# Angus Infrastructure Master Plan

## Class Environmental Assessment

## ADDENDUM NO.1 – WATER SUPPLY & STORAGE

# FINAL

**Township of Essa**

**December 2024**

**Greenland Project No. 22-G-4472**

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## Record of Revisions

| Revision | Date | Description |
|---|---|---|
| 0 | 31 October 2024 | Draft Submission to Township |
| 1 | 05 December 2024 | Submission for 30-day Public Review |

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# 1 BACKGROUND

The Township of Essa (Township) completed an Infrastructure Master Plan (IMP) for the Community of Angus in 2022, identifying preferred solutions for water and wastewater infrastructure to support development over the next 25 years. The Notice of Completion was filed on September 12, 2022. In order to prioritize the Township's progression toward the implementation stage of the EA process for the preferred solutions, an EA Addendum to the Schedule 'B' Class EA IMP is being completed.

We note that the problem & opportunity statement from the IMP has not changed and that the purpose of this EA Addendum is to validate the feasibility and prioritize implementation of preferred water supply and storage projects first identified in the Angus IMP. While the IMP was developed to address the long term servicing needs of the community, the focus of this addendum will on evaluation and development of implementation strategies for IMP solutions to address near-term growth pressures in the municipality, to the limit of the current wastewater system constraints. There is currently a 'servicing gap' of approximately 300 equivalent residential units (ERU) of water supply capacity, when compared to the residual wastewater system capacity of approximately 870 ERU (updated from the IMP based on review of 2023 flow data and recent capacity allocations).

Angus also currently has deficient fire-flows in many existing areas and requires additional water storage to proceed with further development. Additional options not considered in the IMP were explored and evaluated, along with the previous IMP options as part of this EA.

The proposed alternative solutions short-lists for water supply and storage were revisited, screened and re-evaluated based on the additional information gathered through these investigations as part of this EA Addendum. The expanded evaluations and prioritization activities of this EA Addendum have been supported by further detailed background and field data collection and the completion of additional concept level design activities and detailed modeling for shortlisted solutions to verify technical, environmental and socio-economic impacts in a sufficient manner to allow for clear implementation of solutions.

## 1.1 Summary of Previously Recommended Water Supply and Storage Servicing Solutions

The recommended preferred Water Supply and Storage Options for the Angus IMP included the following general characteristics:

- Increase the current Permit to Take Water (PTTW) and well capacity to supply as much of the ultimate demand increase of 4.64 million L/d as possible, shown as **Option W-2 (See Appendix A).** This involved a new well at an existing location with expanded treatment, booster pumps, storage, and fire protection.
- Construction of water storage facilities at three (3) locations was planned under **Option WS-4 (See Appendix A)**. This includes building new storage facilities (elevated, in-ground, or at grade) in the Southwest, Northwest, and Northeast areas of the study region.

## 1.2 Scope and Purpose of Addendum

The water supply and storage options from the IMP included a broad approach as it was determined no single solution would be able to provide for long term servicing needs. The purpose of this addendum is to complete additional investigations and evaluations in order to prioritize and confirm the feasibility of near-term servicing strategies, via IMP identified projects and help meet the current demand for growth in the community of Angus.

For water supply, a hydrogeological investigation was determined to be required as part of the future study requirements in the IMP Summary Report to assess the ability to increase the capacity of the existing wells, per Option W-2 to service the ultimate build-out of Angus (25-year horizon). This addendum included some of the additional required hydrogeological investigations to confirm and prioritize the specific approach to the preferred Option and address requirements of the related project(s). Supply capacity expansion was assumed to also include requirements for a correlated level of treatment capacity expansion, the specific requirements of which (i.e. Chlorine contact time) will need to be confirmed at the detailed design stage following the successful completion of the hydrogeological studies required to support supply expansion. While these specifics have yet to be determined, site assessments for short listed options were completed to confirm sufficient space for treatment expansion, to a concept design level of detail.

The addendum will also confirm pre-design land and technical requirements for the preferred Water Storage solution (i.e. in ground vs. elevated tank, single tank vs. multiple tanks) and re-evaluate the options from the IMP based on siting, storage types, additional detailed hydraulic modeling of the Angus water system and other pertinent details to prioritize and support the near-term servicing needs of the municipality. Conceptual designs will be completed for the preferred Option(s). The benefit and appropriateness of multiple storage locations was also re-evaluated as part of this addendum.

It should be noted that this Addendum applies only to the water supply and storage components of the Angus IMP and does not affect the other recommendations provided in the 2022 IMP (transportation, wastewater, or stormwater management).

The additional detailed investigations completed in support of the EA Addendum are provided in the following Appendices:

**Appendix A – Tables & Figures**
**Appendix B – GEI Hydrogeological Assessment & Work Plan**
**Appendix C – RVA Technical Report: Existing Facilities Condition Assessment & Option Concept Designs**
**Appendix D – WaterGEMS Model Output & Schematics for Shortlisted Options**

(Records of public consultation completed during this EA Addendum are included in **Appendix E**).

# 2 WATER SUPPLY ALTERNATIVES

As identified in the Angus IMP, it is expected that water demand in Angus will increase significantly beyond the combined permitted capacity of the three existing wellfields, which are referred to as the Mill Street, Centre Street, and Brownley wellfields.

Additional hydrogeological investigations were carried out by GEI consultants (GEI, February 2024) to further evaluate water supply expansion options for Angus. A Workplan and Cost Estimates report was also prepared by GEI consultants (September 2024) to support the hydrogeological investigation and re-evaluation of solutions under this addendum. These final reports have been provided in **Appendix B**.

The objectives of the investigation were as follows:

a) Review existing information to determine whether there is unused capacity within the existing supply wells and, if so, estimate that capacity.
b) Provide a list of alternatives to achieve increased water-taking to meet projected demands.

Additionally, a technical assessment of water supply and storage was conducted by RV Anderson and Associates (RVA) to support the conceptual development of the solutions for Angus. The final report has been provided in **Appendix C**.

The objectives of this assessment were as follows:

a) Document the locations of the three (3) existing well facilities (Mill Street, Brownley, and Centre Street - McGeorge) through a site visit and condition assessment and analyze the operational issues at these facilities that should be addressed in the proposed solutions;
b) Review local water testing results to determine if additional treatment is required; and,
c) Develop high-level conceptual solutions for short-listed well supply and storage alternatives.

The focus of this Addendum is to evaluate viable water supply alternatives which will prioritize implementation and provide additional capacity for near-term development in Angus. In order to be considered viable, and therefore shortlisted for detailed evaluation, potential solutions must meet the following criteria:

- Option provides a servicing solution which can address water supply capacity concerns within Angus in the near-term;
- Option is not prohibitively expensive (as compared to other options) from either a Capital or Maintenance cost perspective; and,
- Option is not redundant as compared to other considered Options (i.e. clearly inferior to another similar Option).

Six (6) solutions, including two (2) of the three (3) solutions which were shortlisted as part of the original IMP have been investigated as part of this IMP Addendum. Option W-4 from the IMP, which involved maximizing the use of the current wells for short-term growth through an increase of the permit to take water (PTTW), and then connecting to the New Tecumseth Main for ultimate build-out, has not been considered in this IMP Addendum. This exclusion is due to the current capacity for expansion being allocated to other municipalities, making it difficult for Essa to secure timely or cost-effective capacity from this source. Due to the uncertainty of the timing of the Water Treatment Plant upgrade in Collingwood to supply additional water and the availability to supply Essa through the pipeline, this option is currently not a viable solution for securing additional water supply to meet near-term demands within Angus. We recommend that further investigation occur through discussions between municipalities to address any supply deficits beyond what can be obtained from existing, replaced, or new wells. Once additional water supply is available through the Collingwood-New Tecumseth pipeline, this option may be reconsidered in future updates to the IMP; however, it will not be further discussed in this Addendum.

The options considered are summarized below and figures associated with the assessed options and their locations relative to one another can be found in **Appendix A**.

**Option W-1:** Maximize water-taking from Mill Street Well 1. The Mill Street wellfield currently consists of one (1) high-yield well. The assessment completed by GEI indicates that the capacity of the existing Mill Street well could increase to approximately 4,300,000 L/d, approximately <u>400,000 L/d</u> (10%) more than the current permitted amount of 3,927,774 L/d. Additional field testing would be required to confirm this additional capacity and support approval applications. Due to its proximity to a closed landfill, it is expected that the Ministry of the Environment, Conservation and parks (MECP) will require a thorough assessment of the interaction between the closed waste disposal site and groundwater to confirm no migration of contaminants under increased pumping.

**Option W-2:** Rehabilitate the Centre Street Wells 2 and 3. The Centre Street wells were installed in 1985, and are currently operating at about 30% efficiency compared to 1985. Due to the wells' proximity to each other, it is recommended to increase water taking at one (1) of the wells, to prevent negative interactions with each other. Over the long term it is estimated that the well field is capable of contributing an additional <u>335,000 L/d</u> compared to the current permitted water-taking amount. Maintenance of the wells (e.g. wire brushing, acid flushing) may be a viable alternative to increase well performance and recover lost efficiency. However, due to the artesian conditions of the well field, this may be difficult or impossible to achieve. Gains realized by maintenance are likely less than what would be achieved by well replacement. As a result, this option has been dismissed for further evaluation.

**Option W-3:** Replace the Centre Street Wells 2 and 3. This option involves the replacement of Centre Street Wells 2 and 3, which would facilitate an increase in water extraction at the Centre Street well field. Given the age of the existing wells and the decline in their efficiency over time, replacing them presents an opportunity to recover lost capacity. New wells would be drilled adjacent to the current wells and will be similar in depth and construction as the existing wells, with the exception of the replacement wells being constructed with a larger diameter (300 mm) than the existing wells (250 mm). The replacement wells would have the potential to increase the extraction rate from 1,296,000 L/d to approximately 3,196,000 L/d, resulting in an increase of <u>950,000 L/d</u> from each well. This option was shortlisted for further evaluation; however, it is important to acknowledge that the new wells may not fully achieve the expected capacity increase. Ongoing assessment will be essential to evaluate their performance and ensure adequate water supply. As such, it has been assumed conservatively that only 50% of the potential increase will be viable in the near term.

**Option W-4:** Maximize water taking from Brownley Well 5. The Brownley well field consists of three (3) wells developed over time, with Brownley Well 5 installed in 1994 and the smallest of the three (3) wells. Well, 5 has relatively low permitted water taking compared to Brownley wells 4 and 6. Based on the assessment by GEI (Feb 2024), it is estimated that the Well 5 pumping capacity could upgrade from its current operating condition of 654,000 L/d to 1,086,000 L/d, an approximate increase of <u>432,000 L/d.</u> This equates to a total capacity of the Brownley well site of 4,500,000 L/d.

This estimate does not account for the interaction between the Brownley wells; however, it is expected the increase at Brownley Well 5 is achievable due to the much more aggressive drawdowns from Wells 4 and 6. Technical review of this option as part of this addendum revealed a recognized potential for sand production at the Brownley well, as observed from the previous occurrences. The expansion of operation at the Brownley site introduces significant challenges concerning water quality and supply security. These concerns have the potential to affect the operational efficiency and the integrity of associated equipment at this location. Additionally, the diameter of the well casing limits the size of the new pump that can be installed in the existing well, which would limit the potential capacity increase. Finally, the site lacks sufficient space to accommodate the construction of a new well, in lieu of upgrading Well 5. Therefore, this option has been ruled out for further consideration at this time.

**Option W-5:** Develop a new well (1A) at the Mill Steet Wellfield. Mill Street Well 1 has the highest capacity of any of the individual wells currently servicing Angus. This Option would involve investigating the potential to add a second well to the site with the aim of achieving a similar water capacity to the existing well. If combined with Option W-1, this would double the permissible water taking to a combined discharge rate up to approximately 8,800,000 L/d, from the existing 3,927,000 L/d. Based on the hydrogeological assessment, it is assumed that the capacity of the new well would be approximately 4,400,000 L/d. This Option can be explored in tandem with Option W-1, once it has been confirmed that there will be no negative impacts from the closed landfill site. Since this Option provides the highest potential for additional supply of those explored and can potentially provide the majority of the required 4.64 MLD of long-term supply required for ultimate buildout, it was shortlisted for detailed evaluation.

**Option W-6:** Develop a new well field at a new site. Due to the abundant groundwater resources in the Angus area across three (3) existing wellfields, it is expected that there are opportunities to expand municipal water supply capacity through the development of a new wellfield. For the purpose of this assessment, it is assumed that this new well would be a 10” well at a depth of 40 m. An analysis of available records and information for Angus was undertaken to identify potential locations for a new well field. The south-west side of Angus on Concession 10 was determined to provide the greatest opportunity for future investigations for a new well field. Two (2) locations have been identified: 1) on or near the Circle Pine Golf Course west of Concession 10; 2) on the west side of 20th Sideroad off of Concession 10. Based on the limits of development in Angus, it may be cost-prohibitive to extend linear infrastructure south to 20th Sideroad. The minimum distance to reach one of these proposed sites with new watermain (i.e. to connect to the existing water system) is approximately 1.41 km. This Option was shortlisted for evaluation as although it has a number of challenges and uncertainties, it may need to be explored in order to provide long-term supply (beyond the supply capacity of existing well expansion).

**Note:** Flow values (L/d) for solutions above are based on the most recent-dated applicable aforementioned background reports provided in **Appendix B** and **Appendix C**. Where flow values change amongst the reports, the most recently dated report supersedes any older-dated reports.

## 2.1 Water Supply Options Short List

The water supply Options shortlisted for detailed evaluation were:

1) **Option W-1:** Maximize Water-taking at Mill Street Well 1;

2) **Option W-3:** Replace the Centre Street Wells 2 and 3;

3) **Options W-5**: Develop a New Well (1A) at the Mill Steet Wellfield; and,

4) **Option W-6:** Develop a New Well Field at a New Site.

Based on the Options presented above, no singular Option will provide the total required additional supply capacity needed for the ultimate build-out of Angus. **Table 1**, which summarizes the capacity improvements and timeline of each short-listed Option, is presented below.

**Table 1 Short Listed Water Supply Options Additional Capacity**

| **Ultimate Buildout Additional Capacity Required:** | | 4,635,000 L/d |
|---|---|---|
| **Option** | **Additional Capacity (L/d)** | **Timeline to Approval** |
| W-1 | 400,000 | 2.1 years (25 months) |
| W-3 | 950,000 – 1,900,000 | 2 years (24 months) |
| W-5 | 4,400,000 | 2.25 years (27 months) |
| W-6 | TBD* | TBD* |
| Total (W1 and W5 may be combined) | 4,800,000– 6,700,000; + capacity from W6 | 2-5+ Years to implement all options (longer for W6) |

***Note**: Option W-6: Productivity of a new wellfield is dependent on the hydrogeological conditions at that wellfield as well as the desired size of the well to be installed. Additional study required to confirm.*

High-level cost estimates were also developed for short-listed solutions. Capital costs are summarized by Option in **Table 2**.

**Table 2: Estimated Costs by Short Listed Option**

| **Option** | **Capital** |
|---|---|
| W1 | $1,219,500 |
| W3 | $4,653,750 |
| W5 | $2,227,500 |
| W6 | TBD* |

***Note:** Alternative W6 requires further development to confirm the scope of work and facilities required (ex. pump well directly to the distribution system, well discharge on an onsite reservoir with separate high lift pumping station, land acquisition requirements, etc.) before a capital cost estimate can be developed. For evaluation purposes It is estimated that as a minimum the cost will be similar to W3.*

The proposed long-term strategy for future water supply capacity in Angus necessitates the integration of multiple options, as no single option can independently satisfy the community's requirements. A prioritized order of implementation to meet near-term servicing needs will be essential in effectively addressing the water supply challenges and optimizing the utilization of available resources for sustainable growth.

Considering the need for long-term solutions, the objective is to approach the total required flow of 4.64 million L/d. We note that the 450 L/d per capita flow allocated to future growth, with a 2.05 peaking factor per the IMP represents a conservative estimate for required long-term demand. The purpose of this Addendum is to evaluate the best solutions to approach this ultimate buildout requirement while prioritizing near-term growth needs, which are limited by the 870 ERU of residual capacity in the municipal wastewater system. Regardless of the solutions prioritized in this Addendum, long term supply may need to incorporate additional solutions, following expansion of the wastewater system.

## 2.2 EVALUATION CRITERIA

In order to evaluate the proposed alternative conveyance technologies, each of the Options presented in **Chapter 2** were assessed with respect to their strengths and weaknesses in terms of the following general criteria:

- Natural Environment Impacts (30%):
  - Impacts of the option to vegetation and wildlife; and,
  - Impacts of the option to surface and/or groundwater quality.
- Social / Cultural Environment Impacts (20%):
  - Land Use & Archaeological Considerations;
  - Visual landscape and aesthetic impacts of the option;
  - Traffic Impacts (i.e. during construction); and,
  - Interruption to Residents
- Technical/Operational Considerations (20%):
  - Difficulty to construct or implement the Option relative to other alternatives; and,
  - Efficiency of the Option from an operations and maintenance perspective.
- Economic Impacts (30%):
  - Capital construction costs associated with the option, including restoration requirements;
  - Long term operational costs for the option;
  - Payment structure, cost recovery options for the Municipality; and,
  - Phasing Flexibility.

As part of the Class EA evaluation process, options are submitted to a preliminary screening to eliminate any option which does not satisfy one or more of these criteria (i.e. options which could clearly not be implemented due to prohibitive costs, detrimental environmental effects, or technical infeasibility).

In the case of this Addendum, as no singular Option is anticipated to provide the required additional capacity for the ultimate build-out of Angus, the preferred Options for additional exploration were determined to be options W1, W3, and W5, with future supply to be explored via W6 once the limits to expanding existing sources has been reached. The evaluation process for this Addendum focuses on establishing the preferred order of implementation for these solutions. Based on the evaluation criteria, the preferred immediate solution was determined to be **Option W-5: Develop a new well (1A) at the Mill Steet Wellfield**. The results of the detailed evaluation completed to arrive at this preferred solution for water supply are summarized in **Table 3**.

Servicing Options were ranked using a colour coded system for each of the above ranked criteria, where “green” represented the most preferred concept, “yellow” criteria represented less preferred concepts and criteria in “red” represented the least preferred concept. The option which received the most “green” rankings became the recommended preferred servicing Option.

**Table 3: Angus IMP Water Supply Options & Rankings**

| Evaluation Criteria | | Option W1<br>Increase capacity of Mill Street Well 1 | Option W3<br>Replace Center Street Well 2 and 3 | Option W5<br>Construct Additional Mill Street Well 1A | Option W6<br>Development of a New Wellfield(s) |
|---|---|---|---|---|---|
| **Natural Environment Impacts (30%)** | | | | | |
| Impacts of the option to vegetation, wildlife & the Natural Environment | 10% | Low to medium impact as the overall area of potential impact would only increase by a small area. All waste materials that may be generated during investigations / construction would be removed from site. | Low impact. No increase from what was previously determined would be expected. The replacement wells will be similar in depth and construction as the exisiting wells, with the exception that the replacement wells being constucted will have a larger diameter than exisiting. All waste materials that may be generated during investigations / construction would be removed from site. | Low to medium. The area of potential impact would increase vs. W1 but would provide higher overall supply. All waste materials that may be generated during the investigation would be removed from site. | Low to medium, but will require changes to a greenfield site, making this the highest potential impact of all four choices.. Higher uncertainty, but part of the requirements of the investigation to gain operational approval would include a detailed environmental impact assessment, with potential mitigation measures if required. |
| Surface/groundwater quality & quantity implications | 20% | Low impact, but only minimal increase in water supply. Site has highest yield potential. Additional investigation required to confirm level of impact (if any) from the former landfill nearby. | Low impact given this will be a replacement project on an existing site. Flow testing needed to confirm viable yield of increase (i.e. 950 m3/d for one well vs.1900 m3/d for both) | Slightly higher potential impact than W1 but provides significantly more supply as site has highest yield potential. Additional investigation required to confirm level of impact (if any) from the former landfill nearby, | Likely the highest impact of all four options as groundwater would be coming from an as-yet untapped source (unknown yield potential). Additional studies required to confirm. |
| **Natural Environment Overall Rating** | | 16.7% | 23.3% | 22.7% | 15.0% |
| **Social / Cultural Environment Impacts (20%)** | | | | | |
| Land Use & Archaeological Considerations (Including First Nations) | 7.5% | Minimal as project is contained to existing, previously disturbed muncipal lands. Additional Study required to determine impacts from neighbouring site (former landfill). | Minimal as project is contained to existing, previously disturbed muncipal lands. | Minimal as project is contained to existing, previously disturbed muncipal lands. Additional Study required to determine impacts from neighbouring site (former landfill). | Archaeological study will be required for any new well site. Higher land use requirement due to creation of an additional well site at a new location. |
| Visual landscape/Aesthetic impacts, Traffic impacts & interruption to residents | 5.0% | Low impacts due to maximizing use of existing systems. No disturbance to new areas. Low to Moderate potential for service interruptions during well upgrades. | Low impacts due to maximizing use of existing systems. No disturbance to new areas. Moderate potential for service interruptions during well replacement. | Similar impacts to W1, with less potential for service interruptions as this option doesn't require replacement of existing systems to bring online. Lowest impact option. | Low to Medium impact, uncertainty introduced due to unconfirmed site location. |
| Required Intermunicipal Agreements & Infrastructure | 7.5% | No Intermunicipal Infrastructure or Agreements Required. | No Intermunicipal Infrastructure or Agreements Required. | No Intermunicipal Infrastructure or Agreements Required. | No Intermunicipal Infrastructure required. Agreement likely required with a private land owner depending on final site selection. |
| **Social / Cultural Environment Overall Rating** | | 15.8% | 17.5% | 17.5% | 10.0% |
| **Technical/Operational Considerations (20%)** | | | | | |
| Difficulty to construct or implement the Option relative to other alternatives & additional supply provided. | 15% | Medium. Requires additional landfill investigation upgradient including drilling and laboratory analyses. Need information about site owner and former operations. If testing is successful: May require an upgrade of the pump, distribution upgrade depending on existing capacity, Exiting treatment may require some changes. Replacement or refurbishment of electrical components might be required.<br><br>This option enhances the current capacity from 3,928 $m^3/d$ to 4,300 $m^3/d$, resulting in a potential increase in water supply of 400 $m^3/d$. | Medium to High. This option may require the refurbishment or replacement of the majority of existing equipment and electrical supply in the well pumphouse, A structural condition assessment of the in-ground reservoir to determine if refurbishment is necessary. The existing chemical storage room might need to be demolished and reconstructed with brick and mortor structure. Require additional work such as Environmental study impact, additional water quality testing of well water, and Additional Discharge works Planning. The diesel generator with an outdoor self-enclosed unit with a sub- base fuel tank would be replaced. Water Quality testing would be required to review the water quality of new wells and confirm if any additional treatment is needed.<br><br>This option increases the current capacity of each well from 1,296 $m^3/d$ to 2,246 $m^3/d$, resulting in a combined potential increase in water supply of 1900 $m^3/d$, with an initial increase of 950 $m^3/d$ assuming conservatively that only one well may be increased, subject to testing. | Medium, but with higher ROI potential than other options. Requires additional landfill investigation upgradient including drilling and laboratory analyses. If testing is successful: New pump and infrastructure to connect to the existing system would be required. Water Quality testing would be required to review the water quality of new wells and confirm if any additional treatment is needed. Investigating current condition of Mill Street MCC would be required to confirm if replacement or/and refurbishment of electrical components are needed.<br><br>This option increases the current discharge rate from 3,928 $m^3/d$ to a potential maximum of 8,328 $m^3/d$, resulting in a potential increase in water supply of 4,400 m3/d. Highest potentail yield. If only 50% of this yield increase is available, it would still be more than sufficeint to close the servicing gap between water and wastewater systems, and provide water for anticipated near term growth. | High. High uncertainty when siting new wellfields with limited previous local investigation, especially for high-production municipal wells. A new pumphouse, pumps, additional system storage capacity, potential treatment systems, and potentially extensive distribution infrastructure would be required to connect new wellfield to the larger water system. New pump(s) would be required. This option also would likely require a sodium silicate system, and a chlorine contact tank, pumping test including well monitoring.<br><br>Capacity available at the most likely candidate site (1.4 km away from the existing water system) is currently unknown and would require field investigations to confirm. This option is viewed as a "long term" solution for further investigation per the original IMP, to be explored once all other viable options have been exhausted. |
| Operation & Maintenance Efficiency | 5% | Minimal changes to O&M burden vs. existing conditions. Slightly higher costs due to higher pumping for additional supply. | Minimal changes to O&M burden vs. existing conditions. Slightly higher costs due to higher pumping for additional supply. | Slighly higher than W1 due to addition of another well at an existing site, however overall difference is still minimal. | Highest maintenance burden of any option due to addition of a completely new well & treatment system in a new location. |
| **Technical/Operational Considerations Rating** | | 15.0% | 12.5% | 16.0% | 7.5% |
| **Economic Impacts (30%)** | | | | | |
| Capital / Construction costs & Potential ROI | 15% | Low. Once landfill investigation is completed and as long as the results are favourable to support this option, some additional site work is required, but it would be expanding on that existing knowledge. A pre-consultation with MECP is recommended/required before proceeding with the landfill investigation/characterization.<br><br>Low estimated ROI at $3,049 per m3/d of additional water supply. The estimated capital Cost for this option is $1,219,500. | Medium. Artesian wells can be more expensive to drill, but replacement is expected to be relatively successful.<br><br>Lower estimated ROI of $2,449 per m3/d of additional water supply and relatively high capitcal cost. The estimated capital Cost for this option is $ 4,653,750 (based on replacing both wells and the pumphouse). Capital cost may decrease by approximately $1,000,000 if only a single well is replaced, but ROI would also be lower ($3,846 per m3/d of additional supply). | Low to Medium. Once landfill investigation is completed and as long as the results are favourable to support this option, some additional site work is required, but it would be expanding on that existing knowledge. A pre-consultation with MECP is recommended/required before proceeding with the landfill investigation/characterization.<br><br>Best overall ROI water supply option of $506 per m3/d of additional water supply). The estimated capital Cost for this option is $2,227,500. | High. This option will be expensive to undertake and would likely take a several years to get to the full approval stage. There is also a higher uncertainty of success compared to other options, given that the future investigation site has not had previous site investigation work completed.<br><br>Low near term ROI of new water supply. Estimated to have similar costs per m3 to W3 for installation of new wells, pumps and treatment, plus the added cost of connecting to the distribution system. GEI's estimate for the nearest potentially viable source would also require 1.41 km of pipe to connect to the existing system. |
| Long term/operation & maintenance cost burden | 5% | Minimal changes to O&M burden vs. existing conditions. Slightly higher costs due to higher pumping for additional supply. | Minimal changes to O&M burden vs. existing conditions. Slightly higher costs due to higher pumping for additional supply. | Slighly higher maintenance burden than W1 due to addition of another well at an existing site, however overall difference is still minimal. | Highest O&M. More costly maintenance due to the addition of an additional physical well site. |
| Payment structure, cost recovery options for Municipality, Phasing Priority / Flexibility. | 10% | This option is expected to take 25 months, including the 3-month investigation of waste disposal area, a 2-month approval process for the Drinking Water Works Permit Amendment, a 2-month Permit to Take Water Amendment, a 2-year updates to the Source Water Protection Plan (concurrent with rest of project), and 26 weeks for construction. No agreements are required. | This option is expected to take 24 months, including the 2-month approval process for the Drinking Water Works Permit Amendment, a 2-month Permit to Take Water Amendment, 2 years for updates to the Source Water Protection Plan (concurrent with rest of project), and 52 weeks of construction. No agreements are required. | This option is expected to take 27 months, including the 2-month subsurface investigation, a 2-month approval process for the Drinking Water Works Permit Amendment, a 2-month Permit to Take Water Amendment, 2 years for updates to the Source Water Protection Plan (concurrent with rest of project), and 40 weeks of construction. No agreements are required. | The longest lead time is expected due to the reliance on an unconfirmed water source. Preliminary investigations suggest that the most viable site for the new wellfield is near the Circle Pine Golf Course, located west of Concession 10, as it is situated over a promising water source (thalweg). This location would necessitate approximately 1.41 kilometers of piping to connect to the existing infrastructure. As such, it is considered the lowest priority project |
| **Economic Ranking** | | 20.5% | 21.0% | 25.7% | 13.5% |
| | | | | | |
| **Overall Ranking:** | | 68.0% | 74.3% | 81.8% | 46.0% |

# 3 TASKS REQUIRED TO IMPLEMENT EACH WATER SUPPLY OPTION

An overview of tasks required to implement each of the proposed solutions is presented below, in order of preferred implementation established in the updated evaluation from **Table 3**.

**Option W5 – New Well at Mill Street Well Field (Highest Priority Option)**

1. Conduct a hydrogeological assessment and Investigation of the former waste disposal area near Mill Street wellfield:
   a. Conduct a desktop review of existing information from MECP water well records, Ontario Geological Survey publications, and Conservation Authority mapping.
   b. Undertake a subsurface investigation of the waste disposal site area, including drilling shallow boreholes and installing nested monitoring wells using sonic drilling methods.
   c. Collect and analyze soil samples, measure static groundwater levels, conduct single-well response tests, and sample monitoring wells for contaminants.
   d. Prepare a permit to Take Water application for production well operation.
   e. Pre-consultation and application for Category 2 Permit to Take Water for pumping test.

   **Note:** It is not expected that the former waste disposal site will create significant issues, as the municipality currently draws water from this location; however. the testing will be required for the higher supply rate and to ensure public safety.

2. Drill new well, including permitting and approvals and pumping Tests. <u>Pump tests should likely be conducted with the goal of an initial supply expansion consistent with a maximum of 870 ERU, as this is the current capacity limit in the Angus wastewater system.</u>
3. Install a submersible well pump with a variable frequency drive in the Well, utilizing a pitless adapter for the installation.
4. Continue to perform maintenance cleans on Well #1. Check the condition of Well #1, and ensure the structure can handle the proposed capacity increase, this may involve casing repairs or structural enhancements.
5. Investigate the current condition of Mill Street MCC and see if replacement and /or refurbishment of electrical components are required to support the new well.

It is noted that prior to beginning production from the new wells, some additional works may be required:

a. Environmental Impact Study: This may be necessary if the proposed water-taking indicates the potential to affect the hydrology of the local wetland areas;
b. Additional planning for the selection and setup of discharge works for the pumping test; and/or,
c. Additional water quality testing of well water.

**Option W1 – Maximize Mill Street Well 1 (Second Priority After W5)**

1. Conduct a hydrogeological assessment in the vicinity of Mill Street Well 1 and the former waste disposal site, particularly focusing on characterizing stratigraphy and quantifying hydraulic connection between the disposal site and Aquifer A3/A4. This will involve:
    a. Drilling of shallow boreholes at the waste disposal site in an attempt to characterize the waste material.
    b. Installation or identification of monitoring wells that can be used for aquifer response monitoring during the pumping test of Mill Street Well 1.
    c. Completion of pumping tests to verify well performance, aquifer capacity, and contaminant migration potential.

    **Note:** It may be possible to combine or forego some of the work for item, depending on the results of investigations completed under Option W5.

2. Prepare Permit to Take Water application (and the requisite hydrogeological study report) for the requested increase.
3. Undertake a modeling study to revise the Wellhead Protection Areas.
4. Prepare and submit an application to the MECP for the amendment of the Approved Assessment Report and Source Protection Plan, as applicable.
5. Investigate the current condition of Mill Street MCC and see if replacement and /or refurbishment of electrical components are required.
6. Replace the Well #1 pump with a new 50 L/s submersible pump and motor.

**Option W3 – Replace the Centre Street Wells (Third Priority After W1)**

1. Prepare a Request for Tender to issue to well servicing contractors to construct replacements for Centre Street Wells 2 and 3.
2. Complete follow-up pumping testing to confirm the post-rehabilitation capacity of the wells. This should include the installation of monitoring wells to measure influence on the local aquifer.
3. Prepare Permit to Take Water application (and the requisite hydrogeological study report) for the requested increase.
4. Undertake a modeling study to revise the Wellhead Protection Areas
5. Prepare and submit an application to the MECP for the amendment of the Approved Assessment Report and Source Protection Plan, as applicable.
6. Commission the new Centre Street Wells 2 and 3.
7. Abandon the original Centre Street Wells 2 and 3 in accordance with Ontario Regulation 903

It is noted that prior to beginning production from the new wells, some additional works may be required:

a. Environmental Impact Study: This may be necessary if the proposed water-taking indicates the potential to affect the hydrology of the local wetland areas;

   b. Additional planning for the selection and setup of discharge works for the pumping test; and/or,
   c. Additional water quality testing of well water.

**Option W6 – Site and Develop New Well Field(s) (Lowest Priority)**

1. Conduct a hydrogeological assessment of the projected suitable sites. This will involve:
   a. Identify a suitable location for the new well field through desktop studies and consultation with the Township. Initial investigations completed as part of the EA Addendum suggest potential sites near the Circle Pine Golf Course west of Concession 10 and/or on the west side of 20$^{th}$ Sideroad off of Concession 10.
   b. Conduct utility locates, well surveys, and pumping tests to evaluate well performance and water capacity.
   c. Implement a private well monitoring program and drilling to construct test and monitoring wells.
   a. installation of a 6” test well and a 2” monitoring well, each to a depth of approximately 40 m, for performance testing and monitoring.
   b. Investigation and Impact Assessment.
2. Prepare Permit to Take Water application (and the requisite hydrogeological study report) for the requested construction of new wells.
3. Construction of a new well facility including at minimum the groundwater well pump, disinfection system, potentially sodium silicate system, and chlorine contact tank. Consideration could also be given to including a treated water storage reservoir and high lift pumps.
4. Prepare and submit an application to the MECP for the amendment of the Approved Assessment Report and Source Protection Plan, as applicable.

It is important to emphasize that for any proposed changes in pumping rates or the addition of a new well, it should be expected that preparing and submitting the necessary update to the Source Protection Plan, followed by approval from the MECP, will take approximately 18 to 24 months. The Source Protection Plan revision must be completed and approved by the MECP before operating the pumps as planned. The investigation of the waste disposal area must be conducted prior to initiating any work at the Mill Street wellfield.

# 4 WATER STORAGE

Based on the Ministry of the Environment Design Guidelines (2008) and the forecasted populations for Angus, to address fire storage and storage capacity for Maximum Daily Demand (MDD), Angus will require an additional 4,199 $m^3$ of storage to service the Ultimate Build-Out population. The existing water system in Angus is currently beyond 80% operating capacity as shown in **Table 4** below, and new storage should be provided to support any additional future development.

**Table 4 - Existing Water Storage & Residual Capacity**

| Existing Reservoir Capacity - $m^3$ | Required Storage (Per IMP)- $m^3$ | Residual Capacity – (Per IMP) - $m^3$ | Operating Capacity |
|---|---|---|---|
| 6,154 | 5,144 | 1,010 | 83.6% |

The feasibility of Water Storage Options for this Addendum were evaluated on the basis of enhancing service levels while also considering the need for significant infrastructure improvements. Following initial sensitivity analysis in the systemwide model, a fire flow standard of 100 L/s for existing and future residential areas and 200 L/s for commercial and institutional areas was established. This decision was made because achieving a 150 L/s standard for all of Angus (per the recently updated Township Standards) was not technically possible without substantial replacements of existing infrastructure, which was previously designed to a much lower (historical) fire flow standard of 37 L/s. <u>This lack of available fire flow in existing areas increases the urgency for additional storage prior to proceeding with new development.</u>

The focus of this Addendum was to evaluate viable water storage alternatives supported by additional detailed water system modeling and concept designs for short listed options (see **Appendix A** for Figures and **Appendix D** for model outputs). The modeling exercise involved strategically placing different storage systems within the study area to address shortfalls identified in future conditions. Adjusting parameters to determine high-level pressure requirements for pumping and/ or evaluated storage heads was essential to arrive at a modeled solution that meets all required flows within the pressure ranges recommended by the MECP.

Six (6) solutions with a single storage tank, and two (2) multi-location options from the original IMP have been explored in this IMP Addendum, including the previous preferred solution **WS4**.

The long list of alternative water storage Options considered as part of this IMP Addendum is summarized below. All storage solutions were assessed under the MDD + fire flow scenario, using the fire flow values discussed above. The options considered are summarized below and figures associated with the assessed options and their locations relative to one another can be found in **Appendix A**.

**Option WS1 Storage at a Single Location**

This category of Options involves the construction of a single storage system at a single location to provide for the long-term water storage needs of the community. Throughout the modeling exercise for this EA addendum, six (6) options across four (4) potential sites were evaluated for this purpose. These are described in detail in the subsections below.

**Option WS-1.1– Additional in-ground Storage at the Mill Street Site**

The Mill Street property currently has two (2) in-ground reservoirs located on the north side of the property behind the pumphouse. The in-ground reservoirs have a storage capacity of 2,500 $m^3$ and 902 $m^3$ (respectively). This Option would involve constructing a new in-ground reservoir with a capacity of 4,200 $m^3$ next to the existing cells. Under Maximum Daily Demand (MDD) and Average Daily Demand (ADD) scenarios, the pressure range for this option is 68-93 psi, while for the Fire flow scenario, it's 20-80 psi. The pressure is within the maximum and minimum allowable pressure range in accordance with MECP standards. The modeling exercise for this servicing strategy indicates that it's a feasible solution, but it may necessitate some watermain upgrades (approximately 2,508 m) to ensure the required pressure ranges and fire-flows are met in all areas. This Option was considered viable and a concept design was prepared in support of this EA Addendum to assist with the evaluation process.

**Option WS-1.2 –Additional Elevated Storage at the Mill Street Site**

This Option includes the construction of a new elevated storage tank with a capacity of 4,200 $m^3$ adjacent to the existing reservoir and pumphouse on the south side of the Mill Street site. Under MDD and ADD scenarios, the pressure range for this option is 76-100 psi, while for the Fire flow scenario, it's 20-80 psi. The pressure is within the maximum and minimum allowable pressure range in accordance with MECP standards. The modeling exercise for this servicing strategy indicates that it's a feasible solution, but it may necessitate some watermain upgrades (approximately 2,155 m) to ensure the required pressure ranges are met in all areas.

**Option WS-1.3 –Additional Elevated Storage at the Brownley Site**

In this Option, the proposed elevated tank is situated in the southeast study area, where the ground elevation is 203 m. The tank's volume is the same as the previous Options. Under MDD and ADD scenarios, as well as fire flow scenarios, the pressure range falls within the allowable range based on the MECP standard: 75-98 psi and 20-79 psi, respectively. The modeling exercise for this servicing strategy suggested it as a potentially feasible solution, although it would require some watermain upgrades (approximately 2,056 m). Technical review of the Brownley site and facilities indicated a lack of adequate space on the current property for additional water storage. As such, this Option was dismissed from further evaluation.

**Option WS-1.4 –New Storage at a Greenfield Site (South Angus)**

The Option includes the construction of a new elevated storage structure with a capacity of 4,200 $m^3$ at a new site in southern Angus. This option is similar to WS1.2; however, would require land acquisition and additional associated background studies before proceeding. The pressure range for this Option is 77-100 psi under MDD and ADD scenarios and 20-80 psi under the fire flow scenario. The pressure range is within the allowable pressure range (MECP). The modeling exercise for this Option suggests it's a feasible solution and it was carried forward for detailed evaluation. This site was selected due to its slightly higher elevation of approximately 201 m and the associated potential to reduce watermain replacement requirements using an elevated tank, and as such, no 'in-ground' option at this site was explored in detail.

The amount of watermain replacement required under this option to meet fire flow of 100 L/s in all areas would be approximately 1,879 m.

**Option WS-1.5 –New Storage at the Greenfield site (Northeast Angus)**

This Option includes an elevated tank located in Northeast Angus, where the ground elevation is 189 m. The pressure range for this option is 67-99 psi under MDD and ADD scenarios and 20-71 psi under the fire flow scenario. The pressure range is within the allowable pressure range (MECP) but the amount of watermain replacement required (approximately 2,417 m) is higher compared to other Options. As this Option is effectively an inferior version of WS-1.4, with similar land acquisition requirements and associated unknowns, which might preclude this Option from being implemented in a timely manner, it was not carried forward for detailed evaluation, and no in-ground option for this site was explored.

**Option WS-1.6 –Additional Elevated Storage at the Centre Street**

The elevated tank is proposed in the Northeast corner of Angus, close to the Centre Street wells, where the ground elevation is 196.6 m. The tank's volume is the same as previous Options. Under MDD and ADD scenarios, the pressure range for this option is 67-99 psi and 20-91 psi under the Fire flow scenario. Similar to Option WS1.2, the pressure range is within the allowable pressure range (MECP). The modeling exercise for this option suggests it's a feasible solution. However, it's noted the amount of watermain replacement required (approximately 2,547 m) is higher compared to other Options. The Centre Street site also currently lacks sufficient space on its property to accommodate additional water storage. As a result, this Option has been dismissed for further evaluation.

**IMP Option WS3 - New Storage at Two (2) Locations**

This Option involves constructing two (2) new storage facilities at multiple locations. Three (3) areas close to the existing wells (Mill, Centre, Brownley) onsite or adjusted to the current municipal-owned property in Angus were evaluated. However, after a thorough examination, it was determined that options involving two (2) tanks located in different areas would not be feasible. Despite the potential benefits, such as reduced pipe upgrade requirements to meet a minimum 100 L/s fire flow, the high capital and maintenance costs associated with these configurations make this Option impractical. Furthermore, upon closer scrutiny during this addendum process, it is evident that implementing multiple tanks does not offer significant observable benefits in terms of operational efficiency or effectiveness and two of the sites considered for potential use under a multi-tank option in the IMP (Brownley and Centre St) did not have sufficient space to facilitate the required expansion. Therefore, this Option was not considered a viable solution and was eliminated for the purpose of this study.

**IMP Option WS4 - New Storage at Three (3) Locations**

This servicing strategy involves the construction of three (3) new tank facilities. Similar to Option WS3, the tanks were proposed to be located primarily on existing municipal well sites. As with the two (2) tank Option, due to the operation and maintenance cost and technical limitations, primarily physical space to accommodate storage at two (2) of the existing well sites, this Option was not considered a viable solution and was eliminated from further detailed evaluation for the purpose of this study.

It should be noted that this Option was considered the preferred storage solution under the original IMP. The elimination of this Option following additional technical review is one of the reasons why this project has been completed as an EA Addendum.

### 4.1 Water Storage Options Short List

The water storage options shortlisted for detailed evaluation were:

5) **Option WS-1.1.:** New in-ground Storage at the Mill Street Site;
6) **Option WS-1.2:** New Elevated Storage at the Mill Street Site; and,
7) **Option WS-1.4:** New Storage at a Greenfield site (South of Angus)

**Table 5**, which summarizes the capacity improvements and timeline of each short-listed Option, is presented below.

**Table 5 Water Storage Options Additional Storage**

| **Additional Storage Required:** | | 4,199 $m^3$ |
|---|---|---|
| **Option** | **Additional Storage (m3)** | **Timeline to Approval** |
| WS-1.1 | 4,200 | 2.5 years (31 months) |
| WS-1.2 | 4,200 | 2.25 years (26 months) |
| WS-1.4 | 4,200 | 2.25 years + Unknown Land Acquisition Time |

High-level cost estimates were also developed for short-listed solutions. Capital costs are summarized by Option in **Table 6**.

**Table 6: Estimated Costs by Option**

| **Option** | **Capital** |
|---|---|
| WS-1.1 | \$10,485,125 |
| WS-1.2 | \$11,876,750 |
| WS-1.4 | \$11,876,750 + Land & TBD Costs |

### 4.2 Evaluation of Water Storage Options

While the evaluation of water supply Options for the Addendum was primarily focused on prioritizing the numerous supply Options required to address the original IMP problem statement, the evaluation of storage options was completed in the spirit of the traditional Class EA process to arrive at a single preferred solution for water storage (given the elimination of multi-tank options during the short-list screening). The evaluation criteria used to evaluate shortlisted Water Storage Options were as follows:

- Natural Environment Impacts (30%):
  - Impacts of the option on vegetation, wildlife, and the natural environment; and,
  - Surface and groundwater quality and quantity implications.
- Social/Cultural Environment Impacts (20%):
  - Land use and archaeological considerations (including First Nations);
  - Visual landscape and aesthetic impacts; and,
  - Traffic impacts and interruption to residents.
- Technical/Operational Considerations (20%):
  - Difficulty to construct or implement the Option relative to other alternatives;
  - Water supply security; and,
  - Operation and Maintenance Efficiency.
- Economic Impacts (30%):
  - Capital construction costs;
  - Long-term operation and maintenance cost burden; and,
  - Payment structure, cost recovery options for Municipality, phasing, and flexibility.

As previously mentioned, all three (3) Options require upgrades to existing watermain to ensure the necessary pressure levels are maintained throughout all areas at a minimum fire-flow of 100 L/s in existing residential areas. The lengths of pipe upgrades needed for Options WS1.1, WS1.2, and WS1.4 are 2,508m, 2,155m, and 1,879m, respectively. For this study, the pipe upgrades for each Option have been categorized as high-priority and lesser-priority tasks. Pipes that can provide more than 80% of the required fire flow (>80 L/s) are considered low priority. Conversely, pipes providing less than 80% of the required fire flow (<80 L/s) are considered high-priority upgrades. With this prioritization, the required pipe upgrades for WS1.1, WS1.2, and WS1.4 are reduced to 1,470 m, 1,332 m, and 1,188 m, respectively. We note that these priority areas still meet or exceed the previous Township standard of 37 L/s and upgrades to these pipes will not necessarily be needed to support new development; however, additional storage volume will be required given the current storage volumes are beyond 80% of the required storage under existing conditions.

Furthermore, site visits for existing systems and detailed modeling assessments were conducted for this Addendum to evaluate the feasibility of these single tank options, even if the tanks were only half full (which would reduce maintenance issues associated with building a tank for full buildout as opposed to a phased approach with multiple storage systems). The modeling assessment confirmed that all Options would still function effectively under these conditions.

Based on these criteria, the preferred solution was determined to be **Option WS-1.2.**

The detailed evaluation process completed to arrive at this preferred solution for Water Storage is summarized in **Table 7.**

**Table 7: Angus IMP Water Storage & Fire Flow Alternative Servicing Strategies**

| Evaluation Criteria | | Servicing Strategy WS-1.1<br>Additional in ground resevoirs at the Mill Street Site | Servicing Strategy WS-1.2<br>New Elevated Storage at the Mill Street Site | Servicing Strategy WS-1.4<br>New Elevated Storage at a Greenfield Site (South of Angus) |
|---|---|---|---|---|
| **Natural Environment Impacts (30%)** | | | | |
| Impacts of the option to vegetation, wildlife & the Natural Environment | 15.0% | Low. No increase from what was previously determined would be expected. All waste materials that may be generated during the investigation would be removed from the site. | Low. No increase from what was previously determined would be expected. All waste materials that may be generated during the investigation would be removed from site. | High. Higher uncertainty, but part of the requirements of the investigation to gain operational approval would include a detailed environmental impact assessment, with potential mitigation measures if required. |
| Surface/groundwater quality implications | 15.0% | Minimum impact expected except for construction dewatering. Potential of impacts due to watermain replacements. Most WM replacement requirements of all Options. | Minimum impact expected except for construction dewatering. Potential of impacts due to watermain replacements. Less WM replacement requirements than WS1.1. | Potentially less WM replacement requirments than Option WS-1.2 but higher uncertainty given need to complete site selection and related investigations. |
| **Natural Environment Overall Rating** | | 25.0% | 30.0% | 15.0% |
| **Social / Cultural Environment Impacts (20%)** | | | | |
| Land Use & Archaeological Considerations (Including First Nations) | 7.5% | Minimal as project is contained to existing, previously disturbed muncipal lands & ROW's | Minimal as project is contained to existing, previously disturbed muncipal lands & ROW's | More impact potential and archaeological studies required due to a new, undeveloped property being used for solution. |
| Visual landscape/Aesthetic impacts, Traffic impacts & interruption to residents | 7.5% | Minimal visual or traffic impacts due to current Mill St. location being somewhat remote, and no above ground storage. Potential for interruption to residents due to WM replacement requirements and potential need to take existing storage offline to connect new storage. | Slightly more visual impact due to the above ground reservoir. Less impact to residents due to using a separate storage system vs. augmenting existing, and less WM replacement requirements than WS-1.1. | Potential for interruption to residents due to WM replacement requirement. Some uncertainty on visual / traffic impacts, subject to ultimate site selection, but likely similar to WS-1.2. |
| Required Intermunicipal Agreements & Infrastructure | 5.0% | No Intermunicipal Infrastructure or Agreements Required | No Intermunicipal Infrastructure or Agreements Required | No Intermunicipal Infrastructure, but Agreements may be Required for acquisition of a new storage site. |
| **Social / Cultural Environment Overall Rating** | | 17.5% | 18.5% | 11.3% |
| **Technical/Operational Considerations (20%)** | | | | |
| Difficulty to construct or implement the Option relative to other alternatives | 15% | Medium. Expanded fenced perimeter & site works required to cover the area of expansion. Approximately 2,663 l.m. of watermain upgrades will be required to ensure fire flows >100 L/s in appropriate pressure ranges for all areas. This option will require an amendment to the Drinking Water Works Permit for the addition of a reservoir. | Medium. Expanded fenced perimeter required to cover the area of expansion. This option will require a paved driveway. Approximately 2,157 l.m. of watermain upgrades will be required to ensure fire flows >100 L/s in appropriate pressure ranges for all areas. This option will require an amendment to the Drinking Water Works Permit for the addition of a reservoir. | Similar to Option WS1.2 but with added requirement to complete field investigations, and associated uncertainties. This option will require an amendment to the Drinking Water Works Permit for the addition of a reservoir. Approximately 2,078 l.m. of watermain upgrades will be required to ensure fire flows >100 L/s in appropriate pressure ranges for all areas. With internal WM on the propoerty, the total WM installation requirement is likely similar to or slightly higher than Option WS1.2. |
| Operation & Maintenance Efficiency | 5% | Inspections and cleaning every few years to check for cracks and/or remove iron/manganese deposits. More burden on pumping systems under this option vs. an elevated tank which provides static pressure. | Overcoating of exterior and re-touching of interior at year 10 & full recoating in at year 25. Due to the elevated tank, this option will have less maintenance overall than WS1.1 which relies more heavily on the existing pumps to deliver flow and pressure to the system. | Maintenance will be similar to WS1.2. |
| **Technical/Operational Considerations Rating** | | 12.5% | 19.0% | 11.5% |
| **Economic Impacts (30%)** | | | | |
| Capital/construction costs | 15% | The estimated Capital Cost is $ 10,485,125. | The estimated Capital Cost is $ 11,876,750. | Minimum Capital cost of $11,876,750 as it would utilize the same technical solution as WS1.2 at a different location. This option will incur additional costs vs. WS1.2 related to land acquisition, connection to the existing system (100-200 l.m. of additional pipe) and background studies (i.e. Environmental, Archaeological) |
| Long term/operation & maintenance cost burden | 5% | Minimal maintenance requirements other than inspections and cleaning every few years to check for cracks and/or remove iron/manganese deposits. More burden on pumping systems under this option vs. an elevated tank which provides static pressure. Higher associated energy cost. | Overcoating of exterior and re-touching of interior at year 10 & full recoating in at year 25. Due to the elevated tank, this option will have less maintenance overall than WS1.1 which relies more heavily on the existing pumps to deliver flow and pressure to the system. | Maintenance will be similar to WS1.2. |
| Payment structure, cost recovery options for Municipality, Phasing Priority & Flexibility. | 10% | Good flexibility given the project is on existing municipal lands - Estimated time to construction: 7 months. This option is expected to take a total of 31 months, with 3 months for required approvals including Site Plan Approval, DWPP amendments & Construction Permit to Take Water. | Good flexibility given the project is on existing municipal lands - Estimated time to construction: 7 months. This option is expected to take a total of 26 months, with 3 months for required approvals including Site Plan Approval, DWPP amendments & Construction Permit to Take Water. | Least flexible and longest lead time to a shovel ready solution as agreements would need to be made with private owners in the required pressure zone - timing to achieve this is unknown. |
| **Economic Ranking** | | 24.2% | 24.0% | 14.8% |
| | | | | |
| **Overall Ranking:** | | 79.2% | 91.5% | 52.6% |

# 5 TASKS REQUIRED TO IMPLEMENT EACH STORAGE OPTION

An overview of tasks required to implement each of the proposed short-listed water storage solutions is presented below and was factored into the evaluation process.

**Option W1 –** New In-Ground Storage at the Mill Street Site

1. Construct a cast-in-place concrete reservoir, divided into two isolatable cells, with a total storage capacity of 4,200 m³, including excavation and backfill.
2. Install yard piping connections with isolation valves to link the existing in-ground reservoir cells to the new reservoir cell.
3. Expand the fenced perimeter to encompass the newly constructed area.
4. Complete site restoration with topsoil, sod, and/or terraseeding.

**Option W3 –** New Elevated Storage at the Mill Street Site

1. Construct an elevated water storage tank with a total capacity of 4,200 m³.
2. Install yard piping connections with isolation valves to link the elevated tank to the distribution system.
3. Expand the fenced perimeter to include the area of the new expansion.
4. Restore the site with topsoil, sod, and/or terraseeding.
5. Construct a paved driveway for site access.

**Option W5 –** New Storage at a Greenfield site (South of Angus)

1. Construct an elevated water storage tank with a total volume of 4,200 m³.
2. Install yard piping connections with isolation valves to connect the elevated tank to the distribution system.
3. Expand the fenced perimeter to cover the newly developed area.
4. Complete site restoration with topsoil, sod, and/or terraseeding.
5. Install a paved driveway for improved access.

# 6 IMPLEMENTATION STRATEGY

Following completion of the relevant stages of the EA process (i.e. the IMP and this Addendum), projects associated with the preferred Solutions for water may proceed to the Implementation Stage of the Class EA Process (Phase 5). This Chapter outlines a recommended strategy for implementation of the preferred solutions, including required projects and their associated Class EA Schedules, additional study requirements, and necessary infrastructure approvals; Project phasing recommendations; Opinions of probable project capital costs; and, Potential impacts and mitigation and monitoring requirements to facilitate project implementation. Much of this information has also been presented in earlier sections of this EA Addendum Report.

In addition to meeting the intent of a Schedule 'B' Class EA process (addressed via the IMP and updated via this Addendum report), projects and approval requirements associated with the recommended preferred Options will generally include a number of additional approvals from regulatory agencies such as the Ministry of the Environment, Conservation and Parks (MECP) and the Nottawasaga Conservation Authority (NVCA) as listed within this section.

## 6.1 Consideration of Plans and Policies – Provincial Policy Statement

The proposed solutions outlined in the Angus IMP Addendum are consistent with the goals of the Provincial Policy Statement. Specifically, the evaluation process completed to arrive at the IMP solutions align with the guidelines of PPS Chapter 3 and proposed solutions align with the preferred form of servicing (i.e. Municipal Services) outlined in PPS Section 3.6.2.

The proposed solutions will also allow for timely infrastructure growth to support housing expansion within existing municipal boundaries, in accordance with established municipal land use planning policies and PPS Chapter 2. Consultation processes followed as part of this EA Addendum were also consistent with both MECP and PPS guidelines and the MEA Class EA Process. See **Appendix E** for detailed documentation of the public consultations completed as part of this EA Addendum.

## 6.2 Water Servicing Project Infrastructure Approvals

The recommended preferred water servicing solutions selected as part of this Addendum are generally categorized as Schedule 'B' Projects, and as such may proceed to implementation. Class EA and infrastructure approval requirements for water servicing projects associated with water supply and storage options are summarized in **Table 8**.

**Table 8: Water Supply and Storage Project Class EA Schedules and Approval Requirements**

| Project Description | Class EA Schedule & Study Requirements | Required Agency Approvals |
|---|---|---|
| Water Supply Increase - New Mill St. Well 1A | Eligible for screening or Schedule B. Requires Hydro-G capacity testing and Environmental Studies associated and neighbouring former Landfill. | MECP Permit to Take Water (PTTW) amendment for the addition of a new well, Drinking Water Works Permit amendment for the addition of a new well, and a Section 34 amendment for Source Water Protection Plan. |
| Water Storage - Elevated Storage Tank at Mill Street Site | Schedule B Project (IMP + This Addendum) | Drinking Water Works Permit (DWWP) Amendment for the addition of a storage. |
| Existing Watermain Upgrades (Various Locations) | This Option would be exempt from the EA Act based on the MCEA, 2023. | DWWP Amendment for addition of watermain. NVCA Permits depending on area. |
| Water Supply Increase - Additional Mill St. Well Capacity *Not suggested for near-term implementation* | Exempt from the EA Act based on the MCEA, 2023. Requires Hydro-G capacity testing and Environmental Studies associated and neighbouring former Landfill. | MECP PTTW amendment for the addition of a new well, DWWP amendment for the addition of a new well, and a Section 34 amendment for Source Water Protection Plan. |
| Water Supply - Centre Street (McGeorge) Well & Pumphouse Replacement *Not suggested for near-term implementation* | Eligible for screening or would require a Schedule B class EA (IMP + Addendum). Requires Hydro-G testing and study for increased well supply. | MECP PTTW amendment for the addition of a new well, DWWP amendment for the addition of a new well, and a Section 34 amendment for Source Water Protection Plan. |
| Water Supply - New well Field in Angus area *Not suggested for near-term implementation* | Requires a Schedule B Class EA (IMP + Addendum). Requires archaeological, hydro-g, geotechnical and environmental studies to support work at proposed site(s). | MECP PTTW amendment for the addition of a new well, DWWP amendment for the addition of a new well, and a Section 34 amendment for Source Water Protection Plan. |

## 6.3 Preferred Servicing Option Project Capital Costs (Near-Term Implementation)

The preferred near-term water servicing solutions **(Option W5 and Option WS-1.2)** will generally include increasing the capacity of Angus' water supply through the addition of a new well at Mill Street with an estimated capacity of 4,400 $m^3$/d (approximately 1,590 equivalent residential units of capacity), and constructing a single elevated storage system at the Mill Street site (approximate capacity of 4,200 $m^3$ for the 25-year buildout, filled to 50% for maintenance purposes until additional capacity is required).

