is the average loss over all years (including years when there is no ban). For the entire golf sector in the watershed, the “worst-case” loss at one golf course amounts to a loss of 2.5% or $273,800.

**Residential Water Use**
Municipal water revenues would not be affected by a ban on water withdrawals. It is recognized that municipalities often enact water restrictions during times of drought that temporarily reduce water use. However, municipalities operate their water systems on a cost recovery basis and do not subsidize their water systems from general tax revenues. As capital and operational costs will remain relatively constant despite a slight reduction in water demand, should water restrictions cause a permanent reduction in water demand, municipalities would be required to raise water rates to offset reduced sales, resulting in a revenue neutral situation.
Recreational Fishing
The economic value of recreational fishing, like water supply, is estimated using willingness-to-pay. In this case, willingness-to-pay can be determined by observing the behaviour of anglers or by soliciting statements about value in surveys. The total value of watershed fishing to anglers is $13,200 to $26,200/year, which was estimated from the 2005 Survey of Recreational Fishing in Canada. Surface withdrawals may exacerbate an adverse impact of irrigation on fishing. Switching surface withdrawals to deep wells would mitigate any impact since the deep aquifer does not appear to be connected to stream base flow.

Evaluation of Alternate Water Sources
An initial economic feasibility assessment indicates that the construction of dugout ponds and online reservoirs do not generate a positive rate of return. The feasibility assessment indicates that changing sources from surface to groundwater sources, via groundwater wells could result in a positive rate of return. This depends on how quickly water restrictions are enacted during a Level 3 condition. If water restrictions are enacted within 5 days of a Level 3 flow condition occurring, transitioning to groundwater wells provide a positive rate of return. If water restrictions are enacted greater than 6 days of a Level 3 flow condition occurring, there is expected to be a marginal or no positive rate of return. Given this, transitioning to groundwater supplies may not return the anticipated economic results. However, the water supply security associated with groundwater wells may be desirable by irrigators.

Future Climate
Climate change is occurring and will continue to occur into the future (IPCC, 2013). Temperatures will warm, growing seasons will be extended, and precipitation patterns will shift. In the past, engineering and water management studies have relied on historical climate records to indicate future climate conditions. Climate change introduces a significant amount of uncertainty into using historical climate records as an indication of future climate conditions. There is significant potential for hydrological change in the Innisfil Creek watershed as a result of climate change.

An assessment of climate change effects on flows within the Innisfil Creek watershed was developed consistently with the methods outlined in the Guide for Assessment of Hydrologic Effects of Climate Change in Ontario. Future climate projections are made by Global Climate Models (GCMs), which are developed and maintained by a multitude of expert climate centres around the world. Ten future climate projections were selected, from a range of all GCMs, and respective Greenhouse Gas (GHG) emission scenarios from the Fourth Assessment Report (IPCC 2007).
Each of the ten future climates were simulated within the Innisfil Creek integrated surface and groundwater model to understand changes to the hydrologic regime. Future climate will influence the hydrologic regime with a reduced snowpack, more rain, and warmer temperatures predicted. Seven of the ten climate change scenarios project an increase in annual precipitation; while eight project a decrease in snowfall. Evapotranspiration increases for all future climate scenarios as a result of higher temperatures and in most cases increased precipitation. Table 2 summarizes the water budget for all ten future climate scenarios.
### Table 2: Future Climate Water Budget Comparison