**Table 9** summarizes the anticipated OPC for each project associated with the preferred water servicing solution. Preliminary studies (hydrogeological investigation) have been included within the proposed capital costs.

**Table 9: Opinion of Probable Capital Costs – Water Projects**

| **Project Description** | **Opinion of Probable Capital Cost** |
|---|---|
| **Option W5** - Construct Additional Mill Street Well 1A (incl. hydrogeological & environmental testing/studies) | $ 2,227,500 |
| **Option WS 1.2** - Construct New, Elevated Storage Tank at Mill Street Site (Cost does not include WM Upgrades in existing areas) | $11,876,750 |

**Note:** *OPC's presented herein include design, approvals, additional background studies and/or monitoring programs. However, costs associated with land acquisition (if required) or legal fees are not included.*

We also note that while OPC's for other options were developed for evaluation purposes, given that the water supply evaluation for this Addendum was primarily based on prioritization of near-term projects, only Option W5 has been presented above, as it will provide sufficient capacity (approximately 1,590 ERU) up to at least the limits of the current wastewater treatment system, which has a residual capacity of approximately 870 ERU.

While other assessed supply Options may need to be explored for future capacity beyond this threshold (listed in **Table 8** as *Not suggested for near-term implementation*), we anticipate that associated costs will likely increase by the time these additional supply Options need to be investigated in more detail (i.e. following a Schedule 'C' Class EA for the WWTP and expansion of the WWTP beyond its current capacity limits, per the IMP).

In other words, implementation of these two (2) projects will close the 'residual capacity' gap between the Angus water and wastewater systems and provide additional servicing capacity to support approximately 870 ERU of additional development in the near term, with further water and storage capacity available for at least 720 further ERU, once future wastewater capacity upgrades outlined in the IMP are completed.

## 6.4 Project Mitigation and Monitoring

Mitigation of potential impacts and monitoring the effectiveness of mitigation measures during and following implementation is a critical step of any Class EA Process. The following subsections provide recommendations for mitigation strategies pertaining to both near and long-term impacts, as well as associated recommendations for environmental monitoring.

The environmental impacts of the Recommended Preferred Water Servicing Strategies can be minimized through the implementation of a mitigation and monitoring strategy. For example, the water storage should be constructed outside of environmental protection zones, in an area that is currently undeveloped but minimizes removal of existing vegetation. Routine inspections during the construction phases of all projects associated with the preferred Solution will need to be carried out to ensure adherence to design specifications.

One of the main implementation considerations for water projects is the development and execution of a detailed hydrogeological investigation to allow for the proper collection of monitoring data to confirm capacity and support the expansion of the Township's current PTTW for Angus in accordance with the recommended preferred water supply solution (**Option W5**).

A summary of potential impacts and proposed mitigation strategies associated with the preferred water servicing solutions is provided in **Table 10**.

**Table 10: Water Supply, Distribution, and Storage Project Impacts and Mitigation**

| Potential Impact | Mitigation Strategy |
|---|---|
| **Traffic and Interruption to Local Residents** | • Affected property owners will be notified in advanced as to construction schedule and duration.<br>• Consultation with MTO, the County of Simcoe, local utilities, local school boards and the Township may be required during construction period.<br>• Proposed solution minimizes impacts by limiting work to existing municipal properties/sites as much as feasible and avoids solutions that require existing systems to come offline for long periods of time. |
| **Dust, Noise and Vibration** | • Construction operations will be restricted to the day time period; in addition, the contractor will be required to meet local noise by-laws.<br>• Dust control will be implemented throughout construction. |
| **Visual Impact** | • The locations and types of expanded storage will be finalized in the Schedule 'B' addendum, and will consider minimizing visual impacts. |
| **Sediment and Erosion Control** | • Sedimentation and erosion control strategies will be developed for each individual site prior to construction. |
| **Removal of Vegetation** | • Recommended solution minimizes vegetation/tree removal by utilizing previously disturbed existing municipal lands as much as possible for the proposed solutions.<br>• Vegetation removal will be considered in the locating of expanded water storage |
| **Aquifer and Aquatic Habitat Monitoring** | • Detailed hydrogeological investigation and pre-consultation with MECP is proposed at the outset of these projects, including confirmation of capacity and water quality testing.<br>• Baseline hydrogeological and aquatic ecosystem (as needed) monitoring data should be collected prior to additional development<br>• Monitoring should continue in accordance with recommendations of the initial hydrogeological investigation |

# 7 PUBLIC CONSULTATION

Public consultation is an important part of any Class EA Process, and consultation with the affected public has been carried out throughout all stages of the Angus IMP. Notices associated with the process have been provided in **Appendix E-1,** with copies of all presentations provided in **Appendix E-2**.

A record of all comments received from members of the public and from relevant approvals agencies can be found in **Appendix E-3**.

The circulation list for notices was updated from the original IMP contact list, based on responses received from outreach from the original project, and changes in contacts at relevant agencies or Indigenous Communities.

## 7.1 Notice of Commencement

The Notice of Study Commencement (NOSC) was posted on the Township's website (http://www.essatownship.ca) 10 August 2023. A copy of the NOSC can be found in the Public Consultation Record (**Appendix E-1**).

## 7.2 Public Information Centre (PIC) No. 1

A notice of the Public Open House (PIC) No. 1 was published on the Township's website, and through email to local stakeholders, relevant agencies and Indigenous Communities two weeks prior to the hosting of the PIC. The Notice for PIC No. 1 is provided in **Appendix E-1**.

PIC No. 1 was held on 21 November 2024, virtually. Two (2) presentations were held to provide the public multiple opportunities to attend. A total of eleven (11) people attended. The purpose of the meeting was to present:

- The Class EA process;
- A summary of the Angus IMP solutions;
- The purpose of the Class EA Addendum;
- The updated evaluation of water supply, distribution and storage and disposal alternatives; and,
- The next steps in the project and the Class EA process.

The PIC No. 1 presentation slides, are provided in **Appendix E-2**. The public and review agencies had the opportunity to review the Class EA material and provide input on the information provided to date. The presentation slides were made available online via the Township website and email addresses for project representatives were provided so attendees could provide comments or queries.

No comments or queries from members of the public were received following PIC No. 1. Copies of received acknowledgments in response to the distributed notice are provided in **Appendix E-3**. The Notice of PIC was emailed to an updated list of local stakeholders, provided for the Angus IMP, including agencies and First Nations groups.

## 7.3 Notice of Addendum

The Notice of Addendum for the Angus Infrastructure Master Plan Class Environmental Assessment Addendum – Water Supply and Storage was published on 05 December 2024.

The notice was published on the Township's website and emailed to an updated list from the IMP of local stakeholders (including PIC attendees/respondents) including agencies and First Nations groups.

A copy of the Notice of Addendum is provided in **Appendix E-1.**

# 8 CLOSURE

Based on the foregoing information, Greenland has concluded via the evaluations presented in this EA Addendum report that **Option W5 and Option WS-1.2** (see **Appendix A**) are the preferred servicing alternatives to address near-term growth in Angus, while also providing the first concrete steps towards the anticipated 25-year development horizon of the IMP.

The preferred solution will provide cost effective water supply capacity for up to 1,590 ERU (870 ERU of which could proceed before WWTP upgrades) and will close the servicing gap between the water and wastewater systems, while also meeting the 25-year study horizon storage requirements and improving deficient fire flows through the static pressure provided by the elevated tank. Future upgrades to deficient watermain will also improve these issues further. These upgrades should be prioritized based on the areas highlighted in **Appendix D**. We note that the watermain upgrades can be completed separately from the supply and storage upgrades.

We trust that the findings of this MSP Addendum are satisfactory. Please do not hesitate to contact the undersigned with any questions or if you require clarification to the analysis presented herein.

We look forward to proceeding with the next steps of this important project.

Yours truly,

**GREENLAND INTERNATIONAL CONSULTING LTD.**

Kirsten McFarlane, B.Sc.
Project Coordinator

Josh Maitland, P.Eng.
Project Manager, EA Coordinator

# Appendix A

Tables & Figures

# W1 - Increase Mill St. Well #1 Capacity

| TASK DESCRIPTION | ESTIMATED COST |
|---|---|
| **DESIGN TASKS** | |
| Investigation of Waste Disposal Area near Mill Street Wellfield | $ 105,000.00 |
| Source Water Protection Updates (Assumes existing groundwater model not available) | $ 150,000.00 |
| Engineering Design and Contract Administration | $ 76,000.00 |
| Design Subtotal | $ 331,000.00 |
| **CONSTRUCTION TASKS** | |
| Pump Testing, reporting and permitting (Allowances: Commissioning/Re-Commissioning costs) | $ 93,500.00 |
| Construction of electrical upgrades for new well pump | $ 551,100.00 |
| Construction Subtotal | $ 644,600.00 |
| **SUBTOTAL** | **$ 975,600.00** |
| 25% Contingency (Design and Construction) | $ 243,900.00 |
| **TOTAL W1 OPTION** | **$ 1,219,500.00** |

# W3 - Replace Centre St. Wells #2 and #3

| TASK DESCRIPTION | ESTIMATED COST | |
|---|---|---|
| **DESIGN TASKS** | | |
| Source Water Protection Updates (Assumes existing groundwater model not available) | $ | 150,000.00 |
| Engineering Design and Contract Administration | $ | 526,000.00 |
| Design Subtotal | $ | 676,000.00 |
| **CONSTRUCTION TASKS** | | |
| Construction of Replacement Groundwater Wells, including engineering and allowances | $ | 1,430,000.00 |
| Construction of refurbishment of existing pumphouse and replacement of chemical storage facility | $ | 1,617,000.00 |
| Construction Subtotal | $ | 3,047,000.00 |
| **SUBOTAL** | **$** | **3,723,000.00** |
| 25% Contingency (Design and Construction) | $ | 930,750.00 |
| **TOTAL W3 OPTION** | **$** | **4,653,750.00** |

# W5 - Construct Additional Mill St. Well #1A

| TASK DESCRIPTION | ESTIMATED COST |
|---|---|
| **DESIGN TASKS** | |
| Investigation of Waste Disposal Area near Mill Street Wellfield | $ 105,000.00 |
| Source Water Protection Updates (Assumes existing groundwater model not available) | $ 150,000.00 |
| Engineering Design and Contract Administration | $ 97,000.00 |
| Design Subtotal | $ 352,000.00 |
| **CONSTRUCTION TASKS** | |
| Construction of New Groundwater Well 1A, including engineering and allowances | $ 935,000.00 |
| Construction of electrical upgrades for new well pump | $ 495,000.00 |
| Construction Subtotal | $ 1,430,000.00 |
| **SUBTOTAL** | **$ 1,782,000.00** |
| 25% Contingency (Design and Construction) | $ 445,500.00 |
| **TOTAL W5 OPTION** | **$ 2,227,500.00** |

# W6 - Development of a New Wellfield

| TASK DESCRIPTION | | ESTIMATED COST |
|---|---|---|
| **DESIGN TASKS** | | |
| Desktop Study and Preliminary Work, including municipal and MECP consultation | $ | 24,000.00 |
| Well Installations and Allowances | $ | 194,000.00 |
| Pumping Tests, including well surveys and private well monitoring | $ | 143,500.00 |
| Report Preparation and Project Management | $ | 25,500.00 |
| Design Subtotal | $ | 387,000.00 |
| **CONSTRUCTION TASKS** | | |
| Well Installations | $ | 84,700.00 |
| Pump Testing, reporting and permitting | $ | 72,600.00 |
| Construction Subtotal | $ | 157,300.00 |
| **SUBTOTAL** | **$** | **544,300.00** |
| 25% Contingency (Design and Construction) | $ | 136,075.00 |
| **TOTAL W6 OPTION** | **$** | **680,375.00** |

# WS-1.1 - Additional In-Ground Reservoirs

| TASK DESCRIPTION | ESTIMATED COST |
|---|---|
| **DESIGN TASKS** | |
| Engineering Procurement and Detailed Design | $ 1,369,000.00 |
| Design Subtotal | $ 1,369,000.00 |
| **CONSTRUCTION TASKS** | |
| Construction of new in ground reservoir | $ 7,019,100.00 |
| Construction Subtotal | $ 7,019,100.00 |
| **SUBTOTAL** | **$ 8,388,100.00** |
| 25% Contingency (Design and Construction) | $ 2,097,025.00 |
| **TOTAL WS-1.1 OPTION** | **$ 10,485,125.00** |

# WS-1.1 - New Elevated Storage Tank

| TASK DESCRIPTION | ESTIMATED COST | |
|---|---|---|
| **DESIGN TASKS** | | |
| Engineering Procurement and Detailed Design | $ | 1,550,000.00 |
| Design Subtotal | $ | 1,550,000.00 |
| **CONSTRUCTION TASKS** | | |
| Construction of new elevated reservoir | $ | 7,946,400.00 |
| Construction Subtotal | $ | 7,946,400.00 |
| **SUBTOTAL** | **$** | **9,496,400.00** |
| 25% Contingency (Design and Construction) | $ | 2,374,100.00 |
| **TOTAL WS-1.2 OPTION** | **$** | **11,870,500.00** |

# WS-1.1 - New Storage Tank at a Greenfield Site (assumed elevated)

| TASK DESCRIPTION | ESTIMATED COST |
|---|---|
| **DESIGN TASKS** | |
| Engineering Procurement and Detailed Design | $ 1,550,000.00 |
| Design Subtotal | $ 1,550,000.00 |
| **CONSTRUCTION TASKS** | |
| Construction of new elevated reservoir | $ 7,946,400.00 |
| Construction Subtotal | $ 7,946,400.00 |
| **SUBTOTAL** | **$ 9,496,400.00** |
| 25% Contingency (Design and Construction) | $ 2,374,100.00 |
| **TOTAL WS-1.4 OPTION** | **$ 11,870,500.00** |

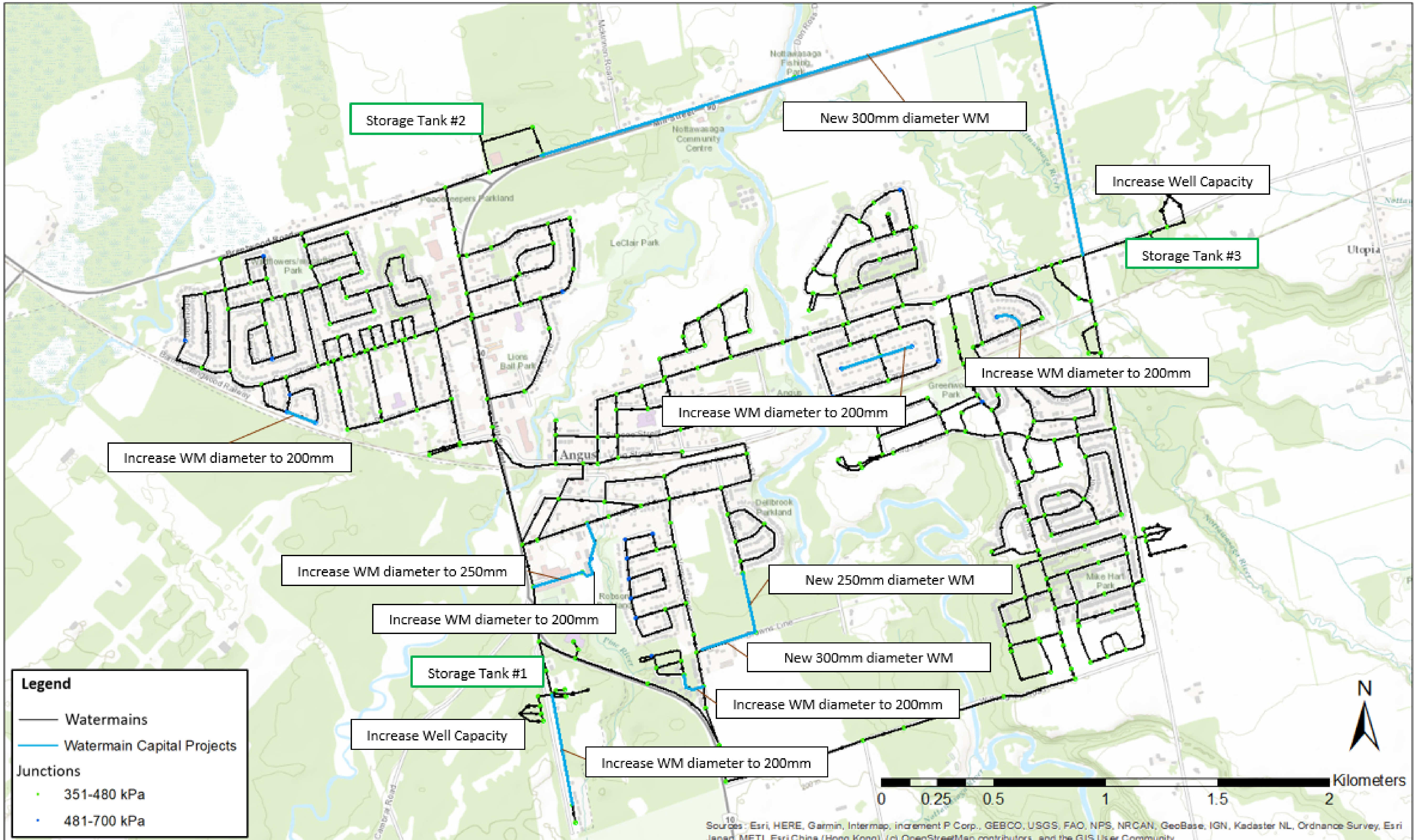
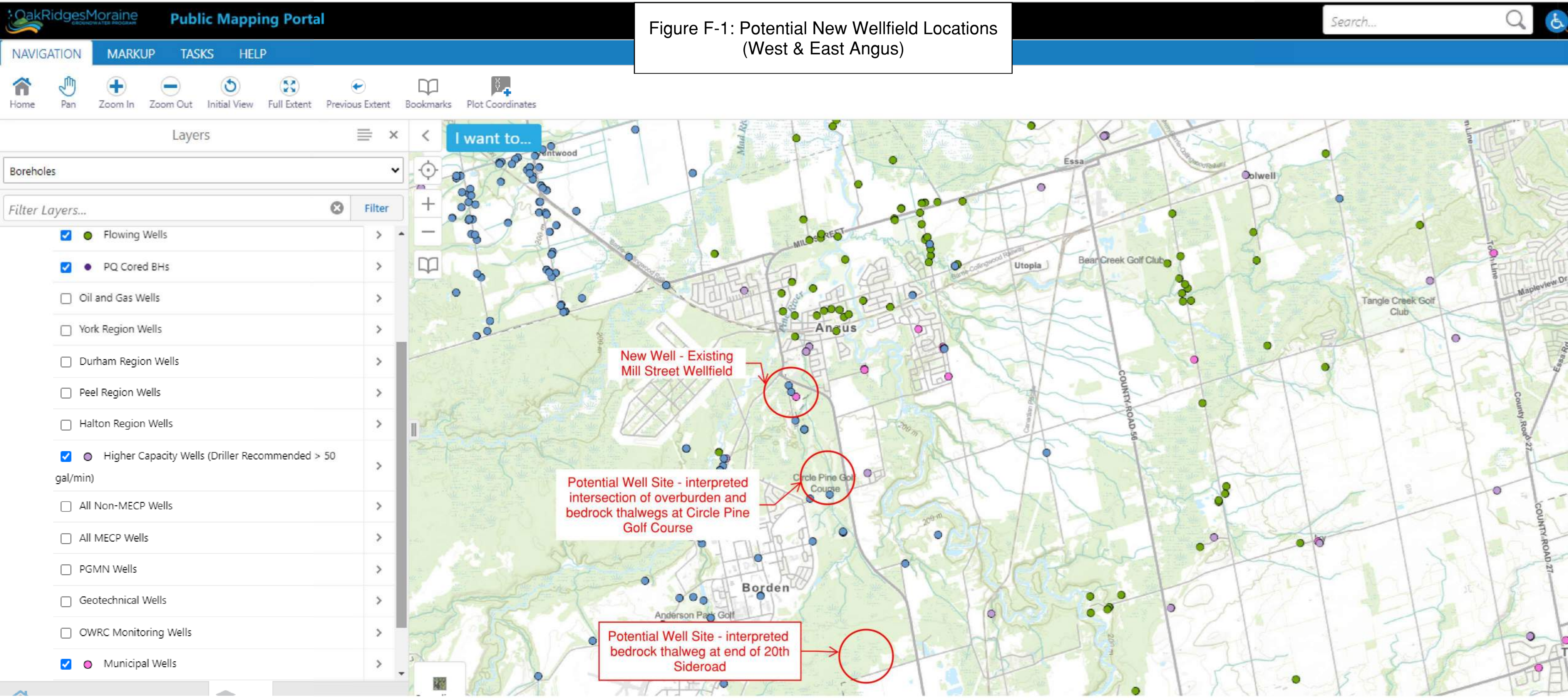



**Figure 9-1 Water System Preferred Master Servicing Strategy (Note: Precise storage tank locations to be confirmed at Pre-Design)**

Figure F-1: Potential New Wellfield Locations (West & East Angus)



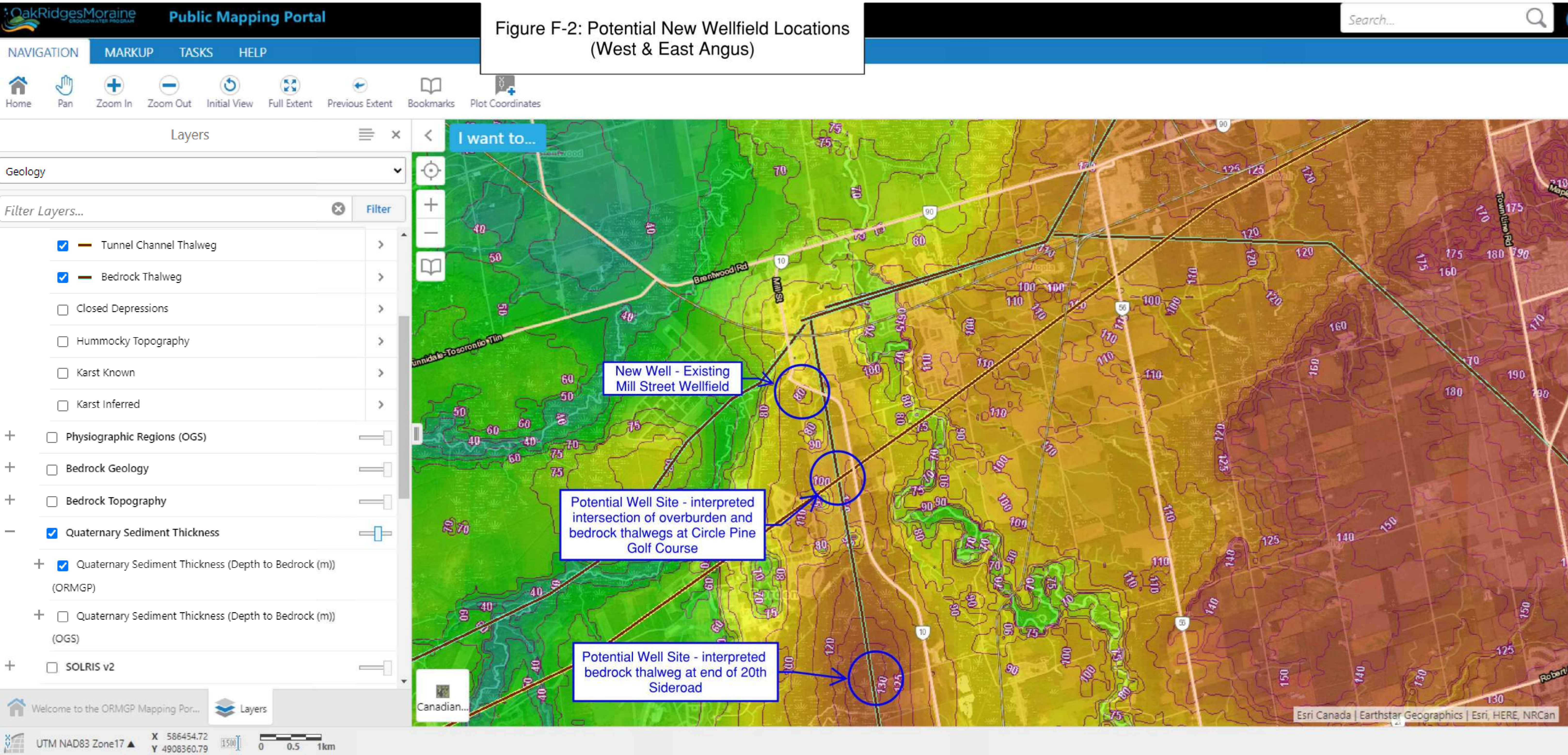
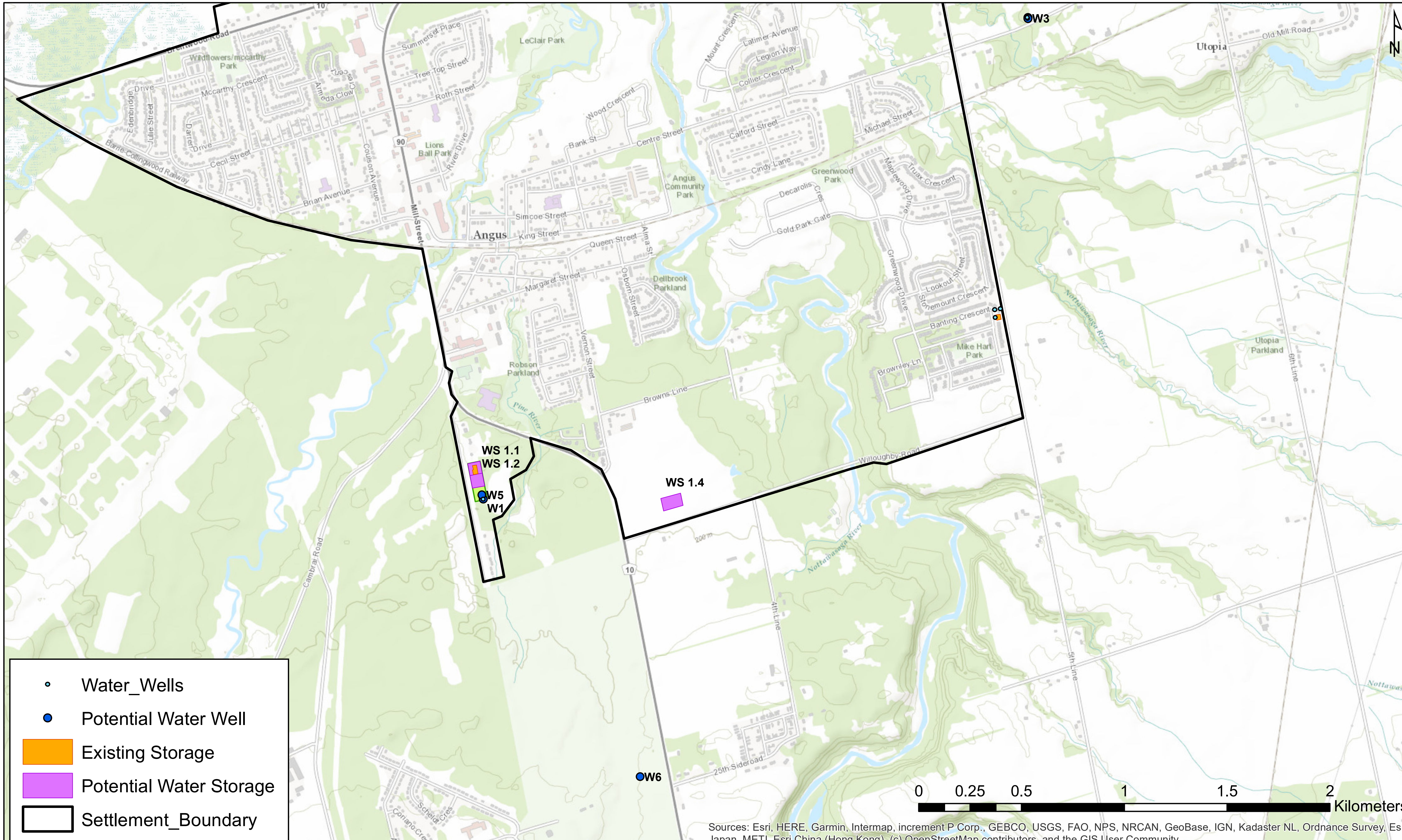



Figure F-2: Potential New Wellfield Locations (West & East Angus)

# Water Supply and Storage Short-Listed Options




**237001 – Essa Water Master Plan Addendum**

**Figure 2: Mill Street Elevated Storage Tank Concept**

RVA

0 25 50 100 Meters

## Appendix B

GEI Hydrogeological Assessment & Work Plan

GEI Consultants

Consulting Engineers and Scientists

Desktop Assessment

# Angus Water Supply Assessment and Options for Expansion

Town of Angus, Essa Township, Ontario

**Submitted to:**
Greenland Consulting
120 Hume Street
Collingwood, Ontario
L9Y 1V5

**Submitted by:**
GEI Consultants Ltd.
647 Welham Road, Unit 14
Barrie, Ontario, L4N 0B7

February 15, 2024
Project No. 2302990

# Table of Contents

# Table of Contents (Continued)

# 1. Introduction

GEI was retained by Greenland International Consulting Engineers (Greenland).to provide hydrogeological services as part of a Schedule B Municipal Class Environmental Assessment (EA) regarding the water and wastewater servicing in the settlement area of Angus, Township of Essa (see Figure 1 for the location of Angus in a subregional context). The EA is being led by Greenland.

Based on growth projections, it is expected that water demand in Angus will increase significantly beyond the combined permitted capacity of the three existing wellfields, which are referred to as the Mill Street, Centre Street, and Brownley wellfields. See Figure 2 for the location of these wellfields in the Angus area.

## 1.1 Purpose and Scope of Work

The objectives of this report are as follows:

a) Review existing information to determine whether there is unused capacity within the existing supply well network and, if so, estimate that capacity.

b) Provide a list of alternatives to achieve increased water-taking to meet the projected demand.

## 1.2 Interpretation

For the purposes of this report, the direction “north” shall be taken to be that direction along 5th Line toward County Road 90.

## 1.3 Methodology

This assessment was conducted as a desktop study and was therefore limited to the review of available reports, mapping, records and other documents relevant to the objectives. In particular, the following documents and data sources were reviewed:

- GIS mapping available through the Ontario Geological Survey for surficial geology, physiography, and bedrock geology;

- GIS mapping available through the Lake Simcoe Region Conservation Authority, including topographic contours, wellhead protection areas (WHPA), significant groundwater recharge areas;

- The Township of Essa, including the Angus settlement area plan (from the Township Official Plan), historical reports documenting well performance testing, real-time well operation data, and the application for the most recent Permit to Take Water renewal;

- Ministry of the Environment, Conservation and Parks documents including water well records, Permits To Take Water, the Waste Disposal Site Inventory (1991), and Freedom of Information release data from an *ad hoc* request for documents related to prior Permit to Take Water applications for the Angus water supply system.

The information from these sources was synthesized to describe the hydrogeological setting of the Angus area, to characterize the local use of groundwater in the area (including source protection “vulnerable areas”), and to assess the potential for additional capacity in the existing supply wells that form the Angus municipal water supply network.

# 2. Permitted System Capacity and Projected Demand

The Angus water supply system is operated subject to Permit to Take Water (PTTW) 0244-CU4QCG (Issued September 12, 2023). A copy of the PTTW is enclosed in Appendix A.

The PTTW identifies six sources across the three wellfields, with one well at Mill Street, two wells at Centre Street, and three wells at Brownley. The permitted water taking is summarized as follows:

- Mill Street Wellfield
  - Well 1: 3,927,774 L/d
- Centre Street Wellfield
  - Well 2: 1,296,000 L/d
  - Well 3: 1,296,000 L/d
- Brownley Wellfield
  - Well 4: 1,800,000 L/d
  - Well 5: 654,624 L/d
  - Well 6: 1,800,000 L/d

Accounting for all six sources, the combined permitted water taking is 9,585,000 L/d.

Based on information received from Greenland, the water demand for the Angus area is projected to increase within the next 25 years such that an increase in water-taking of between 4,005,000 L/d (average demand) and 8,124,000 L/d (maximum demand) will be required. Table 1, below, provides a summary.

**TABLE 1: Summary of Current and Projected Population and Water System Demand.** Water demand estimates are based on an average of 3 residents per residential unit.

| | Residential Units | Extended Population* | Water Usage Rate (L/cap/d) | Avg. Daily Demand ($m^3$/d) | Max. Daily Demand ($m^3$/d) |
|---|---|---|---|---|---|
| Existing Conditions | 4,591 | 13,773 | 214 | 2,947 | 6,096 |
| Increase Required for Ultimate Development | 2,935 | 8,805 | 450 | 4,005 | 8,124 |
| Total | 7,526 | 22,584 | - | 6,952 | 14,220 |

# 3. Hydrogeological Setting

This section provides a general overview of the hydrogeological setting in the vicinity of Angus.

## 3.1 Topography/Hydrology

The topography of the Angus area is relatively flat, with the most significant topographic relief occurring near the valley of the Nottawasaga River and some of its larger tributaries. Within the Angus settlement area, elevations range from about 185 masl (metres above sea level) in the north up to 200 masl in the south and southeast.

Hydrologically, Angus lies within the Nottawasaga River watershed. Per mapping from the MECP Source Protection Information Atlas, the majority of the Angus area is divided into three quaternary watersheds:

- Bear Creek – Nottawasaga River: the area south of County Road 90 and east of the Nottawasaga River, plus the riparian and wetland areas immediately to the west of the River

- Pine River: the area south of County Road 90 and east of the Nottawasaga

- Marl Creek – Nottawasaga River: the area north of County Road 90.

Within Angus there are some notable wetland areas especially extending from the Nottawasaga River south to Willoughby Road and west to Vernon Street as well as in the area north of County Road 90 near Mad River and McKinnon Road. North of the Angus settlement area lies the Minesing Swamp.

The upland areas to the southeast of Angus are the source of numerous tributaries to the Nottawasaga River, including Bear Creek.

## 3.2 Physiography and Surficial Geology

Angus lies within the Nottawasaga Basin of the physiographic region known as the Simcoe Lowlands (Chapman and Putnam, 1984). This area is notable in that most of its area was formerly part of the floor of Lake Algonquin. Lake and deltaic deposits are therefore common throughout the area. Chapman and Putnam (1984) identify Angus to be within an area referred to as the Camp Borden Sand Plains.

Mapping of physiographic landforms indicates that the northern part of the Angus settlement area is located within a clay plain landform, while the southern part lies on a sand plain (Chapman and Putnam, 2007). The sand plain feature is extensive, reaching several kilometers to the east, south and west beyond the Angus settlement area limits. Figure 3 shows the distribution of physiographic landforms in the Angus area.

In terms of surficial geology, mapping provided by the Ontario Geological Survey (2010) indicates that Angus lies within a broad area of glaciofluvial and outwash sand deposits. Alluvial deposits extend along the several watercourses (e.g., Pine Creek, Nottawasaga River, Bear Creek) that converge at Angus. Glaciolacustrine deposits (silt, clayey to sandy) cover much of the northern part of Angus as well as the lands extending north toward the Minesing wetlands. Figure 4 shows the distribution of surficial materials in the Angus area.

## 3.3 Bedrock Geology

Bedrock mapping provided by Ontario Geological Survey (2011) indicates that the bedrock of the Angus area is of the Ottawa Group/ Simcoe Group/ Shadow Lake Formation. These deposits are Ordovician period sedimentary deposits, primarily composed of limestone, dolostone and shale (Ontario Geological Survey 2011).

Based on information from available water well records, the depth to bedrock in the Angus area is generally greater than 70 m below ground surface.

# 4. Local Use of Groundwater

## 4.1 Local Aquifers

It is noted that bedrock aquifers in this area are not likely to produce sufficient yields for municipal use. Singer *et al* (2003) indicate that the Simcoe Group bedrock has “fair” water-yielding capability, owing to its relatively low transmissivity (geometric mean 5.7 $m^2$/day).

Based on a review of local water well records the vast majority of groundwater users in the vicinity of Angus draw from supply wells installed in overburden aquifers: of the hundreds of water well records in the area, only a small proportion of them were drilled to bedrock. It is also noted that the six existing wells that form the Angus water supply network are all installed in overburden formations.

The Approved Assessment Report (Lake Simcoe Source Protection Committee, 2015) indicates that the aquifer system in the Angus area is part of the “Barrie-Borden tunnel valley aquifer system” and it further identifies overburden aquifers as follows:

- A1 (the uppermost aquifer)
    - Type: unconfined aquifer
    - Composition: fine to medium grained sand
    - Elevation/ Thickness: generally located at elevations above 190 masl
- A2
    - Type: confined
    - Composition: sand, interlayered with low permeability materials
    - Elevation/ Thickness: up to 19 m thick, typically shallower than 54 mbgs.
- A3/A4
    - Type: confined
    - Composition: sand
    - Elevation/ Thickness: Generally deeper than 50 mbgs.

The Approved Assessment Report notes that the Brownley wells are installed in Aquifer A2 while the Mill Street and Centre Street wells are installed in Aquifers A3/A4. However, it also notes that all three of the confined aquifers A2, A3 and A4 are understood to be hydraulically connected in the Angus area.

It is noted that the Centre Street wells are both artesian wells: their respective well records indicate static water levels at heights about 3 m above ground surface.

### *4.1.1 Source Water Protection*

The local Source Protection Plan (Lake Simcoe Region Source Protection Committee, 2022) identifies “vulnerable areas” (e.g., wellhead protection areas) as well as policies that are to be applied to those vulnerable areas for the protection of municipal water supplies.

### *4.1.2 Wellhead Protection Areas*

Wellhead Protection Areas (WHPAs) have been identified for each of the three wellfields that supply the Angus municipal water system.

The WHPAs for the Brownley and Mill Street wellfields have a concentric "bullseye" type pattern, indicating that groundwater flows to these wells more or less evenly from all directions. This suggests that the natural seepage of groundwater laterally through their aquifers (A2 at Brownley wellfield and A3/A4 at Mill Street) is relatively slow: the induced flow caused by discharge of water from the wells dominates the local flow in the aquifer(s).

However, the WHPA for the Centre Street wellfield is long and narrow, with "headwaters" in the upland areas near Grenfell, approximately 6 km to the northeast of the wellfield itself. The shape of the WHPA for the Centre Street wellfield indicates that in the area northeast of Angus the rate of lateral groundwater seepage in Aquifer A3/A4 is relatively high.

Figure 5 shows the location and layout of the WHPAs associated with the Angus supply wells.

It is noted that despite being identified as overburden aquifers in an area with predominantly sand/outwash surficial materials, none of the municipal wellfields is identified as being "groundwater under the direct influence of surface water" (GUDI).

### *4.1.3 Significant Groundwater Recharge Areas*

A large proportion of the undeveloped lands within the Angus settlement area have been identified to be Significant Groundwater Recharge Areas (SGRAs), which are areas that are estimated to have an annual groundwater recharge rate of more than 15% above the average recharge rate in the watershed.

Figure 6 shows the distribution of SGRAs in the Angus area.

The prevalence of SGRAs in the Angus area is understood to be due largely to the relatively flat terrain and the predominance of sandy soils that exist throughout the area.

### *4.1.4 Highly Vulnerable Aquifers*

Highly Vulnerable Aquifers (HVAs) are those aquifers that may easily be affected by contaminants originating at the surface. In most cases, HVAs are identified where the overlying strata are of low permeability or low thickness and provide a relatively low degree of hydraulic separation from the surface. However, in some cases an HVA may also be identified where transport pathways (e.g., deep foundations, wells, other structures) may contribute to the reduction in hydraulic separation.

A large proportion of the Angus area has been identified to be underlain by HVAs.

### *4.1.5 Issue Contributing Areas*

Issue Contributing Areas (ICAs) are areas which are understood to have or be susceptible to the presence of certain contaminants in groundwater. Commonly, ICAs are identified for certain persistent chemicals such as chloride or trichloroethylene.

In the Angus area, no ICAs have been identified by local Source Protection Plan. The nearest ICA is approximately 8 km to the east-northeast and is associated with the wellfields of the Barrie municipal water supply.

# 5. Assessment of Additional Capacity

## 5.1 Supply Well Capacity Testing

From 2020 to 2022, each municipal well in the Angus supply network was subjected to step-drawdown testing to evaluate well performance.

Copies of the well test and inspection reports, as well as the applicable MECP water well records, are provided in the Appendices as follows:

- Appendix B – Mill Street Wellfield (Mill Street Well 1)
- Appendix C – Centre Street Wellfield (Centre Street Wells 2 and 3)
- Appendix D – Brownley Wellfield (Brownley Wells 4, 5, and 6)

A summary of the data from these step-drawdown tests is provided in Table 2.

Table 2 also includes estimated allowable discharge rates, based on the extrapolation of the drawdown-discharge plots provided by the latest step test data available for each well. Specifically, an “allowable drawdown” was chosen, and the curve was extrapolated to identify what discharge would be required to induce a drawdown equal to the allowable drawdown.

For the Mill Street and Centre Street wells, the allowable drawdown equal to 80% of the water column height above the top of the aquifer. The rationale for this selection was, in confined aquifers, the available drawdown is typically accepted as the height of the water column above the top of the aquifer: this is intended to prevent desaturation of the production formation which may lead to land subsidence, decreased well efficiency, or decreased aquifer performance. This available drawdown was then multiplied by 80% to provide a degree of conservatism to the estimate as there is some uncertainty as to the relationship between drawdown and discharge as discharge rates increase.

For the Brownley wells, because the wells are shallower and have shorter water columns, two estimation approaches were taken. The first (“confined”) approach is the same as is described above for the Mill Street and Centre Street wells. The second (“unconfined”) approach assumes that the Brownley aquifer is to be treated instead as an unconfined aquifer, for which the available drawdown is typically taken as two-thirds of the height of the water column above the bottom of the aquifer (or the bottom of the well, as the case may be). It is noted that the “unconfined” approach is perhaps more relevant to the Brownley wells because, based on the testing data and the permitted water-taking rates, it appears that the water levels at the Brownley wells are frequently drawn down below the top of the aquifer. This will be discussed further in the subsequent sections addressing the Brownley wells.

### *Mill Street Wellfield*

The Mill Street Wellfield currently consists of one well (Mill Street Well) which is a high-yield well, installed in 1988 with a 610 mm casing and a 300 mm screen.

As previously noted, it is understood to be installed in Aquifer A3/A4, a confined overburden aquifer. The MECP well record (Well ID 5724055) for the Mill Street Well indicates that aquifer formation lies at elevations between 136 and 151 masl (15 m thickness).

Based on the most recent well performance testing (conducted May 2022), it is estimated that the water-taking from the Mill Street Well could be increased substantially before reaching the allowable drawdown (see description above in Section 5.1), potentially supplying up to 6,500,000 L/d compared to the current permitted amount of 3,927,000 L/d. This corresponds to an increase of approximately 2,573,000 L/d.

Reviewing historical well performance testing, it appears that the well (as tested in 2022) is approximately 66% as efficient compared to prior tests (conducted at various times between 1988 and 2015). It is noted that the discharge-drawdown relationship was very similar among those earlier tests, suggesting that the well had historically responded favourably to maintenance activities, the last of which were undertaken in late 2015.

However, from the records available, it is unclear whether the May 2022 test was conducted immediately following a maintenance program. If it was, then it can be reasoned that the well is no longer responding as favourably to rehabilitation. As such, to be conservative regarding long term supply planning, a further 33% reduction in well efficiency is applied to account for losses that may occur due to aging and corrosion. Adjusting the estimated supply rate accordingly, the Mill Street Well may support a long-term discharge of 4,330,000 L/d, or an increase of 403,000 L/d above the permitted amount.

Additional testing would be required to confirm the potential increase in water-taking: available pumping test reports do not show results of recent pumping at rates beyond 40 L/s (3,456,000 L/d). It is likely that this testing would take the form of a multi-day pumping test (e.g., 72 hours), including the installation of monitoring wells to confirm distance-drawdown effects. It would also be worthwhile to undertake well maintenance (e.g., flushing, wire brushing) to confirm the potential well efficiency and its response to maintenance.

Besides the well efficiency and aquifer performance considerations, it is noted that in previous submissions of Permit to Take Water Applications the MECP reviewers identified potential concerns with respect to a closed waste disposal site which is located within 200 m of the well. According to the Waste Disposal Site Inventory, that waste disposal site was closed in 1974 and was a B4 classification landfill, indicating rural usage for municipal or domestic waste (rather than industrial or hazardous waste). The approximate location of the waste disposal site is also shown on the official plan of the Angus Settlement Area (see Appendix E).

If it is proposed to increase the water-taking from Mill Street Well 1, then it is expected that the MECP will require a thorough assessment of the interaction between the closed waste disposal site and the groundwater to confirm that the increased pumping will not result in the migration of contaminants or their potential uptake into the municipal system. However, based on the stratigraphy described in the well record for Mill Street Well 1, it appears that there is likely a thick confining layer separating the well screen depth and the former landfill.

### *5.1.1 Centre Street Wells*

The Centre Street wells were both installed in 1985 with a casing size of 250 mm and 150 mm screen. Both are artesian wells with static water levels approximately 3 m above ground surface. Though water well record forms have been completed for these wells, they do not appear in the MECP water wells database: they were obtained from the Township of Essa.

As previously noted, it is understood that the Centre Street wells are installed in aquifer A3/A4, a confined overburden aquifer. The well records indicates that the aquifer formation lies below and approximate elevation of 149 masl. The well did not explore to greater depths to be able to confirm the lower extent of the aquifer but based on the reported stratigraphy the aquifer is at least 8 m thick in this location.

Based on the most recent well performance testing (conducted May 2022) for these wells, it is estimated that a substantial increase in water-taking may be viable from this wellfield. The estimated maximum allowable discharge for Centre Street Well 2 and Centre Street Well 3 is approximately 1,900,000 L/d and 1,631,000 L/d, respectively.

These estimates do not account for potential interference between the two wells, which is likely to be significant due to their proximity to each other. The estimates also do not account for losses in well efficiency, which may be substantial: compared to historical well testing, these wells (as tested in 2022) appear to be only about 30% as efficient as they were in 1985.

To account for these effects, it is assumed that the water-taking from only one of the wells should be increased and only by the amount indicated by the lesser performing well. Over the long-term, this wellfield may be capable of contributing an additional 335,000 L/d compared to the current permitted water-taking amount.

It is expected that this increase in water-taking would be achievable with the existing 250 mm wells. However, testing would need to be completed to confirm that the well in its current condition would be capable of supplying that increased flow. There may also be mechanical considerations (e.g., pump limitations) to address.

It is also noted that, due to the age of these wells and the apparent degradation of well efficiency with time, it may be advantageous to replace these wells to recover lost efficiency. Doing so may allow a much more substantial increase in water-taking from the Centre Street wellfield, potentially reaching 2,000,000 L/d beyond the current combined permitted capacity.

Maintenance of the wells (e.g., wire brushing, acid flushing) may also be a viable alternative to increasing well performance and recovering lost efficiency but it may be difficult or impossible due to the artesian conditions exhibited by the wells. The gains realized by maintenance are likely to be less than what would be achieved by well replacement.

### *5.1.2 Brownley Wells*

The Brownley wellfield was developed over several years, with Brownley Well 5 being installed in 1994, Brownley Well 4 being installed in 2005 and Brownley Well 6 being installed in 2007.

Brownley Well 5 is the smallest of the three, with a 150 mm casing and 150 mm screen while the other two wells have 200 mm casing and 200 mm screen.

As previously discussed, the Brownley wells are installed in aquifer A2. Well records for the Brownley wells indicate that the production formation lies between elevations of about 161 masl and 180 masl, indicating a thickness of nearly 20 m. It is noted that this formation occupies a range of elevations substantially higher than the A3/A4 aquifer at the other wellfields (below about 150 masl).

The shallow depth of aquifer A2 results in a correspondingly shorter water column at the Brownley wells compared to the other wellfields: available drawdown in the Brownley wells is less than half that available at the other wellfields.

Comparing the findings of recent well testing at the Brownley wellfield (conducted between October 2020 and October 2021) to their respective well records, it is noted that the permitted water taking rates for Brownley Wells 4 and 6 (1,800,000 L/d for each well) are understood to result in water levels being drawn down below the top of the aquifer.

It is noted that drawing the water level in a well below the top of aquifer may result in some negative effects, such as decreased transmissivity due to desaturation, which in turn may result in reduced well yields. Excessive drawdowns may also result in dewatering-induced ground settlement. Therefore, to avoid increased risk of these negative outcomes, it may not be of interest to increase the water-taking from Brownley Wells 4 or 6. It is also noted that Brownley Wells 4 and 6 are exhibiting some degradation of well efficiency (about 50% as efficient compared to original installation, despite recent maintenance), whereas Brownley Well 5 appears not to be exhibiting degradation of well efficiency.

Brownley Well 5, however, has a relatively low permitted water-taking volume of 654,000 L/d. Based on the recent step-drawdown test results and assuming that discharge is to be limited to prevent water levels being drawn down into the aquifer, it is estimated that Brownley Well 5 could support a water-taking of up to 1,086,000 L/d, or an increase of about 432,000 L/d relative to the permitted value. Though this does not account for interference between the other wells in the wellfield, it is expected that this modest increase in pumping is achievable as the other wells are being pumped at more aggressive drawdowns.

### *5.1.3 Summary*

Based on the foregoing discussion, it has been identified that the existing network of supply wells may reasonably be expected to support the following increases:

- Mill Street Wellfield: between 403,000 L/d and 2,573,000 L/d depending on anticipated losses in well efficiency;
- Centre Street Wellfield: up to 470,000 L/d more;
- Brownley Wellfield: up to 432,000 L/d more.

The combined increase in water-taking across all three wellfields is estimated to be between 1,305,000 L/d and 3,475,000 L/d. These estimates fall short of the required increase in projected water demand of between 4,800,000 L/d and 6,700,000 L/d.

Furthermore, the bulk of the estimated available increase is noted to come from Mill Street Wellfield. Because of the proximity of Mill Street Well 1 to a former waste disposal site, there are potential risks associated with contaminant migration and groundwater impacts. It may require a high degree of study and characterization to confirm that an increase in water-taking will not be accompanied by decreased water quality.

As such, rather than increase water-taking from the Mill Street wellfield, it may be more advantageous to conduct investigations to identify and develop a new wellfield at a different location.

Based on the abundance of groundwater in the local aquifers and the relatively small amount of increased water-taking that might be realized by further development of the Centre Street or Brownley Wellfields, the development of a new wellfield may also be preferable to conducting additional testing to expand the water-taking at the Centre Street or Brownley Wellfields.

However, it has also been identified that the Centre Street wellfield may be limited by the degradation of well efficiency that has occurred in since installation in the 1980s. Replacing the wells at the Centre Street wellfield may achieve an increase in capacity of 2,000,000 L/d. In lieu of replacement, it may also be worthwhile attempting a rehabilitation program for these wells to increase well efficiency, though the expected increases in capacity would be less than what would be obtained through replacement.

# 6. New Wellfield Development

In exploring options for new wellfields, there are several considerations. These include ownership of the land, particularly whether the area is within the Township of Essa, which could otherwise be costly to obtain and maintain land as well as how potential locations align with the planned future development in Angus as this can result in higher water transport costs if potential wellfields are placed too far from the current and the future planned development.

Additionally, past experience for municipal supplies and for locating higher capacity wells in the area indicates that potential target aquifers would be A3/A4, with A2 a potential backup. The A3/A4 aquifers tend to be higher productivity while A2 can be productive but doesn't tend to match the volumes of the A3/A4 aquifer.

Given the planned development limits provided to GEI for Angus, these are limited for expansion to the west because of Base Borden, bordered by Country Road 10 and Willoughby Road to the south, 5$^{th}$ Line to the east and Mill Street/County Road 90 and Brentwood Road to the north, with Minesing Swamp beyond that.

GEI reviewed public peer-reviewed mapping published by the Oak Ridges Moraine Groundwater Program that includes multiple geologic layers and well datasets. Two figures were generated from these datasets and are included in Appendix F. Figure F-1 shows the locations of high production wells, municipal wells, and bedrock wells while Figure F-2 shows relevant geologic layers (primarily the overburden thickness) and interpreted overburden and bedrock thalweg locations. This information is further discussed/interpreted when reviewing and proposing potential new wellfield locations.

## 6.1 Mill Street Wellfield

Along the west side of Angus is the Mill Street wellfield, which includes a single well. This well has the highest capacity of any of the individual wells that service Angus. The first option would be to investigate the potential to add a second well at this site, aiming to get something with a similar capacity. However, this option is predicated on investigations associated with potential impacts from the former closed landfill that are also required as part of the investigation to increase takings at the existing well. This option may be something that can be explored in tandem with increasing the existing well rate once MECP's concerns regarding the landfill site are addressed.

## 6.2 New Wellfield – West Angus

Beyond that option at the Mill Street wellfield, mapping available of tunnel channels indicates multiple thalwegs mapped across the Angus area, including both overburden (such as is mapped through the Mill Street wellfield) and bedrock.

One such thalweg is mapped north-south near Concession 10 and maps south-southeast beyond Alliston. This thalweg joins another just north of the Mill Street wellfield. This thalweg maps approximately 300 m west of Concession 10 (on the west side), through the Circle Pine Golf

Course until Concession 10 bends at Camp Hill Road, where it then maps at approximately 800 m west. The thalweg also corresponds with a very thick sequence of overburden deposits ranging between approximately 90 m to 130 m in thickness.

It should be noted also that a bedrock thalweg has also been mapped in a southwest to northeast direction from the escarpment, through Base Borden and Angus and ending at Lake Simcoe through Barrie. This bedrock thalweg crosses the overburden thalweg at the Circle Pine Golf Course.

Depending on land ownership or agreement possibilities to access land on the west of Concession 10, it may be feasible to site an exploration location at or near the Circle Pine Golf Course.

Additionally, given that the development is intended to extend only as far as Willoughby Road, exploration much south of the golf course may not be financially feasible given the amount of pipeline and infrastructure that would be required to both transport water and to operate the facilities would require more upfront capital. That being said, if additional exploration further from this development is required, then another possibility is to investigate areas towards the west end of 20$^{th}$ Sideroad, as this road essentially ends within the thick overburden sequence where the overburden thalweg has been mapped.

## 6.3 New Wellfield – East Angus

The bedrock thalweg discussed in the previous section is mapped to exit the Angus area around the corner of 5$^{th}$ Line and Willoughby Road. This is not far from the Brownley Wellfield that is screened in aquifer A2. Mapping of water well records does not include much if any information on bedrock well productivity and water quality in this area so exploration in this area may be a bigger unknown unless more information is located.

Overburden thalwegs are mapped west to east crossing 5$^{th}$ Line around Centre Street. This is likely the source of the Centre Street wells so additional exploration in this area is not likely to be feasible from an available supply perspective.

Additionally, there were no water well records of note within this area to examine.

As such, locations on the east side of Angus consist of a potential bedrock well in the southeast portion of the build-out area for Angus.

## 6.4 New Wellfield – South Angus

Areas along the south side of the development boundary for Angus are dominated by the Nottawasaga River and several tributaries. It is likely that exploration for a water supply will meet with several additional hurdles from the conservation authority regarding the potential to impact the river.

There were also no notable water wells in this area that suggest a potential high yield unit or zone and the subsurface geology also does not hint at significant units to explore. Unless there is any anecdotal evidence available, there does not appear to be a good option for a well exploration site in this area.

## 6.5 New Wellfield – North Angus

Along the north (along County Road 90) indicates the township boundary. This combined with a review of well information to the north indicating no high performing wells present, suggests to the north of Angus is not the preferred starting point to site a potential new wellfield.

This area is similar to the South Angus area whereby there are no significant productive wells noted, as well as no significant geological features that stand out as potential exploration options. This combined with the proximity of Minesing Swamp and the Nottawasaga and Mad Rivers may make attempts to site and obtain approval for a water supply well in this somewhat prohibitive.

## 6.6 Summary

To summarize potential sites as discussed above, GEI recommends the following in order of preference:

- Additional well at Mill Street Wellfield (assuming that MECP requirements regarding the former landfill will be addressed).
- Additional wellfield site at or near the Circle Pine Golf Course (assuming a site can be obtained).
- Additional wellfield site further south along Concession 10, maybe 20$^{th}$ Sideroad (may be cost-prohibitive to provide the connecting linear infrastructure for this option).

# 7. Alternatives for Increasing Water Supply

Based on the foregoing review and assessment, several alternatives have been identified with respect to expanding the water supply of the Angus municipal well network.

1. Maximize water-taking from Mill Street Well 1
2. Rehabilitate the Centre Street Wells 2 and 3
3. Replace the Centre Street Wells 2 and 3
4. Maximize water-taking at Brownley Well 5
5. Develop a new well at Mill Street Wellfield
6. Develop a new wellfield (likely 2+ would be required, especially if Mill Street Wellfield work is precluded or is not feasible) along Concession Road 10

The following sections provide a high-level overview of the tasks that would be involved in pursuing each of the alternatives.

## 7.1 Maximize Mill Street Well 1

1. Conduct a hydrogeological assessment in the vicinity of Mill Street Well 1 and the former waste disposal site, particularly focusing on characterizing stratigraphy and quantifying hydraulic connection between the disposal site and Aquifer A3/A4. This will involve:
    a. Drilling of shallow boreholes at the waste disposal site in an attempt to characterize the waste material.
    b. Installation or identification of monitoring wells that can be used for aquifer response monitoring during the pumping test of Mill Street Well 1.
    c. Completion of pumping tests to verify well performance, aquifer capacity, and contaminant migration potential.
2. Prepare Permit to Take Water application (and the requisite hydrogeological study report) for the requested increase.
3. Undertake a modeling study to revise the Wellhead Protection Areas.
4. Prepare and submit application to the MECP for the amendment of the Approved Assessment Report and Source Protection Plan, as applicable.

## 7.2 Rehabilitate Centre Street Wells

1. Prepare a Request for Tender to issue to well servicing contractors to rehabilitate Centre Street Wells 2 and 3. The RFT must emphasize the age and artesian condition of the wells.

2. Complete follow up pumping testing to confirm the post-rehabilitation capacity of the wells. This should include the installation of monitoring wells to measure influence on the local aquifer.

3. Prepare Permit to Take Water application (and the requisite hydrogeological study report) for the requested increase.

4. Undertake a modeling study to revise the Wellhead Protection Areas

5. Prepare and submit application to the MECP for the amendment of the Approved Assessment Report and Source Protection Plan, as applicable.

## 7.3 Replace Centre Street Wells

1. Prepare a Request for Tender to issue to well servicing contractors to construct replacements for Centre Street Wells 2 and 3.

2. Complete follow up pumping testing to confirm the post-rehabilitation capacity of the wells. This should include the installation of monitoring wells to measure influence on the local aquifer.

3. Prepare Permit to Take Water application (and the requisite hydrogeological study report) for the requested increase.

4. Undertake a modeling study to revise the Wellhead Protection Areas

5. Prepare and submit application to the MECP for the amendment of the Approved Assessment Report and Source Protection Plan, as applicable.

6. Commission the new Centre Street Wells 2 and 3.

7. Abandon the original Centre Street Wells 2 and 3 in accordance with Ontario Regulation 903.

## 7.4 Maximize Water Taking at Brownley Well 5

1. Conduct a step-drawdown test to confirm the increased capacity that can be achieved at Brownley Well 5.

2. Prepare Permit to Take Water application (and the requisite hydrogeological study report) for the requested increase.

3. Undertake a modeling study to revise the Wellhead Protection Areas according to the increased water-taking.

4. Prepare and submit application to the MECP for the amendment of the Approved Assessment Report and Source Protection Plan, as applicable.

# 8. Assessment Summary

As part of a Schedule B Municipal Class Environmental Assessment being conducted regarding the future expansion of the Angus municipal water and wastewater systems, a review of hydrogeological and well testing information was completed to identify possible alternatives for the required expansion.

The table below provides a summary of potential expansion alternatives, as well as estimated costs and timelines for their completion. The likelihood of approval is somewhat reduced for Alternative 1 (Maximizing water taking from Mill Street Well 1) because it relies upon the specific geological conditions in the vicinity of the landfill, which are unknown at this time. Alternative 5 is contingent on successfully obtaining approval related to the landfill that is required for Alternative 1.

| Option # | Alternative | Cost | Timeline to Approval | Potential Increase in Water Supply | Likelihood of Approval |
|---|---|---|---|---|---|
| 1 | Maximize water taking from Mill Street Well 1 | \$120k to \$250k | 3 to 5 years | 2.5 MLD | Moderate to High |
| 2 | Rehabilitate the Centre Street Wells 2 and 3 | \$120k to \$200k | 2 to 3 years | ~1 MLD | High |
| 3 | Replace the Centre Street Wells 2 and 3 | \$500k to \$750k | 2 to 3 years | >2 MLD | High |
| 4 | Maximize water taking at Brownley Well 5 | \$75k to \$150k | 2 to 3 years | 0.4 MLD | High |
| 5 | Develop a new well at the Mill Street wellfield | \$250k to \$300k | 2 to 3 years | 4-6 MLD | Moderate to High |
| 6 | Develop a new wellfield (likely along Concession 10) | \$750k+ | 3 to 5 years | TBD | Moderate to High |

# 9. Recommendations – Next Steps

Based on a review of the relative costs, timelines to complete, and ease of implementation/completion, the proposed options/alternatives in Section 8 were ranked using the five environments (social, natural, cultural, technical, economic). These rankings, including the rational, are discussed in more detail in this section.

The rankings are based on a relative scale from 1 to 6, with 1 being the most preferred/favoured. The summary of this is included in Table 3.

## 9.1 Option 4 - Maximize Brownley Well 5

Option 4 is considered to be the most preferred and based on ease of implementation and relative cost. This option requires retesting the well at a higher rate and re-evaluating and potentially re-permitting the well. This work can be completed while more detailed workplans are being developed for other more involved tasks.

There is the potential that a pump upgrade may be required as part of this work for the testing and/or as the final pump installation. This would be required to be confirmed prior to initiating the pumping test.

This option could add approximately 0.4 MLD and this option could be initiated and assessed relatively quickly. This option, if successful, could be completed and permitted for use before most of the other options on this list have been completed.

## 9.2 Options 2 and 3 – Rehabilitate or Replace Centre Street Wells

In order to determine whether Option 2 or 3 would be preferred, the potential success of rehabilitation efforts would need to be evaluated. It should be noted that given that these wells are artesian, rehabilitation work will be more complicated and expensive than it would be for a typical water well.

If the wells are assessed to have a reasonable response to rehabilitation then this option can be implemented readily. Follow-up pumping tests would be completed to confirm the rehabilitated capacity and to support the amended Permit to Take Water.

If rehabilitating the wells is not deemed to be feasible or it is decided otherwise not proceed, then the wells could be replaced at the site. Drilling and constructing artesian wells is more complicated and more expensive. However, the main infrastructure needed to put the new wells into operation would mostly exist, facilitating this option. From a permitting perspective, replacement wells are relatively simple to obtain permitting for.

Rehabilitation of the Centre Street wells could add approximately 1 MLD, while replacing these wells could add more than 2 MLD. Due to the age of the wells and the lack of prior inspection and maintenance, the success of rehabilitation is more uncertain.

## 9.3 Option 5 – New Well at Mill Street Wellfield

Option 5 and Option 1 (i.e., maximize Mill Street Well 1) are not rated better due to the need for a detailed investigation of the former landfill located upgradient of the wellfield site. The landfill investigation will take up to one year, resulting in a longer schedule for completion.

Key information that will be required for this investigation includes reviewing available data/reports about the previous site activities, identifying and contacting the site owners, confirming/arranging site access to conduct an investigation, and then scoping and conducting the necessary investigation (which should include a pre-consultation with MECP to obtain their approval on the scope and duration prior to initiation of the work).

This investigation will delay the installation of a new well can be completed. However, the installation of a new well at this wellfield has the potential to provide a significant volume of additional supply to the system once approved. This option could result in an estimated additional 4-6 MLD.

## 9.4 Option 1 - Maximize Mill Street Well 1

As noted in the previous section, implementation of this option is subject to the completion of an investigation of the former landfill.

Once the landfill investigation has been completed, additional testing can be completed on the existing well. This would be a relatively cost-effective option to complete, although it may require additional pump capacity and potentially additional storage and distribution capacity. Completing this option could add approximately 2.5 MLD to the available water supply.

## 9.5 Option 6 – Site and Develop New Wellfield(s)

The development of a new wellfield would require at least some some components of the other options first due to the timeframe of implementation versus the timing for water supply needs. In the event of the alternative options were not found to be viable, then it could be determined how much additional supply would be required to be source at the new locations.

It appears that a good candidate area is along Concession 10, whichis located along the maximum build-out for Angus and has been an area where other productive private wells have been noted historically.

Option 6 would take a relatively long time to complete from the time that the initial field investigation is started to the approval/permitting and connection of the water supply. The relative costs are high due the requirement for the construction of new pumphouse(s) as well as the installation of new distribution infrastructure. Additionally, there is the potential that more than one wellfield could be required to meet the needs of the community.

The exact volume of supply that could be obtained via new supply well locations is still to be determined. Ultimately, the volume of supply that will be required will be dependent on the outcomes of other options that are implemented.

# 10. Limitations

The recommendations and comments provided are necessarily on-going as new information of underground conditions becomes available. More specific information with respect to the conditions between samples, or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, conditions not observed during this investigation may become apparent. Should this occur, GEI should be contacted to assess the situation and additional testing and reporting may be required.

GEI should be retained for a general review of the final design drawings and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, GEI will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of the design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This report was authorized by, and prepared by GEI for, the account of Greenland International Consultants Inc. (as provided in the signed Standard Professional Services Agreement). Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. GEI accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

# 11. Closure

We trust that this information is satisfactory for your purposes. Should you have any questions or comments, please do not hesitate to contact our office.

Yours truly,

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# Tables

**TABLE 2 - SUMMARY OF INFORMATION FROM WELL RECORDS AND PUMPING TESTS**

| | Well# | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| | MECP Well ID | 5724055 | None | None | 5739698 | 5730542 | 7043027 |
| | Wellfield | Mill Street | Centre Street | Centre Street | Brownley | Brownley | Brownley |
| | Year Built | 1988 | 1985 | 1985 | 2005 | 1994 | 2007 |
| | Permitted Water-Taking Volume (cmd) | 3,927 | 1,296 | 1,296 | 1,800 | 654 | 1,800 |
| | Permitted Maximum Max Flow (Lpm) | 2,728 | 900 | 900 | 1,250 | 455 | 1,250 |
| | Well Casing Size (mm) | 610 | 250 | 250 | 200 | 150 | 200 |
| | Well Screen Size (mm) | 300 | 150 | 150 | 200 | 150 | 200 |
| Elevations | Top of Ground (masl) | 198.0 | 195.0 | 195.0 | 202.0 | 202.0 | 202.0 |
| | Top of Aquifer (masl) | 151.4 | 148.7 | 148.4 | 180.0 | 180.4 | 178.8 |
| | Top of Screen (masl) | 145.3 | 148.7 | 148.4 | 165.5 | 165.4 | 165.4 |
| | Bottom of Screen (masl) | 136.1 | 141.4 | 141.1 | 161.8 | 162.4 | 160.5 |
| | Static Water Level (masl) | 191.9 | 198.0 | 197.8 | 192.9 | 192.8 | 192.2 |
| | Well Performance Test Date | May-2022 | May-2022 | May-2022 | Oct-2021 | Mar-2021 | Oct-2020 |
| Confined | Allowable Drawdown* (m) | 32.5 | 39.5 | 39.5 | 10.3 | 10.0 | 10.7 |
| | Minimum Water Level (masl) | 166.0 | 166.4 | 166.1 | 184.6 | 184.8 | 183.6 |
| | Max Allowable Discharge (cmd) | 6,565 | 1,925 | 1,631 | 1,045 | 1,086 | 1,455 |
| Unconfined | Allowable Drawdown† (m) | -- | -- | -- | 16.59 | 16.23 | 16.92 |
| | Min Allowable Water Level (masl) | -- | -- | -- | 176.3 | 176.6 | 175.3 |
| | Max Allowable Discharge (cmd) | -- | -- | -- | 1,614 | 1,680 | 2,275 |

* - Allowable Drawdown (Confined): 80% of the difference in elevation between static water level and the top of aquifer.

† - Allowable Drawdown (Unconfined): 80% of two-thirds the difference in elevation between static water level and the bottom of the aquifer

masl -elevation in metres above sea level.

Lpm - Litres per minute

cmd - cubic metres per day

**Table 3: Identified Well Options Ranked Using EA Screening Criteria**

Desktop Assessment, Angus Water Supply Assessment and Options for Expansion, Town of Angus, Essa Township, ON

| **Rank:** | **5** | **2** | **2(3)** | **1** | **4** | **6** |
|---|---|---|---|---|---|---|
| Option: | Option 1<br>Increase Mill Street Well 1 | Option 2<br>Rehabilitate Centre Street Wells | Option 3<br>Replace Centre Street Wells | Option 4<br>Increase Brownley Well 5 | Option 5<br>Add Additional Mill Street Well | Option 6<br>New Wellfield(s) |
| Category | | | | | | |
| Natural Environmental Impacts | Low to medium as the overall area of potential impact would only increase by a small area, but there is the unknown potential impact from the landfill nearby that requires investigation. | Low. No increase from what was previously determined would be expected. All waste materials that may be generated during the investigation would be removed from site. | Low. No increase from what was previously determined would be expected. All waste materials that may be generated during the investigation would be removed from site. | Low. The overall area of potential impact from operation would only increase by a small area. | Low. No increase from what was previously determined would be expected. All waste materials that may be generated during the investigation would be removed from site. | Low to Medium. Higher uncertainty, but part of the requirements of the investigation to gain operational approval would include a detailed environmental impact assessment, with potential mitigation measures if required. |
| | 4 | 1 | 2 | 3 | 5 | 6 |
| Social/Cultural Environmental Impacts | Nothing permanent (any material disturbed would be replaced/repaired as part of the completion of the work). | Nothing permanent (any material disturbed would be replaced/repaired as part of the completion of the work). | Nothing permanent (any material disturbed would be replaced/repaired as part of the completion of the work). | Nothing permanent (any material disturbed would be replaced/repaired as part of the completion of the work). | Nothing permanent (any material disturbed would be replaced/repaired as part of the completion of the work). | Wellfield site may end up as a park area or some other public/municipal land use to be determined. |
| | 1 | 1 | 1 | 1 | 1 | 1 |
| Technical/Operational Considerations | Requires additional landfill investigation upgradient. Need information about site owner and about former operations. Also require permission to access to conduct investigations.<br><br>If testing is successful:<br>- may require upgrade of pump if test is successful<br>- may require distribution upgrade depending on existing capacity<br>- existing treatment may require some changes | Wells are old, have never been rehabilitated before. Uncertain whether age and condition would make this option feasible vs. replacement.<br><br>If work done is successful:<br>- return wells to originally rated capacity<br>- existing infrastructure should be sufficient | As long as replacement wells perform the same or similar as the original wells, the existing infrastructure would be sufficient. Additionally, the water quality should be very similar to the same as the previous wells, however, there is the potential that some changes may be required to existing treatment systems. | Minimal. No well drilling or rehabilitation is expected to be required. Potential requirement to upgrade the pump to achieve additional operational capacity.<br><br>Would utilize existing servicing. | Requires additional landfill investigation upgradient. Need information about site owner and about former operations. Also require permission to access to conduct investigations.<br><br>If testing is successful:<br>- new pump and infrastructure to connect to the existing system would be required.<br>- additional system storage may be required.<br>- additional treatment system for new well may be required, depending on how system is setup. | High uncertainty when siting new wellfields with limited previous local investigation, especially for high production municipal wells.<br><br>New pumphouse, pumps, additional system storage capacity, potential treatment systems and potentially extensive distribution infrastructure would be required to connect new wellfield to the larger water system. New pump(s) would be required. |
| | 5 | 2 | 3 | 1 | 4 | 6 |

## Table 3: Identified Well Options Ranked Using EA Screening Criteria

Desktop Assessment, Angus Water Supply Assessment and Options for Expansion, Town of Angus, Essa Township, ON

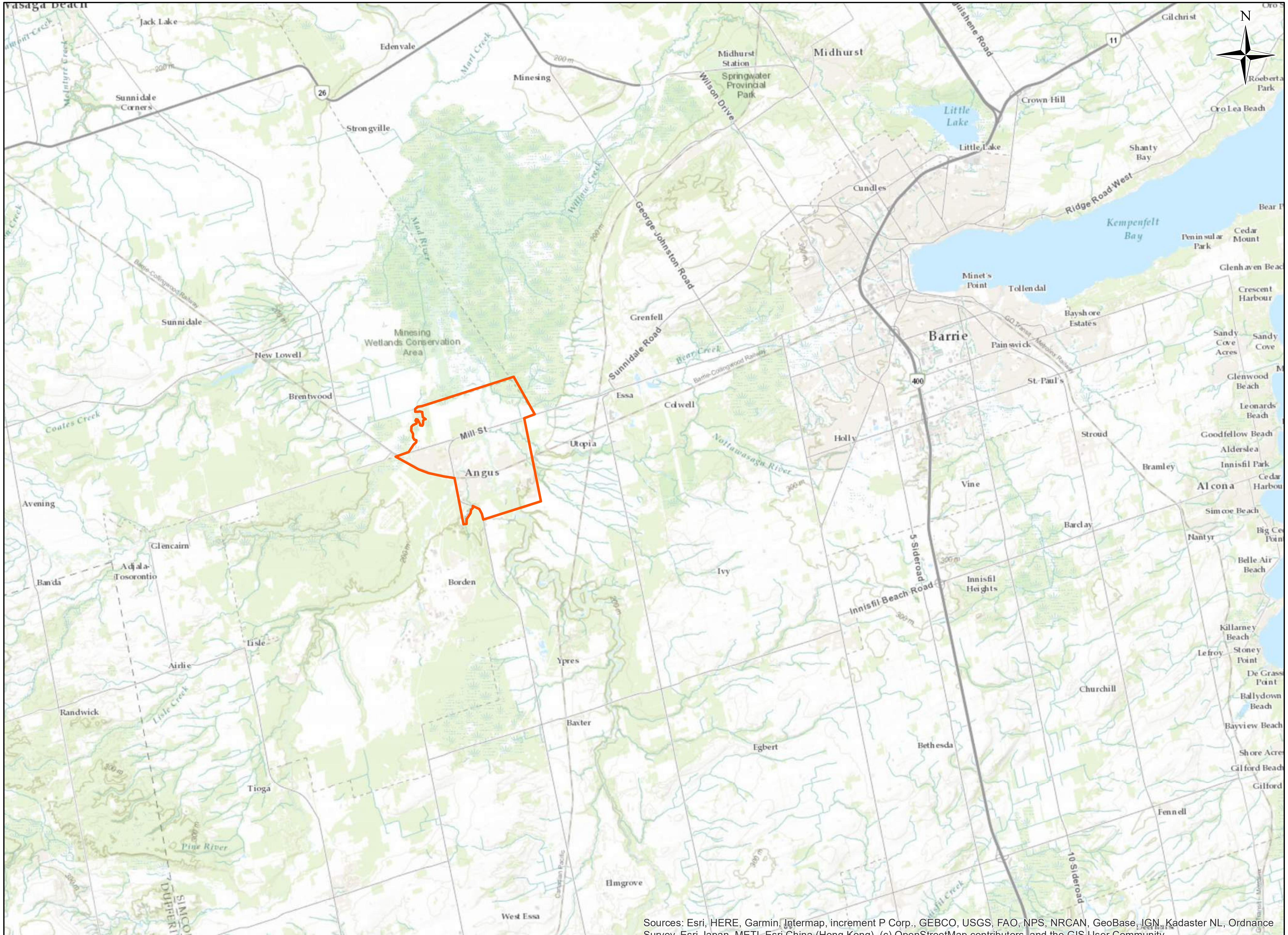
| Rank: | 5 | 2 | 2(3) | 1 | 4 | 6 |
|---|---|---|---|---|---|---|
| Option: | Option 1<br>Increase Mill Street Well 1 | Option 2<br>Rehabilitate Centre Street Wells | Option 3<br>Replace Centre Street Wells | Option 4<br>Increase Brownley Well 5 | Option 5<br>Add Additional Mill Street Well | Option 6<br>New Wellfield(s) |
| Category | | | | | | |
| Economic Impacts | Low to medium. Once landfill investigation is completed and as long as the results are favourable to support this option, some additional site work is required, but it would be expanding on that existing knowledge. Landfill investigation costs are not considered here, a pre-consultation with MECP is recommended/required before proceeding with the landfill investigation/characterization. | Medium to high. Rehabilitation of artesian wells is expensive and given the age of the wells, may not be feasible. Replacement may still be required. | Medium. Artesian wells can be more expensive to drill, but replacement is expected to be relatively successful. | Low. The main task required is additional testing in the existing well. A higher capacity pump may be required to complete the test. | Medium. Once landfill investigation is completed and as long as the results are favourable to support this option, some additional site work is required, but it would be expanding on that existing knowledge. Landfill investigation costs are not considered here, a pre-consultation with MECP is recommended/required before proceeding with the landfill investigation/characterization. | High. This option will be expensive to undertake and would likely take a several years to get to the full approval stage. There is also a higher uncertainty of success compared to other options, given that the future investigation site has not had previous site investigation work completed. |
| | 3 | 5 | 2 | 1 | 4 | 6 |
| **Average Score** | **3.25** | **2.25** | **2** | **1.5** | **3.5** | **4.75** |

Rank
* - rankings 1 (highest or most preferred) to 6 (lowest or least preferred)
Lowest Average Score is the most preferred

# Figures

Project: 2302990
Angus Groundwater
Supply Assessment

Angus, Twp of Essa,
Ontario




Settlement Area Boundary

**Scale: 1: 125,000**
**November 2023**

**Figure 1: Study Location**

GEI Consultants


Project: 2302990
Angus Groundwater
Supply Assessment

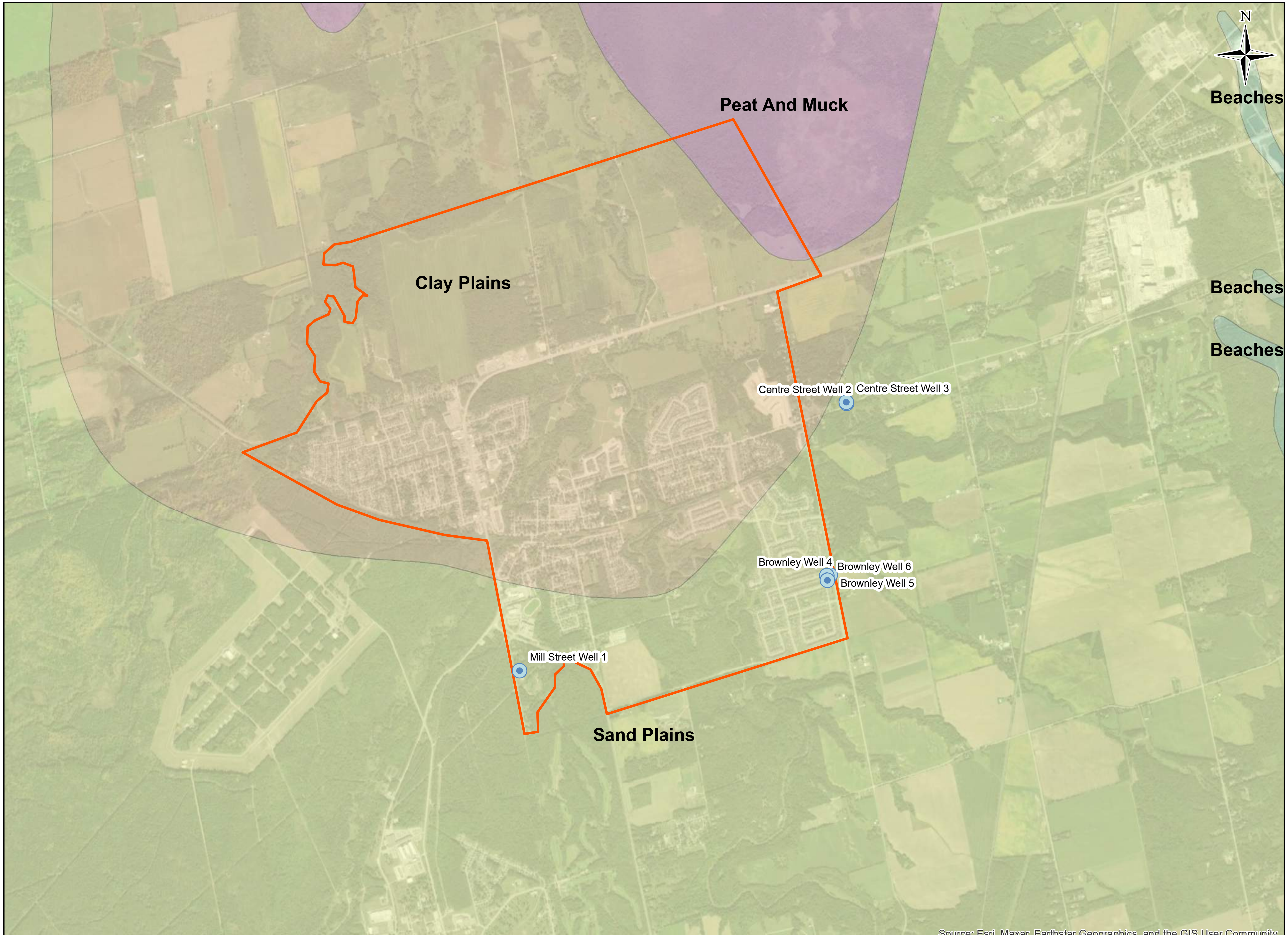
Angus, Twp of Essa,
Ontario

Supply Wells
Settlement Area
Boundary

**Scale: 1: 30,000**
**November 2023**

**Figure 2: Study Area Layout and Municipal Wells**

GEI Consultants




Project: 2302990
Angus Groundwater Supply Assessment

Angus, Twp of Essa, Ontario

Supply Wells
Settlement Area Boundary

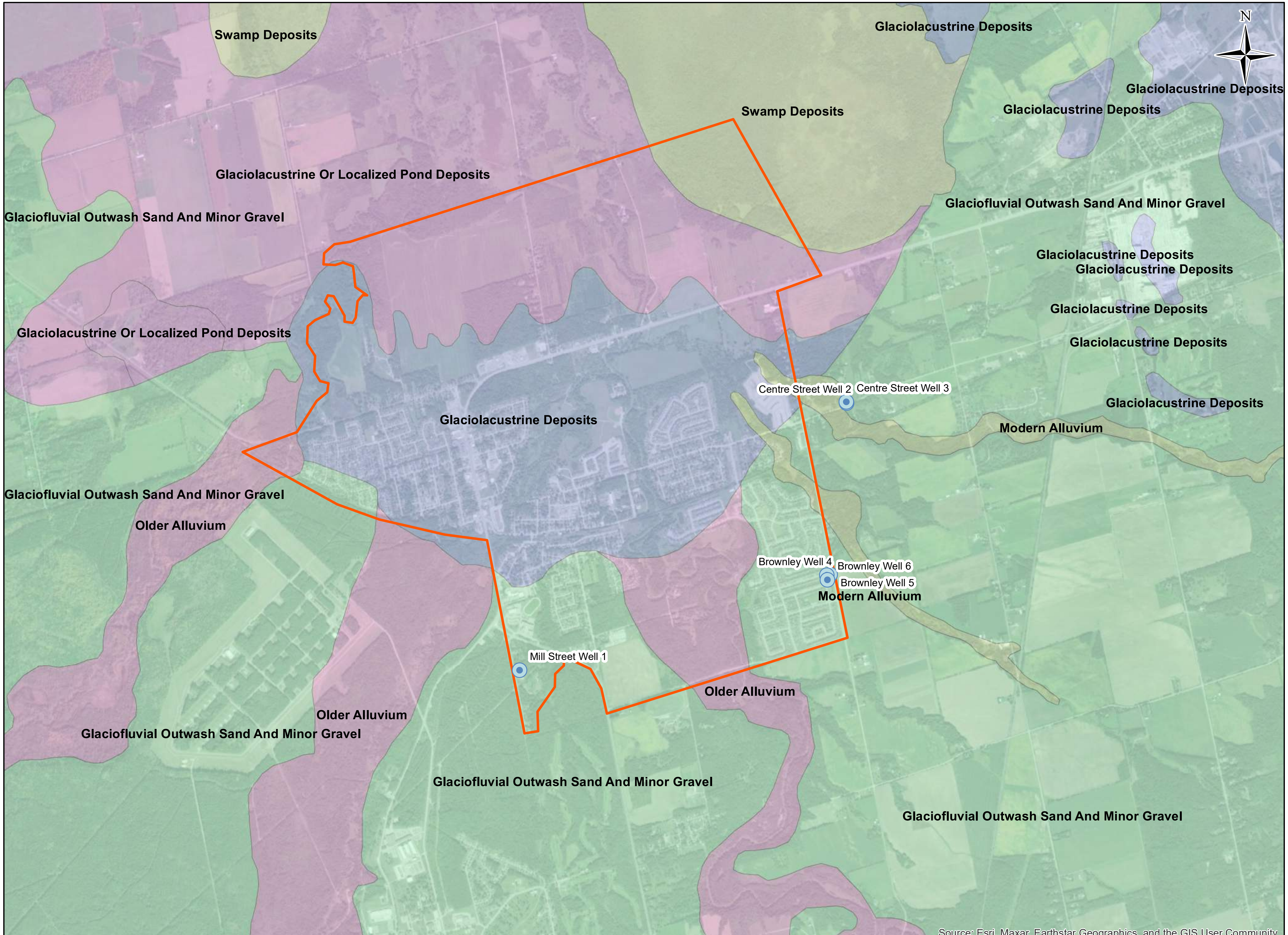
**Physiography of Southern Ontario**

Beaches
Clay Plains
Peat And Muck
Sand Plains

**Scale: 1: 30,000**
**November 2023**

**Figure 3: Physiographic Landforms**

GEI Consultants




Project: 2302990
Angus Groundwater
Supply Assessment

Angus, Twp of Essa,
Ontario

Supply Wells

Settlement Area Boundary

**Surficial Geology of Ontario**

Glaciofluvial Outwash Sand And Minor Gravel

Glaciolacustri... Deposits

Glaciolacustri... Or Localized Pond Deposits

Modern Alluvium

Older Alluvium

Swamp Deposits

**Scale: 1: 30,000**
**November 2023**

**Figure 4: Surficial Geology**


Project: 2302990
Angus Groundwater Supply Assessment

Angus, Twp of Essa, Ontario

**Scale: 1: 30,000**
**November 2023**

**Figure 6: Significant Groundwater Recharge Areas**

GEI Consultants

# Appendix A

## PTTW #0244-CU4QCG

Ontario

Ministry of the Environment, Conservation and Parks
Ministère de l’Environnement, de la Protection de la nature et des Parcs

**PERMIT TO TAKE WATER**
Ground Water

NUMBER 0244-CU4QCG

Reference Number 7144-CPPMP8

*Pursuant to Section 34.1 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:*

The Corporation of the Township of Essa
5786 Simcoe County Road 21
Essa, Ontario, L0M 1T0
Canada

**For the water taking from:** Well 1 Mill Street, Well 2 Centre Street, Well 3 Centre Street, Well 4 Brownley, Well 5 Brownley, Well 6 Brownley

**Located at:** 28 Mill St
Essa, County of Simcoe

6130 Side Road 30
Essa, County of Simcoe

8610 Line 5 Concession 5
Essa, County of Simcoe

*For the purposes of this Permit, and the terms and conditions specified below, the following definitions apply:*

## DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34.1, OWRA.

(b) “Provincial Officer” means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment, Conservation and Parks.

(d) "District Office" means the Barrie District Office.

(e) "Permit" means this Permit to Take Water No. 0244-CU4QCG including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.

(f) "Permit Holder" means The Corporation of the Township of Essa.

(g) "OWRA " means the *Ontario Water Resources Act*, R.S.O. 1990, c. O. 40, as amended.

*You are hereby notified that this Permit is issued subject to the terms and conditions outlined below:*

**TERMS AND CONDITIONS**

**1. Compliance with Permit**

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated November 15, 2022 and signed by Michael Mikael, and all Schedules included in this Permit.

1.2 The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.

1.3 Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.

1.4 This Permit is not transferable to another person without the Director's written consent.

1.5 This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.

1.6 The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.

1.7 The Permit Holder shall report any changes of address to the Director within thirty days of any such change. The Permit Holder shall report any change of ownership of the property for which this Permit is issued within thirty days of any such change.

**2. General Conditions and Interpretation**

2.1 Inspections
The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the *Environmental Protection Act*, R.S.O. 1990, the *Pesticides Act*, R.S.O. 1990, or the *Safe Drinking Water Act*, S. O. 2002.

2.2 Other Approvals
The issuance of, and compliance with this Permit, does not:

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the *Ontario Water Resources Act*, and the *Environmental Protection Act*, and any regulations made thereunder; or

(b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including the authority to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.

2.3 Information
The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person to take any action in relation to the information, or the failure of a Provincial Officer to prosecute any person in relation to the information, shall not be construed as:

(a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or

(b) acceptance by the Ministry of the information's completeness or accuracy.

2.4 Rights of Action
The issuance of, and compliance with this Permit shall not be construed as precluding or limiting any legal claims or rights of action that any person, including the Crown in right of Ontario or any agency thereof, has or may have against the Permit Holder, its officers, employees, agents, and contractors.

2.5 Severability
The requirements of this Permit are severable. If any requirements of this Permit, or the application of any requirements of this Permit to any circumstance, is held invalid or unenforceable, the application of such requirements to other circumstances and the remainder of this Permit shall not be affected thereby.

2.6 Conflicts
Where there is a conflict between a provision of any submitted document referred to in this Permit, including its Schedules, and the conditions of this Permit, the conditions in this Permit shall take precedence.

**3. Water Takings Authorized by This Permit**

3.1 **Expiry**
This Permit expires on **December 31, 2032**. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted
The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of

taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.

**Table A**

| | Source Name / Description: | Source: Type: | Taking Specific Purpose: | Taking Major Category: | Max. Taken per Minute (litres): | Max. Num. of Hrs Taken per Day: | Max. Taken per Day (litres): | Max. Num. of Days Taken per Year: | Zone/ Easting/ Northing: |
|---|---|---|---|---|---|---|---|---|---|
| **1** | Well 1 Mill Street | Well Drilled | Municipal | Water Supply | 2,728 | 24 | 3,927,774 | 365 | 17 589104 4906875 |
| **2** | Well 2 Centre Street | Well Drilled | Municipal | Water Supply | 900 | 24 | 1,296,000 | 365 | 17 591729 4909074 |
| **3** | Well 3 Centre Street | Well Drilled | Municipal | Water Supply | 900 | 24 | 1,296,000 | 365 | 17 591726 4909075 |
| **4** | Well 4 Brownley | Well Drilled | Municipal | Water Supply | 1,250 | 24 | 1,800,000 | 365 | 17 591558 4907673 |
| **5** | Well 5 Brownley | Well Drilled | Municipal | Water Supply | 455 | 24 | 654,624 | 365 | 17 591587 4907673 |
| **6** | Well 6 Brownley | Well Drilled | Municipal | Water Supply | 1,250 | 24 | 1,800,000 | 365 | 17 591567 4907673 |
| | | | | | | **Total Taking:** | 9,585,000 | | |

3.3 Notwithstanding Table A, the combined volume of water taking from all sources identified in Table A, shall not exceed **9,585,000 litres per day**.

## 4. Monitoring

4.1 The Permit Holder shall maintain a record of all water takings. The daily volume of water taken shall be measured by a flow meter or calculated in accordance with the method described in the application for this Permit, or as otherwise accepted by the Director. This record shall include the dates and times of water takings, the rates of pumping, and an estimated calculation of the total amounts of water pumped per day for each day that water is taken under the authorization of this Permit. A separate record shall be maintained for each source. The Permit Holder shall keep all required records up to date and available at or near the site of the taking and shall produce the records immediately for inspection by a Provincial Officer upon request. The Permit Holder, unless otherwise required by the Director, shall submit, on or before March 31st in every year, the records required by this condition to the Ministry's Water Taking Reporting System.

4.2 The Permit Holder shall maintain a continuous water level recorder in each of the production wells identified in Table A, except for at **Source 3** (Well 3 Centre Street; also known as McGeorge Well 2) where monthly static water level measurements shall continue to be collected. By July 2024, the Permit Holder shall install and maintain a continuous water level recorder in Well 3/76 at Mill Street Well. All data collected by the water level recorder shall be available to Ministry staff at any time upon request.

4.3 Any application submitted to the Ministry for an amendment, or a renewal of this Permit shall be accompanied by a report prepared by a qualified individual (P.Geo. or equivalent). The report shall include, but not necessarily be limited to, the following: (1) the information generated by the conditions of this Permit; (2) an analysis and assessment of the information collected; (3) an evaluation of the adequacy of the monitoring program; and (4) recommendations concerning changes to the conditions of the Permit.

## 5. Impacts of the Water Taking

5.1 Notification
The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6060.

5.2 For Groundwater Takings
If the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide, to those affected, temporary water supplies adequate to meet their normal requirements, or shall compensate such persons for their reasonable costs of doing so.

If permanent interference is caused by the water taking, the Permit Holder shall restore the water supplies of those permanently affected.

## 6. Director May Amend Permit

The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal under the *Ontario Water Resources Act*, Section 100 (4).

*The reasons for the imposition of these terms and conditions are as follows:*

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.

2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

*In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:*

1. The portions of the Permit or each term or condition in the Permit in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

*In addition to these legal requirements, the Notice should also include:*

a. The name of the appellant;
b. The address of the appellant;
c. The Permit to Take Water number;
d. The date of the Permit to Take Water;
e. The name of the Director;
f. The municipality within which the works are located;

*This notice must be served upon:*

| | | |
|---|---|---|
| *The Secretary*<br>*Environmental Review Tribunal* | *AND* | *The Director, Section 34.1,*<br>*Ministry of the Environment, Conservation and Parks*<br>*Floor 1, 135 St Clair Ave W*<br>*Toronto, ON*<br>*M4V 1P5* |

***Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal:***

by Telephone at
(416) 212-6349
Toll Free 1(866) 448-2248

by Fax at
(416) 326-5370
Toll Free 1(844) 213-3474

by e-mail at
www.ert.gov.on.ca

Dated at Toronto this 12th day of September, 2023.

Archana Uprety
Director, Section 34.1
*Ontario Water Resources Act*, R.S.O. 1990

**Schedule A**

This Schedule "A" forms part of Permit To Take Water 0244-CU4QCG, dated September 12, 2023.
1. Permit to Take Water Application, dated November 15, 2022 and signed by Michael Mikael.

2. Ontario Clean Water Agency. (March 3, 2023) "Permit to Take Water Renewal Application and Report, Angus Drinking Water System".

# Appendix B

## Mill Street Record and Test Report

MILL STREET WELL 1

Ministry of the Environment
Ontario

The Ontario Water Resources Act
# WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 | 5724055 | MUNICIP. 57002 | CON.

| COUNTY OR DISTRICT | TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE | CON., BLOCK, TRACT, SURVEY, ETC. | LOT |
|---|---|---|---|
| Simcoe | Essa Township - Angus | 3? | 26? |

DATE COMPLETED: DAY 6th MO. Oct YR. 88

OWNER (SURNAME FIRST) / ADDRESS: [redacted] ...ter Ontario.

ELEVATION | RC | BASIN CODE

## LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

| GENERAL COLOUR | MOST COMMON MATERIAL | OTHER MATERIALS | GENERAL DESCRIPTION | DEPTH - FEET FROM | TO |
|---|---|---|---|---|---|
| Brown | sand f | | | 0 | 29 |
| | sand f | sandy clay some sand c | | 29 | 44 |
| Grey | clay | silty sand layers odd gravel | | 44 | 77 |
| Grey | clay | silty | | 77 | 114 |
| Grey | clay | odd bldr | sticky | 114 | 152 |
| Grey | clay | silty | | 152 | 153 |
| | Sand c | some sand m gravel, odd stones | | 153 | 158 |
| | Gravel f | sand gravel m some c | bldrs. silty grey clay | 158 | 176 |
| | Sand | Gravel bldrs | | 176 | 178 |
| | clay | sandy, gravel | | 178 | 180 |
| | Gravel | sand m-c stones odd | bldr; trace of clay | 180 | 205 |

31
32

## 41 WATER RECORD

| WATER FOUND AT - FEET | KIND OF WATER |
|---|---|
| 180 | ☒ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS |
| | ☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS |
| | ☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS |
| | ☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS |
| | ☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERALS ☐ GAS |

## 51 CASING & OPEN HOLE RECORD

| INSIDE DIAM INCHES | MATERIAL | WALL THICKNESS INCHES | DEPTH - FEET FROM | TO |
|---|---|---|---|---|
| 24 | ☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC | .375 | +.75' | 163' |
| 12 | ☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC | .375 | +.75' | 173' |
| | ☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC | | | |

## SCREEN

| SIZE(S) OF OPENING (SLOT NO.) | DIAMETER | LENGTH |
|---|---|---|
| 50 slot | 12 INCHES | 30 FEET |

MATERIAL AND TYPE: stainless steel | DEPTH TO TOP OF SCREEN: 173 FEET

## 61 PLUGGING & SEALING RECORD

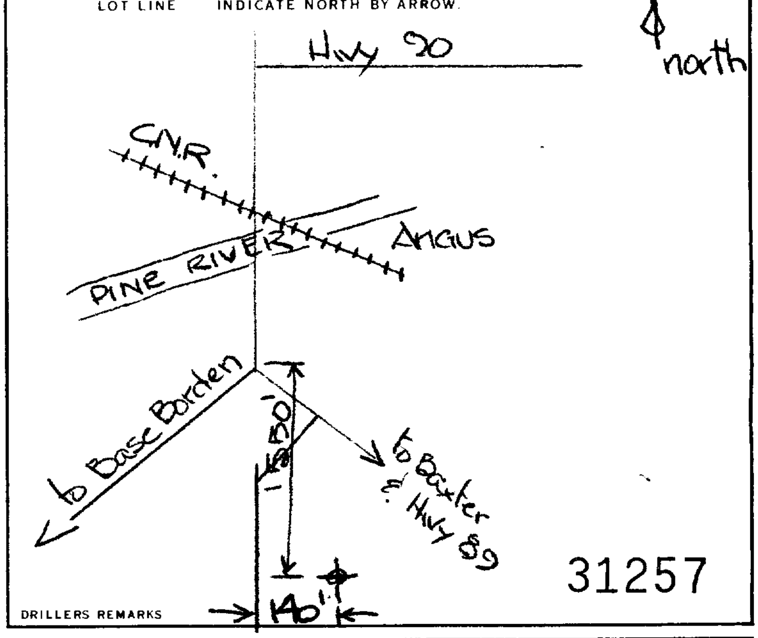
| DEPTH SET AT - FEET FROM | TO | MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.) |
|---|---|---|
| 163 | 6 | cement grout |
| | | |
| | | |

## 71 PUMPING TEST

| | |
|---|---|
| PUMPING TEST METHOD | ☒ PUMP ☐ BAILER |
| PUMPING RATE | 600 GPM |
| DURATION OF PUMPING | 72 HOURS __ MINS |
| STATIC LEVEL | 22 FEET |
| WATER LEVEL END OF PUMPING | 66 FEET |
| WATER LEVELS DURING | ☒ PUMPING ☐ RECOVERY |
| 15 MINUTES | FEET |
| 30 MINUTES | FEET |
| 45 MINUTES | FEET |
| 60 MINUTES | FEET |
| IF FLOWING, GIVE RATE | GPM |
| PUMP INTAKE SET AT | FEET |
| WATER AT END OF TEST | ☐ CLEAR ☐ CLOUDY |
| RECOMMENDED PUMP TYPE | ☐ SHALLOW ☐ DEEP |
| RECOMMENDED PUMP SETTING | FEET |
| RECOMMENDED PUMPING RATE | GPM |

## LOCATION OF WELL 1/88

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.




31257

DRILLERS REMARKS

## FINAL STATUS OF WELL

☒ WATER SUPPLY
☐ OBSERVATION WELL
☐ TEST HOLE
☐ RECHARGE WELL
☐ ABANDONED, INSUFFICIENT SUPPLY
☐ ABANDONED, POOR QUALITY
☐ UNFINISHED
☐ DEWATERING

## WATER USE

☐ DOMESTIC
☐ STOCK
☐ IRRIGATION
☐ INDUSTRIAL
☐ OTHER
☐ COMMERCIAL
☒ MUNICIPAL
☒ PUBLIC SUPPLY
☐ COOLING OR AIR CONDITIONING
☐ NOT USED

## METHOD OF CONSTRUCTION

☐ CABLE TOOL
☐ ROTARY (CONVENTIONAL)
☒ ROTARY (REVERSE)
☐ ROTARY (AIR)
☐ AIR PERCUSSION
☐ BORING
☐ DIAMOND
☐ JETTING
☐ DRIVING
☐ DIGGING
☐ OTHER

## CONTRACTOR

NAME OF WELL CONTRACTOR: International Water Supply
WELL CONTRACTOR'S LICENCE NUMBER: 2801
ADDRESS: P.O. Box 310 Barrie Ont.
NAME OF WELL TECHNICIAN: G. Kaplunski
WELL TECHNICIAN'S LICENCE NUMBER: T0038
SIGNATURE OF TECHNICIAN/CONTRACTOR: [signature]
SUBMISSION DATE: DAY 2 MO. 11 YR. 88

## OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 2801 | DATE RECEIVED NOV 10 1988
DATE OF INSPECTION | INSPECTOR
REMARKS

CSS.ES

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

MILL STREET WELL 1

INTERNATIONAL WATER SUPPLY LTD.

Ground Water Development - Drilling Services
Pumps - Water Treatment - Service & Maintenance

342 Bayview Dr., P.O. Box 310
Barrie, Ontario, Canada, L4M 4T5
Tel.705-733-0111 • 800-461-9636 • Fax 705-721-0138
E-mail: iws@iws.ca www.iws.ca

March 31, 2016

OCWA
30 Woodland Dr
Wasaga Beach, ON
L9Z 2V4

ATTENTION: Brad Hoover
Operations Manager - South

Dear Sir:

RE: **WELL AND PUMP PERFORMANCE TESTING**
**TOWNSHIP OF ESSA ANGUS MILL STREET WELL No. 1**

This letter is a summary of the work carried out on the Angus Mill Street Well No. in December 2015. Updates on the project had been provided by email.

International Water Supply Ltd. (IWS) mobilized to the site on December 2, 2015 and carried out a performance check on the well and pump. The test showed the pump was operating on its performance curve indicating no wear nor plugging. The well performance was about one metre better than a test carried out on July 2, 2008, and about one metre lower than the original construction of the well in October 1988. The pump performance is shown on Drawing A16025 and the well performance is shown on Drawing A16067.

Our crew returned to site on December 1, 2015 and pulled the pump for inspection at our Barrie shop. A downhole video inspection of the well was carried out on December 2, 2015. The video inspection showed the well was in good condition with minor mineral/bio film on the casing and screen. The bottom portion of the screen showed some plugging. It is noted this observed plugging did not appear to be having any affect on the performance of the well. The was less than one foot of soft material in the bottom of the well. A copy of the video is enclosed on a DVD as well as a summary report.

The well was wire brushed and surged with airlifting to clean the casing and screen as a preventative measure. The is work was carried out on December 8 and 9.

The inspection of the pump showed it to be in relatively good condition. The pump bowls are starting to show signs of corrosion but were suitable for reuse. The was some minor wear on the bowl wear rings and bearings but the wear is withing allowable tolerances. The pump was reassembled and painted with an NSF61-approved coating.

The pump drop pie is in fair condition but is showing signs of pitting. The pipe was painted with an NSF61approved coating for reuse.

MILL STREET WELL 1

The check valve on the pump was leaking and inspection showed the ductile iron face at the seal was corroded allowing water to flow past the seal. The check valve was replaced.

It is recommended the pump and drop pipe be replaced at the time of next service in 2020.

The well was disinfected in accordance with Ontario Regulation 903 and the pump was reinstalled on December 11.

We carried out a followup well performance test on December 22, 2016. This test showed the well performance was about the same as when the well was drill in 1988. The results of the test are shown on Drawing A15074.

As we have noted before, the existence of the well pit on the site presents potentially dangerous working conditions. We recommend again the well be fitted with a MAASS heavy duty MB pitless unit and the well pit be filled.

Please contact me if you have any questions.

Yours truly,
International Water Supply Ltd.

Bruce Wilson, M.A.Sc., P.Eng.
Vice President

MILL STREET WELL 1

Pump Data Sheet - LAYNE / VERTI-LINE, 60 Hz

Company: International Water Supply Angus Mill Street
Name:
Date: 3/31/2016

Powered By PUMP-FLO™

**Pump:**

Size: 8TM.2 (2 stage)

| | |
|---|---|
| Type: VERT.TURBINE | Speed: 3500 rpm |
| Synch speed: 3600 rpm | Dia: 5.875 in |
| Curve: 36-068 | Impeller: |
| Specific Speeds: | Ns: --- |
| | Nss: --- |
| Dimensions: | Suction: 6 in |
| | Discharge: 6 in |
| Vertical Turbine: | Bowl size: 7.5 in |
| | *Max lateral: 0.3 in* |
| | Thrust K factor: 3 lb/ft |

**Pump Limits:**

| | |
|---|---|
| Temperature: 150 °F | Power: 225 hp |
| Pressure: 350 psi g | Eye area: --- |
| Sphere size: 0.68 in | |

**Search Criteria:**

Flow: 715 US gpm Head: 115 ft

**Fluid:**

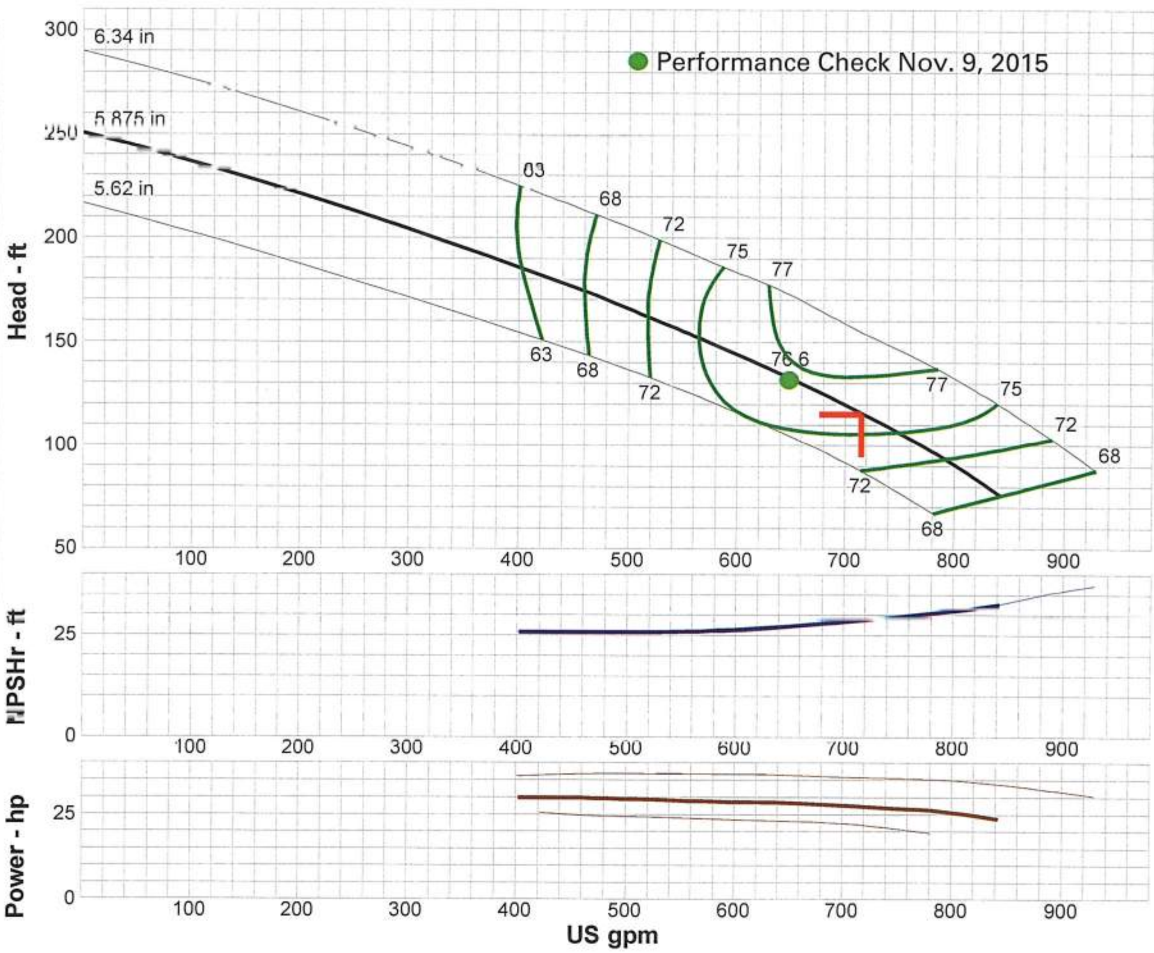
| | |
|---|---|
| Water | Temperature: 68 °F |
| Density: 62.32 lb/ft³ | Vapor pressure: 0.3391 psi a |
| Viscosity: 0.9946 cP | Atm pressure: 14.7 psi a |
| NPSHa: --- | |

**Motor:**

| | |
|---|---|
| Standard: NEMA | Size: 30 hp |
| *Enclosure: SUB* | *Speed: 3600* |
| | Frame: SUB |

Sizing criteria: Max Power on Design Curve

| ---- Data Point ---- | |
|---|---|
| Flow: | 715 US gpm |
| Head: | 115 ft |
| Eff: | 75.5% |
| Power: | 27.3 hp |
| NPSHr: | 28.8 ft |
| **---- Design Curve ----** | |
| Shutoff head: | 251 ft |
| Shutoff dP: | 108 psi |
| Min flow: | --- |
| BEP: | 76.6% @ 649 US gpm |
| NOL power: | 29.9 hp @ 376 US gpm |
| **-- Max Curve --** | |
| Max power: | 36.9 hp @ 528 US gpm |




**Performance Evaluation:**

| Flow US gpm | Speed rpm | Head ft | Efficiency % | Power hp | NPSHr ft |
|---|---|---|---|---|---|
| 858 | 3500 | --- | --- | --- | --- |
| 715 | 3500 | 115 | 75.5 | 27.3 | 28.8 |
| 572 | 3500 | 150 | 75.1 | 28.8 | 26.2 |
| 429 | 3500 | 180 | 65.4 | 29.8 | 25.8 |
| 286 | 3500 | --- | --- | --- | --- |

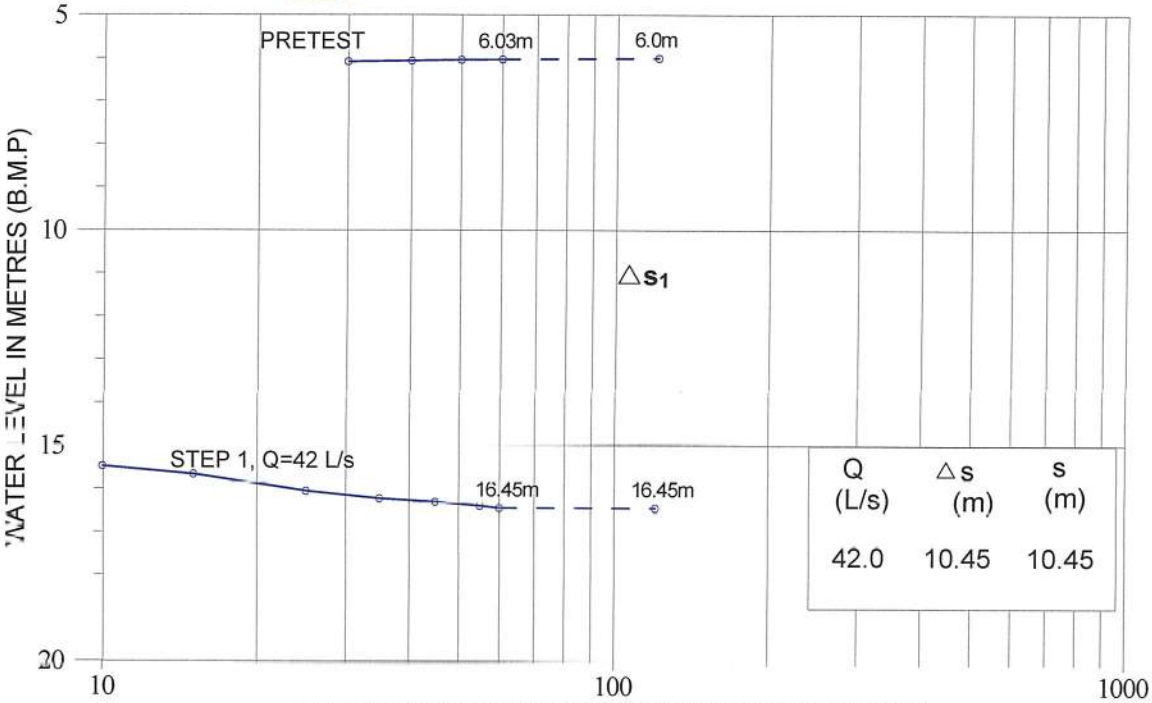
H2Optimize 10.6.1.0

IWS INTERNATIONAL WATER SUPPLY

DRAWING A16025
Angus Mill St. Well No 1 Pump Performance

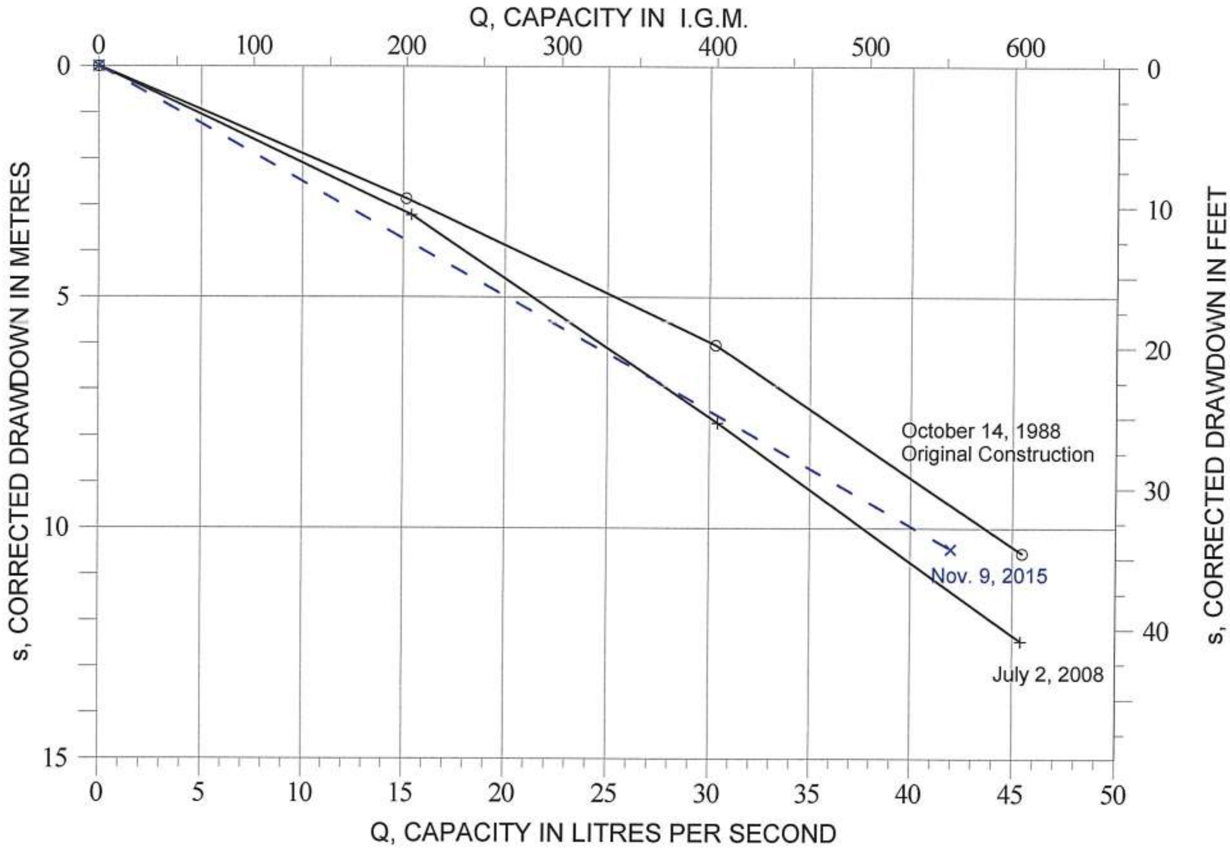
# MILL STREET WELL 1

IWS International Water Supply Ltd.