<table>
<thead>
<tr>
<th>Water Budget Component</th>
<th>Baseline</th>
<th>CLM1</th>
<th>CLM2</th>
<th>CLM3</th>
<th>CLM4</th>
<th>CLM5</th>
<th>CLM6</th>
<th>CLM7</th>
<th>CLM8</th>
<th>CLM9</th>
<th>CLM10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inputs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precipitation</td>
<td>-797</td>
<td>-829</td>
<td>-883</td>
<td>-837</td>
<td>-867</td>
<td>-775</td>
<td>-817</td>
<td>-817</td>
<td>-744</td>
<td>-780</td>
<td>-857</td>
</tr>
<tr>
<td>Snow</td>
<td>-102</td>
<td>-104</td>
<td>-98</td>
<td>-87</td>
<td>-93</td>
<td>-55</td>
<td>-81</td>
<td>-71</td>
<td>-62</td>
<td>-51</td>
<td>-118</td>
</tr>
<tr>
<td><strong>Water Added Via Irrigation</strong></td>
<td>-1.0</td>
<td>-1.5</td>
<td>-1.4</td>
<td>-1.6</td>
<td>-1.6</td>
<td>-1.8</td>
<td>-1.4</td>
<td>-1.4</td>
<td>-1.7</td>
<td>-1.7</td>
<td>-1.4</td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evapotranspiration</td>
<td>594</td>
<td>618</td>
<td>635</td>
<td>629</td>
<td>628</td>
<td>616</td>
<td>616</td>
<td>623</td>
<td>596</td>
<td>622</td>
<td>618</td>
</tr>
<tr>
<td><strong>Total Streamflow</strong></td>
<td>190</td>
<td>197</td>
<td>230</td>
<td>194</td>
<td>222</td>
<td>152</td>
<td>188</td>
<td>182</td>
<td>142</td>
<td>151</td>
<td>221</td>
</tr>
<tr>
<td>Streamflow - Overland</td>
<td>88</td>
<td>88</td>
<td>104</td>
<td>86</td>
<td>101</td>
<td>65</td>
<td>84</td>
<td>82</td>
<td>60</td>
<td>66</td>
<td>101</td>
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<tr>
<td>Streamflow - Interflow</td>
<td>76</td>
<td>82</td>
<td>97</td>
<td>81</td>
<td>92</td>
<td>63</td>
<td>78</td>
<td>75</td>
<td>59</td>
<td>62</td>
<td>92</td>
</tr>
<tr>
<td>Streamflow - Baseflow</td>
<td>26</td>
<td>27</td>
<td>29</td>
<td>27</td>
<td>29</td>
<td>24</td>
<td>26</td>
<td>26</td>
<td>23</td>
<td>23</td>
<td>29</td>
</tr>
<tr>
<td><strong>Total Water Withdrawals</strong></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Groundwater Outflow</td>
<td>12</td>
<td>13</td>
<td>15</td>
<td>13</td>
<td>15</td>
<td>11</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total Change in Storage</strong></td>
<td>-1</td>
<td>-1</td>
<td>2</td>
<td>-1</td>
<td>1</td>
<td>-5</td>
<td>-1</td>
<td>-2</td>
<td>-6</td>
<td>-5</td>
<td>2</td>
</tr>
</tbody>
</table>
As illustrated on FIGURE 4, irrigation demand projections show an increase in all future climate scenarios. Existing irrigation, simulated to be approximately 470,000 m³/year, can be expected to increase by a minimum of 40% to 650,000 m³/year, or a maximum of 90% to 890,000 m³/year. This assumes the same area of cropland is irrigated in the future as was irrigated in 2012. Even for the most optimistic future climate scenario, it is not likely that surface water within the Innisfil Creek watershed can support an irrigation demand increase of 40%.

![Figure 4: Average Annual Total Irrigation for the Various Climate Change Models](image)

The total number of days, predominantly but not exclusively between May and September, with low water conditions for baseline and future climate are provided in Table 3. The future climate scenario is for a different time period and uses only one climate station (Beeton Graham), and as such low water results for the baseline conditions will differ from those provided in evaluated in the previous water use assessment scenarios.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>4,165</td>
<td>3,382</td>
<td>4,219</td>
<td>5,402</td>
</tr>
<tr>
<td>Level 2</td>
<td>2,772</td>
<td>2,361</td>
<td>3,013</td>
<td>4,343</td>
</tr>
<tr>
<td>Level 3</td>
<td>677</td>
<td>433</td>
<td>844</td>
<td>1,889</td>
</tr>
</tbody>
</table>
This increase in irrigation demand, coupled with reduced streamflow conditions will increase the frequency of Level 3 low water conditions by up to 180%. As a result of the changed climate, the hydrologic regime will be modified, resulting in higher streamflows through the winter months, and a spring freshet that occurs earlier and has a smaller magnitude than under existing climate conditions. Summer low flows will be reached earlier in the year and will last later into the fall.