| Q (L/s) | △s (m) | s (m) |
|---|---|---|
| 42.0 | 10.45 | 10.45 |

**November 9, 2015**

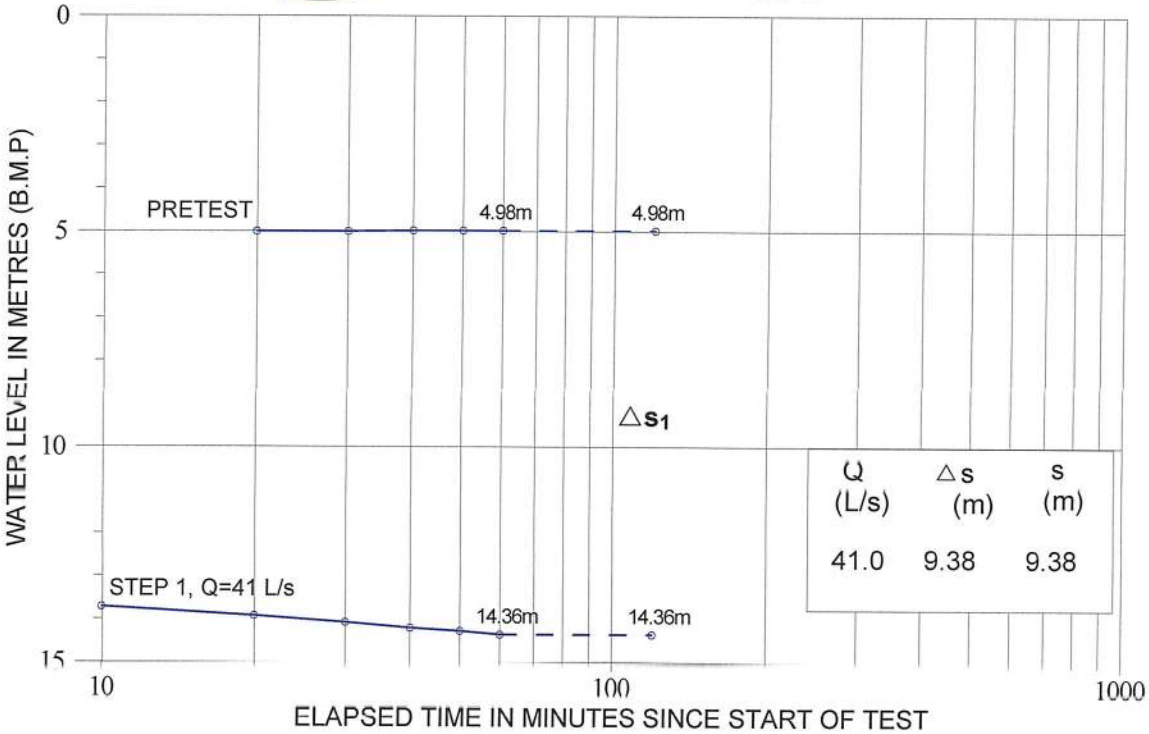



**ESSA TOWNSHIP**

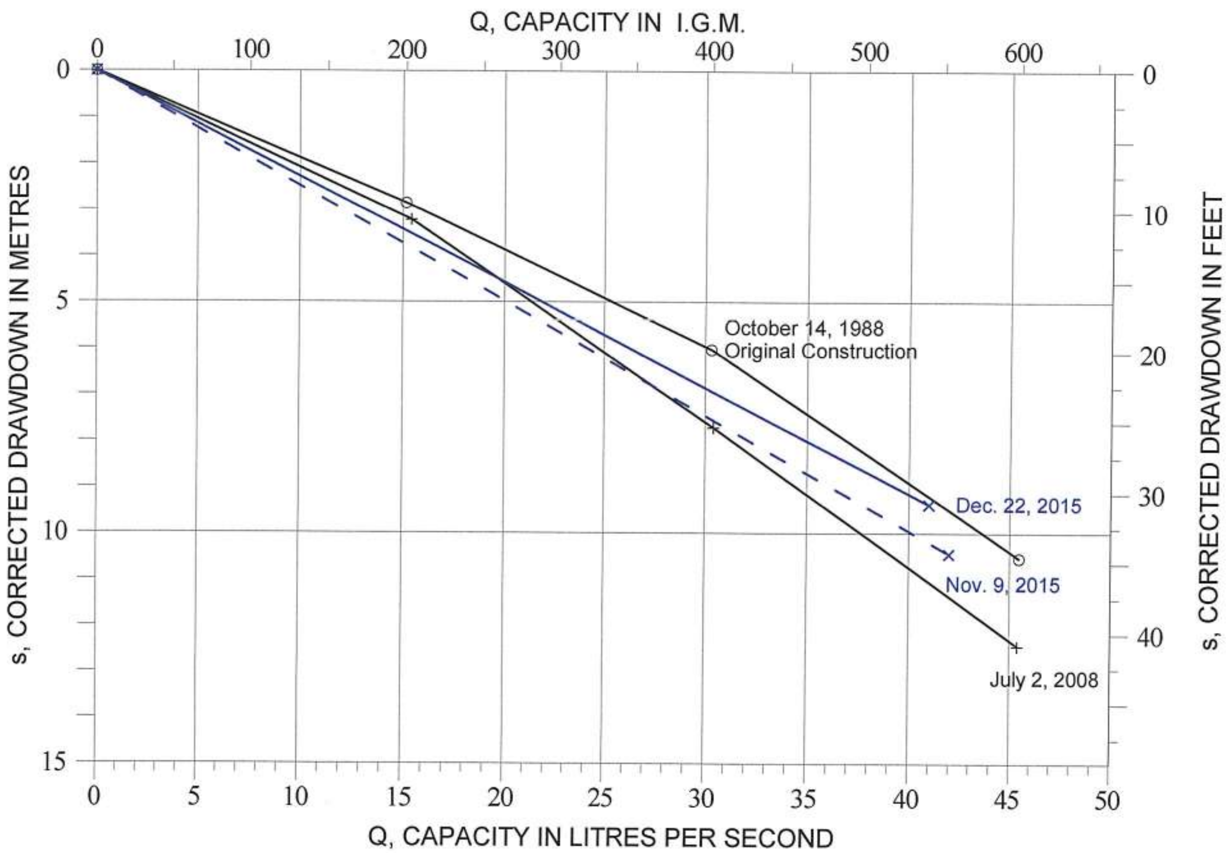
**ANGUS MILL ST. WELL No. 1**
**WELL PERFORMANCE**
**Dwg. No. A15067**

MILL STREET WELL 1

International Water Supply Ltd.




**December 22, 2015**




**ESSA TOWNSHIP**

**ANGUS MILL ST. WELL No. 1**
**WELL PERFORMANCE - POST TREATMENT**
**Dwg. No. A15074**

MILL STREET WELL 1



Essa Township
Angus Mill St. Well
December 2, 2015

International Water Supply Ltd.

## Well Video Inspection

A video inspection of Essa Township Angus Mill Street Well was performed on December 2, 2015. This inspection was part of the Township's well and pump maintenance program. The following observations were made:

- The top of the concrete vault was the video reference measuring point. All measurements are recorded in feet.
- The static water level was measured at 5m (16 ft). A submersible pump was installed in the well to clarify the water and was pumped at approximately 1.4 L/s.
- The 300mm (12 inch) diameter casing had substantial Iron precipitate to depth 21m (69 ft). Minor steel scale was noted from 7-12m (25-40 ft).
- From 21-45m (69-147 ft) the casing colour changed to black, thought to be a Manganese precipitate. Visibility deteriorated, especially in the horizontal view.
- There were carbonate-type deposits in the 43m (140 ft) zone.
- At depth 45m (147 ft), the mineral precipitate decreased and the casing appeared relatively clean below this depth. This approximately corresponds with the pump intake zone.
- The top of the 300mm stainless steel screen was recorded at 52m (171 ft). The top section of the screen was in fair condition, but substantial mineral precipitate and plugging was noted through the lower section.
- The bottom of the well was observed at 61m (200 ft). The total well depth was measured at 62.06 m (203.6 ft.) below top of the concrete vault. It is noted that the difference in total depth may be attributed to the camera winch cable counter and the camera stopping above the accumulation of material in the bottom well.

## Recommendations and Conclusions

- It is recommended that the casing be cleaned by brushing and that the well screen be air-lifted to attempt to remove the mineral precipitate accumulation.
- It is recommended that the below ground vault, which is considered to be a confined space, should be decommissioned and a proper MAASS Model MB Heavy Duty pitless adapter be installed at this location.
- Well and Pump Performance Testing should be conducted in five to seven years to confirm its condition. As with all well and pump maintenance work, the well should be chlorinated in accordance with O. Reg. 903 and AWWA C654, prior to the reinstallation of the pumping equipment.

# MILL STREET WELL 1



Essa Township
Angus Mill St. Well
December 2, 2015

International Water Supply Ltd.

| | | | |
|---|---|---|---|
| **Contract: Essa – Angus Mill St** | | **WELL No:** 1 | **DATE: 2-Dec-15** |
| | | **PUMP No: 546106** | |
| **Employees on Site** | **Well Location (NAD83)** | **Well and Water Level Details** | |
| Terry Brown | **589076E, 4906728N** | Static Water Level : | 5.0m |
| | | Reference Point: | Top of vault (GL) |
| | | Measured Well Depth: | 62.06m |

**WELL DESCRIPTION**

| DEPTH ft | m | CASING JOINTS CONDITION | CASING/WELL CONDITION | SCREEN CONDITION |
|---|---|---|---|---|
| 16 | 4.9 | WL | | |
| 21 | 6.4 | Okay | Heavy Iron precipitate, minor scale 25-39 | |
| 43 | 13.1 | Okay | Iron precipitate | |
| 64 | 19.5 | Okay | Iron precipitate,, black at 69, carbonate at 80 | |
| 86 | 26.2 | Okay | Manganese staining, dark | |
| 106 | 32.3 | Okay | Manganese staining | |
| 128 | 39.0 | Okay | Manganese staining, some mineral "spots", rough at 140-145, reduced precipitate accumulation at 147 | |
| 149 | 45.4 | Okay | Clean , minor Fe, scale 158-165 | |
| 171 | 52.1 | Top of Screen – Okay | | Light Iron precipitate |
| 181 | 55.2 | Okay | | Iron precipitate increasing |
| 191 | 58.2 | Okay | | Iron plugging, blocked openings, 191-200 |
| 200 | 61.0 | | | Well bottom |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

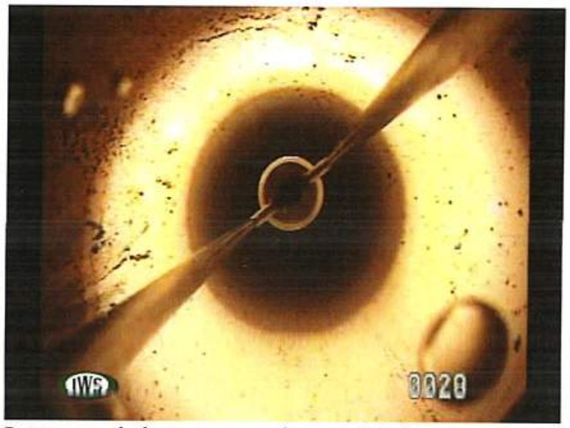
**NOTES:**

# MILL STREET WELL 1

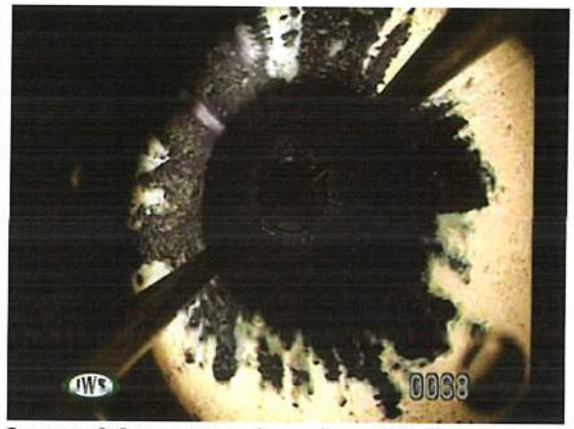


Essa Township
Angus Mill St. Well
December 2, 2015

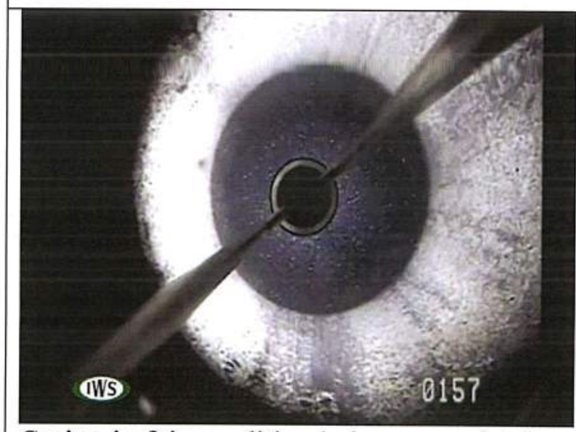
International Water Supply Ltd.



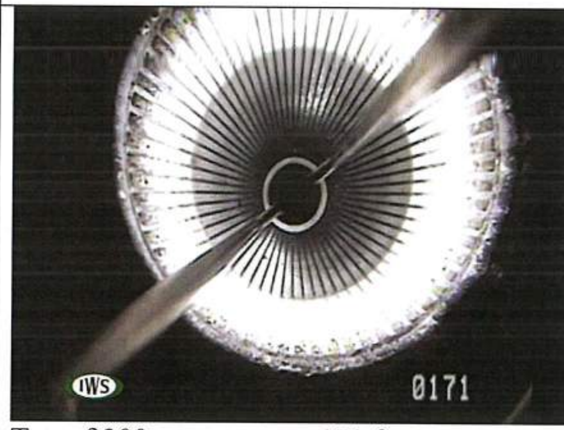
Iron precipitate on casing at 28 feet



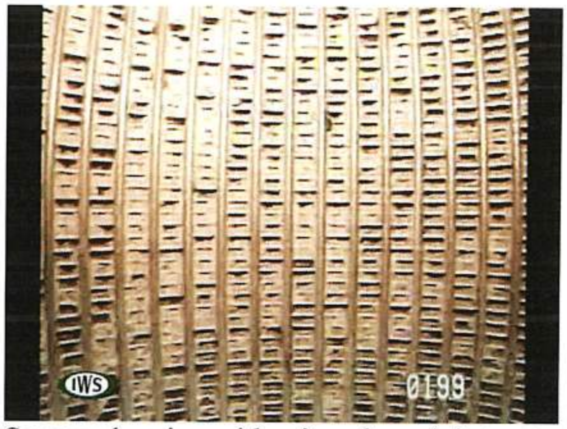
Iron to Manganese deposits at 68 feet



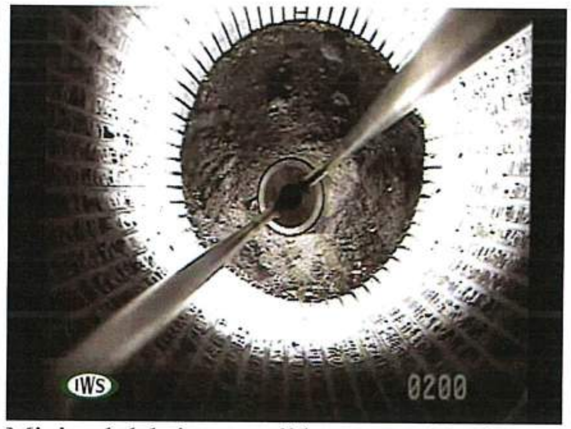

Casing in fair condition below pump intake zone at 157 feet




Top of 300mm screen at 171 feet



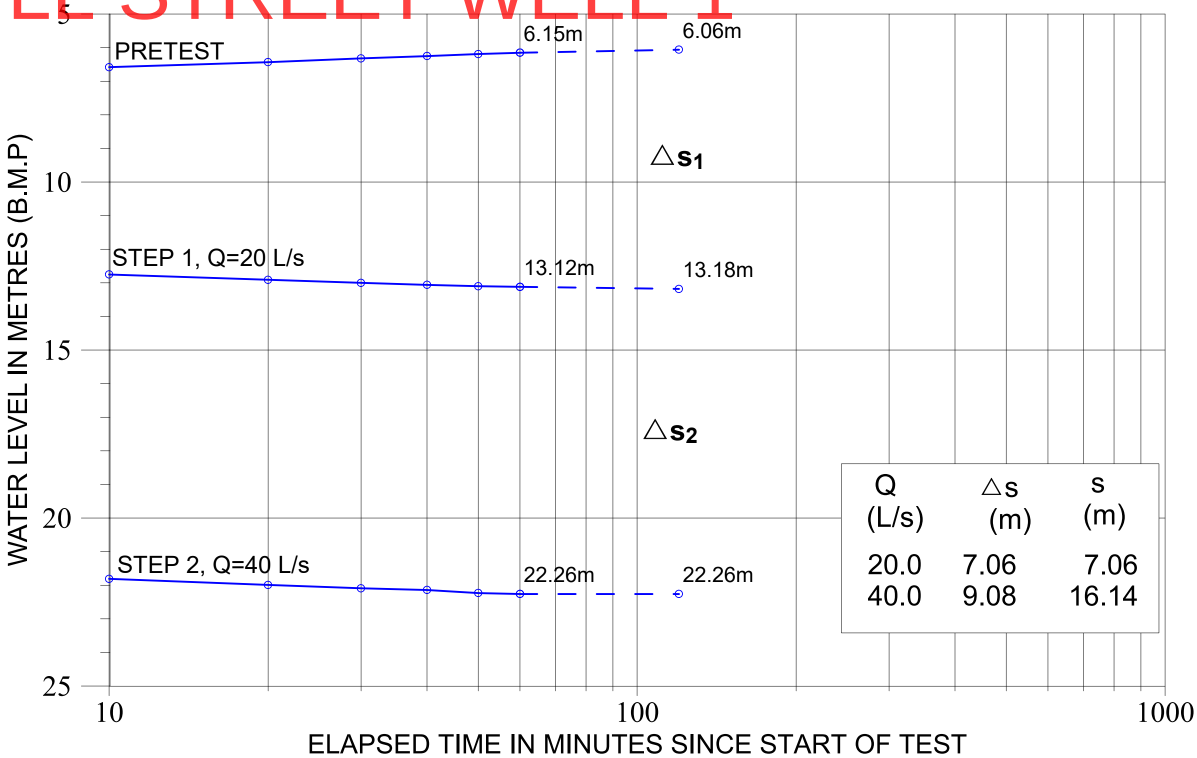
Screen plugging with mineral precipitate at 198 feet




Minimal debris on well bottom at 200 feet

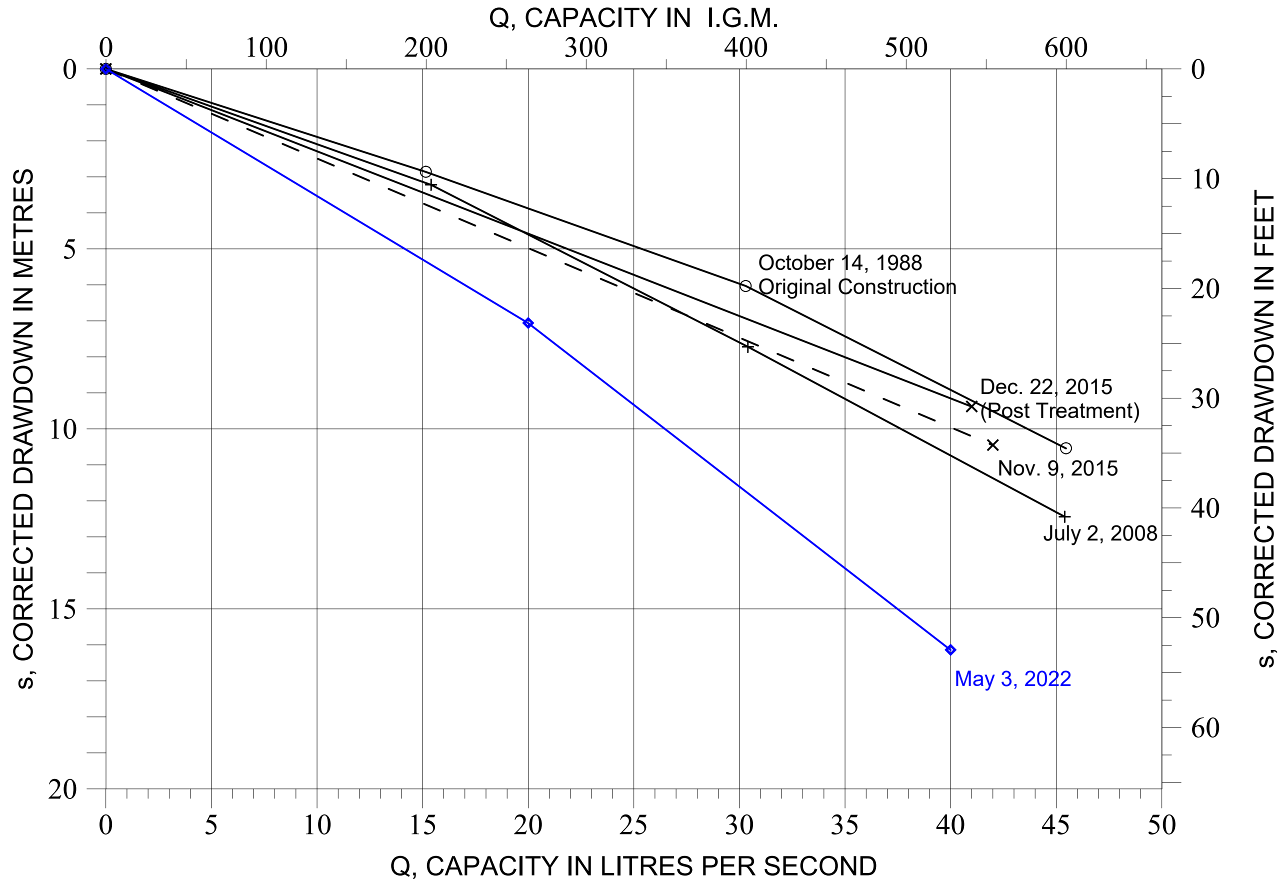
MILL STREET WELL 1

International Water Supply Ltd.




| Q (L/s) | △s (m) | s (m) |
|---|---|---|
| 20.0 | 7.06 | 7.06 |
| 40.0 | 9.08 | 16.14 |

**May 3, 2022**




| | |
|---|---|
| **ESSA TOWNSHIP** | **ANGUS MILL ST. WELL No. 1**<br>**WELL PERFORMANCE**<br>**Dwg. No. A22078** |

# Appendix C

## Centre Street Well Record and Test Report

# CENTRE STREET WELL 2

Ministry of the Environment
Ontario

| County or District | Township, Borough, City, Town, Village | Con. block tract survey etc. | Lot |
|---|---|---|---|
| Simcoe County | Township of Essa | Conc. 5. Part 1, RP STREAM | 31 |

| Owner's (Surname First) | Address | Date Completed |
|---|---|---|
| Town of Angus | Box 10, ... Ontario, L0M 1B0 | 16 04 85 |

PW-No.1-85

## LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

| General Colour | Most Common Material | Other Materials | General Description | Depth - Feet From | To |
|---|---|---|---|---|---|
| Brown | Sand | Silt | Dirty brown silty sand | 0' | 36' |
| Grey | Clay | Silt | Med. silty clay | 36' | 102' |
| Grey | Clay | Pebbles stone | Hard clay | 102' | 150' |
| Grey | Clay | Boulders | Hard clay boulders | 150' | 152' |
| Grey | Sand | Gravel clay | Med. to fine sand gravel with occasional clay layer | 152' | 178' |

~~MAS-7030~~ WELL 1 116 1/2 ft

### WATER RECORD

| Water found at - feet | Kind of water |
|---|---|
| 152' | ☒ Fresh |

### CASING & OPEN HOLE RECORD

| Inside diam inches | Material | Wall thickness inches | Depth - feet From | To |
|---|---|---|---|---|
| 10" | ☒ Open hole | | 0' | 155' |
| 8" | ☒ Steel | .256 | +3' | 155' |
| 6" | ☒ Steel / Screen | | 158' | 175'8" |

### SCREEN

| Slot No. | Diameter | Length |
|---|---|---|
| 40 | 7 1/4" | 23'8" |

Material and type: Stainless Steel. Depth to top of screen: 152' feet

### PLUGGING & SEALING RECORD

| Depth set at - feet From | To | Material and type (cement grout, lead packer, etc.) |
|---|---|---|
| 0' | 155' | Pressure Grout 62 sacks of high early cement |

### PUMPING TEST

| | | | | |
|---|---|---|---|---|
| Pumping test method: ☒ Pump ☐ Bailer | Pumping rate: 200 GPM | Duration of pumping: 24 hrs | | |
| Static level: +10.87 | Water level end of pumping: Flowing 24.50 feet | Water levels during: 15 minutes 18.88 | 30 minutes 19.53 | 45 minutes 19.88 / 60 minutes 20.21 |
| If flowing give rate: DS=10.75 GPM | Pump intake set at: 100' feet | Water at end of test: ☒ Clear ☐ Cloudy | | |
| Recommended pump type: ☐ Shallow ☒ Deep | Recommended pump setting: 100' feet | Recommended pumping rate: 200 IGPM | | |

180'10"
Pump = 66'

### FINAL STATUS OF WELL

☒ Water supply

### WATER USE

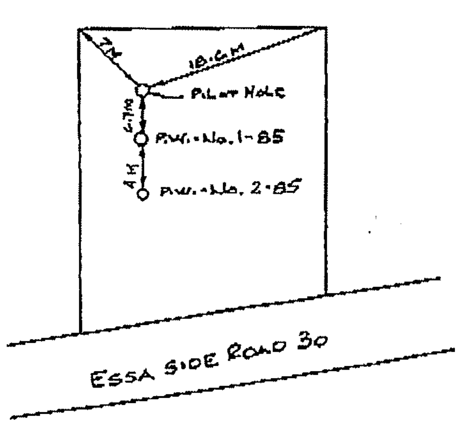
☒ Municipal

### METHOD OF DRILLING

☒ Rotary (conventional)

### LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.




Drillers remarks

### CONTRACTOR

| Name of well contractor | Licence number |
|---|---|
| OLYMPIC DRILLING CO. LIMITED | 4006 |

Address: Box 9180 Terminal "1" OTTAWA, Ont.

Name of driller or borer: Jerry Renwick

Signature of contractor: [signature] (Sec.) Submission date: day 31 mo 05 yr 85

OFFICE USE ONLY

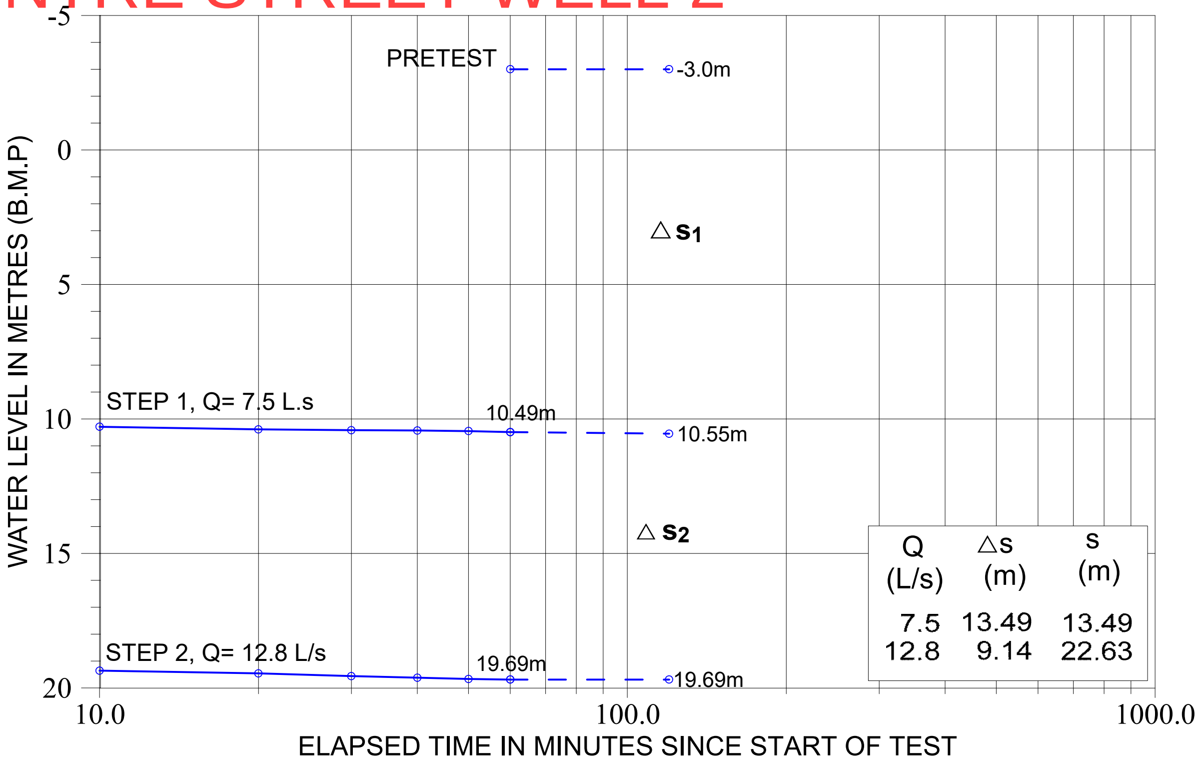
FIGURE B-1

CONTRACTOR'S COPY

FORM NO. 0506

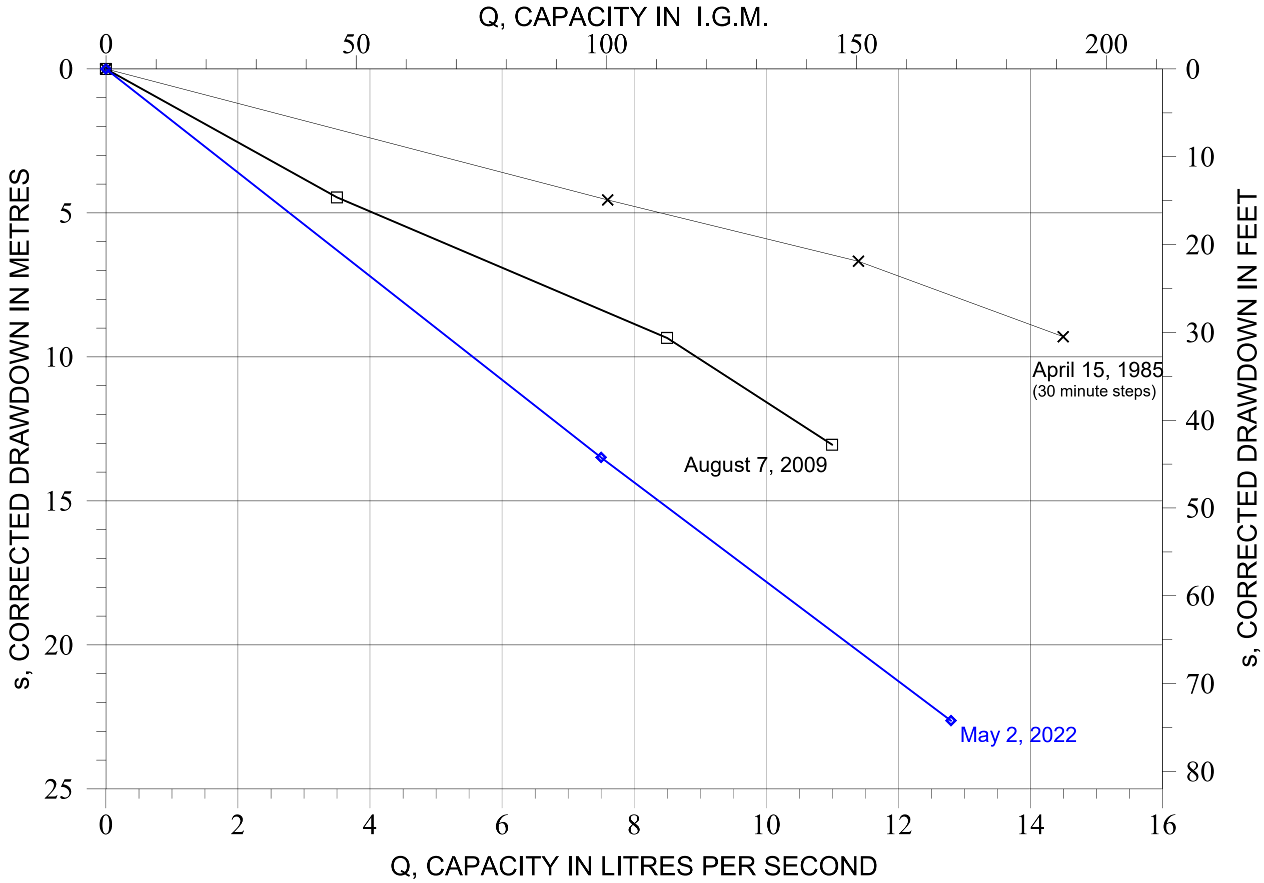
CENTRE STREET WELL 2

International Water Supply Ltd.




| Q (L/s) | △s (m) | s (m) |
|---|---|---|
| 7.5 | 13.49 | 13.49 |
| 12.8 | 9.14 | 22.63 |

**May 2, 2022**




| Township of Essa | ANGUS CENTRE ST. WELL No.1<br>WELL PERFORMANCE<br>Dwg. No. A22079 |
|---|---|

Ontario Environment

# WATER WELL RECORD

CENTRE STREET WELL 3

| COUNTY OR DISTRICT | TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE | CON., BLOCK, TRACT, SURVEY, ETC. | LOT |
|---|---|---|---|
| Simcoe County | Township of Essa | Conc. 5, Part 1, RP 51R-6771 | 31 |

| OWNER (SURNAME FIRST) | ADDRESS | DATE COMPLETED |
|---|---|---|
| Town of Angus | Box 10, Angus, Ontario L0M 1B0 | 17 05 85 |

1W-No. 2-85

## LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

| GENERAL COLOUR | MOST COMMON MATERIAL | OTHER MATERIALS | GENERAL DESCRIPTION | DEPTH - FEET FROM | TO |
|---|---|---|---|---|---|
| Brown | Sand | Slit | Dirty brown slity sand | 0' | 35' |
| Grey | Clay | Slit | Med. slity clay | 35' | 101' |
| Grey | Clay | Pebbles stones | Hard clay | 101' | 150' |
| Grey | Clay | Boulders | Hard clay boulders | 150' | 153' |
| Grey | Sand | Gravel clay with | Med. to fine sand gravel occasional clay layers | 153' | 178' |

~~[illegible]~~

WELL 2

## WATER RECORD

| WATER FOUND AT - FEET | KIND OF WATER |
|---|---|
| 153' | ☒ FRESH |

## CASING & OPEN HOLE RECORD

| INSIDE DIAM INCHES | MATERIAL | WALL THICKNESS INCHES | DEPTH - FEET FROM | TO |
|---|---|---|---|---|
| 10" | ☒ OPEN HOLE | | 0' | 155' |
| 8" | ☒ STEEL | .256 | +4' | 155' |
| 6" | ☒ STEEL | Screen | .53' | 176'8" |

## SCREEN

| SIZE(S) OF OPENING (SLOT NO.) | DIAMETER | LENGTH |
|---|---|---|
| 30 | 7¾" INCHES | 23'9" FEET |

| MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN |
|---|---|
| Stainless Steel | 153' FEET |

## PLUGGING & SEALING RECORD

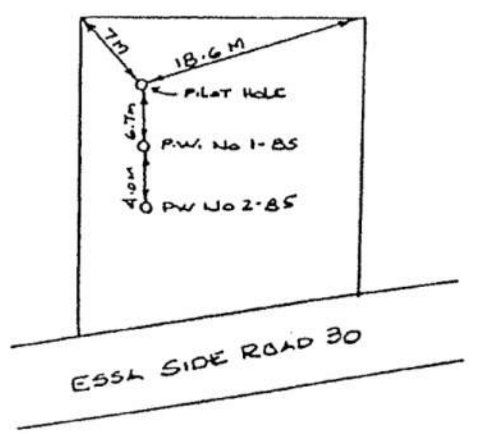
| DEPTH SET AT - FEET FROM | TO | MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.) |
|---|---|---|
| 0' | 153' | Pressure Grout 59 sacks of high early cement |

## PUMPING TEST

| | |
|---|---|
| PUMPING TEST METHOD | ☒ PUMP ☐ BAILER |
| PUMPING RATE | 200 GPM |
| DURATION OF PUMPING | 24 HOURS |
| STATIC LEVEL | +10.92 Flowing |
| WATER LEVEL END OF PUMPING | 31.56 FEET |
| WATER LEVELS DURING: 15 MINUTES | 24.90 FEET |
| 30 MINUTES | 25.48 FEET |
| 45 MINUTES | 25.94 FEET |
| 60 MINUTES | 26.27 FEET |
| PUMP INTAKE SET AT | 100' FEET |
| WATER AT END OF TEST | ☒ CLEAR ☐ CLOUDY |
| RECOMMENDED PUMP TYPE | ☐ SHALLOW ☒ DEEP |
| RECOMMENDED PUMP SETTING | 100' FEET |
| RECOMMENDED PUMPING RATE | 200 GPM |

## LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.




DRILLERS REMARKS

## FINAL STATUS OF WELL

☒ WATER SUPPLY ☐ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL ☐ ABANDONED, INSUFFICIENT SUPPLY ☐ ABANDONED, POOR QUALITY ☐ UNFINISHED

## WATER USE

☐ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ OTHER ☐ COMMERCIAL ☒ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED

## METHOD OF DRILLING

☐ CABLE TOOL ☒ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☐ ROTARY (AIR) ☐ AIR PERCUSSION ☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING

## CONTRACTOR

| | |
|---|---|
| NAME OF WELL CONTRACTOR | OLYMPIC DRILLING CO. LIMITED |
| LICENCE NUMBER | 4006 |
| ADDRESS | Box 9180 Terminal "1" OTTAWA, Ont. |
| NAME OF DRILLER OR BORER | Jerry Renwick |
| SIGNATURE OF CONTRACTOR | (Sec.) |
| SUBMISSION DATE | 31 05 85 |

OFFICE USE ONLY

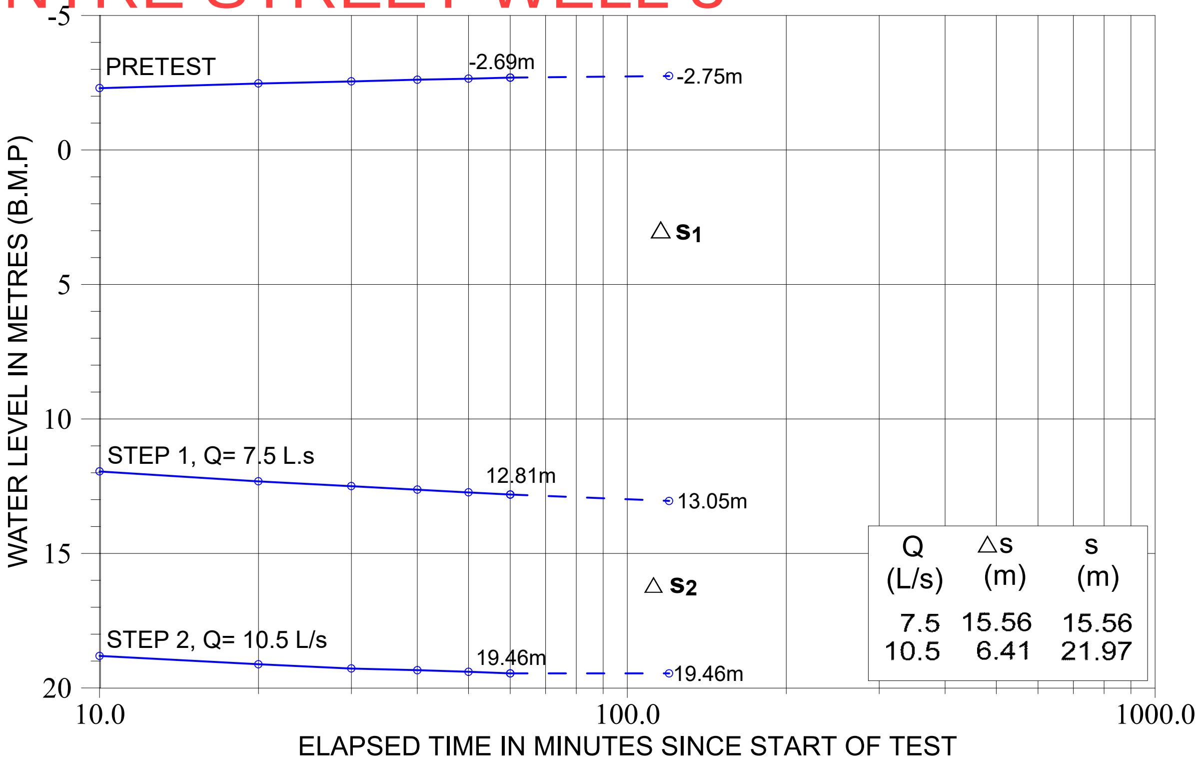
FIGURE B-2

CONTRACTOR'S COPY

FORM NO 0506-4-77 FORM 7

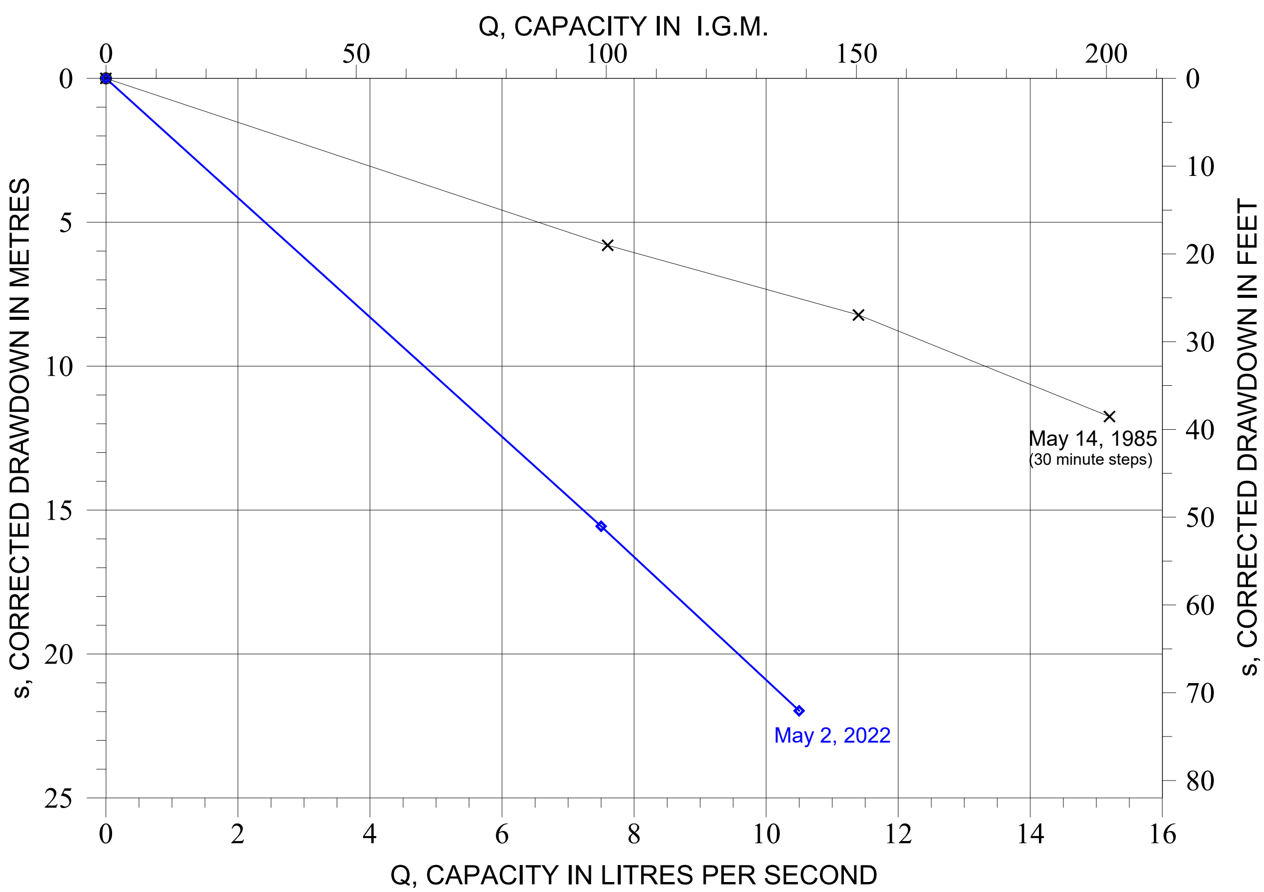
CENTRE STREET WELL 3

International Water Supply Ltd.




| Q (L/s) | △s (m) | s (m) |
|---|---|---|
| 7.5 | 15.56 | 15.56 |
| 10.5 | 6.41 | 21.97 |

**May 11, 2022**




**Township of Essa**

**ANGUS CENTRE ST. WELL No.2**
**WELL PERFORMANCE**
**Dwg. No. A22080**

# Appendix D

## Brownley Well Record and Test Reports

Ontario Ministry of the Environment

Well Tag Number A 011216

A011216

BROWNLEY WELL 4

# Well Record

**Regulation 903 Ontario Water Resources Act**



**Instructions for Completing Form**

- For use in the Province of Ontario only. This document is a permanent **legal** document. Please retain for future reference.
- All Sections **must** be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- **All metre measurements shall be reported to 1/10th of a metre.**
- Please print clearly in blue or black ink only.

**Ministry Use Only**

| MUN | CON | LOT |
|---|---|---|
| | | |

## Well Owner's Information and Location of Well Information

| First Name | Last Name | Mailing Address (Street Number/Name, RR,Lot,Concession) |
|---|---|---|
| TOWNSHIP OF | ESSA | 5786 COUNTY ROAD 21 UTOPIA |

| County/District/Municipality | Township/City/Town/Village | Province | Postal Code | Telephone Number (include area code) |
|---|---|---|---|---|
| SIMCOE | ESSA | Ontario | L0M 1T0 | 705 424 9770 |

| Address of Well Location (County/District/Municipality) | Township | Lot | Concession |
|---|---|---|---|
| SIMCOE | ESSA | 27 | IV |

| RR#/Street Number/Name | City/Town/Village | Site/Compartment/Block/Tract etc. |
|---|---|---|
| CONCESSION 5 | ~~ESS~~ ANGUS | |

| GPS Reading | NAD | Zone | Easting | Northing | Unit Make/Model | Mode of Operation: |
|---|---|---|---|---|---|---|
| | 8 3 | 17 | 591559 | 4907654 | MAGELLAN | ☐ Undifferentiated ☒ Averaged ☐ Differentiated, specify |

## Log of Overburden and Bedrock Materials (see instructions)

| General Colour | Most common material | Other Materials | General Description | Depth Metres From | To |
|---|---|---|---|---|---|
| BROWN | SAND | | | 0 | 3.7 |
| GREY | SAND | | FINE | 3.7 | 8.5 |
| GREY | CLAY | | SOFT | 8.5 | 22.0 |
| | SAND | | FINE TO MEDIUM | 22.0 | 30.2 |
| | GRAVEL M TO C | SAND | PACKED | 30.2 | 36.3 |
| | GRAVEL M TO C | SAND | LOOSE | 36.3 | 40.8 |
| | SAND, GRAVEL | CLAY | | 40.8 | 41.2 |

### Hole Diameter

| Depth Metres From | To | Diameter Centimetres |
|---|---|---|
| 0 | 13.7 | 45.7 |
| 13.7 | 33.8 | 35.6 |
| 33.8 | 41.2 | 32.4 |

### Water Record

| Water found at Metres | Kind of Water |
|---|---|
| ☐ m ☐ Gas ☐ Other: | ☐ Fresh ☐ Sulphur ☐ Salty ☐ Minerals |
| ☐ m ☐ Gas ☐ Other: | ☐ Fresh ☐ Sulphur ☐ Salty ☐ Minerals |
| ☐ m ☐ Gas ☐ Other: | ☐ Fresh ☐ Sulphur ☐ Salty ☐ Minerals |

After test of well yield, water was ☐ Clear and sediment free ☐ Other, specify

Chlorinated ☐ Yes ☐ No

### Construction Record

| Inside diam centimetres | Material | Wall thickness centimetres | Depth Metres From | To |
|---|---|---|---|---|
| **Casing** | | | | |
| 20.3 | ☒ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized | 0.8 | + 0.8 | 36.5 |
| | ☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized | | | |
| | ☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized | | | |
| **Screen** | | | | |
| Outside diam | | Slot No. | | |
| 21.9 | ☒ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized | 50 | 36.5 | 40.2 |
| **No Casing or Screen** | | | | |
| | ☐ Open hole | | | |

### Test of Well Yield

Pumping test method: PUMP

Pump intake set at - (metres): 

Pumping rate - (litres/min): 1253

Duration of pumping: 74 hrs + 0 min

Final water level end of pumping: 18.04 metres

Recommended pump type. ☐ Shallow ☐ Deep

Recommended pump depth. ______ metres

Recommended pump rate. (litres/min)

If flowing give rate - (litres/min)

If pumping discontinued, give reason.

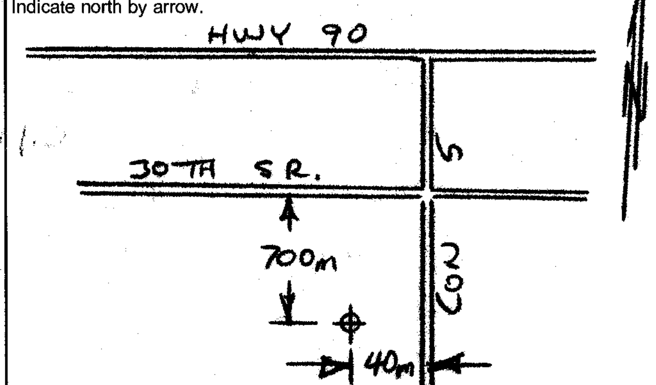
| Draw Down Time min | Water Level Metres | Recovery Time min | Water Level Metres |
|---|---|---|---|
| Static Level | 6.71 | | 18.02 |
| 1 | | 1 | 8.77 |
| 2 | 13.79 | 2 | 8.55 |
| 3 | | 3 | 8.45 |
| 4 | 16.34 | 4 | 8.39 |
| 5 | | 5 | 8.34 |
| 10 | 16.43 | 10 | 8.19 |
| 15 | 16.51 | 15 | 8.09 |
| 20 | 16.59 | 20 | 8.02 |
| 25 | 16.64 | 25 | 7.97 |
| 30 | 16.71 | 30 | 7.92 |
| 40 | 16.80 | 40 | 7.85 |
| 50 | 16.85 | 50 | 7.79 |
| 60 | 16.90 | 60 | 7.73 |

### Plugging and Sealing Record ☒ Annular space ☐ Abandonment

| Depth set at - Metres From | To | Material and type (bentonite slurry, neat cement slurry) etc. | Volume Placed (cubic metres) |
|---|---|---|---|
| 29.9 | 2.4 | NEAT CEMENT | 4 |
| 2.4 | 0 | BENTONITE | 0.2 |

### Location of Well

In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.




### Method of Construction

☒ Cable Tool ☐ Rotary (conventional) ☐ Rotary (reverse) ☐ Rotary (air) ☐ Air percussion ☐ Boring ☐ Diamond ☐ Jetting ☐ Driving ☐ Digging ☐ Other

### Water Use

☐ Domestic ☐ Stock ☐ Irrigation ☐ Industrial ☐ Commercial ☒ Municipal ☐ Public Supply ☐ Not used ☐ Cooling & air conditioning ☐ Other

### Final Status of Well

☒ Water Supply ☐ Observation well ☐ Test Hole ☐ Recharge well ☐ Abandoned, insufficient supply ☐ Abandoned, poor quality ☐ Unfinished ☐ Dewatering ☐ Replacement well ☐ Abandoned, (Other)

Audit No. Z 11288

Date Well Completed: YYYY 2005 MM 04 DD 05

Was the well owner's information package delivered? ☐ Yes ☒ No

Date Delivered: YYYY MM DD

### Well Contractor/Technician Information

Name of Well Contractor: INTERNATIONAL WATER SUPPLY

Well Contractor's Licence No.: 2801

Business Address (street name, number, city etc.): PO BOX 310 BARRIE ON L4M4T5

Name of Well Technician (last name, first name): WALTER NOBES

Well Technician's Licence No.: T0115

Signature of Technician/Contractor: X

Date Submitted: YYYY 2005 MM 04 DD 28

### Ministry Use Only

Data Source

Contractor: 2801

Date Received: MAY 25 2005

Date of Inspection: YYYY MM DD

Remarks

Well Record Number

0506E (09/03) Contractor's Copy ☐ Ministry's Copy ☑ Well Owner's Copy ☐ *Cette formule est disponible en français*

INTERNATIONAL WATER SUPPLY LTD

Groundwater Development – Drilling Services
Pumps – Water Treatment – Service & Maintenance
342 Bayview Drive, P. O. Box 310
Barrie, Ontario, Canada L4M 4T5
Tel:705-733-0111 • 800-461-9636 • Fax: 705-721-0138
email: iws@iws.ca www.iws.ca

November 12, 2021

Ontario Clean Water Agency
30 Woodland Drive
Wasaga Beach, ON
L9Z 2V4

Attention: Mark Yandt
Senior Operations Manager – South Simcoe Hub

Reference: Well and Pump Maintenance
Township of Essa
Angus Brownley Well No. 4

International Water Supply Ltd. (IWS) was authorized conduct Well and Pump Performance Testing and Maintenance Inspection at Brownley Well No. 4. These investigations resulted in the completion of a well rehabilitation and the following is a report of the work completed along with our recommendations.

## Background

The Angus Brownley site located on 8610 5$^{th}$ Line in Essa Township. Wells No. 5 and 6 are also located at this location and the three wells pump into a 2,500m$^3$ underground reservoir. Iron is controlled with the addition of sodium silicate with primary disinfection using sodium hypochlorite.

Brownley Well No. 4 was constructed by International Water Supply Ltd. in 2005 as a single cased gravel wall well with 200mm diameter casing set in a nominal 350mm borehole, with the 200mm screen across the interval from 36.5m to 40.2m. Silica gravel was placed in the 305mm borehole around the screen to depth 30 meters, then the steel casing was grouted to surface.

The well was tested at 20.9 L/s for 72 hours, with a drawdown of approximately 11.3m.

## Procedure and Work Program

Well No. 4 had not been tested since constructed and a well and pump performance test was conducted into the system at 10.0 and 20.0 L/s on February 25, 2021. Results showed approximately 12.4 metres of additional drawdown at 20 L/s as compared to original construction in 2005. Results are plotted on Drawing A21015. Pump performance had deteriorated by 20 metres of head, likely caused from the plugging of water passages. Results can be seen on Drawing A21016.

The submersible pump and motor was removed from the well and transported to our Barrie yard for cleaning and inspection.

Pumping Equipment

The Grundfos 300S400- stage submersible pump, 40 HP motor and drop pipe was heavily coated with iron after removal from the well. The components were cleaned and the pump was dismantled for inspection. The pump water passages were cleaned of iron and was reassembled to the motor. The 100mm drop pipe was cleaned inside and out. Some pitting was evident, but not to the point that it requires replacement. It was re-coated with NSF enamel to prepare for re-installation. The motor insulation was meggared and was suitable for reuse. The pitless spool was also in good condition. In general, the pumping equipment was in fair condition and suitable for use for the next service interval. The Maass pitless spool was cleaned and o-rings checked out satisfactory.


100mm drop pipe prior to cleaning


Pump dissembled and ready for cleaning

Well Video Inspection

The well video inspection was completed on September 14. The inspection showed that the lower seating face of the 250mm Maass pitless barrel was in poor condition. The 200mm casing had some loose corrosion scale and surface corrosion.

Once submerged, the casing had moderate to heavy iron precipitate. The casing had moderate to heavy iron precipitate. Below depth 33m (110 ft), bio-foul activity was noted which increased into the screen below. Iron scale that appeared removed is seen at depth 32m (107ft), thought to be the bottom of the motor. The welded casing joints that were visible appeared to be in good condition. The top of the screen assembly was recorded at 37.5m (123 ft), with heavy bio foul activity throughout its depth.
The total depth was measured at 41.38m (135.9 ft) below reference point A detailed report of both video inspection are included with this report. A USB drive was previously provided with video copy of the inspection.

Recommendations were approved by OCWA to clean mineral and biofilm from the casing and screen and redevelop the well using enhanced acid and surfactant/ disinfection and remove the accumulated debris from the well bottom.

## Well Maintenance

Due to the buildup of iron precipitate and bio-foul activity, the 200mm diameter casing and screen was brushed in the presence of a pH corrected chlorinated solution to loosen and remove initial material. The screen was mechanically brushed and resulting debris was airlifted from the bottom into a sediment bag. The well was re-developed the following day. With the treatment success recently achieved at Well 5, a surfactant treatment for bio-film and mineral scale dissolving solution was injected into the well, mechanically agitated for several hours, and pumped off into a containment tank to be neutralized.
A 25% larger volume solution was injected on September 24 and the product was mechanically agitated (surged) with the double-ring packer and left overnight. The treatment solution was neutralized and pumped to waste the following day and the well was airlift developed. A third treatment consisted of an enhanced surfactant in an attempt to remove any aquifer fines. The well was surged with the mechanical packer assembly for several hours and the well was airlifted until the water was clear. A small diameter well inspection camera was deployed and the condition of the wall screen was improved and visibly clean. Prior to installing the pump, a pH corrected disinfection volume providing 175 mg/L chlorine prior to setting the pump.

## Well Performance

On October 1, the pump was electrically connected and a step test was conducted through the in-line flow meter to waste, where the water was dechlorinated. Rehabilitation recovered approximately 3.7m of drawdown compared to the pre-rehabilitation testing. The test results are plotted on Drawing A21094.

Conclusions and Recommendations

1. Well and pump performance testing and results of the video inspection of Brownley Well 4 indicated iron precipitate with bio-foul activity present. Well cleaning as well as chemical and mechanical rehabilitation was undertaken.

2. A decreased well service interval is suggested in order to not allow as severe decline in well performance to occur. Additional well rehabilitation may help to further restore well performance.

3. The Grundfos 300S400-9 stage submersible pump performance appears to have been restored by approximately 30 PSI with cleaning. The main from the well to the treatment building was also flushed with a chlorinated solution. The pump drop pipe was coated with NSF enamel and all components were reused and installed.

4. Regular recordings of production water levels, flow rates and pump pressures should be maintained in order to monitor any changes in well or pump performance.

5. Well and Pump performance test should be conducted in 3 years, to track interim performance. This should be completed in advance of scheduling the next well and pump maintenance inspection in five years.

6. A Well Video Inspection should be conducted when the pump is removed.

Should you have any questions, please don't hesitate to contact us.

Regards,
International Water Supply Ltd.

John A. Harris, P.Eng.

## Well Video Inspection

A video inspection of Essa Township, Angus Brownley Well No. 4 was performed on September 14, 2021 as part of the Township of Essa's Well and Pump Maintenance schedule, as undertaken by OCWA. The following observations were made:

- The flange the the Maass MB pitless was the video reference measuring point. All measurements are recorded in feet. The well matches Water Well Record matches Well ID 7043027.
- Following pump and motor removal, the well was pumped for approximately 90 minutes to improve clarity while conducting the video. The static water level was measured at 10.60m below reference point.
- The pitless adapter was seen at approximately 1.8m (6 ft), with the lower seating face appearing to be in poor condition.
- The 200mm (8 inch) diameter casing had loose metal scale and corrosion above the pitless with surface corrosion to the water level. Below this depth, iron precipitate and some scale was noted.
- The casing had moderate to heavy iron precipitate. Below depth 33m (110 ft), bio-foul activity was noted which increased into the screen below.
- Iron scale that appeared removed is seen at depth 32m (107ft), thought to be the bottom of the motor.
- The welded casing joints that were visible appeared to be in good condition.
- The top of the screen assembly was recorded at 37.5m (123 ft), with heavy bio-foul activity throughout its depth.
- The total depth was measured at 41.38m (135.9 ft) below reference point. It is noted that the difference in total depth may be attributed to the camera winch cable counter and the camera stopping above the material in the bottom of the well.

## Recommendations and Conclusions

- The well casing was noted to be fair condition, with heavy bio-foul activity in the screen. The well should be mechanically/chemically cleaned to remove the growth and be redeveloped.
- As with all well and pump maintenance work, the well and pumping equipment should be chlorinated in accordance with AWWA C654, prior to the reinstallation of the pumping equipment.

BROWNLEY WELL 4



Township of Essa
Brownley Well No. 4
September 14, 2021

**International Water Supply Ltd.**

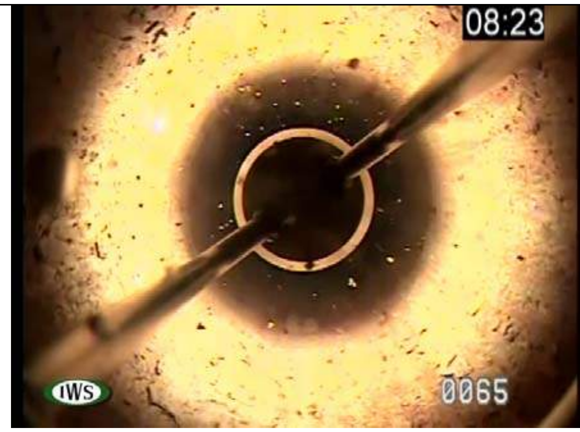
| Contract: OCWA- Angus Brownley | | WELL No: 4 | | DATE: 14-Sep-21 | |
|---|---|---|---|---|---|
| | | **Well and Water Level Details** | | | |
| **Employees on Site** | **Well Location (NAD83)** | | | | |
| Terry Brown | **591562mE, 4907647mN** | Static Water Level : | 10.60m | Casing Dia (mm) | 200mm |
| | 8610 5th Line | Measured Depth: | 41.38m | Casing Height (mAGL) | 0.50m |
| | | Video Depth Reference: | | Top pitless flange | |

**WELL DESCRIPTION**

| DEPTH ft | DEPTH m | CASING JOINTS CONDITION | CASING/WELL CONDITION | SCREEN CONDITION |
|---|---|---|---|---|
| | | | Corrosion scale | |
| 6 | 1.8 | Pitless – lower seating face appears in poor condition | | |
| 7 | 2.1 | Threaded coupling? | Surface corrosion, some scale | |
| 16 | 4.9 | Okay – corrosion scale | | |
| 31? | | Not seen – 35' WL | Iron precip, fair condition | |
| 51 | 15.5 | Okay | Iron precip, pitting | |
| 72 | 21.9 | Okay | Iron precip and Scale, pitting | |
| 92 | 28.0 | Not seen | Iron precip and scale, tubercles, pitting | |
| 112 | 34.1 | Not seen | Heavy iron bacteria below 110, tubercles near top of screen | |
| | | | | |
| 123 | 37.5 | Top of screen | | Heavy iron fouling and iron bacteria, |
| 132 | 40.2 | Video bottom | | Iron bacteria and soft material on bottom |

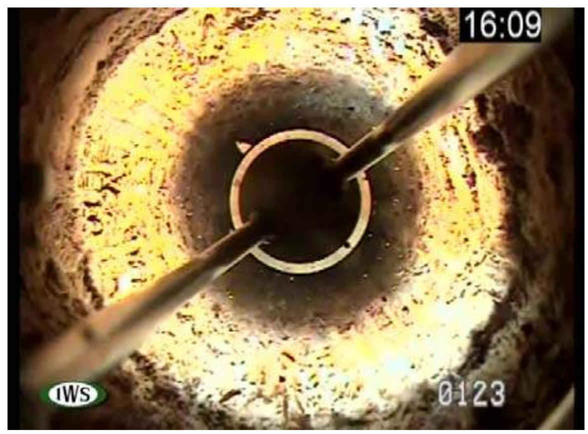
**NOTES:**
Pumping 1 L/s
Most northerly well in compound

Pitless seat in poor condition at 7 ft



Iron precipitate and scale at 65 ft

Heavy iron bacteria at 118 ft



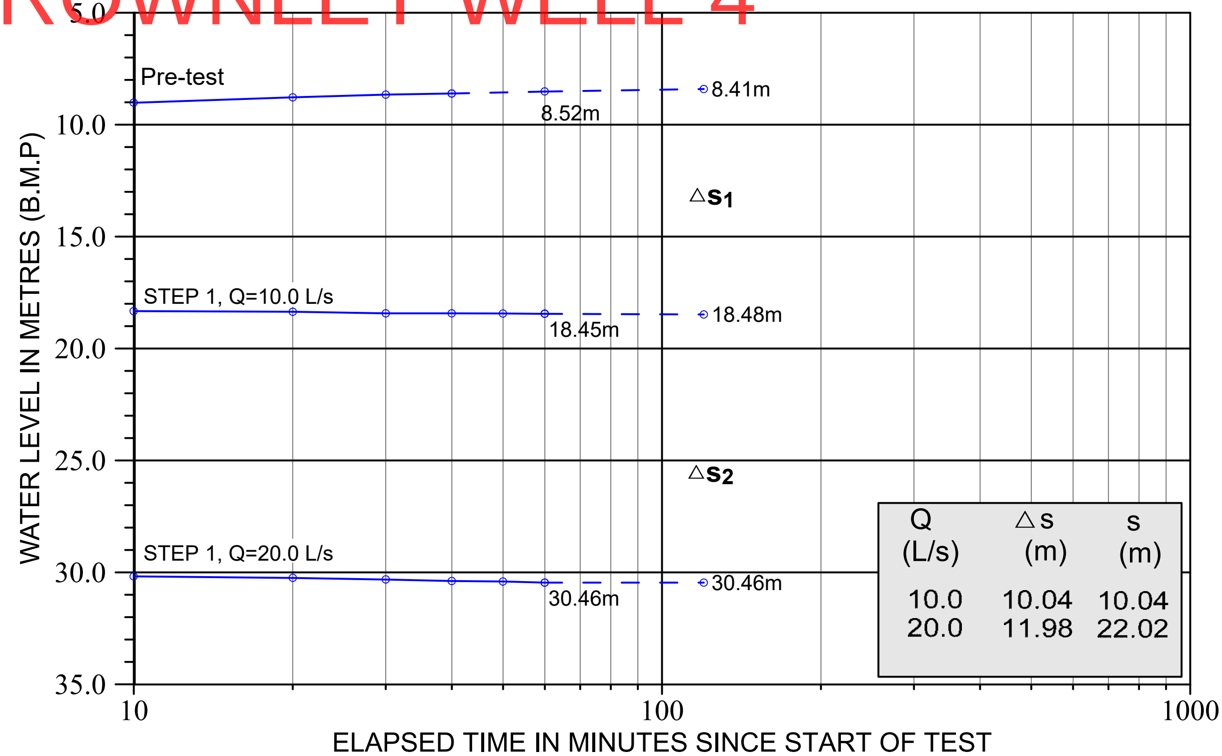
Top of screen at 123 ft

Horizontal view deposits on screen at 132 feet

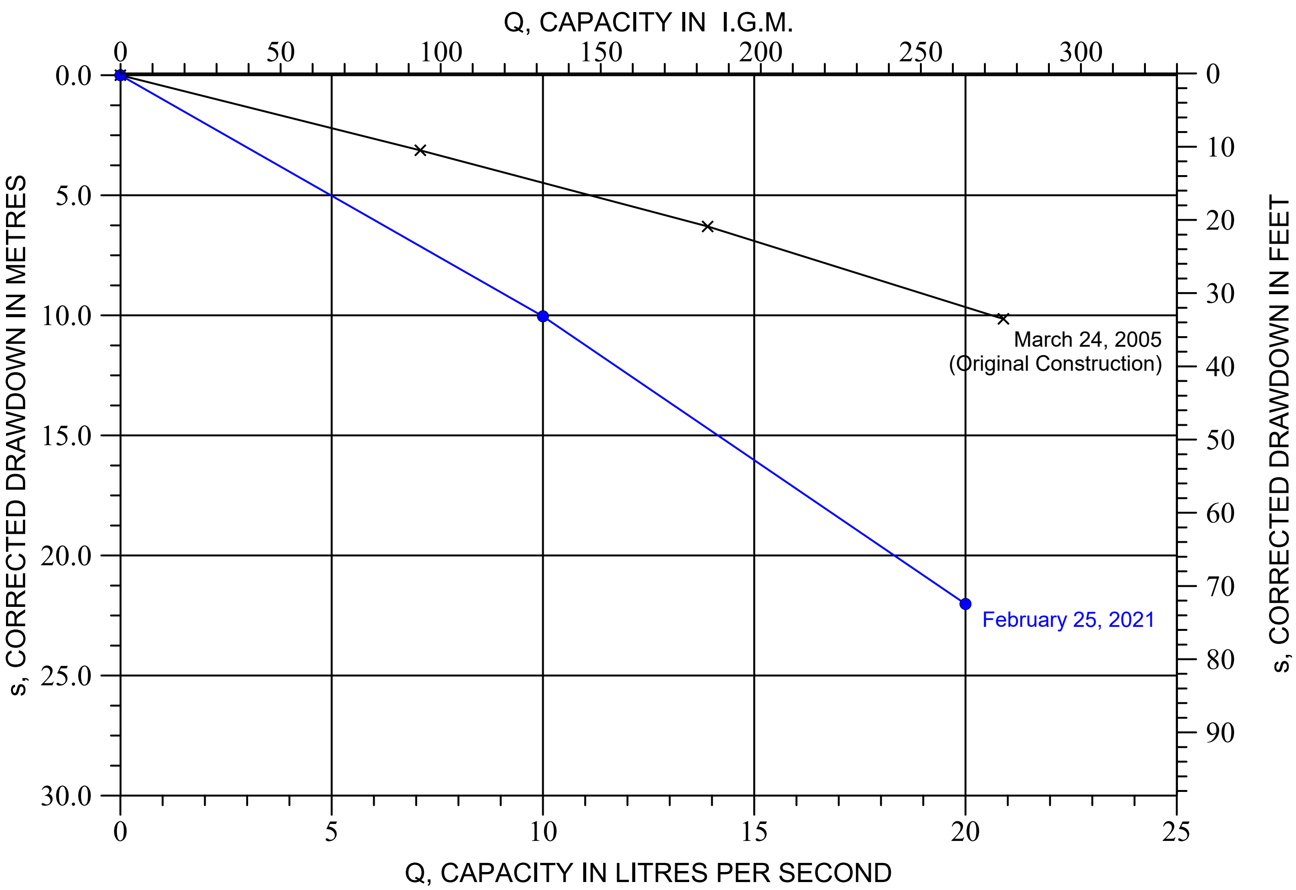
Approaching well bottom at 132 feet

BROWNLEY WELL 4

**International Water Supply Ltd.**



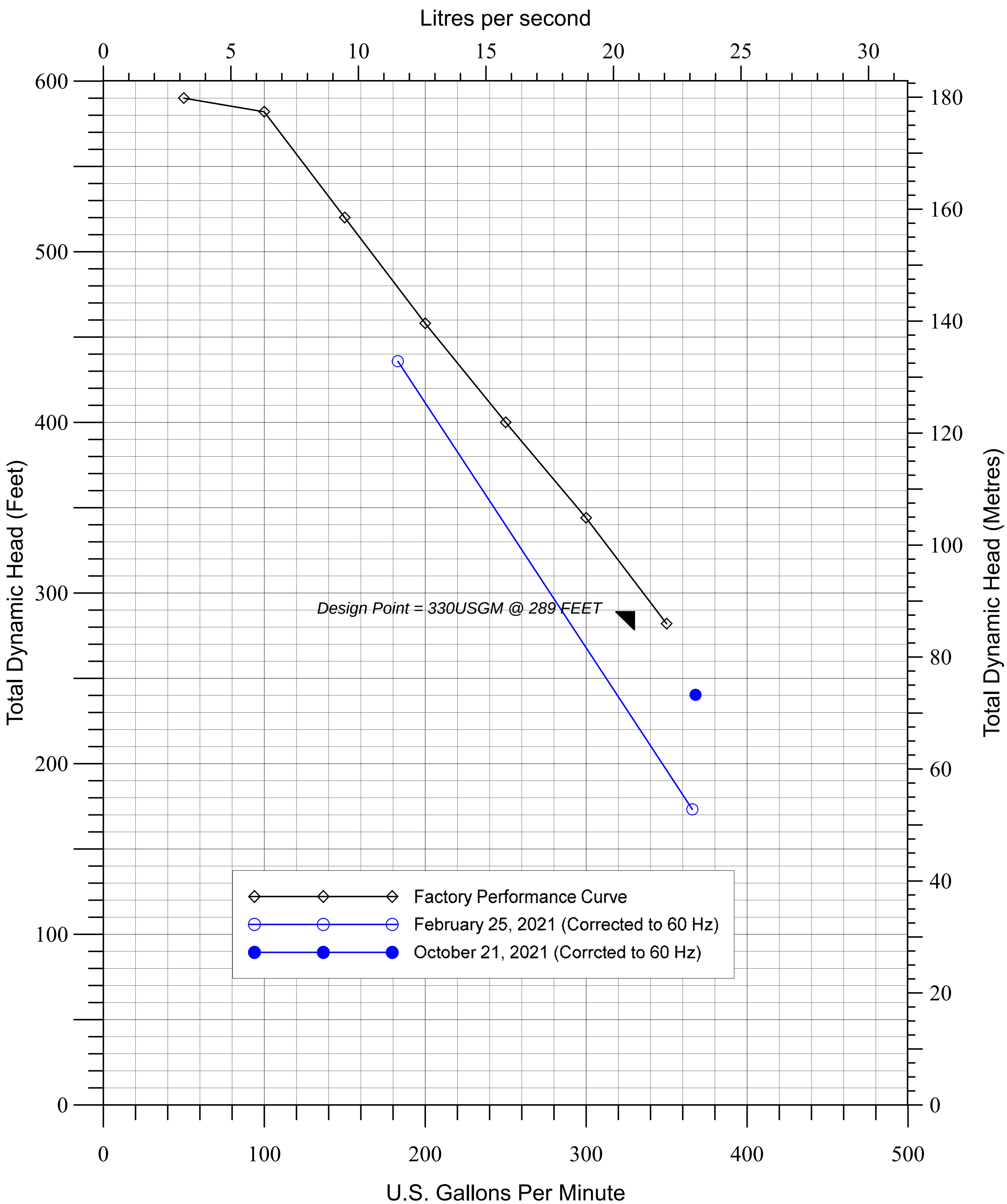

**February 25, 2021**




| | |
|---|---|
| **Township of Essa** | **Angus Brownlee Well No. 4**<br>**Well Performance Test**<br>**Dwg. No. A21015** |

BROWNLEY WELL 4

International Water Supply Ltd.



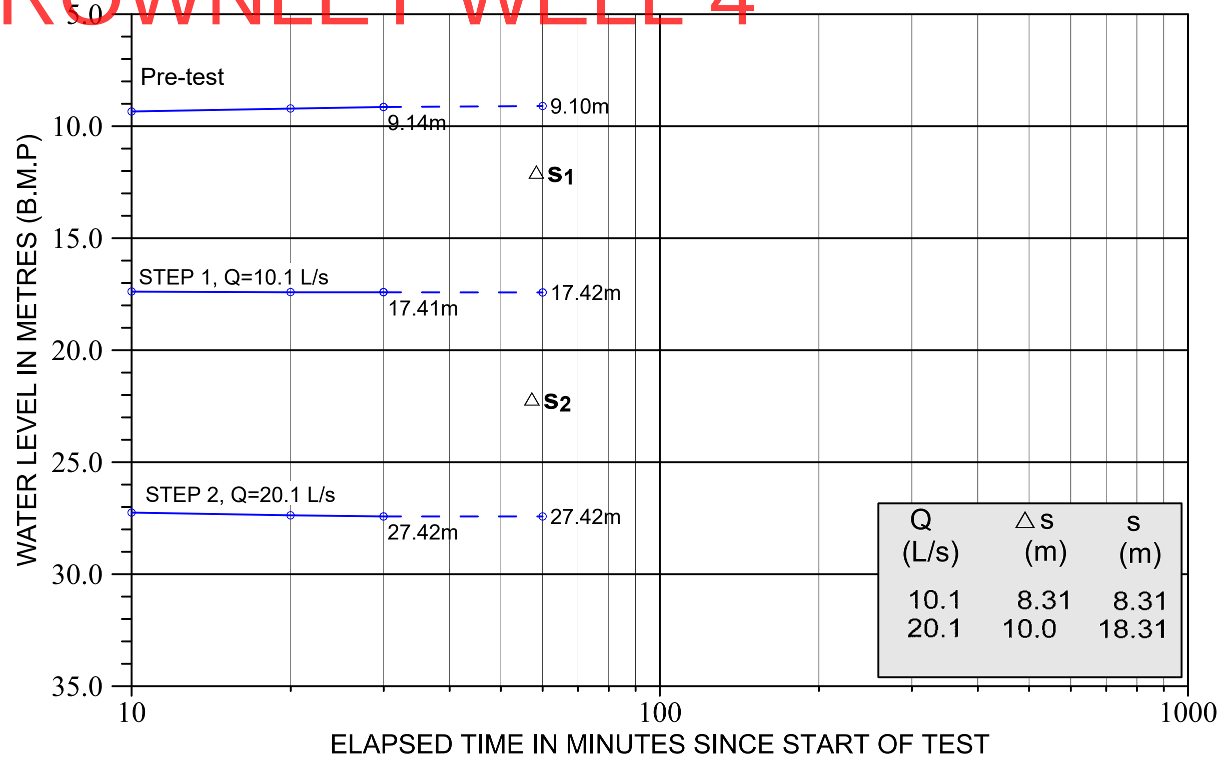

February 25, 2021

Brownley Well No. 4
Pump Performance
Grundfos 300S400-9

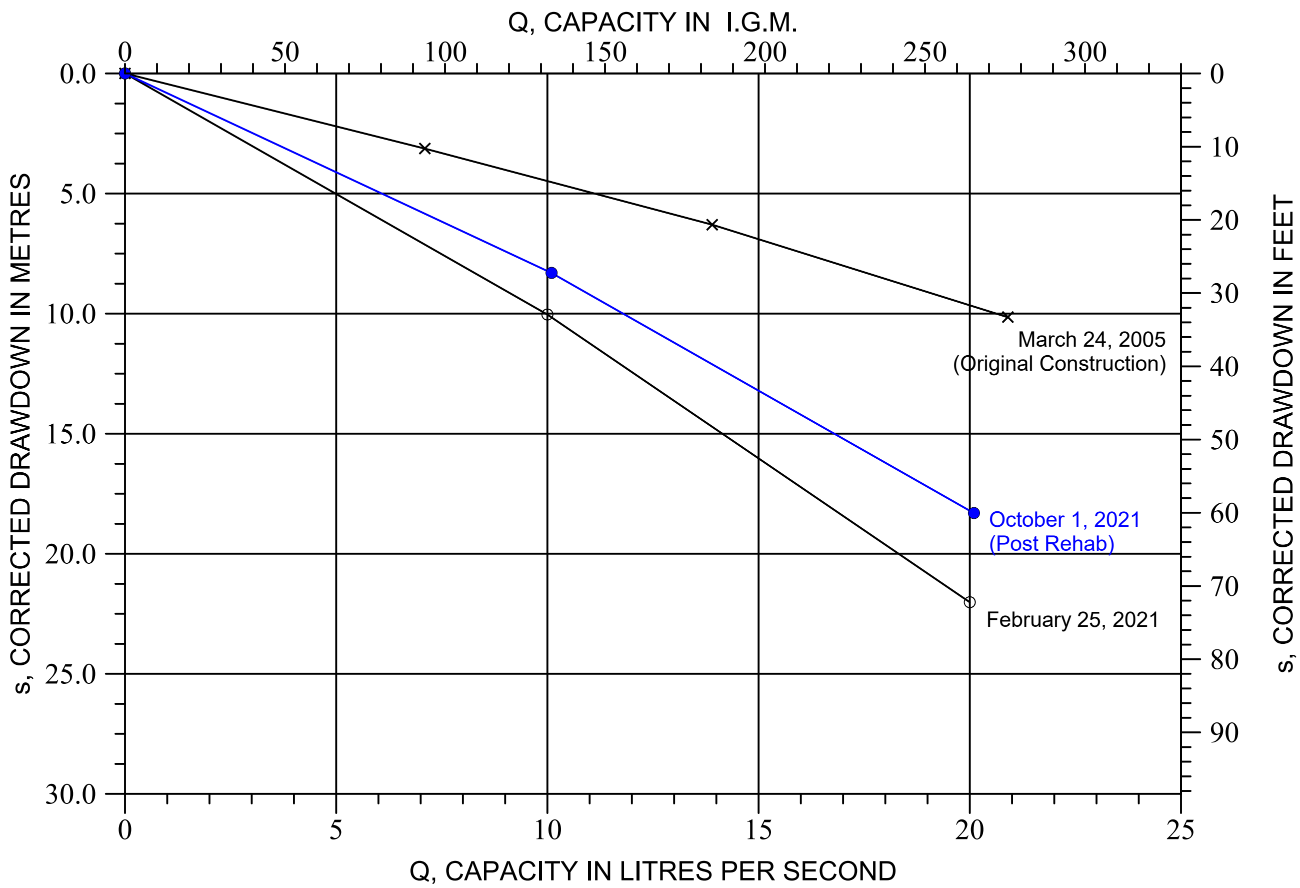
Dwg. No. A21016

BROWNLEY WELL 4

International Water Supply Ltd.




**October 1, 2021**




| | |
|---|---|
| **Township of Essa** | **Angus Brownley Well No 4**<br>**Well Performance Test**<br>**Dwg. No. A21094** |

BROWNLEY WELL 5

Ministry of the Environment
Ontario

The Ontario Water Resources Act

# WATER WELL RECORD

5730542

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11

MUNICIP. 57002 | CON. CON 04

| COUNTY OR DISTRICT | TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE | CON., BLOCK, TRACT, SURVEY, ETC. | LOT |
|---|---|---|---|
| SIMCOE | ESSA | CON IV | 27 |

| OWNER (SURNAME FIRST) | ADDRESS | DATE COMPLETED |
|---|---|---|
| TOWNSHIP | OF ESSA | DAY 12 MO 10 YR 93 |

21 | ZONE | EASTING | NORTHING | RC. | ELEVATION | RC. | BASIN CODE | II | III | IV

## LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

| GENERAL COLOUR | MOST COMMON MATERIAL | OTHER MATERIALS | GENERAL DESCRIPTION | DEPTH - FEET FROM | TO |
|---|---|---|---|---|---|
| BROWN | SAND | | | 0 | 33 |
| GRAY | CLAY | SILT | SOFT | 33 | 71 |
| BROWN | SAND | | f. to md. | 71 | 88 |
| | GRAVEL | | med. | 88 | 107 |
| | GRAVEL | | FINE | 107 | 115 |
| | GRAVEL | | CS. | 115 | 133 |
| GRAY | SAND | ~~SA~~ GRAVEL CLAY | TILL | 133 | 182 |
| GRAY | SAND | SILT CLAY TILL | | 182 | 276 |
| GRAY | CLAY | SILT | | 276 | 310 |
| GRAY | CLAY | STONES CEMENTED GRAVEL | | 310 | 341 |
| GRAY | SHALE | BROKEN LIMESTONE CLAY | | 341 | 346 |
| | | FINISHED DEPTH 130 FEET | | | |

31

32

## 41 WATER RECORD

| WATER FOUND AT - FEET | KIND OF WATER |
|---|---|
| 71-133 | 1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS — NOT TESTED |
| | 1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS |
| | 1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS |
| | 1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS |
| | 1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERALS 6 ☐ GAS |

## 51 CASING & OPEN HOLE RECORD

| INSIDE DIAM INCHES | MATERIAL | WALL THICKNESS INCHES | DEPTH - FEET FROM | TO |
|---|---|---|---|---|
| 6¼ | 1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC | .188 | +2 | 128 |
| 5 | 1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC | .188 | 116 | 120 |
| 10 | 1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC | .205 | +3 | 21 |

## SCREEN

| SIZE(S) OF OPENING (SLOT NO.) | DIAMETER | LENGTH |
|---|---|---|
| .045 .040 | 6 INCHES | 10 FEET |

| MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN |
|---|---|
| STAINLESS STEEL | 120 FEET |

## 61 PLUGGING & SEALING RECORD

| DEPTH SET AT - FEET FROM | TO | MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.) |
|---|---|---|
| 0-20 | | Cement grout |
| 35-40 | 210-220 | Holeplug |
| 55-60 | 140-150 | seal. |
| 75-80 | | |

## 71 PUMPING TEST

| PUMPING TEST METHOD | PUMPING RATE | DURATION OF PUMPING |
|---|---|---|
| 1 ☒ PUMP 2 ☐ BAILER | 200 I GPM | 24 HOURS 0 MINS |

| STATIC LEVEL | WATER LEVEL END OF PUMPING | WATER LEVELS DURING | 1 ☒ PUMPING 2 ☐ RECOVERY | | |
|---|---|---|---|---|---|
| | | 15 MINUTES | 30 MINUTES | 45 MINUTES | 60 MINUTES |
| 8.06 m | 26.71 m | 23.46 m | 23.80 m | 23.96 m | 24.26 m |

IF FLOWING, GIVE RATE ____ GPM | PUMP INTAKE SET AT 110 FEET | WATER AT END OF TEST 1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE ☐ SHALLOW ☐ DEEP | RECOMMENDED PUMP SETTING ____ FEET | RECOMMENDED PUMPING RATE ____ GPM

50-53

## FINAL STATUS OF WELL

1 ☒ WATER SUPPLY
2 ☒ OBSERVATION WELL
3 ☐ TEST HOLE
4 ☐ RECHARGE WELL
5 ☐ ABANDONED, INSUFFICIENT SUPPLY
6 ☐ ABANDONED, POOR QUALITY
7 ☐ UNFINISHED
☐ DEWATERING

## WATER USE

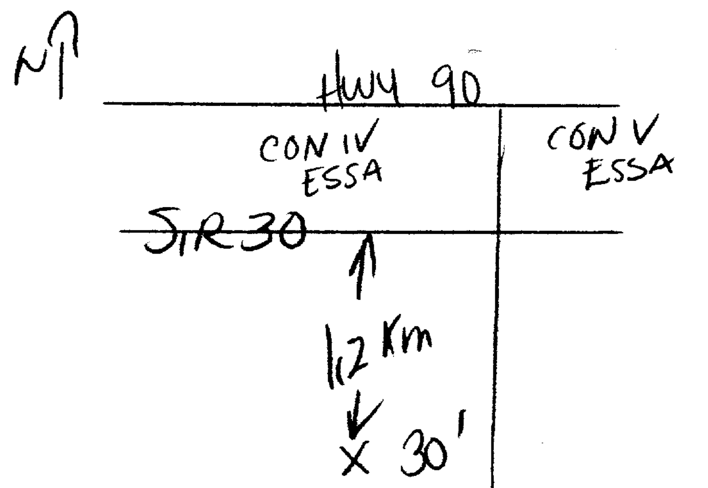
1 ☐ DOMESTIC
2 ☐ STOCK
3 ☐ IRRIGATION
4 ☐ INDUSTRIAL
☐ OTHER
5 ☐ COMMERCIAL
6 ☒ MUNICIPAL
7 ☐ PUBLIC SUPPLY
8 ☐ COOLING OR AIR CONDITIONING
9 ☐ NOT USED

## METHOD OF CONSTRUCTION

1 ☐ CABLE TOOL
2 ☒ ROTARY (CONVENTIONAL)
3 ☐ ROTARY (REVERSE)
4 ☐ ROTARY (AIR)
5 ☐ AIR PERCUSSION
6 ☐ BORING
7 ☐ DIAMOND
8 ☐ JETTING
9 ☐ DRIVING
☐ DIGGING
☐ OTHER

## LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.




119529

DRILLERS REMARKS

## CONTRACTOR

NAME OF WELL CONTRACTOR: ALLAN WRIGHT WATER WELLS INC
WELL CONTRACTOR'S LICENCE NUMBER: 5528
ADDRESS: RR#1 HILLSDALE ONT L0L 1V0
NAME OF WELL TECHNICIAN: ALLAN WRIGHT
WELL TECHNICIAN'S LICENCE NUMBER: T0250
SIGNATURE OF TECHNICIAN/CONTRACTOR: Allan Wright
SUBMISSION DATE: DAY ____ MO. ____ YR. ____

## OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 5528 | DATE RECEIVED FEB 15 1994
DATE OF INSPECTION | INSPECTOR
REMARKS
CSS.ES

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

INTERNATIONAL WATER SUPPLY LTD

Groundwater Development – Drilling Services
Pumps – Water Treatment – Service & Maintenance
342 Bayview Drive, P. O. Box 310
Barrie, Ontario, Canada L4M 4T5
Tel:705-733-0111 • 800-461-9636 • Fax: 705-721-0138
email: iws@iws.ca www.iws.ca

October 20, 2021

Ontario Clean Water Agency
30 Woodland Drive
Wasaga Beach, ON
L9Z 2V4

Attention: Mark Yandt
Senior Operations Manager – South Simcoe Hub

Reference: Well and Pump Maintenance
Township of Essa
Angus Brownley Well No. 5

International Water Supply Ltd. (IWS) was authorized conduct Well and Pump Performance Testing and Maintenance Inspection at Brownley Well No. 5. These investigations resulted in the completion of a well rehabilitation and the following is a report of the work completed along with our recommendations.

## Background

The Angus Brownley site located on 8610 5$^{th}$ Line in Essa Township. Wells No. 4 and 6 are also located at this location and the three wells pump into a 2,500m$^3$ underground reservoir. Iron is controlled with the addition of sodium silicate with primary disinfection using sodium hypochlorite.

Brownley Well No. 5 was constructed by others in 1993 as a nominal 152mm casing with telescoped wire wrap screen across the interval from 36.6m to 39.6m. The well was tested at 15.2 L/s for 24 hours, with a drawdown of approximately 11.4m.

## Procedure and Work Program

Well No. 5 had not been tested since constructed and a well and pump performance test was conducted into the system at 3.5 and 7.5 L/s on February 25, 2021. Results showed approximately 8.58 metres of additional drawdown at 7.5 L/s as compared to original construction in 1993. Results are plotted on Drawing A21017. Pump performance had deteriorated by 7.5 metres of head, likely caused from the plugging of water passages. Results can be seen on Drawing A21018.

BROWNLEY WELL 5

The submersible pump and motor was removed from the well and transported to our Barrie yard for cleaning and inspection.

Pumping Equipment

The Grundfos 150S150-6 stage submersible pump, 15 HP motor and drop pipe was heavily coated with iron after removal from the well. The components were cleaned and the pump was dismantled for inspection. The 75mm drop pipe was cleaned inside and out. Some lengths were beginning to pit. It was re-coated with NSF enamel to prepare for re-installation. Equipment was in fair condition and suitable for use for the next service interval. The Maass pitless spool was cleaned and o-rings checked out satisfactory.


Location of Well No. 5 (note O/H power lines)


Treatment Plant piping with line to waste through wall

Well Video Inspection

The well video inspections were completed on March 11 and following rehabilitation again on March 22. The follow-up video showed that the 250mm Maass pitless barrel reduced to 150mm diameter at 1.8m (6 ft) and some of the corroded pieces of the upper barrel had been removed. The 150mm (6 inch) diameter casing was intentionally avoided during the rehabilitation. Loose corroded metal scale remained and the casing appeared to be in very poor condition above the water level.

Once submerged, the casing had corrosion pitting, with residual iron precipitate to depth 24m (78 ft). Below 24m (78 ft), residual scale remained with a scuff at 26m. The welded casing joints that were visible had scale buildup and appeared to be in satisfactory condition. The transition from casing to the Figure-K packer at depth 36.3m (119 in the horizontal view) appeared to show heavily corroded casing. The top of the K-Packer was recorded at 36m (118 ft). Minor precipitate was noted leading into the top of the screen at 37.2m (122 ft). The screen appeared in fair to good condition, with some residual precipitate along one side. The coupling between screen lengths at 38.7m appeared pitted. The well bottom was recorded at 39.9m (131 ft).
A detailed report of both video inspection are included with this report. A USB drive is provided with video copies of the inspections.

Recommendations were approved by OCWA to clean mineral and biofilm from the casing and screen and redevelop the well using enhanced surfactant/ disinfection and remove the accumulated debris from the well bottom.

## Well Maintenance

Due to the apparent poor condition of the 150mm diameter well casing, the well was brushed with a 127mm brush, sized for the telescoped well screen only. The screen was mechanically brushed and resulting debris was airlifted from the bottom into a sediment bag. A surfactant, with bio-film and mineral scale dissolving solution was injected into the well, agitated and left in the well overnight.
The following day, and the product was mechanically agitated, neutralized and pumped to waste. The well was airlift developed into the containment tank. A second acid treatment was injected and mechanically agitated with the double-ring packer and left overnight. The treatment solution was neutralized and pumped to waste the following day and the well was airlift developed. A third treatment consisted of a clay dispersant in an attempt to clean up any residual drilling fluids that were left behind in the formation during the construction process. The well was surged with the mechanical packer assembly for several hours and the well was airlifted until the water was clear. Prior to installing the pump, a pH corrected disinfection volume providing 200 mg/L chlorine prior to setting the pump.

## Well Performance

On March 23, the pump was electrically connected and a step test was conducted through the in-line flow meter to waste. The water was dechlorinated, and appeared red on initial start-up. Post-rehabilitation well performance was slightly improved to the original 1993 construction. The test results are plotted on Drawing A21052.

Conclusions and Recommendations

1. Well and pump performance testing and results of the video inspection of Brownley Well 5 indicated iron precipitate with heavy bio-foul activity present. Well cleaning and rehabilitation was undertaken.

2. Due to the proximity of overhead power-lines at the site, extreme caution needs to be exercised while the crane is in operation.

3. Well cleaning and redevelopment efforts resulted in full restoration of well performance similar to that of original construction.

4. The 150mm casing, especially above the water level, appears to be in poor condition, with corrosion scale and pitting. It was not brushed during the well service.

5. The Grundfos 150S150-6 stage submersible pump performance appears to have been restored by approximately 15 PSI with cleaning. The main from the well to the treatment building was also flushed with a chlorinated solution. The pump drop pipe was coated with NSF enamel and all components were reused and installed.

6. An interim test at the well operating rate should be conducted to confirm current performance and to check the pump house flow meter calibration.

7. Regular recordings of production water levels, flow rates and pump pressures should be maintained in order to monitor any changes in well or pump performance.

8. Well and Pump performance test should be conducted in not more than 5 years. This should be completed in advance of scheduling the next well and pump maintenance inspection.

9. A Well Video Inspection should be conducted when the pump is removed.

Should you have any questions, please don't hesitate to contact us.

Regards,
International Water Supply Ltd.

John A. Harris, P.Eng.

## Well Video Inspection

A video inspection of Essa Township, Angus Brownley Well No. 5 was performed on March 11, 2021 as part of OCWA's Well and Pump maintenance program. The following observations were made:

- Ground level was the video reference measuring point. All measurements are recorded in feet. The original Water Well Record matches 5730542.
- Following pumping equipment removal, the well was pumped for approximately 60 minutes to improve clarity prior to conducting the video. The static water level was measured at 8.03m below reference point.
- The 250mm Maass pitless barrel reduced to 150mm diameter at 1.8m (6 ft) and appeared to have a corroded upper spool section above the seating surface.
- The 150mm (6 inch) diameter casing had loose metal scale and corrosion and was in very poor condition above the water level.
- Once submerged, the casing had corrosion pitting, iron precipitate with small tubercles to depth 24m (78 ft).
- The condition improved below 24m with corrosion at 26m (86 ft), and buildup and early tuberculation below 27.4m (90 ft), with iron precipitate below.
- The welded casing joints had scale buildup which were not visible for inspection.
- The top of the screen assembly was recorded at 36m (118 ft). Iron precipitate and tubercles leading into the top of the screen at 37.2m (122 ft).
- The screen had mineral buildup and bio-foul and was mostly blocked below 38.4m (126 ft). The well bottom was recorded at 39.6m (130 ft).
- The total depth was measured at 40.62m (133.3 ft) below reference point. It is noted that the difference in total depth may be attributed to the camera winch cable counter and the camera stopping above the material in the bottom of the well.

## Recommendations and Conclusions

- The well is noted to be fair to poor condition. Considering the mineral plugging in the well screen, the well should be mechanically/chemically cleaned to remove deposits and be redeveloped.
- As with all well and pump maintenance work, the well and pumping equipment should be chlorinated in accordance with AWWA C654, prior to the reinstallation of the pumping equipment.

| | | | | | |
|---|---|---|---|---|---|
| **Contract: OCWA G. Bay – Angus Brownley** | | **WELL No: 5** | | **DATE: 11-Mar-21** | |
| **Employees on Site** | **Well Location (NAD83)** | **Well and Water Level Details** | | | |
| Terry Brown | **591590mE, 4907652mN** | Static Water Level : | 8.03m | Casing Dia (mm) | 150mm |
| | | Measured Depth: | 40.62m | Casing Height (mAGL) | 0.86m |
| | **8610 5th Line Essa** | Reference Point: | | Ground Level | |

**WELL DESCRIPTION**

| DEPTH ft | DEPTH m | CASING JOINTS CONDITION | CASING/WELL CONDITION | SCREEN CONDITION |
|---|---|---|---|---|
| 5 | 1.5 | Maass MB - scale at joint | | |
| 6 | 1.8 | Reduce to 150mm, overlap at base of reducer | Poor cond, loose corrosion scale | |
| | | None seen above SWL | Heavily corroded above WL | |
| | | 25 WL | | |
| 34 | 10.4 | Scale buildup | Corrosion pitting, deep pits 36-40, small tubercles | |
| 57 | 17.4 | Scale buildup | Corrosion pitting, minimal precip. | |
| 78 | 23.8 | Scale buildup | Fair condition, scale 86 | |
| | | | | |
| 90 | 27.4 | Scale buildup | Buildup below joint, pitting 92 then scale ,early tuberculation | Well off vertical |
| 100 | 30.5 | Buildup | Darker precip below 110 | |
| | | | | |
| 118 | 36.0 | K-Packer | Buildup, bio foul and tubercles 121 | |
| | | | | |
| 122 | 37.2 | Top of screen | | Minor buildup, small barnacles, screen appears mostly plugged below 126 |
| 127 | 38.7 | Deposit/buildup on joint | | Heavier iron buildup below 127 |
| 130 | 39.6 | Video bottom | | Mineral buildup (soft) on screen, soft material on bottom |
| | | | | |
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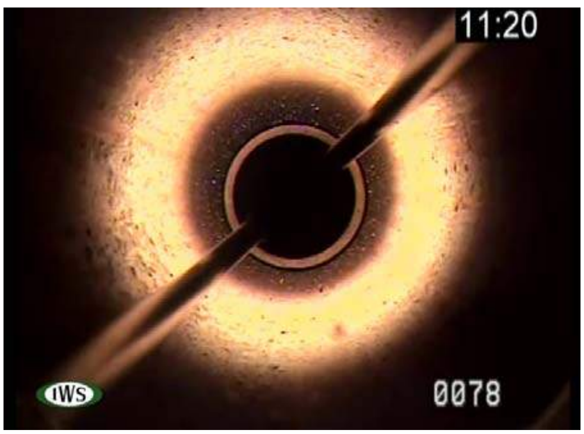
**NOTES:**
9610 light head – new bulb
Pump 1L/s 60 min prior to inspection

BROWNLEY WELL 5



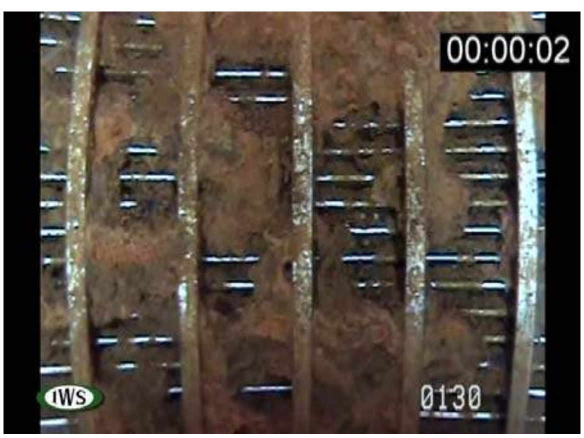
Corrosion of upper spool on pitless at 4 ft

Casing in poor condition at 14 ft

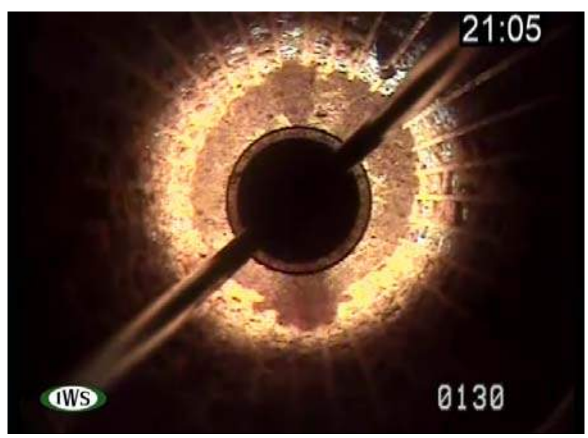


Iron precipitate and pitting on casing at 78 ft

Horizontal view of bio-activity at 124 ft



Horizontal view of deposits on screen at 130 feet



Soft sediment on bottom at 130 feet

## Well Video Inspection

A video inspection of Essa Township, Angus Brownley Well No. 5 was performed on March 22, 2021 following well rehabilitation efforts. The following observations were made:

- Ground level was the video reference measuring point. All measurements are recorded in feet. The original Water Well Record matches 5730542.
- The well was pumped for approximately 45 minutes to improve clarity prior to conducting the video. The static water level was measured at 7.94m below reference point.
- The 250mm Maass pitless barrel reduced to 150mm diameter at 1.8m (6 ft) and some of the corroded pieces of the upper spool had been removed.
- The 150mm (6 inch) diameter casing was intentionally avoided during the rehabilitation. Loose corroded metal scale remained and the casing appeared to be in very poor condition above the water level.
- Once submerged, the casing had corrosion pitting, with residual iron precipitate to depth 24m (78 ft).
- Below 24m (78 ft), residual scale remained with a scuff at 26m.
- The welded casing joints that were visible had scale buildup and appeared to be in satisfactory condition.
- The transition from casing to the Figure-K packer at depth 36.3m (119 in the horizontal view) appeared to show heavily corroded casing.
- The top of the K-Packer was recorded at 36m (118 ft). Minor precipitate was noted leading into the top of the screen at 37.2m (122 ft).
- The screen appeared in fair to good condition, with some residual precipitate along one side. The coupling between screen lengths at 38.7m appeared pitted. The well bottom was recorded at 39.9m (131 ft).
- The total depth was measured at 41.1m (134.8 ft) below reference point. It is noted that the difference in total depth may be attributed to the camera winch cable counter and the camera stopping above the material in the bottom of the well.

## Recommendations and Conclusions

- Turbidity trends and bacteriological results should be monitored as an indicator of potential casing perforation.
- As with all well and pump maintenance work, the well and pumping equipment should be chlorinated in accordance with AWWA C654, prior to the reinstallation of the pumping equipment.

Township of Essa
Brownley Well No. 5
March 22, 2021

International Water Supply Ltd.

| | | | | | |
|---|---|---|---|---|---|
| **Contract: OCWA G. Bay – Angus Brownley** | | **WELL No: 5** | | **DATE: 22-Mar-21** | |
| | | **Well and Water Level Details** | | | |
| **Employees on Site** | **Well Location (NAD83)** | | | | |
| | **591590mE, 4907652mN** | Static Water Level : | 7.94m | Casing Dia (mm) | 150mm |
| | | Measured Depth: | 42.0m | Casing Height (mAGL) | 0.86 m |
| | **8610 5th Line Essa** | Reference Point: | | Ground Level | |

**WELL DESCRIPTION**

| DEPTH ft | m | CASING JOINTS CONDITION | CASING/WELL CONDITION | SCREEN CONDITION |
|---|---|---|---|---|
| 5 | 1.5 | Maass HB - scale at joint | | |
| 6 | 1.8 | 250mm to 150mm adapter corroded on bottom | Poor cond, loose corrosion scale | |
| | | None seen above SWL | Heavily corroded above WL | |
| | | 25 WL | | |
| 34 | 10.4 | Okay | Pitting, fair cond | |
| 57 | 17.4 | Okay | Pitting, fair cond | |
| 78 | 23.8 | Okay | Pitting, fair cond, Scuff 85, scale 89, Buildup (tubercles) and scale , some removed | |
| 100 | 30.5 | Okay, minor scale | Darker mineral buildup, pitting | |
| | | | | |
| 118 | 36.0 | K-Packer assembly | Casing above packer-questionable condition-residual scale 120 | See 119 in Horizontal view |
| | | | | |
| 122 | 37.2 | Top of screen | | Clean to 122, residual precipitate |
| 127 | 38.7 | | | Pitting on coupling, minor residual deposits along one side |
| 131 | 39.9 | Video bottom | | Fine sediment |
| | | | | |
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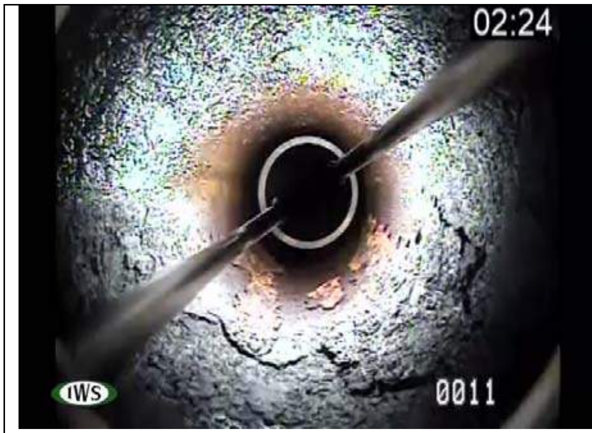
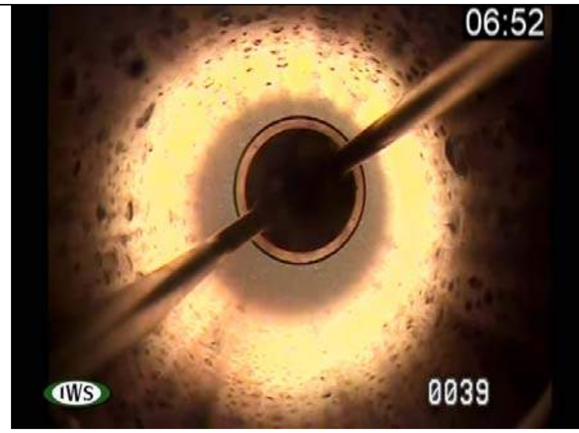
**NOTES:**
Re-run Horizontal View due to disk write error
Pump 1L/s 45 min prior to inspection

International Water Supply Ltd.