When evaluating the water use scenarios under a changed climate, it is apparent that the most significant factor resulting in an increase in low water days is not the water use scenarios themselves, but the expected change in climate. This change will not occur immediately, but will require constant adaptation to a gradually warming climate. If the most extreme climate projection occurs, what is now considered to be extreme low flow, this would become the new normal. This modification to the hydrologic regime of Innisfil Creek is so significant that without significant adaptation measures the creek may not be considered a reliable source of water to meet irrigation demands.

3 EXISTING INTEGRATED WATER RESOURCE MANAGEMENT STRATEGY

An Integrated Water Resource Management Strategy (IWRMS) for the Innisfil Creek watershed was adopted in 2009 and has been partially implemented since that time. The current Drought Management Plan builds on the existing IWRMS by providing a more detailed approach to the considerations around alternative water supplies and also water security considerations associated with longer term climate change conditions.

The following were five key topics addressed in the IWRMS:

**Planning Objectives**
- Develop an IWRMS to serve as a road map for current and future water users in the Innisfil Creek watershed.
- Shift water takings from direct takings from surface water toward water supply alternatives.
- Identify and implement measures for improved water management

**Water Supply Alternatives**
- Identified to be dugout ponds*, storage ponds*, and groundwater supplies

*The IWRMS did not investigate the economic feasibility of constructing ponds.*
**Stakeholders and Their Roles and Responsibilities**

- Stakeholders included the permit holders, the municipal sector, the NVCA, and the federal and provincial agencies.
- Recommended process to be driven by the permit holder stakeholder group.
- Other agencies encouraged to coordinate efforts and contribute with in kind and financial support (e.g. the use of a meeting room, holding PTTW seminars, and coordinating meetings between agencies to investigate the possibility of streamlining PTTW requirements.)

**Individual and Collective Management Options**

- Individual options evaluated included measures such as instituting water conservation techniques to self-policing irrigation schedules from communal supplies.
- Collective management options developed through the Innisfil Creek Water Users Association (ICWUA) were very beneficial in further developing and implementing the IWRMS within the group of agricultural stakeholders:
  - The ICWUA developed a template Schedule for Water Conservation Measures and hosted PTTW seminars to help ensure that all water takings above 50,000 L per day acquired a PTTW.
  - The ICWUA also participated in communal monitoring to meet the needs of the local permit holders.
  - The ICWUA found that securing adequate leadership, time, and money in the short term was a key consideration that shaped the success of the collaborative approach to the IWRMS.
- Long-term financial viability of the IWRMS dependent upon the level of effort made by NVCA (as a member of the ICWUA) to seek financial support and incentives through available sources of funding.

**Suggested Governance Model**

- Preferred governance model for the ICWUA was a stakeholder led model.
- Membership in the ICWUA was open to all water users in the watershed (including local residents).
- Leadership provided by an Executive Committee tasked to make decisions and to communicate with stakeholders.
- Ad Hoc committees and working groups used to help to prioritize issues were recommended to allow for broader involvement of the membership of the ICWUA and to provide a venue for leadership development and a pool from which to identify future leaders.
- ICWUA meetings were proposed for at least once a quarter.
• Regular email communication was established to provide updates on issues and to report progress on priorities that the ICWUA had identified.