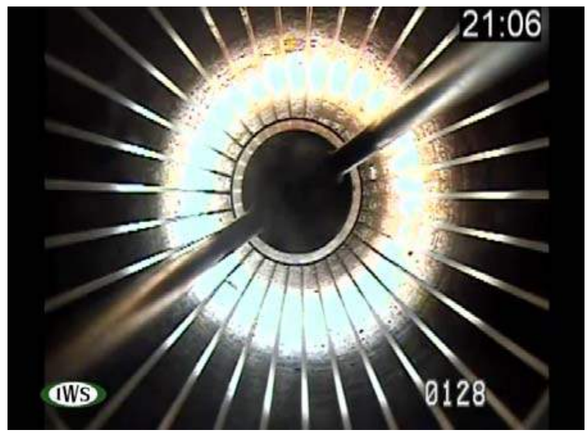


Corrosion scale at 11 ft



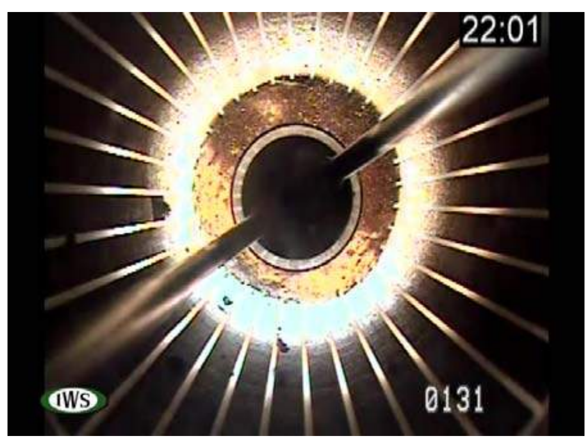
Iron precipitation and pitting at 39 ft

Casing corrosion at K-Packer at 119 ft



Vertical view of screen in good condition at 128 ft

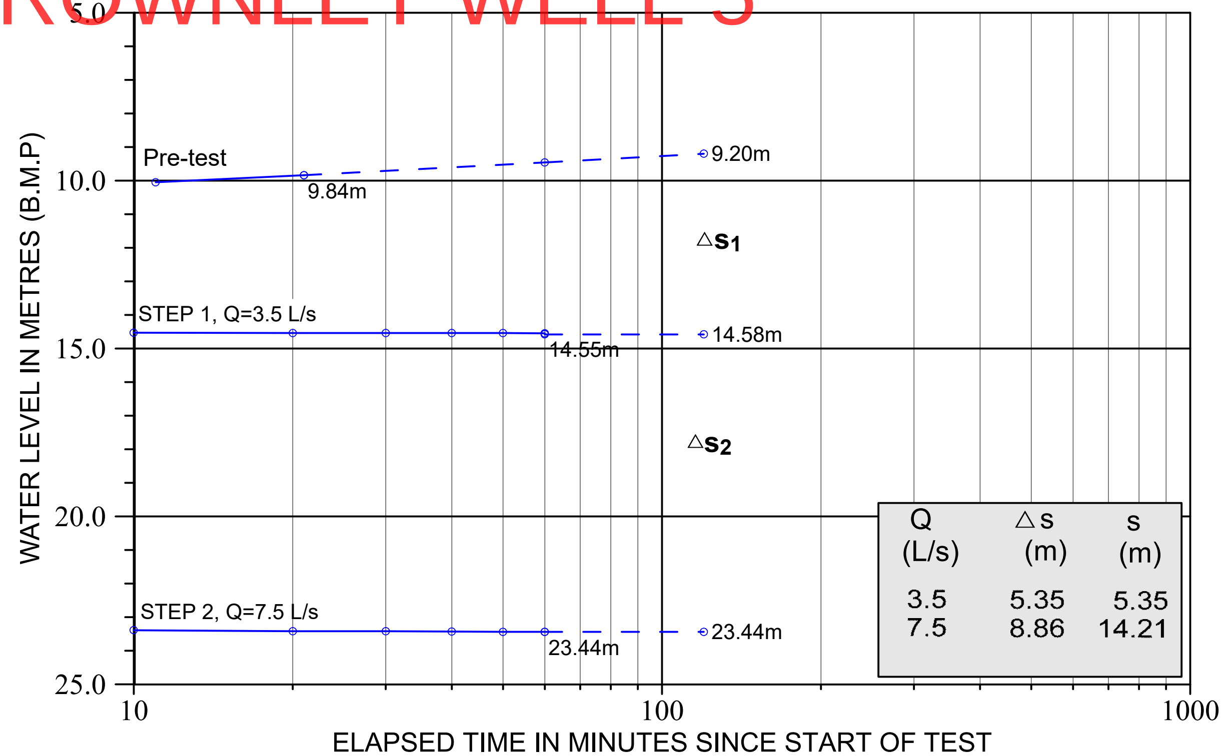
Filter pack material seen behind screen at 132 feet



Sediment on bottom at 131 feet

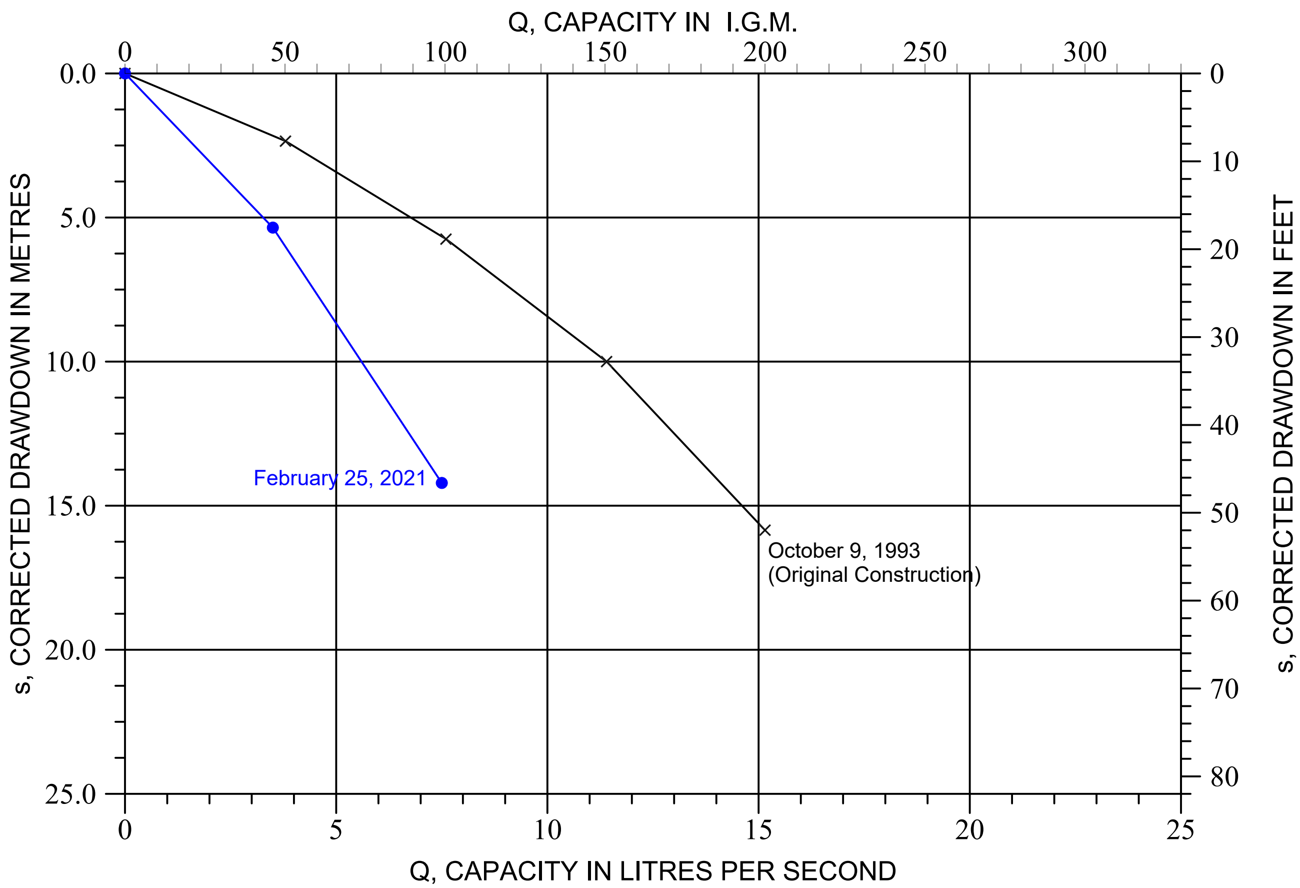
BROWNLEY WELL 5

International Water Supply Ltd.




| Q (L/s) | △s (m) | s (m) |
|---|---|---|
| 3.5 | 5.35 | 5.35 |
| 7.5 | 8.86 | 14.21 |

**February 25, 2021**

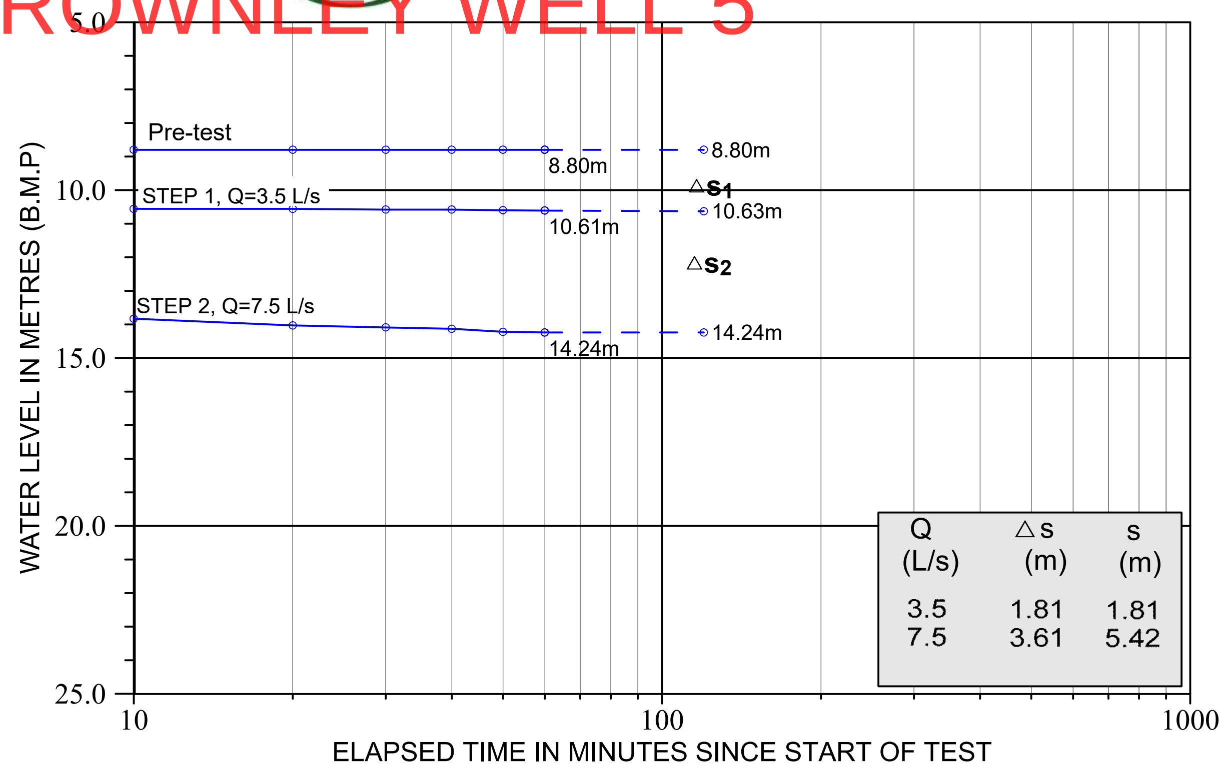



**Township of Essa**

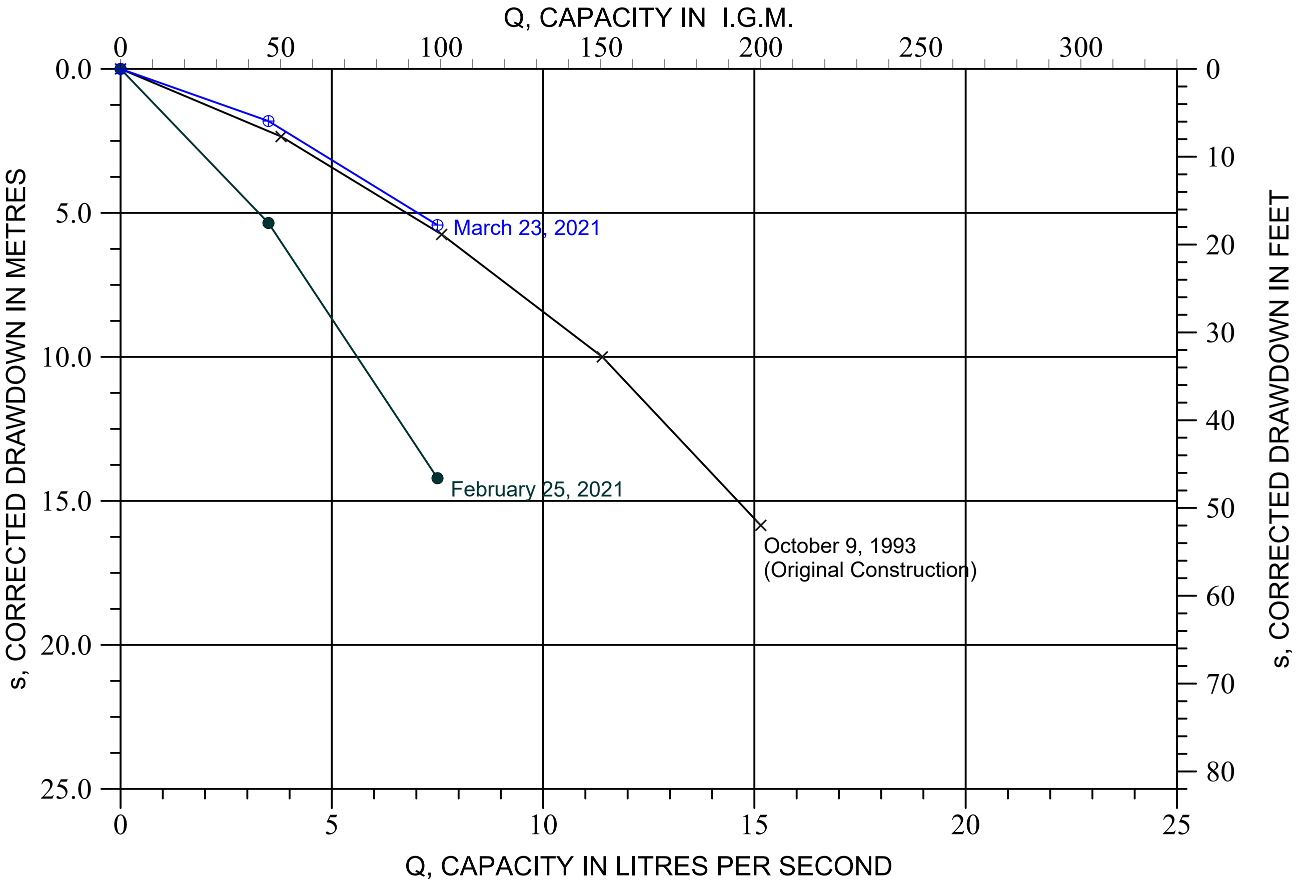
**Angus Brownley Well No. 5**
**Well Performance Test**
**Dwg. No. A21017**

BROWNLEY WELL 5

International Water Supply Ltd.



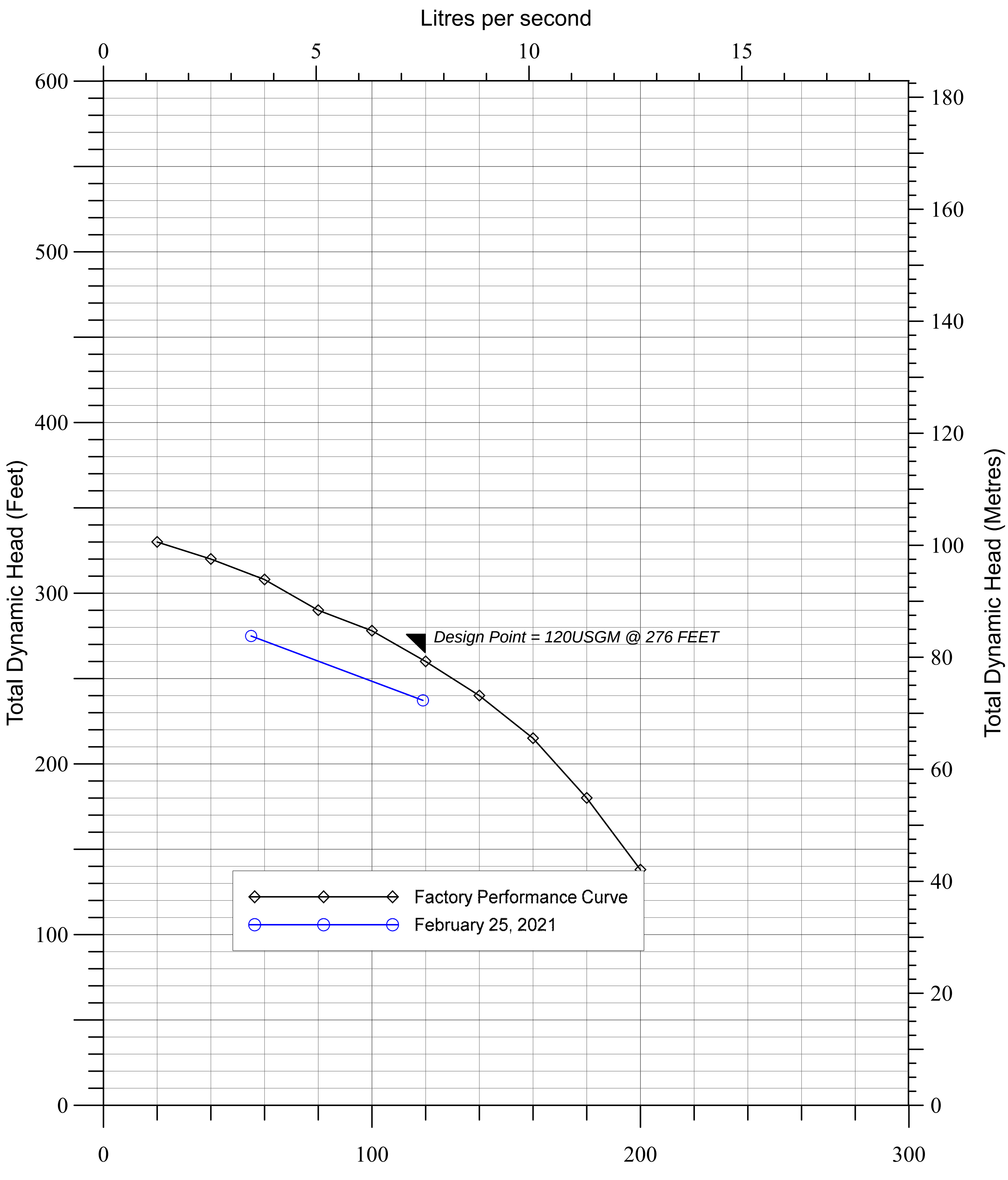

**March 23, 2021**




| | |
|---|---|
| **Township of Essa** | **Angus Brownley Well No. 5**<br>**Well Performance Test**<br>**Dwg. No. A21052** |

BROWNLEY WELL 5

International Water Supply Ltd.



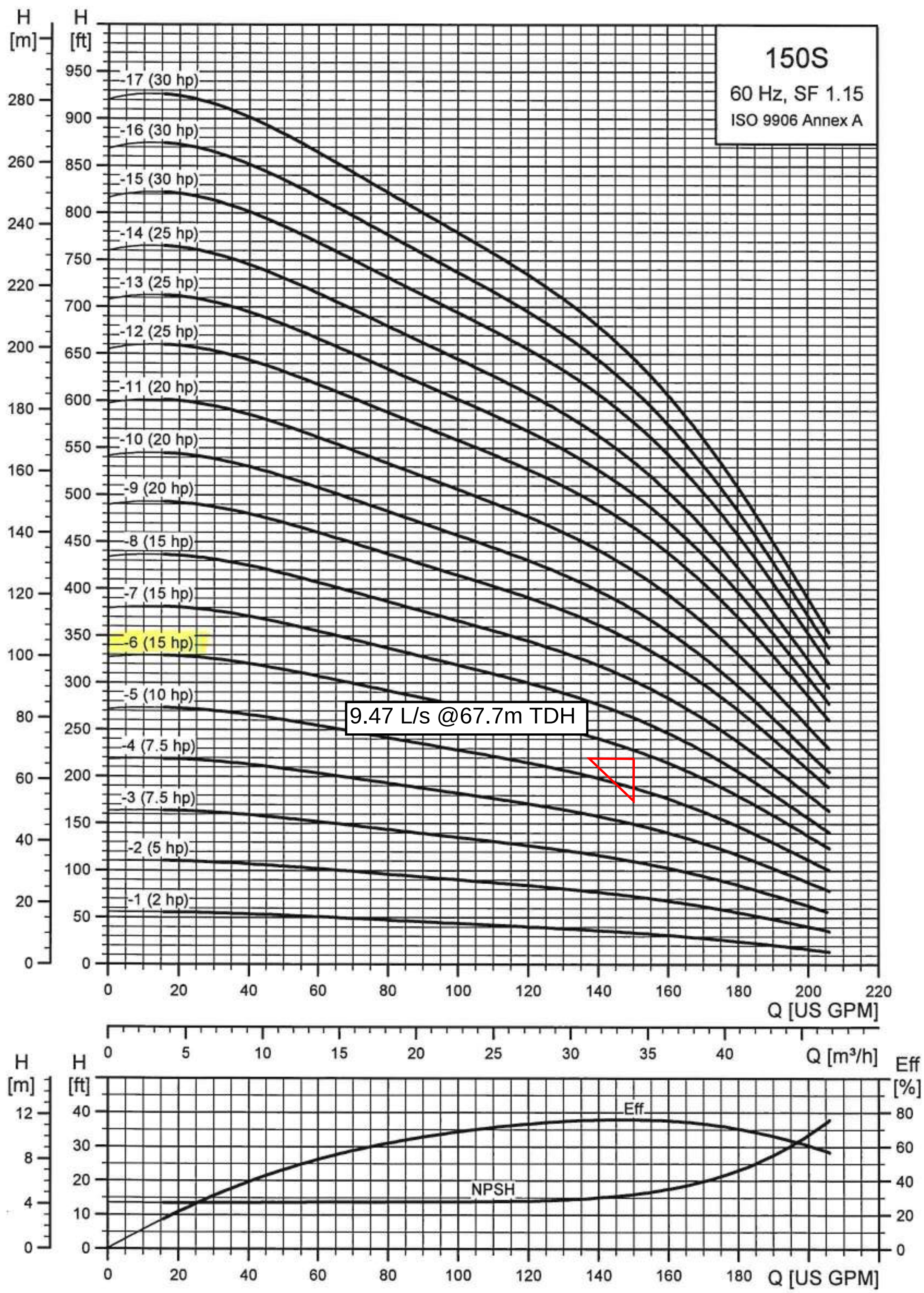

February 25, 2021

Brownley Well No. 5
Pump Performance
Grundfos 150S150-6 Dwg. No. A21018

# BROWNLEY WELL 5

## 6" and larger wells - continued

## SP 150S (150 gpm)




Township of Essa
Angus- Brownley Well No. 5
Grundfos 150S150-6 Performance Curve

Ontario Ministry of the Environment

**Well Tag Number** (Place sticker and print number below) A011230

# Well Record

*Regulation 903 Ontario Water Resources Act*

page 1 of 2

BROWNLEY WELL 6

**Instructions for Completing Form**

- For use in the **Province of Ontario** only. This document is a permanent **legal** document. Please retain for future reference.
- All Sections **must** be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- **All metre measurements shall be reported to 1/10th of a metre.**
- Please print clearly in blue or black ink only.

**Ministry Use Only** MUN | CON | LOT

## Well Owner's Information and Location of Well Information

| | | | |
|---|---|---|---|
| First Name: Twp of | Last Name: Essa | Mailing Address (Street Number/Name, RR, Lot, Concession): 5786 County Rd 21 Utopia | |
| County/District/Municipality: Simcoe | Township/City/Town/Village: Essa | Province: Ontario | Postal Code: L0M 1T0 / Telephone Number (include area code): 705 424 9770 |
| Address of Well Location (County/District/Municipality): Simcoe | Township: Essa | Lot: 28 | Concession: IV |
| RR#/Street Number/Name: Concession 5 | City/Town/Village: Angus | Site/Compartment/Block/Tract etc. | |
| GPS Reading NAD 83, Zone 17, Easting 591567, Northing 4907632 | Unit Make/Model: Magellan | Mode of Operation: ☐ Undifferentiated ☑ Averaged ☐ Differentiated, specify | |

## Log of Overburden and Bedrock Materials (see instructions)

| General Colour | Most common material | Other Materials | General Description | Depth From (Metres) | Depth To (Metres) |
|---|---|---|---|---|---|
| Brown | Sand | | Fine | 0 | 3.1 |
| Grey | Sand | | Fine | 3.1 | 6.7 |
| Grey | Clay | | Soft | 6.7 | 18.3 |
| Grey | Clay | Sand | Hard | 18.3 | 23.2 |
| Grey | Sand | | Coarse Loose | 23.2 | 25.3 |
| Grey | Gravel | Boulders | Coarse Packed | 25.3 | 28.4 |
| Grey | Sand | Gravel | Fine-Medium Packed | 28.4 | 30.2 |
| Grey | Sand | | Packed | 30.2 | 31.4 |
| Brown | Sand | Gravel | Medium-Coarse | 31.4 | 34.13 |

### Hole Diameter

| Depth From (Metres) | Depth To (Metres) | Diameter (Centimetres) |
|---|---|---|
| 0 | 13.7 | 50.8 |
| 13.7 | 42.1 | 30.5 |

### Water Record

Water found at 23 Metres — Kind of Water: ☑ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

After test of well yield, water was ☑ Clear and sediment free ☐ Other, specify

Chlorinated ☑ Yes ☐ No

### Construction Record

| Inside diam centimetres | Material | Wall thickness centimetres | Depth From (Metres) | Depth To (Metres) |
|---|---|---|---|---|
| **Casing** | | | | |
| 20.3 | ☒ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized | 0.84 | +0.91 | 36.6 |
| | ☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized | | | |
| | ☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized | | | |
| **Screen** — Outside diam | | Slot No. | | |
| 22.0 | ☒ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized | 30 | 36.6 | 41.5 |
| **No Casing or Screen** | ☐ Open hole | | | |

### Test of Well Yield

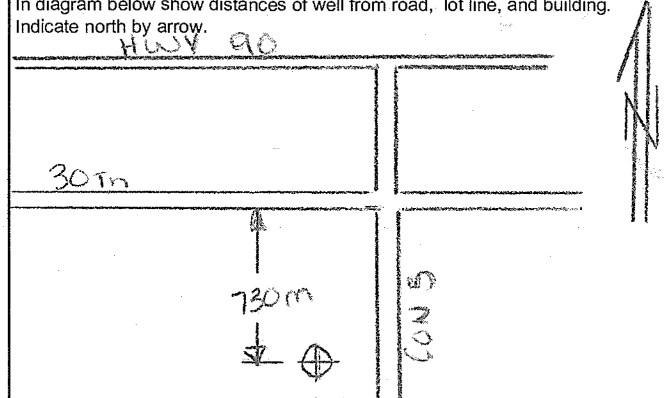
| Pumping test method | Draw Down Time min | Draw Down Water Level Metres | Recovery Time min | Recovery Water Level Metres |
|---|---|---|---|---|
| Pump intake set at - (metres) | Static Level | 7.65 | | 17.58 |
| Pumping rate - (litres/min) | 1 | | 1 | |
| Duration of pumping ___hrs + ___ min | 2 | 13.5 | 2 | 11.39 |
| Final water level end of pumping ___metres | 3 | | 3 | |
| Recommended pump type. ☐ Shallow ☐ Deep | 4 | 13.54 | 4 | 11.11 |
| Recommended pump depth. ___metres | 5 | | 5 | |
| Recommended pump rate. (litres/min) | 10 | 13.86 | 10 | 10.70 |
| | 15 | 13.97 | 15 | 10.50 |
| If flowing give rate - (litres/min) | 20 | 14.05 | 20 | 10.35 |
| | 25 | 14.11 | 25 | 10.24 |
| If pumping discontinued, give reason. | 30 | 14.17 | 30 | 10.155 |
| | 40 | 14.25 | 40 | 10.00 |
| | 50 | 14.32 | 50 | 9.88 |
| | 60 | 14.38 | 60 | 9.78 |

### Plugging and Sealing Record ☒ Annular space ☐ Abandonment

| Depth set at - Metres From | To | Material and type (bentonite slurry, neat cement slurry) etc. | Volume Placed (cubic metres) |
|---|---|---|---|
| 0 | 1.1 | Bentonite | 0.158 |
| 1.1 | 34.1 | Neat Cement | 3.9 |

### Location of Well

In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.




### Method of Construction

☒ Cable Tool ☐ Rotary (conventional) ☐ Rotary (reverse) ☐ Rotary (air) ☐ Air percussion ☐ Boring ☐ Diamond ☐ Jetting ☐ Driving ☐ Digging ☐ Other

### Water Use

☐ Domestic ☐ Stock ☐ Irrigation ☐ Industrial ☐ Commercial ☒ Municipal ☐ Public Supply ☐ Not used ☐ Cooling & air conditioning ☐ Other

### Final Status of Well

☒ Water Supply ☐ Observation well ☐ Test Hole ☐ Recharge well ☐ Abandoned, insufficient supply ☐ Abandoned, poor quality ☐ Unfinished ☐ Dewatering ☐ Replacement well ☐ Abandoned, (Other)

Audit No. Z 33279

Date Well Completed: YYYY 2007 MM 03 DD 08

Date Delivered: YYYY MM DD

Was the well owner's information package delivered? ☐ Yes ☒ No

### Well Contractor/Technician Information

| | |
|---|---|
| Name of Well Contractor: International Water Supply | Well Contractor's Licence No.: 2801 |
| Business Address (street name, number, city etc.): PO Box 310 Barrie ON L4M 4T5 | |
| Name of Well Technician (last name, first name): Peter Marchildon | Well Technician's Licence No.: T0364 |
| Signature of Technician/Contractor: X | Date Submitted: YYYY 2007 MM 04 DD 12 |

### Ministry Use Only

| | |
|---|---|
| Data Source | Contractor 2801 |
| Date Received APR 27 2007 | Date of Inspection YYYY MM DD |
| Remarks | Well Record Number |

0506E (09/03) Contractor's Copy ☐ Ministry's Copy ☒ Well Owner's Copy ☐ *Cette formule est disponible en français*

Ontario | Ministry of the Environment

**Well Tag Number** (Place sticker and print number below) A011230

# Well Record
*Regulation 903 Ontario Water Resources Act*



BROWNLEY WELL 6

**Instructions for Completing Form**

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- All Sections **must** be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- **All metre measurements shall be reported to 1/10th of a metre.**
- Please print clearly in blue or black ink only.

Ministry Use Only
MUN | CON | LOT

[redacted]

| Address of Well Location (County/District/Municipality) | Township | Lot | Concession |
|---|---|---|---|
| Simcoe | Essa | 28 | IV |

| RR#/Street Number/Name | City/Town/Village | Site/Compartment/Block/Tract etc. |
|---|---|---|
| Concession 5 | Angus | |

GPS Reading NAD 8 3 Zone Easting Northing | Unit Make/Model | Mode of Operation: ☐ Undifferentiated ☐ Averaged ☐ Differentiated, specify

## Log of Overburden and Bedrock Materials (see instructions)

| General Colour | Most common material | Other Materials | General Description | Depth Metres From | Depth Metres To |
|---|---|---|---|---|---|
| Brown | Sand | | Fine - Medium | 34.2 | 37.8 |
| Brown | Sand | Gravel | Medium - Coarse | 37.8 | 38.1 |
| Brown | Gravel | Sand | Medium - Coarse | 38.1 | 39.6 |
| Brown | Sand | Gravel | Medium - Coarse | 39.6 | 40.8 |
| Brown | Sand | | Medium - Packed | 40.8 | 41.8 |
| Grey | Clay | Sand & Gravel | | 41.8 | 42.1 |

### Hole Diameter

| Depth Metres From | Depth Metres To | Diameter Centimetres |
|---|---|---|
| | | |

### Water Record

Water found at ___ Metres / Kind of Water
- ___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:
- ___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:
- ___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

After test of well yield, water was ☐ Clear and sediment free ☐ Other, specify

Chlorinated ☐ Yes ☐ No

### Construction Record

| Inside diam centimetres | Material | Wall thickness centimetres | Depth Metres From | Depth Metres To |
|---|---|---|---|---|
| **Casing** | | | | |
| | ☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized | | | |
| | ☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized | | | |
| | ☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized | | | |
| **Screen** | | | | |
| Outside diam | ☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized | Slot No. | | |
| **No Casing or Screen** | | | | |
| | ☐ Open hole | | | |

### Test of Well Yield

| Pumping test method | Draw Down Time min | Draw Down Water Level Metres | Recovery Time min | Recovery Water Level Metres |
|---|---|---|---|---|
| Pump intake set at - (metres) | Static Level | | | |
| Pumping rate - (litres/min) | 1 | | 1 | |
| Duration of pumping ___hrs + ___ min | 2 | | 2 | |
| Final water level end of pumping ___metres | 3 | | 3 | |
| Recommended pump type. ☐ Shallow ☐ Deep | 4 | | 4 | |
| Recommended pump depth. ___metres | 5 | | 5 | |
| Recommended pump rate. (litres/min) | 10 | | 10 | |
| | 15 | | 15 | |
| If flowing give rate - (litres/min) | 20 | | 20 | |
| | 25 | | 25 | |
| If pumping discontinued, give reason. | 30 | | 30 | |
| | 40 | | 40 | |
| | 50 | | 50 | |
| | 60 | | 60 | |

### Plugging and Sealing Record ☒ Annular space ☐ Abandonment

| Depth set at - Metres From | To | Material and type (bentonite slurry, neat cement slurry) etc. | Volume Placed (cubic metres) |
|---|---|---|---|
| | | | |

### Method of Construction

☒ Cable Tool ☐ Rotary (air) ☐ Diamond ☐ Digging ☐ Rotary (conventional) ☐ Air percussion ☐ Jetting ☐ Other ☐ Rotary (reverse) ☐ Boring ☐ Driving

### Water Use

☐ Domestic ☐ Industrial ☐ Public Supply ☐ Other ☐ Stock ☐ Commercial ☐ Not used ☐ Irrigation ☒ Municipal ☐ Cooling & air conditioning

### Final Status of Well

☒ Water Supply ☐ Recharge well ☐ Unfinished ☐ Abandoned, (Other) ☐ Observation well ☐ Abandoned, insufficient supply ☐ Dewatering ☐ Test Hole ☐ Abandoned, poor quality ☐ Replacement well

### Well Contractor/Technician Information

| Name of Well Contractor | Well Contractor's Licence No. |
|---|---|
| International Water Supply | 2801 |

Business Address (street name, number, city etc.) PO Box 310 Barrie ON L4M 4T5

| Name of Well Technician (last name, first name) | Well Technician's Licence No. |
|---|---|
| Peter Marchildon | T0364 |

Signature of Technician/Contractor X [signature] | Date Submitted YYYY MM DD 2007 04 12

### Location of Well

In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.

Audit No. Z 33280 | Date Well Completed YYYY MM DD

Was the well owner's information package delivered? ☐ Yes ☐ No | Date Delivered YYYY MM DD

### Ministry Use Only

| Data Source | Contractor 2801 |
|---|---|
| Date Received APR 2 7 2007 | Date of Inspection YYYY MM DD |
| Remarks | Well Record Number |

BROWNLEY WELL 6

INTERNATIONAL WATER SUPPLY LTD

Groundwater Development – Drilling Services
Pumps – Water Treatment – Service & Maintenance
342 Bayview Drive, P. O. Box 310
Barrie, Ontario, Canada L4M 4T5
Tel:705-733-0111 • 800-461-9636 • Fax: 705-721-0138
email: iws@iws.ca www.iws.ca

January 6, 2021

Ontario Clean Water Agency
30 Woodland Drive
Wasaga Beach, ON
L9Z 2V4

Attention: Mark Yandt
Senior Operations Manager – South Simcoe Hub

Reference: Well and Pump Maintenance
Township of Essa
Angus Brownley Well No. 6

International Water Supply Ltd. (IWS) was authorized conduct Well and Pump Performance Testing and Maintenance Inspection at Brownley Well No. 6. These investigations resulted in the completion of a well rehabilitation and the following is a report of the work completed along with our recommendations.

<u>Background</u>

The Angus Brownley site located on 8610 5$^{th}$ Line in Essa Township. Wells No. 4 and 5 are also located at this location and the three wells pump into a 2,500m$^3$ underground reservoir. Iron is controlled with the addition of sodium silicate with primary disinfection using sodium hypochlorite.

Brownley Well No. 6 was constructed by International Water Supply Ltd in December 2006 as a 200 mm diameter gravel wall well with 30 slot screen set across the interval 36.6 to 41.5 m below ground level. The 200mm casing was cement grouted inside a 450mm borehole to depth 13.7m and the 355mm diameter borehole to 34.1m. Long term testing completed in March 2007, resulted in the well producing 20.8L/s with 8.24m of drawdown after 24 hours of continuous pumping.

<u>Procedure and Work Program</u>

Well No. 6 had not been tested since constructed and a well performance test was conducted into the system at 10 L/s on August 11, 2020. Results showed approximately 5.2 metres of additional drawdown at 10 L/s as compared to original construction in 2006. Results are plotted on Drawing A20102.

OCWA approved a well and pump inspection and the submersible pump and motor was removed from the well and transported to our Barrie yard for cleaning and inspection.

Pumping Equipment

The Grundfos 300S400-9 stage submersible pump, 40 HP motor and drop pipe was heavily coated with iron after removal from the well. The components were cleaned and the pump was dismantled for inspection. The 100mm drop pipe was cleaned and coated with NSF enamel. Equipment was in fair condition and suitable for reinstallation.

Pump performance on August 11 was calculated and was about 18m below the factory curve at 10L/s. Cleaning of the pump has appeared to restore approximately 40m TDH at 20 L/s as plotted on Drawing A21000.


Pump and motor coated in Iron


Note Iron deposits on interior of drop pipe

Well Video Inspection

The well video inspection was completed on August 12. The 200mm (8 inch) diameter casing had loose metal scale and corrosion and corrosion to depth 9m (30 ft). Below this depth, the casing appeared pitted. The casing had moderate iron precipitate with mineral scale buildup. Below depth 34m (112 ft), bio-foul activity was noted which increased into the screen below. The top of the screen assembly was recorded at 37.8m, with heavy bio-foul activity throughout. A detailed video inspection report is included with this report. Copies of of the video inspection was previously provided on a USB drive.

Recommendations were approved by OCWA to clean mineral and biofilm from the casing and screen and redevelop the well using enhanced surfactant/ disinfection and remove the accumulated debris from the well bottom.

## Well Maintenance

The well casing and screen was brushed in the presence of a pH corrected disinfectant solution and worked through the well for several hours. The following day, an isolation packer was placed in the screened area and the well was air-lift developed to waste into a containment tank to be dechlorinated. Development continued and a 950L solution of chlorinated surfactant was injected across the length of screen and agitated for 6 hours and left overnight. The following day, a double volume treatment was injected and the product was mechanically agitated with the double-ring packer. The well was airlift developed into the containment tank and dechlorinated. While airlift pump into the tank, it appeared that the water levels had improved by approximately 1 meter at 7.6 L/s, The water appeared greyish in colour with some fine sand. The third treatment consisted of a three times volume treatment which was injected and mechanically agitated with the double-ring packer. The well was airlift developed for another 6 hours into the containment tank until clear and dechlorinated. The mechanical packer assembly was removed from the well and the crew injected an enhanced disinfection volume providing 133 mg/L chlorine prior to setting the pump.

## Well Performance

On September 4, IWS Well Technicians returned to the site to have the pump electrically connected and test the installation. After 30 minutes pumping to waste while dechlorinating, and no residual was remaining, samples were collected for analysis. Unfortunately, adverse bacteriological results were reports a few days later and on September 15, IWS returned to the site to inject a 3000L chlorinated solution through the pitless spool, providing approximately 275 mg/L. Pumping to waste through the plant was stopped once chlorine was present and the chlorinated solution was allowed to treat the line from the well to the plant overnight. The well was pumped to waste while declorinating and a second sample was collected. Results were returned okay and the well was put back into service. OCWA operations staff commented that higher pumping rates were achieved following the chlorination of the line to the plant. This was like the result of cleaning the iron deposits from the pump impellers.

On October 5, a performance test was conducted to waste through the flow meter in the plant. The results are plotted in Drawing No. A20103. Approximately 2.1 metres of drawdown was recovered at 10 L/s. Specific capacity is currently half that of original construction, with an additional 6 metres of drawdown at 20L/s.

## Conclusions and Recommendations

1. Video inspection of Brownley Well 6 indicated iron precipitate with heavy bio-foul activity present. Well cleaning and rehabilitation was undertaken.

2. Well cleaning and redevelopment efforts did not result in full restoration of well performance. Additional rehabilitation may be required if performance deteriorates.

3. Wells 4 and 5 are expected to be found in similar conditions. A revised procedure will be considered to attempt improved results.

4. The Grundfos 300S400 submersible pump performance appears to have been restored with cleaning. The pump drop pipe was coated with NSF enamel and all components were reused and installed.

5. An interim test at the well operating rate should be conducted to confirm current performance and to check the pump house flow meter calibration.

6. Regular recordings of production water levels, flow rates and pump pressures should be maintained in order to monitor any changes in well or pump performance. Additional rehabilitation work may be required at next servicing in not more than 5 years.

7. Well and Pump performance test should be conducted in not more than 5 years. This should be completed in advance of scheduling the next well and pump maintenance inspection.

8. A Well Video Inspection should be conducted when the pump is removed.

Should you have any questions, please don't hesitate to contact us.

Kindest Regards,

Terry Brown, C. Tech.

John A. Harris, P.Eng.

**Well Video Inspection**

A video inspection of Essa Township, Angus Brownley Well No. 6 was performed on August 12, 2020 following pump removal to replace the transducer which was taped to the pump riser pipe. The following observations were made:

- The flange the the Maass MB pitless was the video reference measuring point. All measurements are recorded in feet. The original Water Well Record matches 5739698.
- Following pump and motor removal, the well was pumped for approximately 90 minutes to improve clarity prior to conducting the video. The static water level was measured at 11.27m below reference point.
- The pitless adapter was seen at approximately 2.4m (8 ft). The 200mm (8 inch) diameter casing had loose metal scale and corrosion and corrosion to depth 9m (30 ft). Below this depth, the casing appeared pitted.
- Once submerged, the casing had moderate iron precipitate with mineral buildup. Below depth 34m (112 ft), bio-foul activity was noted which increased into the screen below.
- An abrasion mark is seen in the horizontal view at depth 36m (119 ft), thought to be the bottom of the motor.
- The welded casing joints that were visible appeared to be in good condition.
- The top of the screen assembly was recorded at 37.8m (124 ft), with heavy bio-foul activity throughout its depth.
- A partial blockage in the screen was encountered near the well bottom at 40.8m (134 ft).
- The total depth was measured at 42.0m (137.9 ft) below reference point. It is noted that the difference in total depth may be attributed to the camera winch cable counter and the camera stopping above the material in the bottom of the well.

**Recommendations and Conclusions**

- The well is noted to be fair to poor condition, considering the bio-foul activity in the well screen. The well should be mechanically/chemically cleaned to remove growth and be redeveloped.
- As with all well and pump maintenance work, the well and pumping equipment should be chlorinated in accordance with AWWA C654, prior to the reinstallation of the pumping equipment.

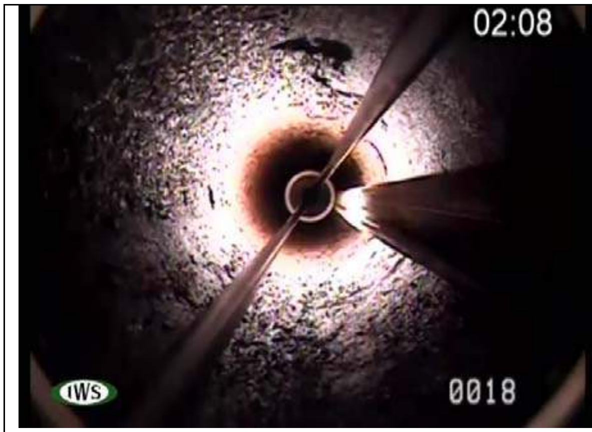
| Contract: Essa Township Angus Brownley | | WELL No: 6 | DATE: 12-Aug-20 |
|---|---|---|---|
| | | PUMP No: | |
| **Employees on Site** | **Well Location (NAD83)** | **Well and Water Level Details** | |
| Terry Brown | 591566E, 4907608N | Static Water Level : | 11.27m |
| | 8610 5th Line | Reference Point: | Top of Flange |
| | | Measured Well Depth: | 42.0m |

**WELL DESCRIPTION**

| DEPTH ft | m | CASING JOINTS CONDITION | CASING/WELL CONDITION | SCREEN CONDITION |
|---|---|---|---|---|
| 8 | 2.4 | Top weld of pitless | Heavy oxidation, loose scale below 14, iron deposits in discharge | |
| 19 | 5.8 | Okay | Pitting, surface corrosion and metal scale | |
| 28 | 8.5 | Corrosion buildup, PWL 38 | Pitting, surface corrosion | |
| 40 | 12.2 | okay | Pitting, surface corrosion | |
| 70? | | Not seen on Horiz run | Iron buildup, scale/pitting | |
| 81 | 24.7 | Okay – partially obscured my mineral buildup | Iron buildup.scale/pitting, -deep pits 80 Horiz, tubercles 95 | |
| 102 | 31.1 | | Iron buildup, pitting, increased particulate, heavy iron deposits 110, Bio-foul activity (IRB?) below 112 | |
| 117 | 35.7 | unknown | Abrasion / wear mark seen in horizontal view 119 ( bottom of motor) | |
| 124 | 37.8 | Top of Screen | | Heavy bio-foul and iron buildup |
| 134 | 40.8 | | | Bio-foul, partial blockage due to buildup |
| 135 | 41.1 | Video bottom | | Sediment |

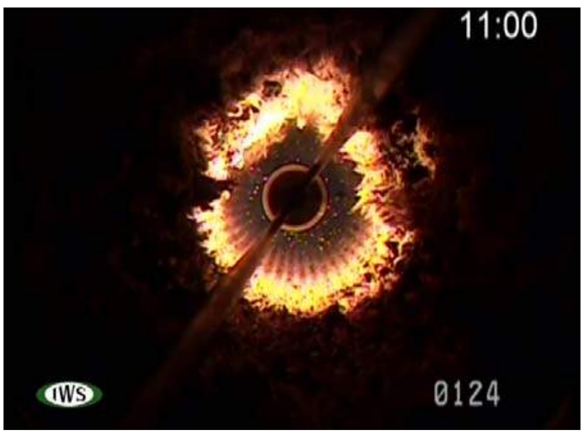
**NOTES:**

Chlorinate on ascent
LED lighthead
Post-service video recommended to assess condition after cleaning

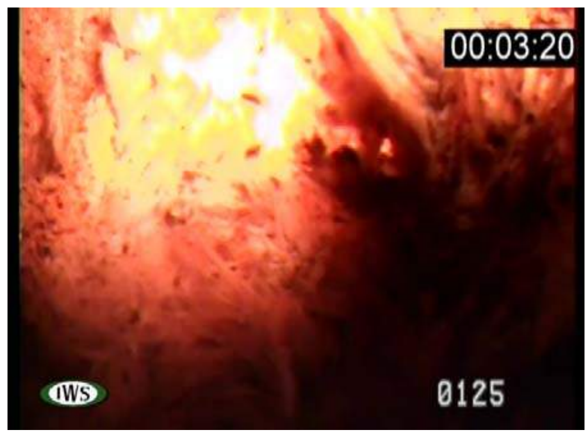


Loose corrosion scale at 18 ft

Abrasion mark at 119 ft from bottom of motor



Bio-activity in screen at 124 ft



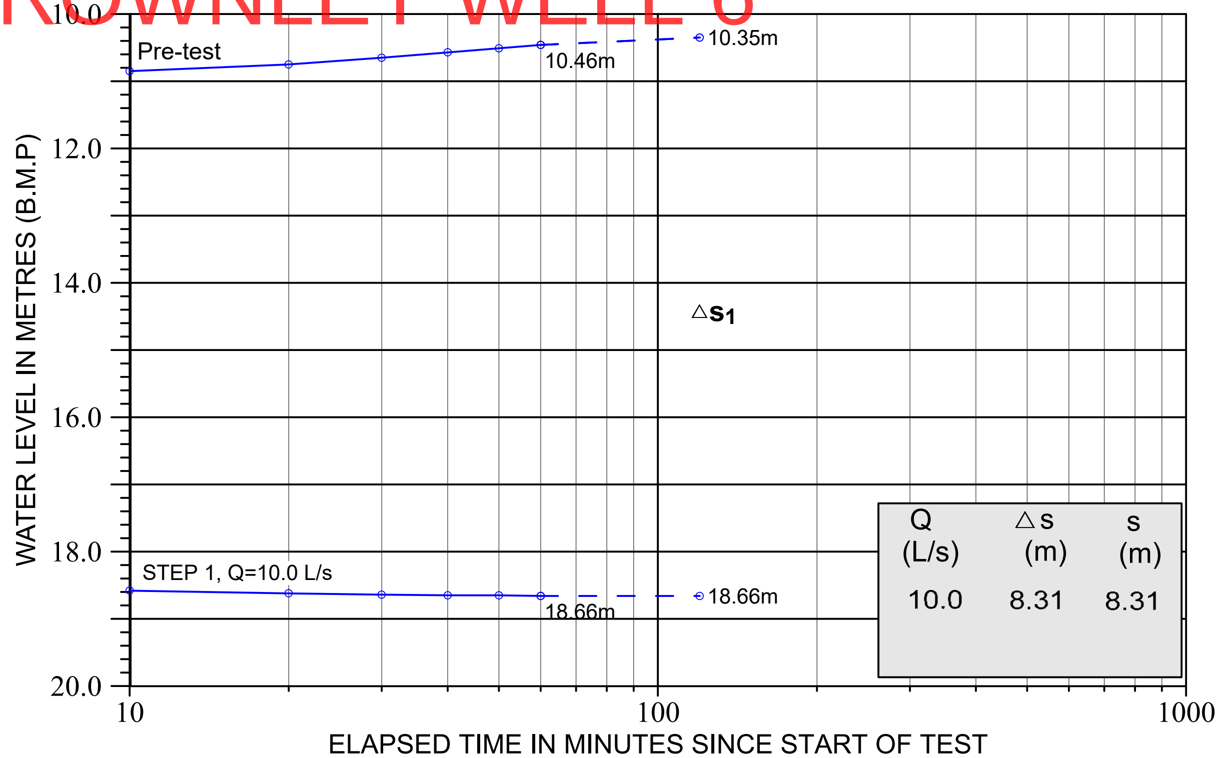
Horizontal view of bio-activity at 125 ft

Horizontal view deposits on screen at 135 feet

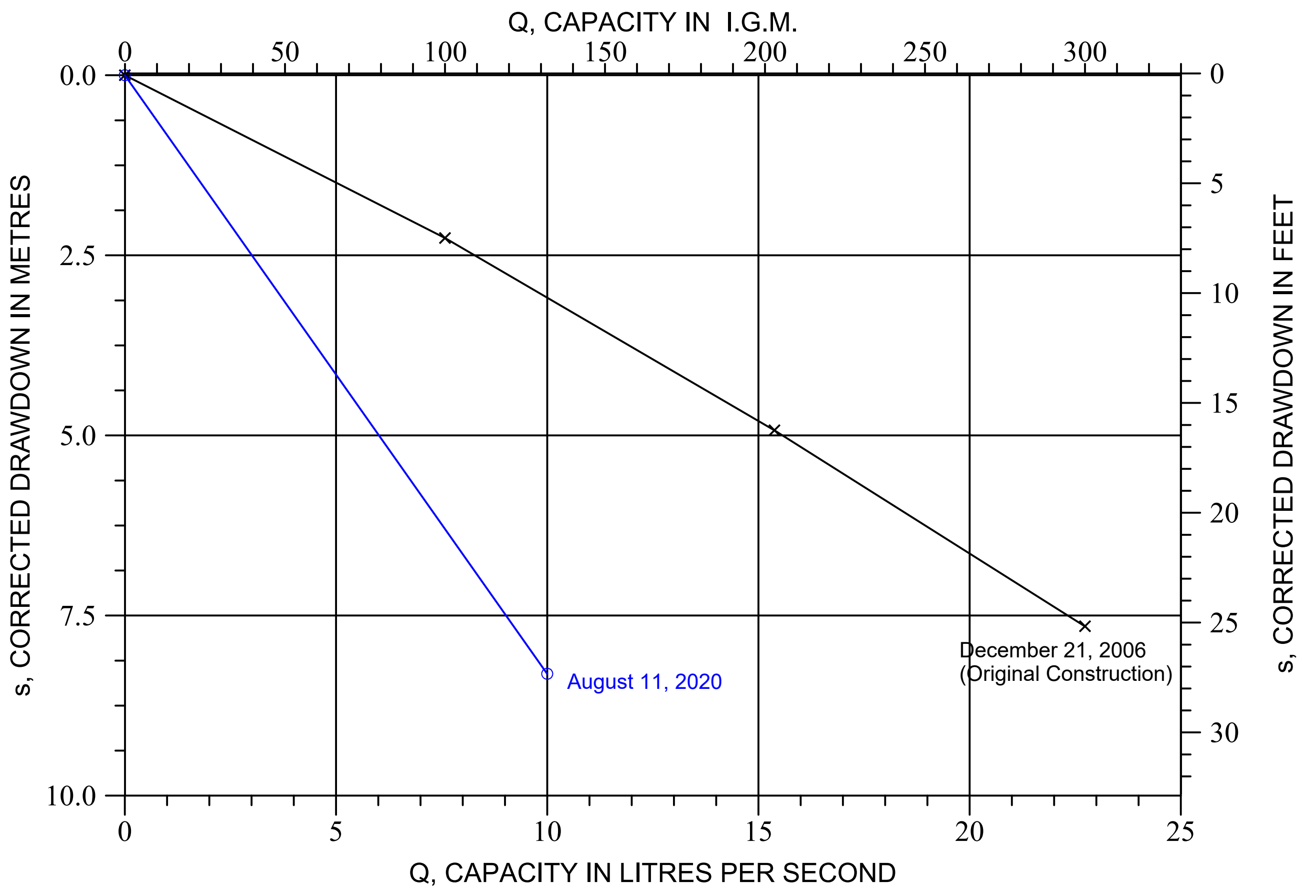
Partial blockage near bottom at 134 feet

BROWNLEY WELL 6

International Water Supply Ltd.



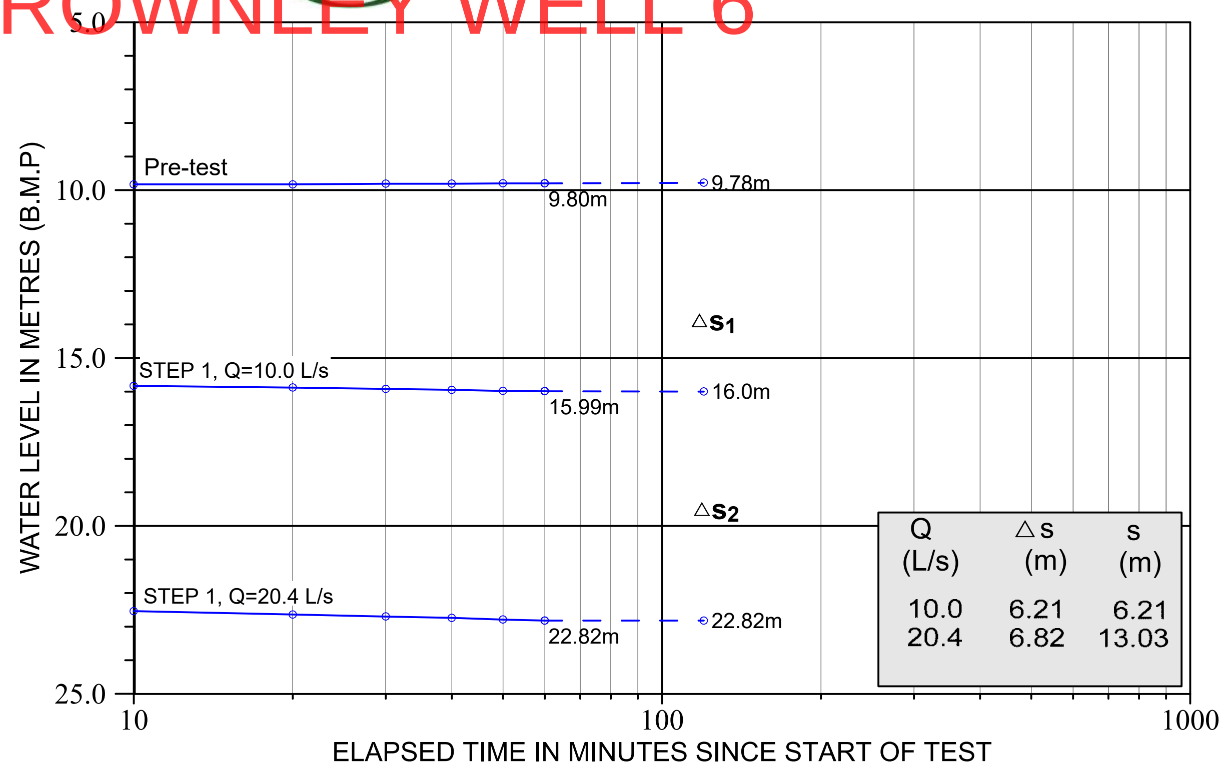

**August 11, 2020**



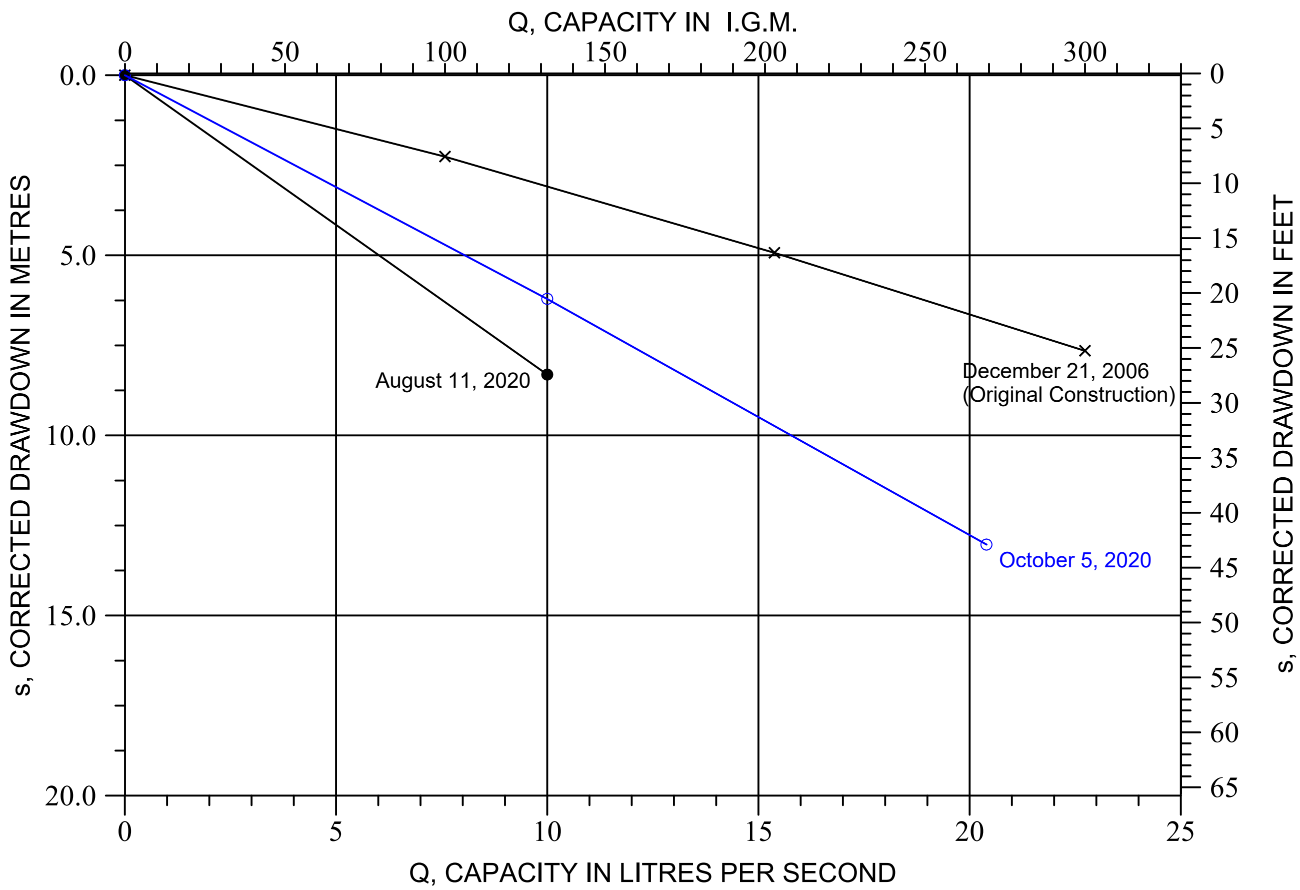

| | |
|---|---|
| **Township of Essa** | **Angus Brownlee Well No. 6**<br>**Well Performance Test**<br>**Dwg. No. A20102** |

BROWNLEY WELL 6

International Water Supply Ltd.