4 THE DROUGHT MANAGEMENT PLAN AND RECOMMENDATIONS

The Drought Management Plan needs to integrate the demands of all water users by considering both surface water and groundwater users. The stakeholder group in the Innisfil Creek watershed is a diverse and broad group; therefore, an effective drought management strategy must provide an overall framework that can accommodate a variety of specific circumstances and needs. The issue of water security requires a collaborative approach for success.

Program and policy options for addressing the goal of secure, reliable, and affordable access to good quality and quantity of water should be developed in full awareness of the fact that critical decisions that affect the local stakeholder’s access to water are often being made by external actors such the MOECC and the PTTW application process. Given how local stakeholders are dependent on regulators outside the watershed to meet their water needs, collaboration with other outside agencies is essential.

In light of high and growing uncertainty, a strategy to increase water security for the agricultural sector should maximize flexibility and the potential for adaptation. A key consideration is the degree of control or influence that the stakeholders have over the future of their water supply. For example, many of the critical changes that are needed to ensure there is a sustainable and adequate supply of water to meet the ongoing and possibly growing needs of agriculture are not under the control of actors in the agriculture sector.

Therefore, the recommended Drought Management Plan options are chosen because they are measures that potentially could be implemented by actors within the agricultural sector, alone, or in partnership with other stakeholders in the watershed or externally; not included are options that depend entirely on external actors for their success.

5 DROUGHT MANAGEMENT ACTIONS - SHORT TERM

The more detailed understanding of the flow system obtained through this pilot project has provided a more science-based road map to increased water reliability in the long term for all water users in the watershed. Many of the short-term drought management actions are consistent with those of the existing IWRMS, but the actions can now be taken with a substantially enhanced understand of the flow system and the expected impacts of climate change on this system.
The key short-term drought management actions include the following:

- Coordination of “land swapping” with existing PTTW holders using surface water supplies should be completed to facilitate a transition from surface water supplies to more secure alternative groundwater supplies as described in the longer term actions described in the next section below.

- An annual coordinated water use scheduling for surface water users should be drafted by the ICWUA each spring. This schedule should be based on the final number of acres and specific type of crop requiring irrigation planted each year. This schedule should be reviewed and refined upon the declaration of Level 1 conditions by the Local WRT. This would provide an opportunity to adjust the schedule to accommodate the diverse needs associated with critical stages in crop development and variability in precipitation across the watershed. Associated with this short-term action would be the need to install additional rain gauges that should be integrated as an online digital precipitation mapping network. This work is underway and partially complete.

- Additional refining and review of the adjusted water use schedule should occur upon the declaration of Level 2 conditions by the local WRT. The adjustments should take into consideration critical stages in specific crop development and variability in precipitation across the watershed. At this stage, all stakeholders dependant on surface water for irrigation should be notified that a Level 3 condition may be imminent and that an alternative to water supply should be pursued and options explored to minimize the adverse impact of drought conditions.

- The self-policing framework that was initially established by the ICWUA should be maintained and enhanced. This will reinforce the value of being part of the network of water users governed by the ICWUA.

- Coordination of development of communal water supplies should be completed (e.g., alternative source development, hydrogeological investigations, communal PTTW applications as described in the longer term actions below).

In addition to these key short-term actions the following short-term actions should continue to be pursued by the ICWUA:

- Education and communication efforts on new regulations and policies;
- Conflict resolution and mediation training; and
- Coordination of proposals and applications for funding or seeking to partner with other agencies pursuing similar objectives and goals.
The last point noted above could potentially secure funding to help develop and maintain the proposed integrated precipitation network as well as fund resources to help the ICWUA carry out its proposed mandate.

**Expanding Stakeholder Representation**

The ICWUA needs to revisit its TOR and expand its membership to ensure that the membership is made up of members who can speak to the needs, concerns, and interests of all stakeholders in the watershed. All members of the ICWUA should ideally be a part of the decision-making level in their organizations. The expanded ICWUA should also ensure that they are represented on the Local WRT during low water conditions.

**Increased Capacity of Stakeholders**

The need for ongoing coordination and communication between stakeholders within the watershed is imperative. These working relationships need to be established proactively before the stakeholder group needs to respond to low water levels in Innisfil Creek and its tributaries. Of note, the level of effort needed to implement and manage a Drought Management Plan within a watershed is more than typically expected from volunteer leaders. However, volunteer leaders remain a critical component of the collaborative approach to water management within the watershed.

The establishment of a secretariat position for the ICWUA is therefore highly recommended for it to function effectively long term. Funding should be secured to support the secretariat for at least a 5-year term.

Continued support of the ICWUA from NVCA or other municipal or provincial agencies is also essential as it provides a stronger link between stakeholders and local public sector agencies.

**Renewed Message**

The development of a renewed communications strategy should be a top priority for the ICWUA. The proactive drought management strategy must have a communication plan that resonates with all stakeholders and provides the more detailed understanding of the flow system in the watershed.

Innisfil Creek and its tributaries are a valuable resource in the watershed. A detailed investigation of the flow system has shown that the creek and its tributaries are runoff driven, and consequently, are not reliable sources of streamflow during dry periods. Surface water features in the watershed regularly experience low water conditions, even if no water was extracted for irrigation. Climate change projections have indicated that low flow periods will start earlier and last longer, accordingly irrigation demand may greatly increase. These factors, when considered
together, strongly suggest that Innisfil Creek is not a suitable or reliable long-term water supply for irrigation purposes. The ICWUA recommends that more reliable groundwater alternatives for irrigation purposes can be pursued without undesirable impacts on surface water features.

**Increased Coordination - Water Demand**
A Drought Management Plan should take into account the ability to use new technology to create feedback and reach larger audiences; include new information available in a timely fashion; and permit regular updates when required. Assuming there is adequate funding to increase the capacity of the ICWUA, this plan should be able to meet the above-noted important components of a Drought Management Plan.

6 **DROUGHT MANAGEMENT ACTIONS - LONG TERM**

The short-term actions outlined previously are meant to assist the water user community to manage near-term water shortages. Accordingly, there is also a need for the Drought Management Plan to incorporate long-term actions that will increase water supply security for both water users and the natural environment.

**Continue to Limit New Surface Water Withdrawals from Innisfil Creek**
Due to the physiographic nature of the watershed, as well as the large number of water users, Innisfil Creek and its tributaries do not have reliable streamflow during the summer months. Hydrologic analysis has indicated that a Level 3 flow condition will occur at least for 1 day every 1.7 years on average. Permitting new withdrawals from the creek would only increase the frequency of these low water conditions occurring.

As both the number of farms and amount of land irrigated have been declining since 1991, it is not expected there is a large demand for additional water withdrawals. However, it should be cautioned that economic circumstances can change quickly, resulting in resurgence in agriculture and the demand for irrigated cropland. As such, it is prudent to maintain the current limit on surface water withdrawals.

**Transition of Water Source**
Alternative water source options in the Innisfil Creek watershed were considered. Rather than relying on continued surface water withdrawals, the research findings suggested that a shift to groundwater wells is an economically and hydrologically feasible option. Regional, large-scale transitioning of 100% of all surface water users to groundwater would result in a more reliable water supply for all water users, and would result in a more reliable streamflow for ecological needs. However, the impact of adverse water quality on sensitive crops should be investigated before proceeding with installation of groundwater wells.
Assuming that more reliable flow within the Innisfil Creek is deemed to be in the public’s interest, it is recommended that an implementation plan be developed to support the transition of sources from surface to groundwater. Required aspects of this implementation plan would be a funding source to assist irrigators in transitioning from surface to groundwater sources, as well as a coordinating body to assist in completing the site-specific technical studies required to support PTTW applications. The estimated total annual cost to support this transition is $1,500,000 per year until all permitted surface water takings have transitioned to groundwater sources. This cost includes the amortized capital cost of well/storage pond construction, ongoing operations and maintenance, technical studies to support permit applications, and the opportunity cost of the lost land associated with the storage pond.