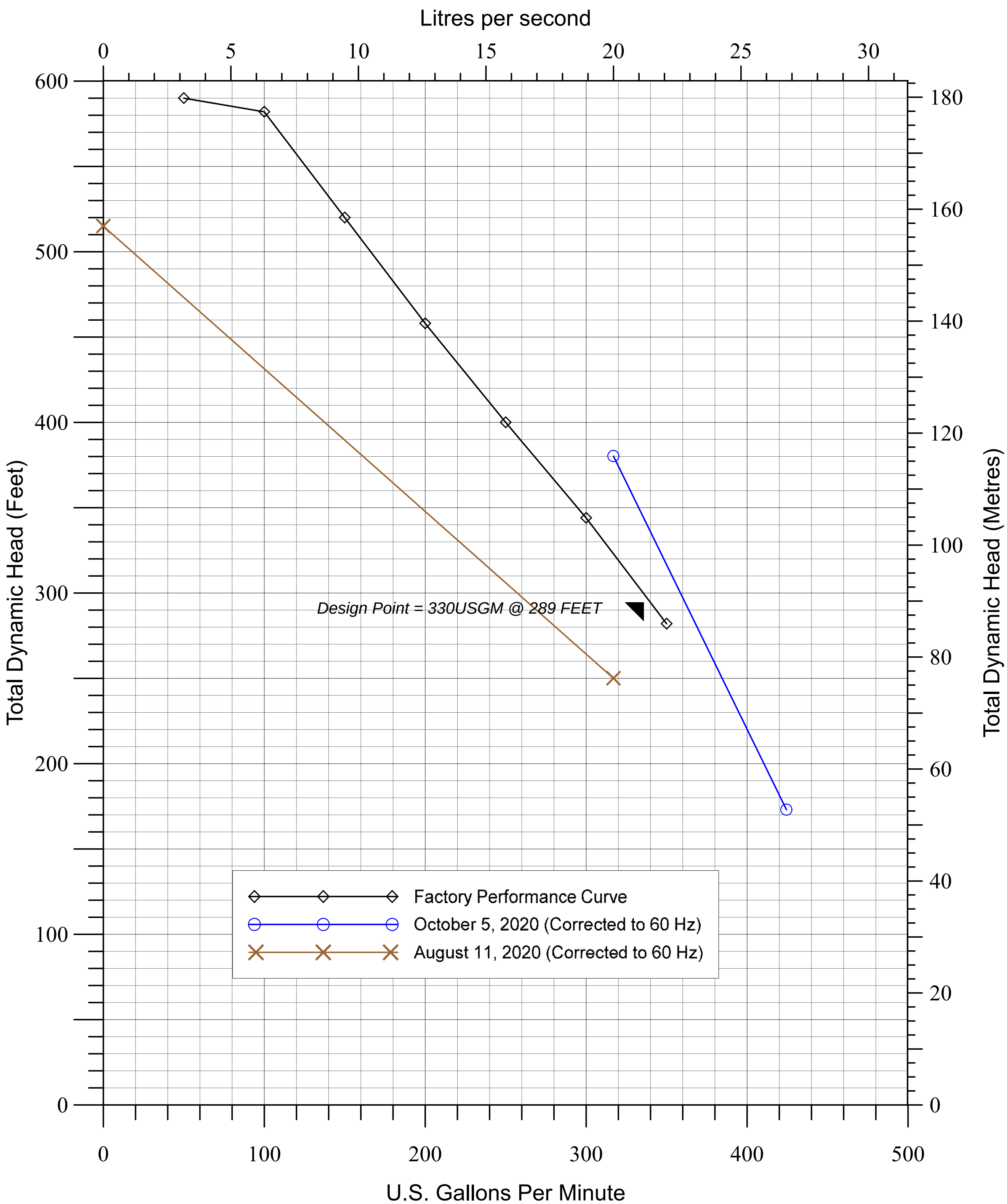

**October 5, 2020**




| | |
|---|---|
| **Township of Essa** | **Angus Brownlee Well No. 6**<br>**Well Performance Test**<br>**Dwg. No. A20103** |

BROWNLEY WELL 6

IWS International Water Supply Ltd.




December 23, 2020

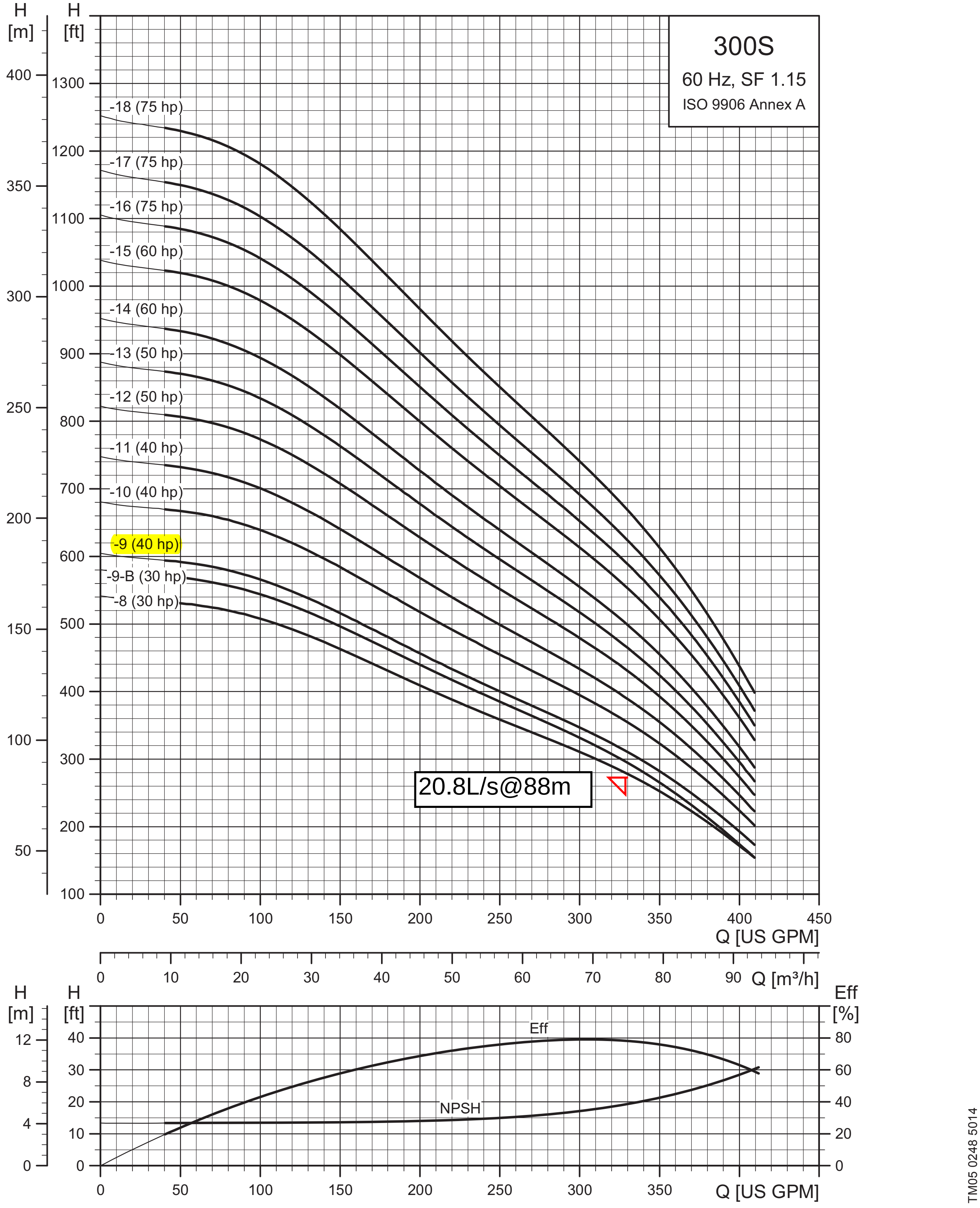
Brownley Well No. 6
Pump Performance
Grundfos SP300S400-9

Dwg. No. A21000

# BROWNLEY WELL 6

## 6" and larger wells - continued

## SP 300S (300 gpm)




Essa Township
Angus Brownley Well No. 6
Grundfos 300S400-9 Performance Curve

# Appendix E

## Plan Map (including Landfill Location)


# SCHEDULE 'B'
# TOWNSHIP OF ESSA
# OFFICIAL PLAN

## ANGUS

N

### LEGEND

- RESIDENTIAL
- RESIDENTIAL – MULTIPLE
- RESIDENTIAL – SPECIAL
- RESIDENTIAL – MOBILE
- RESIDENTIAL – FUTURE
- COMMERCIAL
- COMMERCIAL – RECREATION
- INSTITUTIONAL
- OPEN SPACE
- RURAL
- TRANSPORTATION & UTILITY
- AGRICULTURAL
- ENVIRONMENTAL
- ENVIRONMENTAL – WETLAND
- INDUSTRIAL
- ABANDONED WASTE DISPOSAL SITE
- ARTERIAL ROADS
- COLLECTOR ROADS

Ainley CONSULTING ENGINEERS PLANNERS

1:15000
SCALE 0 600m

# Appendix F

## Potential New Wellfield Locations

Figure F-1: Potential New Wellfield Locations (West & East Angus)

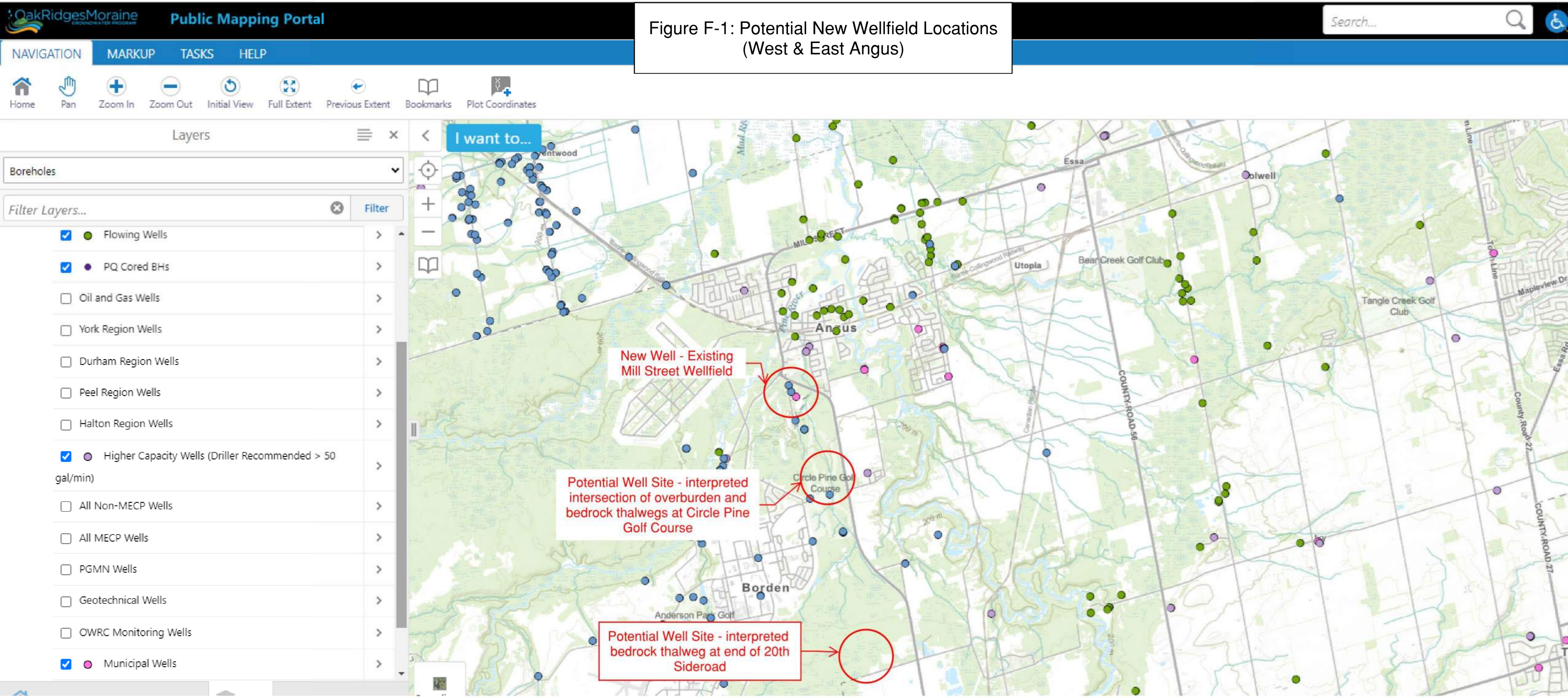
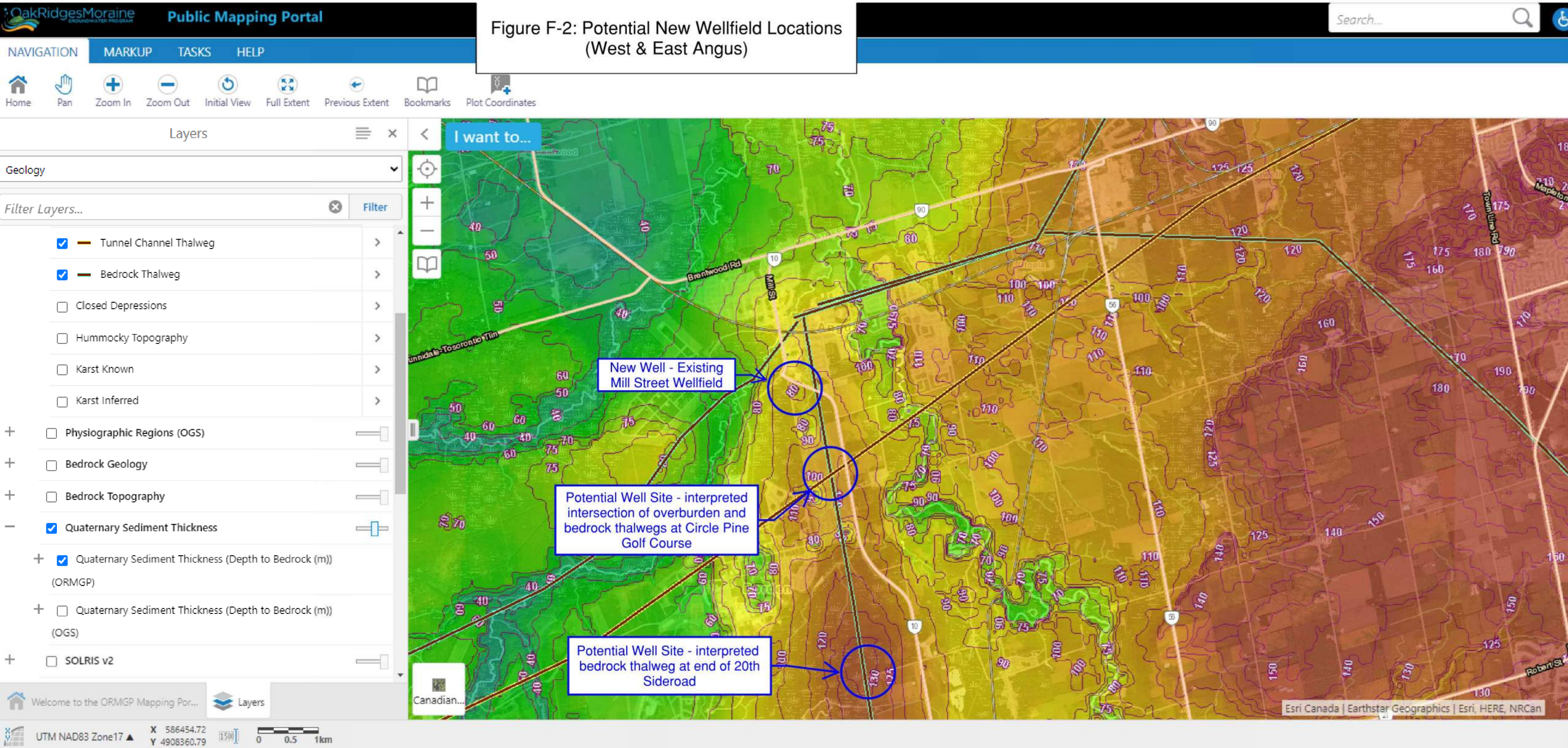


Figure F-2: Potential New Wellfield Locations (West & East Angus)



September 17, 2024
Proposal No. 2302990

VIA EMAIL: jmaitland@grnland.com

Greenland Consulting Engineers
ATTN: Josh Maitland
120 Hume Street
Collingwood ON  L9Y 1V5

**Re: Workplan and Cost Estimates for Investigations to Support Supply Well Network Expansion**
**Angus Groundwater Supply Assessment**
**Township of Essa, Ontario**

Dear Mr. Maitland:

GEI Consultants Canada Ltd. (GEI) have been retained by Greenland Consulting Engineers (the Client) to provide hydrogeological services as part of the ongoing Municipal Class Environmental Assessment that reviews options for the expansion of municipal water services in Angus, Township of Essa.

This document provides a set of planning-level workplans and cost estimates for anticipated hydrogeological investigation, well testing, and approvals-related tasks associated with supplemental investigations that support determining the preferred alternatives for the proposed expansion of the municipal supply well network in Angus.

## Background

The settlement area of Angus is serviced by a municipal water system that obtains its supply from a set of six supply wells in three wellfields, drawing from three overburden aquifers that had been identified by previous investigations:

- Mill Street Well 1
- Centre Street Well 2
- Centre Street Well 3
- Brownley Well 4
- Brownley Well 5
- Brownley Well 6

The current Permit to Take Water 0244-CU4QCG for the Angus municipal well system provides a permitted water-taking rate of 9,585 $m^3$/day.

Based on growth projections, the Township of Essa anticipates that within the next 25 years the water supply system will need to support daily demand of between 13,590 $m^3$/d (average demand) and 17,709 $m^3$/d (maximum demand).

In a desktop review report, GEI provided several recommendations for increasing the capacity of the Angus water supply well network, noting that additional investigation would be required to confirm the viability of those alternatives and the incremental supply that they would provide.

Subsequent discussion with the Township of Essa and their consultants (R.V. Anderson Associates Limited, Greenland Consulting Engineers) has indicated a preference to prioritize the following supplemental investigations:

1. Maximize water-taking from Brownley Well 5
2. Replace Centre Street Wells 2 and 3
3. Maximize water-taking from Mill Street Well 1
4. Install an additional well at Mill Street Wellfield.
5. Construct a new well at a new wellsite (i.e., development of a new wellfield).

Subsequent discussion has indicated that water-taking from Brownley Well 5 cannot be feasibly increased unless completely replaced with a well having a larger casing. Due to congestion at the Brownley wellsite, alternative options are under consideration.

Therefore, this workplan and cost estimate will address the other four (4) options (i.e., items 2 through 5 above).

# 1. Replacement of Centre Street Wells 2 and 3

## *1.1. Workplan*

The replacement wells for Centre Street Wells 2 and 3 are anticipated to be installed on the same parcel as the existing Centre Street wells. The replacement wells will be similar in depth and construction as the existing wells, with the exception of the replacement wells being constructed with a larger diameter (300 mm) than the existing wells (250 mm).

The overall workflow is proposed as follows:

1. Pre-consultation with the MECP to confirm the scope of study and proposed testing.
2. Installation of a network of monitoring wells to characterize local shallow hydrogeology and provide for the monitoring groundwater-surface water interaction during subsequent pumping tests.
3. Installation of replacement wells, Centre Street Well B and Well C.
4. Pumping tests to confirm the capacity of the new wells and the potential impacts on the local hydrogeological system
5. Preparation of a Permit to Take Water application for municipal well production

A more detailed breakdown of tasks is as follows:

- Prepare a pre-consultation brief and submit to the MECP technical support section with the proposed scope of study and testing. This would include:
    - Review of other historical reports or background information that may not have previously been available for review.
    - Attendance at a pre-consultation meeting with the MECP to confirm the scope.
- Arrange for private and public utility locates to clear drilling locations for the proposed network of monitoring wells.
- Arrange for a geo-environmental drilling contractor to install the monitoring wells for the proposed monitoring well network
    - Monitoring wells would likely be located along the right of way of Centre Street/ Side Road 20.
    - It is anticipated that two nests of three wells would be sufficient, with each nest composed of:
        - one well (2” PVC with slotted screen) at 10 m depth, installed by hollow stem auger
        - one well (2” PVC with slotted screen) at 20 m depth, installed by hollow stem auger
        - one well (grouted-in vibrating wire piezometer) at 48 m depth (i.e., into the source aquifer), installed by mud rotary
            - A conventional monitoring well is not recommended for this well because of the known artesian conditions in this area.
- Attend drilling operations to observe and collect soil samples, advise on monitoring well installation, and prepare stratigraphic logs.
- Arrange for traffic control during monitoring well drilling.
- Complete a suite of geotechnical laboratory tests to support characterization of soils encountered during monitoring well installation
    - Up to 6 samples tested for grain-size analysis
    - Up to 4 samples tested for Atterberg limits
- Installation (by manual means, hand auger) of up to four piezometers in the wetland area associated with Bear Creek
- Procure monitoring instruments for installation in the monitoring wells and piezometers:
    - Two vibrating wire piezometers
    - Eight datalogging pressure transducers (e.g., Solinst Levelogger or similar)
- Monitoring of water levels for a period of one month and comparison with precipitation records and Centre Street well field operations (i.e., daily pumping quantities).
- Preparation of a technical memorandum to summarize the findings of the monitoring network setup, including the following:
    - descriptions of observations made during the installation of the monitoring network
    - monitoring well logs
    - review and analysis of responses in groundwater level data as compared to well operations and precipitation events.

- Conduct a door-to-door private well survey to properties within 500 m of the Centre Street wellsite.
- Undertaking of a private well monitoring program at select supply wells for which the owners have provided consent and where wells are in adequate condition to allow access/use.
    - Assumes four participants
    - Includes installation of a datalogging pressure transducers to collect water level measurements
- Preparation of a “pumping test design report” per the requirements of O.Reg. 63/16
- Registration of the pumping test activity to the Environmental Activity and Sector Registry
- Arrangement with a water well drilling contractor to conduct production well installation and pumping testing according to this proposed workflow:
    - Installation of Centre Street Well B, including pilot hole to confirm stratigraphy and select an appropriate well screen.
    - Completion of a step test at Centre Street Well C, with proposed steps of 7 Lps, 14 Lps, 21 Lps and 28 Lps (total test duration of 6 hours).
    - Installation of Centre Street Well B, including pilot hole to confirm stratigraphy and select an appropriate well screen.
    - Completion of a step test at Centre Street Well B, with proposed steps of 7 Lps, 14 Lps, 21 Lps and 28 Lps (total test duration of 6 hours).
    - Completion of a 72-hour pumping test on both new wells at an approximate rate of 26 Lps (a combined daily discharge of 4,500,000 L/d).
    - Over the course of the three pumping tests, a total of 6 samples of discharge water will be collected and submitted to laboratory for analysis of a suite of general water chemistry parameters covering those parameters listed in Tables 1, 2 and 3 of MECP *Procedure D-5-5* as well as in Table 4 of the *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines*.
- Preparation of a Permit to Take Water Report, including
    - General characterization of the local hydrogeology based on available reference material (e.g., MECP water well records, Ontario Geological Survey reports and geospatial data, historical hydrogeological reports provided by the client).
    - Results of investigations, water level monitoring activities, and pumping tests.
    - Preparation of hydrogeological cross-sections
    - Hydrogeological impact assessment regarding other water users and/or environmental features (e.g., surface water, wetland areas)
    - Proposed water-taking rates.
- Preparation and submission of a Permit to Take Water application for production well operation.

It is noted that prior to beginning production from the new wells, some additional works may be required such as:

- Environmental Impact Study
    - This may be necessary if the proposed water-taking indicates potential to affect the hydrology of the local wetland areas.
- Additional planning for the selection and setup of discharge works for the pumping tests
- Additional water quality testing of well water

- Source Protection Plan updates, including modeling of new Wellhead Protection Areas.

Allowances will be provided for these items in the cost estimate (Section 1.2).

## *1.2. Estimated Costs*

Table 1 provides anticipated costs to complete the workplan outlined above.

**Table 1. Cost Estimates[1] for Investigations and Hydrogeological Reports for Centre Street Wells B and C.**

| Task | Engineering Fees and Disbursements | Sub-Contractor Costs |
|---|---|---|
| Pre-Consultation and Project Management | $8,500 | ~ |
| Monitoring Network Setup[2] and Door-to-Door Well Survey | $28,000 | $63,500 |
| Installation of Pumping Wells | $14,000 | $784,500 |
| Completion of Pumping Tests, including pumping test design report and EASR registration | $29,000 | $151,500 |
| Preparation of PTTW Application | $13,000 | ~ |
| Column Subtotals | $92,500 | $999,500 |
| Subtotal, before Allowances | $1,093,000 | |
| Allowance: EIS | $100,000 | |
| Allowance: Additional Discharge Works Planning | $15,000 | |
| Allowance: Additional Water Quality Testing[3] | $20,000 | |
| Allowance: Source Protection Plan Updates | $30,000 | |
| **Grand Total** | **$1,257,000** | |

Notes:
1. Estimated costs do not include HST.
2. It is assumed that all monitoring wells can be placed on municipal property. Additional coordination fees may be incurred if monitoring wells or piezometers must be placed on private property or property for which permission must be obtained from other agencies.
3. Additional testing intended to address all parameters included in Tables 1, 2, and 4 of the *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines* as well as gross alpha and beta radiation.

## *1.3. Schedule*

To complete this project in support of approvals for the operation of replacement of the Centre Street wells, we anticipate a project timeline as follows:

- Pre-consultation Phase: 1 to 2 months
- Monitoring Network Setup: 2 months
- Installation and Testing of Pumping Wells: 2 to 3 months
    - Includes time to prepare the pumping test design report

- Preparation of Permit to Take Water Application: 2 months.

Acounting for some overlap between tasks, it is expected that this project could be completed in approximately 6 to 7 months.

## 2. Investigation of Waste Disposal Area near Mill Street Wellfield

Due to the proximity of the Mill Street wellfield to a closed waste disposal site, the proposal to increase water-taking from the Mill Street wellfield will require characterization of the hydrogeological system in the vicinity of the waste disposal site to evaluate potential for impacts to the drinking water supply.

This project will primarily involve drilling and monitoring well installation to characterize stratigraphy, shallow groundwater quality, and potential for contaminant transport from the waste disposal site to the Mill Street well source aquifer. If applicable, monitoring would be conducted to assess whether the activity of Mill Street Well 1 (e.g., daily pumping quantities) affect the hydrogeological conditions which might contribute to increased potential for contaminant transport from the waste disposal site.

### *2.1. Workplan*

To achieve the characterization and impact assessment objectives, the following tasks are expected to be undertaken:

- Conduct a desktop review of existing information as may be available from MECP water well records, Ontario Geological Survey publications, and Conservation Authority mapping.
- Arrangement for public locates and retain a private locates contractor to clear proposed borehole locations.
- Undertake a subsurface investigation of the waste disposal site area, including,
    - Coordination with a licensed well drilling contractor to:
        - Drill a series of shallow boreholes (up to 9 locations to a depth of 3 m) to delineate the fill perimeter in the northwesterly part of the waste disposal area (i.e., the side closest to the existing Mill Street well).
        - Drill three nested monitoring well groups. Each nest would be composed of three monitoring wells (2” PVC casing) installed to approximate depths of 6 m, 18m, and 27 m below ground surface.
            - Due to the depth of drilling and the need to collect high-quality stratigraphic data, it is proposed that these monitoring wells be installed using sonic drilling methods.
    - Collection and analysis of up to 9 soil samples for grain-size analyses and Atterberg Limits.
    - Measurement of static groundwater levels to determine vertical and lateral hydraulic gradients and interpreted patterns of groundwater flow.
    - Completion of single-well response tests in each monitoring well to characterize hydraulic conductivity of each stratum.
    - Sampling of each monitoring well for a range of Contaminants of Potential Concern associated with landfills, including:
        - PHCs (F1-F4)

        - VOCs
        - General water quality including major anions, dissolved metals and other index parameters (e.g., hardness, alkalinity, pH).
- Preparation of a hydrogeological study report including
    - Presentation of results of subsurface investigation
    - Analysis of collected data to interpret patterns of groundwater flow and seepage rates
    - Preparation of hydrogeological cross-sections of the wellsite and waste disposal site area
    - Evaluation of potential for contaminant transport from the waste disposal site to the source aquifer.

### *2.2. Estimated Costs*

Table 2 provides anticipated costs to complete the workplan outlined above for the investigation of the waste disposal area near Mill Street wellfield.

**Table 2. Cost Estimates[1] for Investigations and Hydrogeological Reports for Waste Disposal Area.**

| Task | Engineering Fees and Disbursements | Sub-Contractor Costs |
|---|---|---|
| Project Management and Coordination | $4,000 | ~ |
| Subsurface Investigation, including drilling and laboratory analyses | $27,000 | $65,500 |
| Report Preparation | $8,000 | ~ |
| Column Subtotals | $39,000 | $65,500 |
| **Grand Total** | **$104,500** | |

Notes:
1. Estimated costs do not include HST.
2. It is assumed that all monitoring wells can be placed on municipal property. Additional coordination fees may be incurred if monitoring wells or piezometers must be placed on private property or property for which permission must be obtained from other agencies.

### *2.3. Schedule*

To complete this project for the investigation of the waste disposal site near Mill Street wellfield, we anticipate that the duration of the major tasks will be approximately as follows:

- Subsurface Investigation: 2 months
- Report Preparation: 1 to 2 months

Therefore, we anticipate that this project could be completed in approximately 3 to 4 months.

## 3. Increased Water-Taking from Mill Street Well 1

Prior assessments indicate that the existing Mill Street Well 1 may have a capacity of approximately 4,300,000 L/d, approximately 10% more than the current permitted amount of 3,927,774 L/d.

Additional testing would be required to confirm this additional capacity and support approvals applications (e.g., PTTW).

## *3.1. Workplan*

The following workplan is proposed:

- Review existing operating conditions (drawdowns, flow rates, total dynamic head) to confirm that an appropriate pump is available to achieve the required increase in flow.
- Conduct a door to door private well survey within 500 m of Mill Street Well 1
- Preparation of a pumping test design report per O.Reg. 63/16 and registration of the pumping test activity to the Environmental Activity and Sector Registry
- Implement a private well monitoring program by installing datalogging pressure transducers in private wells (subject to well owner consent):
    - Assumes up to 4 participants.
- Arrange with a water well drilling contractor to conduct a step-drawdown test (approximate discharge rates of 12 Lps, 25 Lps, 37 Lps, 50 Lps), including:
    - Installation of a datalogger in the pumping well
    - Installation of dataloggers in each of the nine (9) monitoring wells installed during the waste disposal site investigation
    - Collection of one sample of discharge water across the two tests (three from Well A and two from Well 1) and submission to laboratory for analysis of a suite of general water chemistry parameters covering the following parameter suites:
        - Tables 1, 2 and 3 of MECP *Procedure D-5-5* as well as
        - Table 4 of the *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines*.
- Preparation of a pumping test analysis report, including
    - Description of test
    - Presentation of test results
    - Analysis of pumping test data and water level observations in monitoring wells
    - Recommendations regarding further testing.

It is noted that some additional works may be required for the successful completion of this part of the project, including:

- Costs associated with re-commissioning related to the removal/replacement of the service pump
    - The pumping test may require the installation of a higher capacity pump than is currently installed in the well.

## *3.2. Estimated Costs*

Table 3 provides anticipated costs to complete the workplan outlined above.

**Table 3. Cost Estimates[1] for Investigations and Hydrogeological Reports for Re-Rating of Mill Street Well 1.**

| Task | Engineering Fees and Disbursements | Sub-Contractor Costs |
|---|---|---|
| Pumping Test, including pumping test design report and well monitoring program | $27,000 | $27,500 |
| Report Preparation and Project Management | $5,500 | ~ |
| Column Subtotals | $32,500 | $27,500 |
| Subtotal, before Allowances | $60,000 | |
| Allowance: Commissioning/Re-Commissioning Costs | $25,000 | |
| **Grand Total** | **$85,000** | |

Notes:
1. Estimated costs do not include HST.

## *3.3. Schedule*

To complete this project in support of the re-rating of the existing Mill Street Well 1, we anticipate that the duration of the major tasks will be approximately as follows:

- Pumping Test: 2 to 3 months
- Report Preparation: 1 to 2 months

The anticipated duration of this project is expected to be approximately 3 to 5 months.

# 4. Installation of a New Well at Mill Street Wellfield

Due to the high yield available at Mill Street Well 1, it is expected that the area could support an additional pumping well.

## *4.1. Workplan*

The workplan will generally involve the following objectives:

1. Pre-consultation and application for Category 2 Permit to Take Water for pumping tests
2. Well installation and pumping tests
3. Application for Permit to Take Water for production well operation

The following is a list of tasks that are expected to be required to achieve the objectives:

- Pre-consultation with the MECP regarding the scope of study and anticipated water-takings, including
    - Preparation of a pre-consultation brief
    - Attendance at a pre-consultation meeting
- Preparation of a pumping test report and Permit to Take Water application

- Installation of up to 4 piezometers using manual means (i.e., hand auger) in the wetland areas near the stream located to the south and east of the Mill Street wellfield.
- Installation of two 2” PVC monitoring wells into the production aquifer (approximate depth 64 m)
- Arrangement with a licensed water well drilling contractor to install Mill Street Well A (total depth of 62.5 m with 14” casing and 12” screen), including:
    - Pilot hole to confirm stratigraphy and collect grain-size samples for well screen sizing
- Undertaking of a step-drawdown test to confirm pumping rates (anticipated discharge rate steps of 12 Lps, 25 Lps, 40 Lps, 55 Lps; total test time of 6 hours)
- Undertaking of a 72 hour pumping test of both Mill Street Well 1 and Mill Street Well A (combined discharge rate of approximately 8,800,000 L/d), including
    - Private well monitoring (subject to well owner consent; 4 participants assumed)
    - Monitoring of drawdowns in existing monitoring wells and piezometers (13 total instruments) using datalogging pressure transducers.
- Collection of a total of 5 samples of discharge water across the two tests (three from Well A and two from Well 1) and submission to laboratory for analysis of a suite of general water chemistry parameters covering the following parameter suites:
    - Tables 1, 2 and 3 of MECP *Procedure D-5-5* as well as
    - Table 4 of the *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines*.
- Preparation of a Permit to Take Water report, including:
    - General characterization of the local hydrogeology based on available reference material (e.g., MECP water well records, Ontario Geological Survey reports and geospatial data, historical hydrogeological reports provided by the client).
    - Results of investigations, water level monitoring activities, and pumping tests.
    - Preparation of hydrogeological cross-sections
    - Hydrogeological impact assessment regarding other water users and/or environmental features (e.g., surface water, wetland areas)
    - Proposed water-taking rates.
- Preparation and submission of a Permit to Take Water application for production well operation.

It is noted that prior to beginning production from the new wells, some additional works may be required such as:

- Environmental Impact Study
    - This may be necessary if the proposed water-taking indicates potential to affect the hydrology of the local wetland areas.
- Additional planning for the selection and setup of discharge works for the pumping tests
- Additional water quality testing of well water
- Source Protection Plan updates, including modeling of new Wellhead Protection Areas.

Rough estimates of allowances for these items will be provided in the cost estimate section below (Section 4.2).

## 4.2. Estimated Costs

Table 4 provides anticipated costs to complete the workplan outlined above.

**Table 4. Cost Estimates[1] for Investigations and Hydrogeological Reports Installation, Testing and Approvals for a New Well at Mill Street Wellfield (Mill Street Well A).**

| Task | Engineering Fees and Disbursements | Sub-Contractor Costs |
|---|---|---|
| Pre-Consultation and Permit to Take Water for Testing | $14,000 | ~ |
| Well Installation and Pumping Tests | $29,000 | $593,000 |
| Permit to Take Water Report and Application | $15,000 | ~ |
| Column Subtotals | $58,000 | $593,000 |
| Subtotal, before Allowances | $651,000 | |
| Allowance: Environmental Impact Study | $100,000 | |
| Allowance: Commissioning/Recommissioning | $25,000 | |
| Allowance: Additional Discharge Works Planning | $15,000 | |
| Allowance: Additional Water Quality Testing[2] | $20,000 | |
| Allowance: Source Protection Plan Updates[3] | $30,000 | |
| **Grand Total** | **$841,000** | |

Notes:
1. Estimated costs do not include HST.
2. Additional testing intended to address all parameters included in Tables 1, 2, and 4 of the *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines* as well as gross alpha and beta radiation.
3. Intended to include for modeling to establish Wellhead Protection Areas and submission of updated Source Protection Plan for approval.

## 4.3. Schedule

To complete this project for the installation, testing and approvals applications in support of the operation of a new well at the Mill Street Wellfield, we anticipate that the duration of the major tasks will be approximately as follows:

- Pre-Consultation and Permit to Take Water for Testing: 3 to 5 months
- Well Installation and Pumping Tests: 2 to 4 months
- Permit to Take Water Report and Applications: 2 months

The anticipated duration of this project is expected to be approximately 6 to 9 months.

# 5. Development of a New Wellfield

Due to the abundant groundwater resources in the Angus area across the three existing wellfields, it is expected that there are opportunities to expand municipal water supply capacity through the development of a new wellfield (i.e., construction of a well at a site other than one of the existing three wellfields).

Development of a new wellfield may require a separate Municipal Class Environmental Assessment (MCEA). However, MCEA services are considered to be outside the scope of this planning document, which is limited to the hydrogeological assessment of well performance, aquifer characterization, and identification of potential impacts.

## *5.1. Workplan*

This project is expected to involve the following tasks:

- Desktop study and consultation with the Township to identify a suitable location for the new wellfield.
- Completion of public and private utility locates at the proposed drilling locations.
- Conduct a door-to-door well survey within 500 m of the wellsite.
- Preparation of pumping test design report and registration of the pumping test activity to EASR.
- Implementation of a private well monitoring program (water level only) through the installation of dataloggers in private wells (subject to well owner consent)
    - Assume 4 participating well owners.
- Arrangement with a licensed well drilling contractor to construct:
    - One 6” test well to an estimated depth of 40 m
    - One 2” monitoring well to an estimated depth of 40 m
- Completion of a step drawdown test to gauge well performance, with estimated pumping rate steps of 1.2 Lps, 2.4 Lps, 3.6 Lps and 5 Lps (estimated test duration of 6 hours). This will include monitoring of water levels in the pumping well and monitoring well using a datalogging pressure transducer.
- Across the two pumping tests, a total of 3 samples of discharge water will be collected and submitted for a suite of general water quality testing, including those parameters listed in:
    - Tables 1, 2 and 3 of MECP *Procedure D-5-5* as well as in
    - Table 4 of the *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines*.
- Completion of a constant rate pumping test at a rate determined by the result of the step drawdown test, including associated water level monitoring.
- Preparation of a pumping test analysis report, including
    - Description of test methodology
    - Presentation of pumping test results (e.g., water quality data, drawdown response data)
    - Analysis of pumping test data to assess aquifer characteristics
    - Recommendations for further investigation and development

It is noted that the workplan described above does not include for the installation of a production well, the completion of detailed investigations and impact assessments or for the preparation of a Permit to Take Water Application. Allowances for these tasks have been provided in the estimated cost section below.

## 5.2. Estimated Costs

Table 5 provides anticipated costs to complete the workplan outlined above.

**Table 5. Cost Estimates[1] for Investigations and Hydrogeological Reports for Development of a New Wellfield.**

| Task | Engineering Fees | Sub-Contractor Costs |
|---|---|---|
| Desktop Study and Preliminary Work, including municipal and MECP consultation | $9,000 | ~ |
| Well Installations | $4,000 | $77,000 |
| Pumping Tests, including well surveys and private well monitoring | $18,500 | $66,000 |
| Report Preparation and Project Management | $10,500 | ~ |
| Column Subtotals | $42,000 | $143,000 |
| Subtotal, before Allowances | $185,000 | |
| Allowance: Additional Discharge Works Planning | $15,000 | |
| Allowance: Production Well Installation[2] | $190,000 | |
| Allowance: Pumping Tests and Impact Assessment Investigations on the Production Well | $125,000 | |
| Allowance: Preparation of PTTW Report and Application | $15,000 | |
| **Grand Total** | **$530,000** | |

Notes:
1. Estimated costs do not include HST.
2. Assumes a 10" well installed to a depth of 40 m (estimated maximum production of approximately 1,900,000 L/d)

## 5.3. Schedule

To complete this project in support of the development of a new wellfield, we anticipate that the duration of the major tasks will be approximately as follows:

- Desktop Study and Preliminary Work: 3 months
- Well Installations: 2 to 3 months
- Pumping Tests: 1 month
- Report Preparation: 1 to 2 months

The anticipated duration of this project is expected to be approximately 5 to 8 months.

## 6. Summary

Below (see Table 6) is a summary of the costs and timelines for each of the projects outlined above.

**Table 6. Summary of Estimated Project Budgets and Timelines**

| Project | Anticipated Budget (excluding HST) | Estimated Schedule[1] | Potential Increase in Water Supply ($m^3$/d) |
|---|---|---|---|
| Replacement of Centre Street Wells | $1,257,000 | 6 to 8 months | 1,900 |
| Investigation of Waste Disposal Area near Mill Street Wellfield | $104,500 | 3 to 4 months | N/A |
| Increased Water-Taking from Mill Street Well 1 | $85,000 | 3 to 5 months | 400 |
| Installation of New Well at Mill Street Wellfield | $841,000 | 7 to 11 months | 4,400 |
| Development of a New Wellfield | $530,000 | 6 to 9 months[2] | 1,900[3] |

Notes:
1. Project Schedules do not account for time preparation of Source Protection Plan updates or for subsequent approval of those updates. In addition, the project "Development of a New Wellfield" does not include for the installation of a production-ready well or for the preparation of a Permit to Take Water for production.
2. There may be additional Municipal Class Environmental Assessment tasks to complete before confirming the selection of a new wellfield location: those tasks are not included in this timeline estimate.
3. Productivity of new wellfield is dependent on the hydrogeological conditions at that wellfield as well as the desired size of well to be installed.

In all cases where a change in pumping rate is proposed or a new well is proposed to be brought online, it should be assumed that 18 to 24 months' time would be required to prepare the necessary Source Protection Plan update submission and subsequently obtain approval from the MECP. It is our understanding that the revision to the Source Protection Plan must be completed and approved by the MECP before beginning to operate the pumps as intended.

It is noted that the scheduling of these projects is more or less independent (i.e., they may be completed in series or in parallel) with the exception of the investigation of the waste disposal area, which should precede the other projects at the Mill Street wellfield.

## 7. Limitations

This set of workplans and cost estimates is provided for planning purposes only. Estimates provided here are based on anticipated effort associated with the listed tasks. Actual tasks may vary from those listed above for a variety of reasons, including but not limited to:

- results of pre-consultation with regulatory agencies (e.g., MECP),

- unforeseen physical or environmental constraints related to the execution of the project (e.g., discharge management),
- results of pumping tests (e.g., subsequent requirement for additional investigation or additional wells and testing),
- changes in chargeout rates, contractor fees, and material costs due to the passage of time.

Though efforts have been made to provide a reasonable scope of work and associated costs to achieve the project goals, this document is not to be construed as a binding fee proposal or agreement to provide services. If the Client would like to proceed with a project involving works such as those described in this document, it is recommended that a formal proposal and/or quote from contractors be obtained.

Based on the large proportion of project cost being related to production and test well installation, it has been assumed that the drilling contractor would act as the Project Contractor and that GEI/consultant would act as the contractor administrator. With this arrangement, the drilling contractor would be retained directly by the municipality under separate contract, while GEI would provide facilitation, documentation, and administration services.

It is reiterated that this set of workplans addresses primarily the hydrogeological aspects of the obtainment of additional municipal water supply from local aquifers. It is not intended to address the following:

- Engineering design of watermains, reservoirs, water treatment systems, or other infrastructure that may be required to deliver and distribute water;
- Fulsome environmental assessment for identification of preferred options or the development of new wellfields.

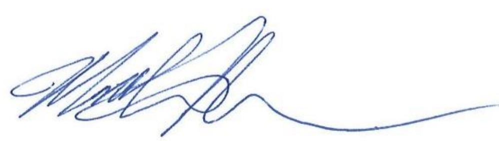
## 8. Closing

If you have any questions, please feel free to contact me as follows:

- Office: 519.824.8150 x1274
- Mobile: 780.913.9833
- Email: MaLong@geiconsultants.com

Sincerely,

GEI Consultants Canada Ltd.



Matthew Long, M.Eng., P.Eng.
Senior Project Engineer

Matthew Nelson, P.Eng., P.Geo.
Vice President, Environmental Practice Lead

ML/mn

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cc: Kristen McFarlane, Greenland Consulting Engineers
Alex Winkelmann, GEI Consultants Canada Ltd.

# Appendix C

RVA Technical Report:
Existing Facilities
Condition Assessment &
Option Concept Design

GREENLAND®

# ANGUS INFRASTRUCTURE MASTER PLAN – CLASS EA ADDENDUM

## Angus Water Supply and Storage Alternatives

**October 23, 2024**

Prepared for:

TOWNSHIP of ESSA

GREENLAND® international consulting ltd.

RVA

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RVA 237001

October 23, 2024

Greenland International Consulting Ltd.
120 Hume Street
Collingwood, ON
L9Y 1V5

Attention: Josh Maitland, P.Eng
Project Manager

Dear Mr. Maitland:

Re: Angus Water Supply and Storage Alternatives

Please find the enclosed Draft Water Supply and Storage Alternatives for the Angus Infrastructure Master Plan – Class EA Addendum.

Yours very truly,

R.V. ANDERSON ASSOCIATES LIMITED

Kimberly Sayers, P.Eng., P.M.P.

Project Manager

# ANGUS INFRASTRUCTURE MASTER PLAN – CLASS EA ADDENDUM

## Angus Water Supply and Storage Alternatives

## Final

## Essa Township



**RVA 237001**

**October 23, 2024**

# ANGUS WATER SUPPLY AND STORAGE ALTERNATIVES

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## APPENDICES

# 1.0 Introduction

The Township of Essa (Township) initiated a Municipal Class Environmental Assessment (Class EA) in 2021 to develop an Infrastructure Master Plan (IMP) to forecast the capital projects necessary for water, wastewater, and transportation servicing over the next 25 years to accommodate anticipated growth for the Community of Angus.

The preferred solutions for water supply and storage include:

- Water Supply: Increase water supply capacity by 40 L/s, considering existing Angus wells and new locations.
- Water Storage: Increase available storage by 4,200 m³.

Greenland Consulting Engineers was subsequently retained by the Township to complete a Class EA Addendum to allow the recommended solutions to move towards implementation.

## 1.1 Scope of Work

R. V. Anderson Associates Limited (RVA) has been retained by Greenland to support the conceptual development of the solutions. RVA's scope includes:

- Document existing conditions of three well facility locations (Mill Street, Brownley and Centre Street (McGeorge)), and understand operational issues at the existing facilities that would need to be incorporated into the solution.
- Review local water testing results to determine if additional treatment is required
- Develop high level conceptual solutions of the proposed well supply and storage upgrade alternatives.

# 2.0 Existing Conditions

The following section describes the Angus water system.

## 2.1 Angus Water System Description

The Angus Drinking Water System includes three facilities: McGeorge, Mill Street, and Brownley, serving the Town of Angus through a common distribution system.

The water supply is obtained from ground water wells that pump into each of these pumphouses. Table 1 summarizes the capacities of each groundwater well. All wells are considered true groundwater sources (ie. not under the direct influence of surface water). Please note that data used to populate these tables comes from the GEI Desktop Assessment (GEI,2024) which has gathered multiple sources of inspection data that have varied information.

The facilities include treatment processes for the groundwater supply, reservoirs to store treated water, and high lift pumping stations to distribute water to Angus. Each of the pumphouses use Sodium Silicate and Sodium Hypochlorite for iron sequestering and disinfection. Data storage for any and all results of water sample testing and flow readings are saved on the OCWA server. All security and alarm monitoring for each site is controlled by Huronia Alarms.

Table 2 summarizes the capacity of each reservoir and high lift pumping station.

It is noted that existing drawings and operations manuals were not available for all of the sites, and information was obtained from various sources. Any parameters for the well and high lift pumping stations (depth of well, flows etc.) should be confirmed as a part of any future works.

## TABLE 1 - WELL CAPACITIES

| Pumphouse | Well Number | Well / Casing Diameter (mm) | Depth (m) | Permitted Daily Supply (L/day) | Pump Rating | Motor | Backup Generator Capacity (kW) |
|---|---|---|---|---|---|---|---|
| Mill Street | Well #1 | 610 | 61.9 | 3,927,774 | 45.5 L/s at 24 m | 30 hP | 400 |
| Brownley | Well #4 | 200 | 40.2 | 1,800,000 | 20.8 L/s at 88 m | 40 hP | 400 |
| | Well #5 | 150 | 39.6 | 654,624 | 7.6 L/s at 84 m | 15 hP | |
| | Well #6 | 200 | 40.2 | 1,800,000 | 20.8 L/s at 88 m | 40 hP | |
| McGeorge / Centre St | Well #2 | 250 | 53.3 | 1,296,000 | 15.2 L/s at 59.1 m | | 64 |
| | Well #3 | 150 | 53.3 | 1,296,000 | 15.2 L/s at 59.1 m | | |

**TABLE 2 - PUMPHOUSE AND RESERVOIR CAPACITIES**

| Pumphouse | High Lift Pump Capacity | Reservoir Capacity($m^3$) | Reservoir Dimensions (m) |
|---|---|---|---|
| Mill Street | 70 L/s at 53 m<br>70 L/s at 53 m<br>70 L/s at 53 m<br>106 L/s at 42 m | 2500 + 902 | Unknown |
| Brownley | 75 L/s at 53 m<br>75 L/s at 53 m<br>75 L/s at 53 m | 2500 | Cell No.1 & No. 2 – 49 x 5.3 |
| Centre Street (McGeorge) | 6.5 L/s at 42 m<br>20.1 L/s at 46 m | 95 + 157 | Unknown |

# 3.0 SITE VISIT

A visual condition assessment was performed on Friday, May 24, 2024. The observed condition of the facilities is summarized below.

## 3.1 Mill Street Facility

The Mill Street Facility is located at 28 Mill Street, and includes a groundwater well installed in a below ground vault, a pumphouse building with two (2) rooms (pumphouse & chemical storage) and an underground treated water storage reservoir.

The pumphouse was constructed in 1991 with one reservoir cell. Two reservoir cells were constructed in 2005, along with some equipment upgrades including replacement pumps, process piping and chemical systems.

### 3.1.1 Well #1

The IWS Well Assessment Report (March 31, 2016) included the following recommendations. It is unknown if the recommended works have been completed to date:

- Well pump was operating on its performance curve, indicating to wear or plugging. The pump was inspected and was found to be in relatively good condition. Minor maintenance was completed.
- Video inspection showed the well was in good condition, with minor mineral/biofilm on the casing and screen. The bottom portion of the screen showed some plugging, however it did not appear to impact the performance of the well.
- Recommended to replace the pump and drop pipe at the time of next service in 2020.
- Recommended to decommission the below-ground vault and install a MAASS Model MB Heavy Duty pit less adapter to address access and maintenance issues.

### 3.1.2 Building & Building Envelope Observations

The station consists of two separate rooms: the existing Mill Street Pumphouse and the Chemical Storage. The exterior of the Mill Street pumping station is in good condition, with no visible cracks or damage to the walls. The interior walls have a painted finish and the finishes appeared to be in fair condition. Minor visible stains and paint peeling was observed in some locations. Additionally, the ceiling of the pumping station interior is made up of metal panels. These panels appear to be in good condition with minimal discoloration. Refer to **Figure 1** to **Figure 7** that show the current conditions of the site:

FIGURE 1 - EXTERIOR OF MILL STREET (NORTH-WEST) SITE

FIGURE 2 - EXTERIOR OF MILL STREET (EAST) SITE

FIGURE 3 - EXTERIOR OF MILL STREET (SOUTH) SITE

FIGURE 4 - INTERIOR OF EXISTING MILL STREET PUMPHOUSE (NORTH-EAST) SITE

FIGURE 5 - INTERIOR OF EXISTING MILL STREET PUMPHOUSE (EAST) SITE

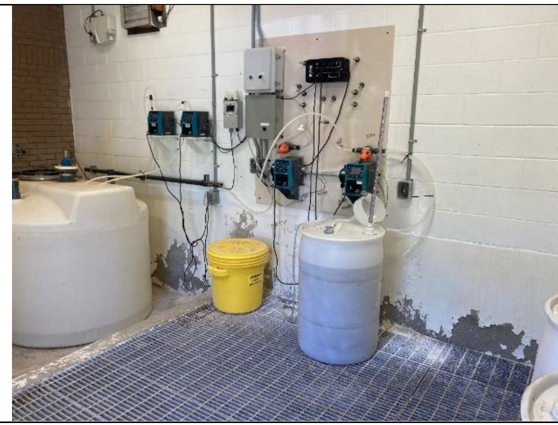

FIGURE 6 - INTERIOR OF CHEMICAL STORAGE SITE

FIGURE 7 - INTERIOR OF EXISTING MILL STREET PUMPHOUSE (CENTER-WEST) SITE

### 3.1.3 Electrical Observations

Power is supplied to the pumphouse from a 300KVA pad-mounted transformer, with 600V 3-phase power distributed through an MCC with a 600A main breaker to various loads. This power is further stepped down to 208/120V for the lighting panel, though the space in front of the lighting panel was occupied by storage items and should be cleared.

The MCC, approximately 25-30 years old, showed signs of corrosion on some buckets and has one available slot for a small load. The MCC is approaching the end of life, and plans should be made for equipment replacement.

An arc flash study was last performed in 2017 and should be updated. An electrical single-line diagram (SLD) was not visible at the site and should be installed. Please refer to Figure 8 and Figure 9 that show the position of the electrical panel and a part of the MCC unit.

The 494KW diesel generator, installed in 2006, is in good condition. Some exterior building lights are damaged and need replacement.

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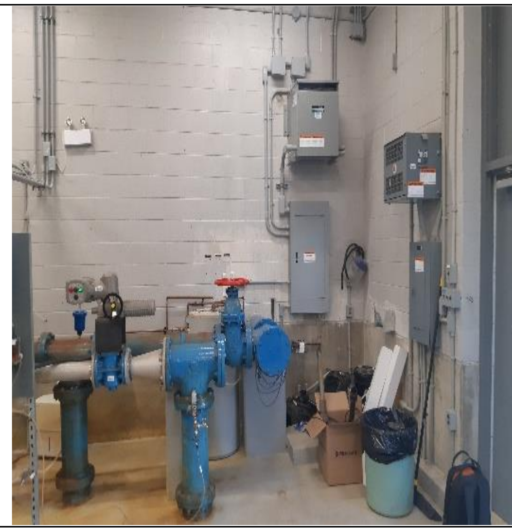
|---|---|
|  |  |
| FIGURE 8 - COMPLETE MCC PANEL AT MILL STEET SITE (NORTHWEST) | FIGURE 9 - ELECTRICAL PANEL HOUSED INSIDE THE MILL ST PUMPHOUSE (SOUTH) |

### 3.1.4 Mechanical Observations

The building is electrically heated with unit heaters. The heaters appear to be in good condition, however, were not operating at the time of the site visit.

Ventilation is provided by exhaust fans. The HVAC intake vent covers appear to be in good condition, with minor discoloration on the metal framing. The exhaust fans in the pumping station were functioning at the time of the site visit and seem to be in adequate condition.

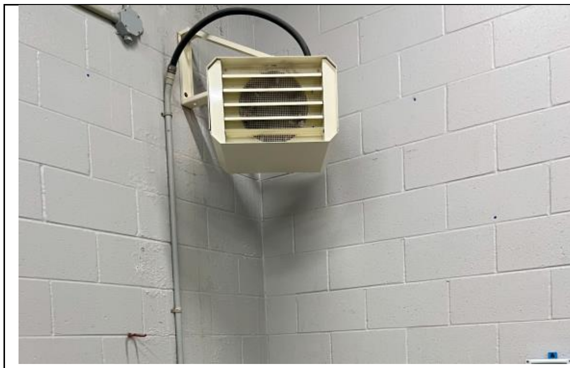


FIGURE 10 - EXHAUST FAN IN CHEMICAL STORAGE

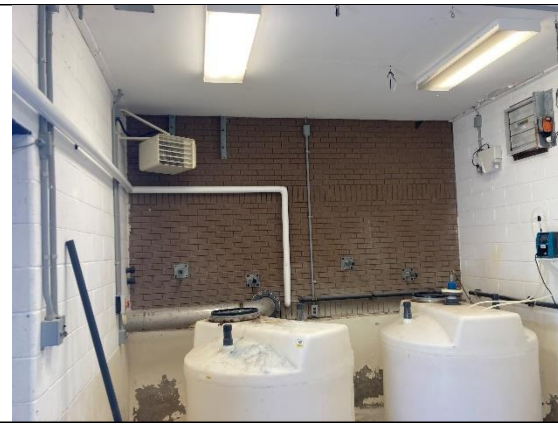


FIGURE 11 - UNIT HEATER AND MOTORIZED LOUVRE IN CHEMICAL STORAGE

Process piping is primarily stainless steel with some painted carbon steel piping sections. The painted carbon steel portions show moderate corrosion and are recommended to be sandblasted and repainted.

Chemical storage and pumping equipment appear to be in good condition.

FIGURE 12 - CHEMICAL STORAGE TOTES INSIDE OF CHEMICAL STORAGE (NORTH) SITE

FIGURE 13 - CHEMICAL STORAGE TOTES INSIDE OF CHEMICAL STORAGE (SOUTH) SITE

### 3.1.5 Site/Civil Observations

The metal fence surrounding the Mill Street pumping station perimeter is in good condition. Access to the site is controlled by a padlock, with keys held only by OCWA and Township of Essa operations personnel. The driveway is also in good condition, with no cracks or broken asphalt.

There is an in-ground concrete reservoir at the site, which was not inspected as part of this work. The site has four outdoor access hatches, valve operators, and vent piping at ground level, all of which appear to be in good condition. However, one junction box at one of the hatches is damaged and should be replaced. The operation of the valves was not tested during the visit.