**Support the Transition to Water Efficient Irrigation Technologies**

While some agricultural producers have invested in high efficiency irrigation systems (micro-irrigation: trickle or drip; and sub-irrigation: piping water below the root zone), the majority of irrigation techniques employed within the Innisfil Creek watershed are less efficient sprinkler irrigation such as fixed sprinkler systems (e.g., hand-move portable systems, semi-permanent systems, solid-set permanent systems and fixed-volume gun hand-moved systems) and mobile sprinkler systems (e.g., travelling gun systems, low pressure boom traveller system, centre pivot systems and lateral move systems). By utilizing more efficient irrigation techniques such as variable rate irrigation, possibly by retrofitting existing equipment, studies have shown a reduction in water requirements of 8% to 20%. Wide-scale adoption of efficient irrigation technologies would result in reduced water withdrawal pressure on Innisfil Creek, thereby reducing irrigator’s risk to periods of low water. Other benefits of high efficiency techniques such as variable rate irrigation include the following:

- Even distribution of irrigated water reduce stresses related to excess moisture, reducing incidence of disease, and stress-related quality problems;
- Reduced energy use and correspondingly reduced carbon emissions from reduced water pumping requirements; and
- Potential for additional precision application of fertilizers.

Transitioning to higher efficient techniques requires extensive upfront capital investment. Previous studies have estimated the cost to retrofit a 67 acre pivot irrigation system to be $30,000 US (2014 dollars). Given the current economic conditions of the agricultural sector within the Innisfil Creek watershed, it is difficult for an individual irrigator to justify making this transition without financial support. As a result, it is recommended that the ICWUA investigate opportunities to obtain funding with the aim to provide irrigators with this financial and technical support. Similar to the preceding section, this recommendation presumes that a more reliable flow within Innisfil Creek is deemed to be in the public’s interest.
Climate Change Adaptation

Due to climate change effects, the Innisfil Creek watershed will experience changing precipitation patterns, warmer weather, reduced snowpack, a longer growing season, and increased evapotranspiration. As a result, the Innisfil Creek watershed irrigation requirements will increase from 50% to 100% by 2040, assuming the composition of crops and irrigated lands remain similar. In 90% of the climate scenarios investigated, the frequency of days with drought events (Level 3 flow conditions) will increase from 25% to 180%. Given the current condition of the watercourse, the increase in irrigation requirements and Level 3 conditions would result in an untenable position in terms of a reliable water supply. It is recommended that agricultural producers within the Innisfil Creek watershed should investigate alternative crops that are more resilient to water shortages. Transitions such as this are long term, but may be expedited by the presence of financial support to aid in the transition to alternative crops.

7 SUMMARY

This pilot project sought to incorporate the knowledge and experience gained through the Provincial Water Budget Program under the Clean Water Act, the existing Integrated Water Resource Management Strategy (IWRMS), and from proactive individuals and organisations (e.g. ICWUA, NVCA, and MNRF) to develop a suitable Drought Management Plan to ensure that provincial and local authorities, such as the NVCA, are prepared in the event of persistent low water conditions.

A more detailed understanding of the flow system obtained through this pilot project has provided a more science-based road map to increased water reliability in the long term for all water users in the watershed. Many of the short-term drought management actions are consistent with those of the existing IWRMS, but the actions can now be taken with a substantially enhanced understand of the flow system and the expected impacts of climate change on this system.

The Drought Management Plan aims to shift the drought response in Innisfil Creek from a reactive approach to a proactive approach through a robust, locally driven process that is designed to orchestrate action when drought-like conditions occur and/or minimize the potential for low water conditions to occur from human-induced water taken, when possible. This knowledge supplies the foundation to build a road map to increase water reliability for all water users in the watershed including the ecosystem.