## 3.2 Brownley Facility

The Brownley Facility is located at 8610 5th Line and includes three groundwater wells installed with pit less adapters, a Well Pumphouse divided into an electrical room and a process piping and chemical storage room, a single-room High Lift Pumphouse, and an underground storage reservoir.

The exact age of the facilities is not known. The original Well #5 was constructed in 1993, and Wells #4 and #6 were constructed in 2006. The Well Pumphouse was constructed in 2008, and the High Lift Pumphouse was constructed in 2010.

### 3.2.1 Well Observations

The IWS Well Assessment Well and Pump Maintenance Report (November 21, 2021, October 20, 2021, and January 6, 2021) included the following recommendations. It is unknown if the recommended works have been completed to date:

Well #4

- Pump performance had deteriorated by 20 m of head, likely caused from the plugging of water passages. The pump was removed for inspection, cleaned, and minor maintenance. The pump was returned to service and was expected to be suitable for use for the next service interval.
- Based on the video inspection observations, the well casing was cleaned of mineral and biofilm buildup, and the well was redeveloped using enhanced acid and surfactant/disinfection. The rehabilitation works was able to recover approximately 3.7 m of drawdown.
- The report recommended a decreased well service interval to prevent severe performance decline noted in previous assessments.

Well #5

- Pump performance has deteriorated by 7.5 m of head, likely caused from the plugging of water passages. The pump was removed for inspection, cleaned, and minor maintenance. The pump was returned to service and was expected to be suitable for use for the next service interval.
- Based on the video inspection observations, the well casing was cleaned of mineral and biofilm buildup, and the well was redeveloped using enhanced acid and

surfactant/disinfection. The rehabilitation works was able to recover the well to slightly better than the original 1993 construction.

- The 150 mm casing, especially above the water level, appears to be in poor condition, with corrosion scale and pitting. It was not brushed during the well service works.
- Recommended to conduct an interim performance test to confirm current conditions and check the pump house flow meter calibration, followed by another test in five years.

Well #6

- The pump was removed for inspection, cleaned, and minor maintenance. The pump was returned to service and was expected to be suitable for use for the next service interval. Cleaning of the pump restored approximately 40 m of TDH at 20 L/s.
- Based on the video inspection observations, the well casing was cleaned of mineral and biofilm buildup, and the well was redeveloped using enhanced acid and surfactant/disinfection.
- The rehabilitation works was able to recover approximately 2.1 m of drawdown and did not result in full restoration of the well performance. Additional rehabilitation may be required if performance deteriorates.
- Recommended to conduct an interim performance test to confirm current conditions and check the pump house flow meter calibration, followed by another test in five years.

### 3.2.2 Building & Building Envelope Observations

The Brownley pumping station contains two (2) separate buildings: the existing Brownley Pumphouse and the Chemical Storage building. The Chemical Storage building is split into two (2) sections where the electrical panels and generator are in the front half of the building and the chemical storage totes and dosing equipment are in a separate area in the back of the building.

The pumphouse and chemical storage building exteriors are both in good condition, with no cracks or damaged walls. The interior walls of both buildings have a painted finish and the finishes appeared to be in fair condition. Minor visible stains and paint peeling was observed in some locations of the pumphouse, but the chemical storage building was in good condition.

Additionally, the pumphouse and chemical building ceilings are made up of ceiling tiles. These panels appear to be in good condition with minor discoloration. Refer to **Figure 14** to **Figure 23** that show the current conditions of the site:

| | |
|---|---|
|  |  |
| FIGURE 14 - EXTERIOR OF BROWNLEY PUMPHOUSE (EAST) SITE | FIGURE 15 - EXTERIOR OF BROWNLEY PUMPHOUSE (WEST) SITE |
|  |  |
| FIGURE 16 - EXTERIOR OF BROWNLEY CHEMICAL STORAGE (WEST) SITE | FIGURE 17 - EXTERIOR OF BROWNLEY CHEMICAL STORAGE (EAST) SITE |

FIGURE 18 - INTERIOR OF BROWNLEY PUMPHOUSE SITE

FIGURE 19 - INTERIOR OF BROWNLEY PUMPHOUSE SITE

FIGURE 20 - INTERIOR OF BROWNLEY PUMPHOUSE SITE

FIGURE 21 - INTERIOR OF BROWNLEY CHEMICAL STORAGE SITE

FIGURE 22 - INTERIOR OF BROWNLEY CHEMICAL STORAGE (NORTH-EAST) SITE

FIGURE 23 - INTERIOR OF BROWNLEY CHEMICAL STORAGE SITE

### 3.2.4 Electrical Observations

Power is supplied to the pump house via a 500KVA pad-mounted transformer. The site has two MCCs: MCC-1 (800A 600V 3-phase with a 420A main breaker) and MCC-2, which is powered from MCC-1 through a 300A spare breaker provided at commissioning. A distribution transformer supplies 208/120V loads via a lighting panel. MCC-2 has four spare buckets for small loads, though larger loads may require modifications. MCC-1 and MCC-2 were installed in 2008 and 2011, respectively.

While the MCC area meets code space requirements, the space in front of the PLC panel is obstructed by storage and should be cleared. An arc flash study was last performed in 2017 and should be updated. An electrical single-line diagram (SLD) was not visible at the site and should be installed.

The 400KW diesel generator from 2006 is in good condition. All of the exterior lights appear to be in good condition. Please refer to Figure 24 that shows the generator in the center of the Chemical Storage building and a part of the MCC unit.

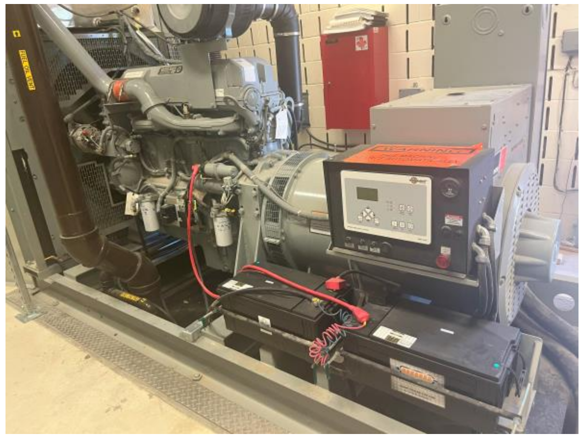


FIGURE 24 - GENERATOR IN THE CENTER OF THE CHEMICAL STORAGE BUILDING

### 3.2.5 Mechanical Observations

The buildings are electrically heated with unit heaters. The heaters appear to be in good condition, however, were not operating at the time of the site visit. Ventilation is provided by multiple exhaust fans in both buildings. The HVAC intake vent covers for both the chemical storage and high-lift pump station buildings are in good condition.

FIGURE 25 - EXHAUST FAN AND INTAKE VENT OF CHEMICAL STORAGE BUILDING

FIGURE 26 - UNIT HEATER, MOTORIZED LOUVRE AND EXHAUST FAN IN CHEMICAL STORAGE BUILDING SITE

Process piping is primarily stainless steel with some painted carbon steel piping sections. The painted carbon steel portions show moderate corrosion and are recommended to be sandblasted and repainted (**Figure 27** and **Figure 28**).

| | |
|---|---|
|  |  |
| FIGURE 27 - PROCESSING PIPING INSIDE OF PUMPHOUSE (EAST) | FIGURE 28 - PROCESSING PIPING INSIDE OF PUMPHOUSE (WEST) |

Sodium silicate is delivered in drums. Chemical storage and pumping equipment appears to be in good condition.

| | |
|---|---|
|  |  |
| FIGURE 29 - CHEMICAL DOSING PUMPS INSIDE CHEMICAL STORAGE BUILDING | FIGURE 30 - CHEMICAL STORAGE TOTES INSIDE CHEMICAL STORAGE BUILDING |

FIGURE 31 - PROCESSING PIPING AND CHEMICAL STORAGE TOTES IN CHEMICAL STORAGE BUILDING

### 3.2.6 Site/Civil Observations

The metal fence surrounding the Brownley pumping station site perimeter is in good condition, with the paint still in good condition and no cracks or scratches. Access to the site is controlled using a padlock, with keys held only by OCWA and Township of Essa operations personnel. The driveway is also in good condition, with no cracks or broken asphalt.

There is an in-ground concrete reservoir at the site, which was not inspected as part of this work. The site has four access hatches, valve operators, and vent piping at ground level, all of which appear to be in good condition. All of the access hatches are located inside the pumphouse. The operation of the valves was not tested during the visit.

## 3.3 Centre Street (McGeorge) Facility

The Centre Street (McGeorge) Facility is located at 6130 Side Road 30 and consists of groundwater wells installed in a below ground vault and a pumphouse building. An extension to the building was constructed to house the chemical systems. There is also a single cell underground treated water storage reservoir. Drawings of the facility were not available for review.

The Well records indicate that the Wells were drilled in 1985. The Pumphouse building is assumed to be constructed around 1985, and the chemical building extension constructed at a later date.

### 3.3.1 Well #2 and #3

The records presented in IWS Well Assessment Report (Appendix B, GEI, 2024) for Well #2 and Well #3 show that a pump test was conducted May 2, 2022 (Well #2) and May 11, 2022 (Well #3). Well #2 and #3 pump performance were significantly reduced compared to previous pump tests completed in 1985.

Discussions with operations during the site visit identified that the wells are artesian, and when the wells are not running the wells will overflow around their casings and discharge to the outside.

### 3.3.2 Building & Building Envelope Observations

The station is comprised of two (2) buildings: Centre Street (McGeorge) Pumphouse & Underground Reservoir and Chemical Storage building. The Chemical Storage building was added as an extension to the original pumphouse. The Pumphouse building exterior is made of brick and mortar building envelope, and the Chemical Storage building addition is made of metal panels. Both building exteriors are in fair shape.

The interior of the pump room is in fair condition, with some peeling surfaces observed and accumulation of rust debris from the piping.

The chemical storage room interior consists of aluminum cladding. The cladding is rusting in numerous locations, likely as a result of an incompatibility with the chemicals being stored in the room. It is recommended that the corrosion be cleaned, and the metal panels be coated with a chemical resistant coating.

The guard posts inside the Chemical Storage building have rusted to the point of deterioration and should be replaced. Refer to **Figure 32** to **Figure 39** that show the current conditions of the site:

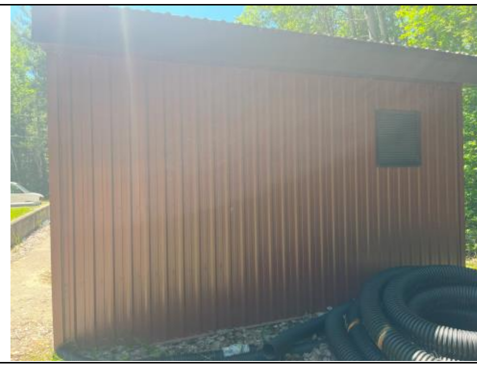
| | |
|---|---|
|  |  |
| FIGURE 32 - EXTERIOR OF CENTRE STREET (SOUTH) SITE | FIGURE 33 - EXTERIOR OF CENTRE STREET (NORTH) SITE |
|  |  |
| FIGURE 34 - EXTERIOR OF CENTRE STREET (EAST) SITE | FIGURE 35 - INTERIOR OF CENTRE STREET PUMPHOUSE (SOUTH) SITE |

FIGURE 36 - INTERIOR OF CENTRE STREET PUMPHOUSE SITE

FIGURE 37 - INTERIOR OF CENTRE STREET CHEMICAL STORAGE (WEST) SITE

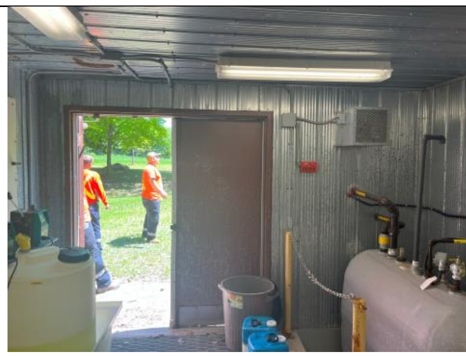


FIGURE 38 - INTERIOR OF CENTRE STREET CHEMICAL STORAGE (EAST) SITE

FIGURE 39 - INTERIOR OF CENTRE STREET CHEMICAL STORAGE (SOUTH) SITE

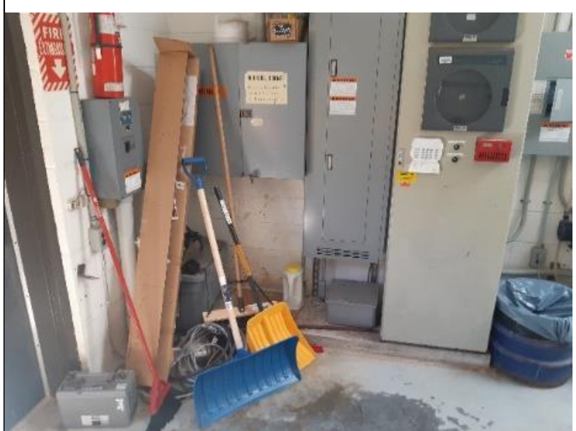
### 3.3.3 Electrical Observations

Power is supplied to the pump house from a pole-mounted 3x25KVA transformer with a cumulative capacity of 75KVA and a main incoming breaker rated at 200A. The room is very small, with no space to add extra panels. Some panels, appearing to be approximately 25-30 years old, along with process equipment, show signs of corrosion. Additionally, there is insufficient clearance in front of the main breaker, VFD, and ATS to meet code requirements.

The 80KW diesel generator appears to have surpassed its useful lifetime. No electrical single-line diagram (SLD) was posted nearby the panel and one should be installed.

All exterior lights were found to be in good condition. Please refer to **Figure 40** to **Figure 45** that will highlight some of the corrosion inside the electrical panel, lack of space in front of the main breaker/VFD/ATS and the current condition of the diesel generator.

| | |
|---|---|
|  |  |
| FIGURE 40 - INTERIOR OF ELECTRICAL PANEL SHOWING SIGNS OF CORROSION | FIGURE 41 - INTERIOR OF ELECTRICAL PANEL SHOWING SIGNS OF CORROSION |

| | |
|---|---|
|  |  |
| FIGURE 42 - SPACE IN FRONT OF MAIN BREAKER/VFD/ATS, SHOWS LACK OF SPACE (1) | FIGURE 43 - SPACE IN FRONT OF MAIN BREAKER/VFD/ATS, SHOWS LACK OF SPACE (2) |
|  |  |
| FIGURE 44 - SPACE IN FRONT OF MAIN BREAKER/VFD/ATS, SHOWS LACK OF SPACE (3) | FIGURE 45 - CURRENT CONDITION OF DIESEL GENERATOR |

### 3.3.4 Mechanical Observations

The buildings are electrically heated with unit heaters. The heaters appear to be in good condition, however, were not operating at the time of the site visit. Ventilation is provided by multiple exhaust fans in both buildings. The HVAC intake vent covers show some signs of aging over time, such as discoloration and slight rust on the metal framing. The exhaust fans in the pumping station are functional and seem to be in adequate condition. The site was not operational at the time of the site visit, as operations staff were performing maintenance on the pumps.

| | |
|---|---|
|  |  |
| FIGURE 46 - EXHAUST FAN AND INTAKE VENT THE CENTRE STREET (MCGEORGE) PUMPHOUSE. | FIGURE 47 - EXHAUST FAN IN CENTRE STREET (MCGEORGE) CHEMICAL BUILDING |

Process piping is primarily ductile iron with some stainless steel sections. The painted ductile iron portions show significant of corrosion and are recommended to be sandblasted and repainted (**Figure 48** and **Figure 49**).

| | |
|---|---|
|  |  |
| FIGURE 48 - CENTRE STREET PUMPHOUSE PROCESS PIPING CONDITION (1) | FIGURE 49 - CENTRE STREET PUMPHOUSE PROCESS PIPING CONDITION (2) |

Operations staff indicated that the raw water piping runs through the treated water reservoir to reach the pumphouse.

Sodium silicate is delivered in drums, and chlorine is stored in bulk storage tanks. Chemical storage tanks and chemical feed pumps appear to be in fair condition. Operations staff indicated that the chlorine dose required at this well is 7.5 mg/L (compared to 3.0 mg/L at other facilities).


FIGURE 50 - CHEMICAL DOSING PUMPS INSIDE CHEMICAL STORAGE BUILDING

FIGURE 51 - CHEMICAL STORAGE TOTES INSIDE CHEMICAL STORAGE BUILDING

### 3.3.5 Site/Civil Observations

The site perimeter consists solely of the building envelope (brick and mortar). There is no fencing available for this site. Access to the site is controlled using a padlock/keylock for the front door, and only OCWA and Township of Essa operations personnel have keys to access the facility.

There is an in-ground concrete reservoir at the site, which was not inspected as part of this work. The site has two (2) access hatches, valve operators, and vent piping at ground level, all of which appear to be in good condition. One of the accesses hatches is outside and one is located within the pumphouse. The operation of the valves was not tested during the visit. The driveway is in good condition, with no cracks or broken asphalt.

# 4.0 Water Supply Alternatives

Based on a desktop hydrogeological review (GEI 2024) and a review of alternatives by the Greenland Team, the following alternatives to increase the water supply capacity were identified for further development:

1. Maximize the water taking from Brownley Well #5 by increasing the pumping rate from the existing well.
2. Replace Well's #2 and #3 at the Centre Street (McGeorge) facility with new larger capacity wells.
3. Increase capacity of existing Mill Street Well #1.
4. Install a new well at Mill Street Well field.
5. Develop a new well in the Angus area, separate from the three (3) existing sites.

## 4.1 Water Quality Review

As stated in Table 4 – Objectives and Guidelines of the Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines, the aesthetic objective (AO) for iron in a drinking water sample for the province of Ontario is 0.3 mg/L.

The Township of Essa water quality results from 2019 are summarized in Table 3. The Brownley and Mill Street pumphouses have lower levels of iron compared to the AO in the Ontario Drinking Water Standards, however, Centre Street (McGeorge) has slightly exceeded the 0.3 mg/L threshold, reporting values at 0.313 mg/L.

The well sites in Angus currently use sequestration, through the addition of sodium silicate, to control the aesthetic problems caused by iron and manganese in drinking water sources without removing these compounds. Sequestration involves adding chemicals to groundwater supply to maintain iron and manganese in a soluble form. If the water contains for combined iron and manganese concentrations up to 1.0 mg/L, sequestration can be an effective and inexpensive method that generates no sludge.

Iron and manganese levels above the limits of sequestration would require additional treatment to remove these compounds, such as ion exchange or oxidation/filtration methods.

Based on the results of the iron and manganese samples, sequestration with sodium silicate is a suitable method to address aesthetic concerns from these water quality parameters.

Please note these results were taken in 2019 and should be confirmed with updated samples for any future works. Additional treatment would be recommended to be investigated if there are significant user complaints.

During the site visit, operations staff indicated that the chlorine dose required at Center St (McGeorge) Wells is much higher (7.5 mg/L) than other wells (3.0 mg/L). It is recommended to perform general water quality analysis on the existing wells supply, or any new well supply, to confirm raw water quality characteristics and determine the cause of the higher raw water chlorine demand.

## TABLE 3 - IRON CONCENTRATION FOR TOWNSHIP OF ESSA (AUGUST 10 TO SEPTEMBER 19, 2019)

| Site | Mill | Mill | McGeorge | McGeorge | Brownley | Brownley |
|---|---|---|---|---|---|---|
| Month-Year | Sep-19 | Sep-19 | Sep-19 | Sep-19 | Sep-19 | Sep-19 |
| Hardness (mg/L) | 159 | 159 | 168 | 168 | 216 | 216 |
| | Hard | Hard | Hard | Hard | Hard | Hard |
| Grains/Gallon | 11 | | | | | |
| Iron (µg/L) | 220 | 220 | 313 | 313 | 117 | 117 |
| Month-Year | Jul-18 | Jul-18 | Jul-18 | Jul-18 | Jul-18 | Jul-18 |
| Fluoride (mg/L) | 0.17 | 0.17 | 0.21 | 0.21 | 0.19 | 0.19 |
| Sodium (mg/L) | 17.5 | 17.5 | 13.9 | 13.9 | 15.6 | 15.6 |

## 4.2 Alternative 1 - Brownley Well Capacity Increase

This alternative solution includes the pumping capacity upgrade of Well #5 from its current operating condition of 654,000 L/day to 1,086,000 L/day. This equates to an increase in total capacity of the Brownley Well site from 4,254,624 L/day to 4,500,000 L/day. As the pumping capacity of the well system will be increased, the capacity of the electrical system and chlorine contact time for primary disinfection was reviewed.

The water from Wells #4, #5 and #6 are combined in the pumphouse, and primary disinfection is currently achieved through the addition of chlorine, and contact time is achieved in the reservoir. Water is then pumped from the reservoir by high lift pumps to the distribution system. The normal target chlorine residual leaving the plant is between 0.5 and 1.0 mg/L, and during the site visit, the pre-chlorine residual reading was 0.61 mg/L

Water from the groundwater wells at this site is required to achieve 2-log virus inactivation, which requires a “CT” value of 4 mg/L.min. However, it is anticipated that the MECP may request that any newly drilled well be designed to achieve increased disinfection targets of 4-log virus inactivation, which would require a “CT” value of 8 mg/L.min. Therefore, this alternative will be reviewed assuming the higher disinfection level is required.

The existing system CT calculations are based on the flow measurements from the high lift pumps, and the highest flow condition of 200 L/s, based on estimated Fire Flows (FF) plus Maximum Day Demand (MDD). Increasing the flowrate from Well #5 will not impact the highest flow condition, therefore CT calculations have been performed at a flowrate of 200 L/s.

Table 4 below summarizes the minimum chlorine residuals needed to achieve 2 or 4-log virus inactivation under the maximum flow of 200 L/s while maintaining the minimum level in the reservoir of 1.5 m. Operations staff should be consulted to confirm that the minimum chlorine residual of 0.72 mg/L (plus a safety factor) is an acceptable condition to achieve higher levels of disinfection when one reservoir cell is out of service, or if the minimum water level should be raised in this scenario. Based on the results of the CT calculations, increasing the capacity of Well #5 does not require further upgrades to the station to achieve primary disinfection.

### TABLE 4 - CT CALCULATION SUMMARY FOR BROWNLEY WELL RESERVOIR

| | 2-log Virus Inactivation | | 4-log Virus Inactivation | |
|---|---|---|---|---|
| Required "CT" | 8 mg/L*min | | | |
| Flow | 200 L/s (MDD + FF) | | | |
| Minimum Water Level | 1.5 m | | | |
| Reservoir Cells in Service | 1 | 2 | 1 | 2 |
| Minimum Chlorine Residual | 0.36 mg/L | 0.2 mg/L | 0.72 mg/L | 0.4 mg/L |

Increasing the capacity of Well #5 will require a larger pump and larger motor. There is sufficient capacity to upsize the well pump from 15hP to 30hP motor.

The following works are recommended to increase capacity of Well #5 and to address the recommendations made during the site visit to maintain the system in a state of good repair:

- Continue to perform maintenance cleans on Wells #4, #5 and #6. Check condition of Well #5, and ensure structure can handle proposed capacity increase, this may involve casing repairs or structural enhancements.
- Replace Well #5 pump with new 30 hP submersible pump.
- Adjust chlorine dose setpoints to handle proposed capacity increase while meeting Ontario Drinking Water Standards.

Subsequent to this evaluation, this alternative was ruled out for further consideration. The well casing diameter limits the size of the new pump that could be installed in the existing well. Furthermore sufficient space is not available on the site to support the construction of an additional well.

## 4.3 Alternative 2 - Centre Street (McGeorge) Well Replacement

This alternative includes the replacement of Wells #2 and #3 which each operate at 1,296,000 L/day with two new 2,296,000 L/day wells. The location of the new wells is to be confirmed by the project team, and for the purposes of this study has been assumed to be on the same site. Furthermore, this study has assumed that the new wells would be non-GUDI, and no additional treatment would be required above chlorination and sequestration with sodium silicate. If this solution is implemented, water quality testing is recommended to review the water quality of the new wells and confirm if any additional treatment is required.

The majority of the equipment in the pumphouse appears to be original and is therefore assumed to be reaching the end of life at approximately 40 years old. It is recommended that all electrical and mechanical equipment be replaced to service the new wells. It is also recommended that the chemical storage building be completely replaced as there is prominent rust on the aluminium cladding visible and there is no source of insulation.

As discussed earlier, it is anticipated that the MECP may request that any newly drilled well be designed to achieve increased disinfection targets of 4-log virus inactivation, which would require a “CT” value of 8 mg/L.min. The existing combined reservoir volume is 252 m3 of usable storage, as per the Drinking Water Works Permit. When both new wells are operating, the total flow rate would be 26.6 L/s. The minimum water level in the reservoir to achieve 4-log virus inactivation assuming a minimum chlorine residual of 0.5 mg/L and baffle factor of 0.3 would be 34% full when both cells are online. This minimum water level should be suitable to manage on a day to day basis, therefore, the existing two reservoir cells and associated contact time can accommodate the increased well flows and 4-log virus inactivation.

The following works are recommended to replace Wells #2 and #3 and to address the recommendations made during the site visit to maintain the system in a state of good repair:

- Decommission existing Wells #2 and #3.
- Drill new Wells #2A and #3A, including permitting and approvals.
- Equip wells with submersible well pumps and variable frequency drives in a pitless adaptor style installation.
- Refurbish/replace existing equipment in well pumphouse.
- Perform structural condition assessment of in-ground reservoir to determine if refurbishment is required.

- Upgrade electrical supply to service new larger pumps
- Replace diesel generator with outdoor self enclosed unit with sub-base fuel tank.
- Demolish and reconstruct existing chemical storage room with brick and mortar structure.

### 4.3.1 Capital Costs and Schedule

A cost estimate was developed for the capital costs, with an accuracy range of -20% to +30% for each alternative. A more detailed breakdown of the cost estimate is contained in Appendix 2. Costs are shown in 2024 dollars and should be adjusted annually to account for inflation. The following assumptions were used to develop all of the cost estimates

- Allowance of 10% for General Contractor overhead, profit, mobilization, demobilization, bonding, temporary facilities, etc.
- Allowance of 30% for design development and pricing contingency of 30% of the total construction costs.
- Allowance of 25% for engineering design and services during construction.
- These estimates will depend on the actual labour and material costs, competitive market conditions and final project scope, among other variables. As a result, the project feasibility and funding needs must be carefully reviewed prior to making final project decisions to obtain adequate funding.

Table 5 summarizes the capital cost estimate and schedule for this alternative:

TABLE 5 - ALTERNATIVE 2 – CENTRE STREET (MCGEORGE) WELL REPLACEMENT

| Tasks | Cost | Schedule |
|---|---|---|
| Construction of Replacement Groundwater Wells, including engineering and allowances | $1,300,000 | 6 to 7 months |
| Source Water Protection Updates (Assumes existing groundwater model not available) | $150,000 | 2 years (concurrent with detailed design and construction) |
| Engineering Design and Contract Administration | $526,000 | 5 months (procurement and design) |
| Construction of refurbishment of existing pumphouse and replacement of chemical storage facility | $2,103,000 | 13 months |
| **Total Duration** | +/- 1 to 1.5 years | |
| **Estimated Sub Total (-20% to +30%)** | $4,079,000 | |

### 4.3.2 Environmental Assessment, Permits and Approvals

Based on the March 2023 version of the Municipal Class Environmental Assessment document, this project scope falls under the following descriptions:

- *Install a new well on an existing municipal well site*

Based on the descriptions above, the project is eligible for screening or a Schedule B Class EA may be required.

The following additional approvals are anticipated to be required:

- Permit to Take Water Amendment for the addition of a new well.
- Drinking Water Works Permit Amendment for the addition of a new well

- Source Water Protection Plan – If an update to the WHPA is required, a Section 34 amendment could be triggered which would require studies to examine threats on the landscape for new parcels of land not included in the existing plan and update the source water protection report with MECP. We understand this process could take around 6 months to 2 years to complete.

## 4.4 Alternative 3 - Increase Capacity of Mill Street Well #1

This alternative includes increasing the pumping rate of the existing Well #1 from 3,927,774 L/day to 4,300,000 L/day (50 L/s). Due to the proximity of the Mill Street wellfield to a closed waste disposal site, characterization of the hydrogeological system in the vicinity of the waste disposal site has been recommended by GEI Consultants to evaluate potential for impacts to the drinking water supply.

This study has assumed that the existing wells would be non-GUDI, and no additional treatment would be required above chlorination and sequestration with sodium silicate. If this solution is implemented, water quality testing is recommended to review the water quality and confirm if any additional treatment is required.

Increasing the capacity of Well #1 will require a larger pump and likely a larger motor. An electrical single-line diagram (SLD) was not visible at the site and the existing loads could not be confirmed to determine if there is sufficient electrical capacity to supply a larger pump. The majority of the electrical equipment in the pumphouse appears to be original and is therefore assumed to be reaching the end of life at approximately 35 years old. Three (3) pumps, some of the process piping and a new chemical system were refurbished/replaced in 2005. It is recommended that all electrical equipment be replaced. It is also recommended that the painted carbon steel process piping should be sandblasted and repainted as they show moderate corrosion.

As discussed earlier, it is anticipated that the MECP may request that any newly drilled well be designed to achieve increased disinfection targets of 4-log virus inactivation, which would require a “CT” value of 8 mg/L.min. The high lift pump capacity is much higher than the proposed increased capacity of Well #1. Therefore CT calculations have been performed the firm capacity (largest pump out of service) of 210 L/s.

Drawings showing the dimensions of the existing 2500 and 902 $m^3$ reservoirs were not available at the time of this report. The minimum water level in the reservoir to achieve 4-log virus inactivation assuming a minimum chlorine residual of 0.5 mg/L and baffle factor of 0.3 would be 20% full when all cells are online. For the purposes of the CT calculations, a minimum water level of 1.5 m was assumed. This minimum water level should be suitable to manage on a day to day basis, therefore, the existing two reservoir cells and associated contact time can accommodate the increased well flows and 4-log virus inactivation.

The following works are recommended to increase the capacity of Mill St Well #1 and to address the recommendations made during the site visit to maintain the system in a state of good repair:

- Investigation of waste disposal Area near Mill Street wellfield.
- Replace Well #1 pump with new 50 L/s submersible pump and motor.
- Continue to perform maintenance cleans on Well #1. Check condition of Well #1, and ensure structure can handle proposed capacity increase, this may involve casing repairs or structural enhancements.
- Investigate current condition of Mill Street MCC and see if replacement and /or refurbishment of electrical components are required.

### 4.4.1 Capital Costs and Schedule

A cost estimate was developed for the capital costs, with an accuracy range of -20% to +30% for each alternative. A more detailed breakdown of the cost estimate is contained in Appendix 2. Costs are shown in 2024 dollars and should be adjusted annually to account for inflation. The following assumptions were used to develop all of the cost estimates

- Allowance of 10% for General Contractor overhead, profit, mobilization, demobilization, bonding, temporary facilities, etc.
- Allowance of 30% for design development and pricing contingency of 30% of the total construction costs.
- Allowance of 25% for engineering design and services during construction.
- These estimates will depend on the actual labour and material costs, competitive market conditions and final project scope, among other variables. As a result, the project feasibility and funding needs must be carefully reviewed prior to making final project decisions to obtain adequate funding.

Table 6 summarizes the capital cost estimate and schedule for this alternative:

TABLE 6 - ALTERNATIVE 3 – INCREASE MILL ST WELL #1 CAPACITY

| Tasks | Cost | Schedule |
|---|---|---|
| Investigation of Waste Disposal Area near Mill Street Wellfield | $105,000 | 3 to 4 months |
| Pump testing, reporting and permitting | $85,000 | 3 to 6 months |
| Source Water Protection Updates (Assumes existing groundwater model not available) | $150,000 | 2 years (concurrent with detailed design and construction) |
| Engineering Design and Contract Administration | $76,000 | 12 months (procurement and design) |
| Construction of electrical upgrades for new well pump | $501,000 | 6 months |
| **Total Duration** | +/- 1.5 to 2 years | |
| **Estimated Sub Total (-20% to +30%)** | $917,000 | |

### 4.4.3 Environmental Assessment, Permits and Approvals

Based on the March 2023 version of the Municipal Class Environmental Assessment document, this project scope falls under the following descriptions:

- *Deepen or increase the pumping capacity of an existing well where the well is located on an existing municipal well site and the existing rated yield will be exceeded.*

Based on the description above, this project would be exempt from the EA act.

The following additional approvals are anticipated to be required:

- Permit to Take Water Amendment for the addition of a new well.
- Drinking Water Works Permit Amendment for the addition of a new well
- Source Water Protection Plan – If an update to the WHPA is required, a Section 34 amendment could be triggered which would require studies to examine threats on the landscape for new parcels of land not included in the existing plan and update the source water protection report with MECP. We understand this process could take around 6 months to 2 years to complete.

## 4.5 Alternative 4 – Construct New Mill Street Well #1A

This alternative includes constructing a new Well #1A at the Mill Street site, to achieve a combined discharge rate up to 8,800,000 L/day (101 L/s). Similar to Alternative 3, characterization of the hydrogeological system in the vicinity of the waste disposal site has been recommended by GEI Consultants to evaluate potential for impacts to the drinking water supply.

This study has assumed that the existing wells would be non-GUDI, and no additional treatment would be required above chlorination and sequestration with sodium silicate. If this solution is implemented, water quality testing is recommended to review the water quality of the new wells and confirm if any additional treatment is required.

The upgrade recommendations to the existing Mill St facility are the same as Alternative 3.

The CT calculations are also the same as Alternative 3, as the combined flow rate from the wells would remain less than the firm capacity of the high lift pumps.

The following works are recommended to construct a new Mill St Well #1A and to address the recommendations made during the site visit to maintain the system in a state of good repair:

- Investigation of waste disposal Area near Mill Street wellfield
- Drill new Well #1A, including permitting and approvals.
- Equip Well #1A with submersible well pump and variable frequency drive in a pitless adaptor style installation.
- Continue to perform maintenance cleans on Well #1. Check condition of Well #1, and ensure structure can handle proposed capacity increase, this may involve casing repairs or structural enhancements.
- Investigate current condition of Mill Street MCC and see if replacement and /or refurbishment of electrical components are required to support the new well.

### 4.5.1 Capital Costs and Schedule

A cost estimate was developed for the capital costs, with an accuracy range of -20% to +30% for each alternative. A more detailed breakdown of the cost estimate is contained in Appendix 2. Costs are shown in 2024 dollars and should be adjusted annually to account for inflation. The following assumptions were used to develop all of the cost estimates

- Allowance of 10% for General Contractor overhead, profit, mobilization, demobilization, bonding, temporary facilities, etc.
- Allowance of 30% for design development and pricing contingency of 30% of the total construction costs.
- Allowance of 25% for engineering design and services during construction.
- These estimates will depend on the actual labour and material costs, competitive market conditions and final project scope, among other variables. As a result, the project feasibility and funding needs must be carefully reviewed prior to making final project decisions to obtain adequate funding.

Table 7 summarizes the capital cost estimate and schedule for this alternative:

TABLE 7 - ALTERNATIVE 4 – NEW MILL ST WELL #1A

| Task | Cost | Schedule |
|---|---|---|
| Investigation of Waste Disposal Area near Mill Street Wellfield | $105,000 | 3 to 4 months |
| Construction of New Groundwater Well 1A, including engineering and allowances | $850,000 | 6 to 9 months |
| Source Water Protection Updates (Assumes existing groundwater model not available) | $150,000 | 2 years (concurrent with detailed design and construction) |
| Engineering Design and Contract Administration | $97,000 | 12 months (procurement and design) |
| Construction of electrical upgrades for new well pump | $644,000 | 12 months |
| **Total Duration** | +/- 1.5 to 2 years | |
| **Estimated Sub Total (-20% to +30%)** | $1,846,000 | |

### 4.5.2 Environmental Assessment, Permits and Approvals

Based on the March 2023 version of the Municipal Class Environmental Assessment document, this project scope falls under the following descriptions:

- *Install a new well on an existing municipal well site*

Based on the description above, the project is eligible for screening, or a Schedule B Class EA may be required.

The following additional approvals are anticipated to be required:

- Permit to Take Water Amendment for the addition of a new well.
- Drinking Water Works Permit Amendment for the addition of a new well
- Source Water Protection Plan – If an update to the WHPA is required, a Section 34 amendment could be triggered which would require studies to examine threats on the landscape for new parcels of land not included in the existing plan and update the source water protection report with MECP. We understand this process could take around 6 months to 2 years to complete.

## 4.6 Alternative 5 - New Well Field in Angus Area

This alternative includes the construction of a new well at a new site in the Angus area. This alternative would require multiple steps, including but not limited too:

- Desktop study and consultation with the Township to identify a suitable location for the new wellfield.
- Permitting and approvals, test well drilling and construction of a new well(s).
- Construction of a new well facility including at minimum the groundwater well pump, disinfection system, potentially sodium silicate system, and chlorine contact tank. Consideration could also be given to including a treated water storage reservoir and high lift pumps.

The cost estimate for this alternative has considered a direct pump system, and that a new reservoir and high lift pumping station would not be included.

### 4.6.1 Capital Costs and Schedule

This alternative requires further development to confirm the scope of work and facilities required (ex. pump well directly to the distribution system, well discharge on an onsite reservoir with separate high lift pumping station, land acquisition requirements, etc.) before a capital cost estimate can be developed.

### 4.6.2 Environmental Assessment, Permits and Approvals

Based on the March 2023 version of the Municipal Class Environmental Assessment document, this project scope falls under the following descriptions:

- *Establish a well at a new municipal well site.*

Based on the description above, a Schedule B Class EA would be required.

The following additional approvals are anticipated to be required:

- Permit to Take Water Amendment for the addition of a new well.
- Drinking Water Works Permit Amendment for the addition of a new well
- Source Water Protection Plan – If an update to the WHPA is required, a Section 34 amendment could be triggered which would require studies to examine threats on the landscape for new parcels of land not included in the existing plan and update the source water protection report with MECP. This process could take between 6 months to 2 years.

# 5.0 Water Storage

Based on and a review of alternatives by the Greenland Team, the following alternatives to increase the water storage capacity were identified for further development:

- Construction of an additional in-ground concrete reservoir (4200 $m^3$) at the Mill St. site,
- Construction of a new elevated tank (4200 $m^3$) at the Mill St. site,
- Construction of a new elevated tank (4200 $m^3$) at a greenfield site in the south end of Angus.

## 5.1 Alternative 1 -Additional Storage at the Mill Street Site

The Mill Street property currently has two (2) in ground reservoirs located on the east side of the property behind the pumphouse. The in-ground reservoirs have a storage capacity of 2500 $m^3$ and 902 $m^3$ (respectively).

To meet the demands for water storage listed in the IMP, this option will review a new in ground reservoir with a capacity of 4200 $m^3$. The new cell would be constructed next to the existing cells.

The following works are recommended but not limited to construct a new in ground reservoir at the Mill Street site:

- Cast in place concrete reservoir, divided into two isolatable cells with a total storage volume of 4,200 m3 including excavation and backfill.
- yard piping connections complete with isolation valves between the existing in ground reservoir cells and the new in ground reservoir cell.
- Expand fenced perimeter to cover the area of expansion.
- Topsoil, sod and/or terraseeding.

Please refer to **Appendix 3,** which shows a conceptual design plan for the in-ground reservoir at the Mill Street site.

### 5.1.1 Capital Costs and Schedule

A cost estimate was developed for the capital costs, with an accuracy range of -20% to +30% for each alternative. A more detailed breakdown of the cost estimate is contained in Appendix 3. Costs are shown in 2024 dollars and should be adjusted annually to account for inflation. The following assumptions were used to develop all of the cost estimates

- Allowance of 10% for General Contractor overhead, profit, mobilization, demobilization, bonding, temporary facilities, etc.
- Allowance of 30% for design development and pricing contingency of 30% of the total construction costs.
- Allowance of 25% for engineering design and services during construction.
- These estimates will depend on the actual labour and material costs, competitive market conditions and final project scope, among other variables. As a result, the project feasibility and funding needs must be carefully reviewed prior to making final project decisions to obtain adequate funding.

Table 8 summarizes the capital cost estimate and schedule for this alternative:

TABLE 8- ALTERNATIVE 1 - ADDITIONAL STORAGE AT THE MILL STREET SITE

| Task | Cost | Schedule |
|---|---|---|
| Engineering Procurement and Detailed Design | $1,369,000 | 7 to 10 months |
| Construction of new in ground reservoir | $9,126,000 | 6 to 10 months |
| **Total Duration** | +/- 1.5 to 2 years | |
| **Estimated Sub Total (-20% to +30%)** | $10,495,000 | |

### 5.1.2 Environmental Assessment, Permits and Approvals

Based on the March 2023 version of the Municipal Class Environmental Assessment document, this project scope falls under the following descriptions:

- *Replace/expand existing water storage facilities provided all such facilities are in either an existing road allowance or an existing utility corridor or where no land acquisition is required.*

Based on the description above, this project would be exempt from the EA act.

The following additional approvals are anticipated to be required:

- Drinking Water Works Permit Amendment for the addition of a reservoir.

## 5.2 Alternative 2- New Elevated Storage at the Mill Street Site

This alternative includes the construction of a new elevated storage tank with a capacity of 4200 $m^3$ adjacent to the existing reservoir and pumphouse on the south side of the Mill Street site.

The following works are recommended but not limited to construct a new elevated storage tank at the Mill Street site:

- Elevated water storage with a total storage volume of 4,200 $m^3$.
- Yard piping connections including isolation valves to connect the elevated tank to the distribution system piping.
- Expand fenced perimeter to cover the area of expansion.
- Topsoil, sod and/or terraseeding.
- Paved driveway.

Please refer to Appendix 4, which shows a conceptual design plan for the in-ground reservoir at the Mill Street site.

### 5.2.1 Capital Costs and Schedule

A cost estimate was developed for the capital costs, with an accuracy range of -20% to +30% for each alternative. A more detailed breakdown of the cost estimate is contained in Appendix 4. Costs are shown in 2024 dollars and should be adjusted annually to account for inflation. The following assumptions were used to develop all of the cost estimates

- Allowance of 10% for General Contractor overhead, profit, mobilization, demobilization, bonding, temporary facilities, etc.
- Allowance of 30% for design development and pricing contingency of 30% of the total construction costs.

- Allowance of 25% for engineering design and services during construction.
- These estimates will depend on the actual labour and material costs, competitive market conditions and final project scope, among other variables. As a result, the project feasibility and funding needs must be carefully reviewed prior to making final project decisions to obtain adequate funding.

Table 9 summarizes the capital cost estimate and schedule for this alternative:

TABLE 9 - ALTERNATIVE 2- NEW ELEVATED STORAGE AT THE MILL STREET SITE

| Task | Cost | Schedule |
|---|---|---|
| Engineering Procurement and Detailed Design | $1,550,000 | 4 to 6 months |
| Construction of new elevated tank and site works | $10,332,000 | 4 to 6 months |
| **Total Duration** | +/- 1 to 1.5 years | |
| **Estimated Sub Total (-20% to +30%)** | $11,882, 000 | |

### 5.2.2 Environmental Assessment, Permits and Approvals

Based on the March 2023 version of the Municipal Class Environmental Assessment document, this project scope falls under the following descriptions:

- *Replace/expand existing water storage facilities provided all such facilities are in either an existing road allowance or an existing utility corridor or where no land acquisition is required.*

Based on the description above, this project would be exempt from the EA act.

The following additional approvals are anticipated to be required:

- Drinking Water Works Permit Amendment for the addition of a reservoir.

## 5.3 Alternative 3 - Additional Storage at a Greenfield Site (South of Angus)

This alternative includes the construction of a new water storage structure with a capacity of 4,200 $m^3$ at a new site in the Angus area. This alternative could be an in-ground reservoir coupled with a new groundwater well and high lift pumping station, or it could be a new elevated storage tank.

For the purposes of this evaluation, it has been assumed that this alternative would consist of a new elevated water storage tower on a greenfield property owned by the Township. The alternative would include:

- Elevated water storage with a total storage volume of 4,200 $m^3$.
- Yard piping connections including isolation valves to connect the elevated tank to the distribution system piping.
- Expand fenced perimeter to cover the area of expansion.
- Topsoil, sod and/or terraseeding.
- Paved driveway.

### 5.3.1 Capital Costs and Schedule

The costs and timelines for this option of an elevated storage tank at a new site have been assumed to be the same as a new elevated tank at the Mill St site location. Costing has not considered any costs associated with land acquisition.

### 5.3.2 Environmental Assessment, Permits and Approvals

Based on the March 2023 version of the Municipal Class Environmental Assessment document, this project scope falls under the following descriptions:

- *Replace/expand existing water storage facilities provided all such facilities are in either an existing road allowance or an existing utility corridor or where no land acquisition is required.*
- *Establish new water storage facilities where the facility is not located in or adjacent to an environmentally sensitive natural area, residential or other sensitive land use, or on lands with cultural heritage or archaeological potential*

Based on the descriptions above, this project may be eligible for screening, or would require a Schedule B Class EA.

The following additional approvals are anticipated to be required:

- Drinking Water Works Permit Amendment for the addition of a reservoir.

# 6.0 SUMMARY OF CAPITAL COSTS & FUTURE STEPS

Please refer to **Table 10** which outlines:

1. All alternative options discussed in this report.
2. The total capital cost associated with each alternative.

TABLE 10 - SUMMARY OF SUBJECT CAPITAL COSTS FOR EACH LISTED ALTERNATIVE

| Subject | Alternative No. | Estimated Sub Total (-20% to +30%) | Estimated Total Project Duration |
|---|---|---|---|
| Water Supply - Centre Street (McGeorge) Well Replacement | 2 | $4,079,000 | +/- 2 years |
| Water Supply - Increase Mill St Well #1 Capacity | 3 | $917,000 | +/- 1 to 1.5 years |
| Water Supply - New Mill St Well #1A | 4 | $1,846,000 | +/- 1.5 to 2 years |
| Water Storage – In Ground Reservoir | 1 | $10,495,000 | +/- 1.5 to 2 years |
| Water Storage – Elevated Storage Tank | 2 | $11,882, 000 | +/- 1 to 1.5 years |

Of the listed alternatives for Water Supply the most cost-effective alternative is #3, to increase the capacity of the Mill Street Well #1. For Water Storage the most cost-effective alternative is #1, the additional of an in-ground reservoir at the Mill Street site.

Please refer to **Appendix 5** for a draft project schedule for all alternatives discussed in this report.

# APPENDIX 1

## GEI Consultants Workplan

September 17, 2024
Proposal No. 2302990

VIA EMAIL: jmaitland@grnland.com

Greenland Consulting Engineers
ATTN: Josh Maitland
120 Hume Street
Collingwood ON  L9Y 1V5

**Re: Workplan and Cost Estimates for Investigations to Support Supply Well Network Expansion**
**Angus Groundwater Supply Assessment**
**Township of Essa, Ontario**

Dear Mr. Maitland:

GEI Consultants Canada Ltd. (GEI) have been retained by Greenland Consulting Engineers (the Client) to provide hydrogeological services as part of the ongoing Municipal Class Environmental Assessment that reviews options for the expansion of municipal water services in Angus, Township of Essa.

This document provides a set of planning-level workplans and cost estimates for anticipated hydrogeological investigation, well testing, and approvals-related tasks associated with supplemental investigations that support determining the preferred alternatives for the proposed expansion of the municipal supply well network in Angus.

## Background

The settlement area of Angus is serviced by a municipal water system that obtains its supply from a set of six supply wells in three wellfields, drawing from three overburden aquifers that had been identified by previous investigations:

- Mill Street Well 1
- Centre Street Well 2
- Centre Street Well 3
- Brownley Well 4
- Brownley Well 5
- Brownley Well 6

The current Permit to Take Water 0244-CU4QCG for the Angus municipal well system provides a permitted water-taking rate of 9,585 $m^3$/day.

Based on growth projections, the Township of Essa anticipates that within the next 25 years the water supply system will need to support daily demand of between 13,590 $m^3$/d (average demand) and 17,709 $m^3$/d (maximum demand).

In a desktop review report, GEI provided several recommendations for increasing the capacity of the Angus water supply well network, noting that additional investigation would be required to confirm the viability of those alternatives and the incremental supply that they would provide.

Subsequent discussion with the Township of Essa and their consultants (R.V. Anderson Associates Limited, Greenland Consulting Engineers) has indicated a preference to prioritize the following supplemental investigations:

1. Maximize water-taking from Brownley Well 5
2. Replace Centre Street Wells 2 and 3
3. Maximize water-taking from Mill Street Well 1
4. Install an additional well at Mill Street Wellfield.
5. Construct a new well at a new wellsite (i.e., development of a new wellfield).

Subsequent discussion has indicated that water-taking from Brownley Well 5 cannot be feasibly increased unless completely replaced with a well having a larger casing. Due to congestion at the Brownley wellsite, alternative options are under consideration.

Therefore, this workplan and cost estimate will address the other four (4) options (i.e., items 2 through 5 above).

# 1. Replacement of Centre Street Wells 2 and 3

## *1.1. Workplan*

The replacement wells for Centre Street Wells 2 and 3 are anticipated to be installed on the same parcel as the existing Centre Street wells. The replacement wells will be similar in depth and construction as the existing wells, with the exception of the replacement wells being constructed with a larger diameter (300 mm) than the existing wells (250 mm).

The overall workflow is proposed as follows:

1. Pre-consultation with the MECP to confirm the scope of study and proposed testing.
2. Installation of a network of monitoring wells to characterize local shallow hydrogeology and provide for the monitoring groundwater-surface water interaction during subsequent pumping tests.
3. Installation of replacement wells, Centre Street Well B and Well C.
4. Pumping tests to confirm the capacity of the new wells and the potential impacts on the local hydrogeological system
5. Preparation of a Permit to Take Water application for municipal well production

A more detailed breakdown of tasks is as follows:

- Prepare a pre-consultation brief and submit to the MECP technical support section with the proposed scope of study and testing. This would include:
  - Review of other historical reports or background information that may not have previously been available for review.
  - Attendance at a pre-consultation meeting with the MECP to confirm the scope.
- Arrange for private and public utility locates to clear drilling locations for the proposed network of monitoring wells.
- Arrange for a geo-environmental drilling contractor to install the monitoring wells for the proposed monitoring well network
  - Monitoring wells would likely be located along the right of way of Centre Street/ Side Road 20.
  - It is anticipated that two nests of three wells would be sufficient, with each nest composed of:
    - one well (2” PVC with slotted screen) at 10 m depth, installed by hollow stem auger
    - one well (2” PVC with slotted screen) at 20 m depth, installed by hollow stem auger
    - one well (grouted-in vibrating wire piezometer) at 48 m depth (i.e., into the source aquifer), installed by mud rotary
      - A conventional monitoring well is not recommended for this well because of the known artesian conditions in this area.
- Attend drilling operations to observe and collect soil samples, advise on monitoring well installation, and prepare stratigraphic logs.
- Arrange for traffic control during monitoring well drilling.
- Complete a suite of geotechnical laboratory tests to support characterization of soils encountered during monitoring well installation
  - Up to 6 samples tested for grain-size analysis
  - Up to 4 samples tested for Atterberg limits
- Installation (by manual means, hand auger) of up to four piezometers in the wetland area associated with Bear Creek
- Procure monitoring instruments for installation in the monitoring wells and piezometers:
  - Two vibrating wire piezometers
  - Eight datalogging pressure transducers (e.g., Solinst Levelogger or similar)
- Monitoring of water levels for a period of one month and comparison with precipitation records and Centre Street well field operations (i.e., daily pumping quantities).
- Preparation of a technical memorandum to summarize the findings of the monitoring network setup, including the following:
  - descriptions of observations made during the installation of the monitoring network
  - monitoring well logs
  - review and analysis of responses in groundwater level data as compared to well operations and precipitation events.

- Conduct a door-to-door private well survey to properties within 500 m of the Centre Street wellsite.
- Undertaking of a private well monitoring program at select supply wells for which the owners have provided consent and where wells are in adequate condition to allow access/use.
  - Assumes four participants
  - Includes installation of a datalogging pressure transducers to collect water level measurements
- Preparation of a “pumping test design report” per the requirements of O.Reg. 63/16
- Registration of the pumping test activity to the Environmental Activity and Sector Registry
- Arrangement with a water well drilling contractor to conduct production well installation and pumping testing according to this proposed workflow:
  - Installation of Centre Street Well B, including pilot hole to confirm stratigraphy and select an appropriate well screen.
  - Completion of a step test at Centre Street Well C, with proposed steps of 7 Lps, 14 Lps, 21 Lps and 28 Lps (total test duration of 6 hours).
  - Installation of Centre Street Well B, including pilot hole to confirm stratigraphy and select an appropriate well screen.
  - Completion of a step test at Centre Street Well B, with proposed steps of 7 Lps, 14 Lps, 21 Lps and 28 Lps (total test duration of 6 hours).
  - Completion of a 72-hour pumping test on both new wells at an approximate rate of 26 Lps (a combined daily discharge of 4,500,000 L/d).
  - Over the course of the three pumping tests, a total of 6 samples of discharge water will be collected and submitted to laboratory for analysis of a suite of general water chemistry parameters covering those parameters listed in Tables 1, 2 and 3 of MECP *Procedure D-5-5* as well as in Table 4 of the *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines*.
- Preparation of a Permit to Take Water Report, including
  - General characterization of the local hydrogeology based on available reference material (e.g., MECP water well records, Ontario Geological Survey reports and geospatial data, historical hydrogeological reports provided by the client).
  - Results of investigations, water level monitoring activities, and pumping tests.
  - Preparation of hydrogeological cross-sections
  - Hydrogeological impact assessment regarding other water users and/or environmental features (e.g., surface water, wetland areas)
  - Proposed water-taking rates.
- Preparation and submission of a Permit to Take Water application for production well operation.

It is noted that prior to beginning production from the new wells, some additional works may be required such as:

- Environmental Impact Study
  - This may be necessary if the proposed water-taking indicates potential to affect the hydrology of the local wetland areas.
- Additional planning for the selection and setup of discharge works for the pumping tests
- Additional water quality testing of well water

- Source Protection Plan updates, including modeling of new Wellhead Protection Areas.

Allowances will be provided for these items in the cost estimate (Section 1.2).

## *1.2. Estimated Costs*

Table 1 provides anticipated costs to complete the workplan outlined above.

**Table 1. Cost Estimates[1] for Investigations and Hydrogeological Reports for Centre Street Wells B and C.**

| **Task** | **Engineering Fees and Disbursements** | **Sub-Contractor Costs** |
|---|---|---|
| Pre-Consultation and Project Management | $8,500 | ~ |
| Monitoring Network Setup[2] and Door-to-Door Well Survey | $28,000 | $63,500 |
| Installation of Pumping Wells | $14,000 | $784,500 |
| Completion of Pumping Tests, including pumping test design report and EASR registration | $29,000 | $151,500 |
| Preparation of PTTW Application | $13,000 | ~ |
| Column Subtotals | $92,500 | $999,500 |
| Subtotal, before Allowances | $1,093,000 | |
| Allowance: EIS | $100,000 | |
| Allowance: Additional Discharge Works Planning | $15,000 | |
| Allowance: Additional Water Quality Testing[3] | $20,000 | |
| Allowance: Source Protection Plan Updates | $30,000 | |
| **Grand Total** | **$1,257,000** | |

Notes:
1. Estimated costs do not include HST.
2. It is assumed that all monitoring wells can be placed on municipal property. Additional coordination fees may be incurred if monitoring wells or piezometers must be placed on private property or property for which permission must be obtained from other agencies.
3. Additional testing intended to address all parameters included in Tables 1, 2, and 4 of the *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines* as well as gross alpha and beta radiation.

## *1.3. Schedule*

To complete this project in support of approvals for the operation of replacement of the Centre Street wells, we anticipate a project timeline as follows:

- Pre-consultation Phase: 1 to 2 months
- Monitoring Network Setup: 2 months
- Installation and Testing of Pumping Wells: 2 to 3 months
    - Includes time to prepare the pumping test design report

- Preparation of Permit to Take Water Application: 2 months.

Acounting for some overlap between tasks, it is expected that this project could be completed in approximately 6 to 7 months.

## 2. Investigation of Waste Disposal Area near Mill Street Wellfield

Due to the proximity of the Mill Street wellfield to a closed waste disposal site, the proposal to increase water-taking from the Mill Street wellfield will require characterization of the hydrogeological system in the vicinity of the waste disposal site to evaluate potential for impacts to the drinking water supply.

This project will primarily involve drilling and monitoring well installation to characterize stratigraphy, shallow groundwater quality, and potential for contaminant transport from the waste disposal site to the Mill Street well source aquifer. If applicable, monitoring would be conducted to assess whether the activity of Mill Street Well 1 (e.g., daily pumping quantities) affect the hydrogeological conditions which might contribute to increased potential for contaminant transport from the waste disposal site.

### *2.1. Workplan*

To achieve the characterization and impact assessment objectives, the following tasks are expected to be undertaken:

- Conduct a desktop review of existing information as may be available from MECP water well records, Ontario Geological Survey publications, and Conservation Authority mapping.
- Arrangement for public locates and retain a private locates contractor to clear proposed borehole locations.
- Undertake a subsurface investigation of the waste disposal site area, including,
    - Coordination with a licensed well drilling contractor to:
        - Drill a series of shallow boreholes (up to 9 locations to a depth of 3 m) to delineate the fill perimeter in the northwesterly part of the waste disposal area (i.e., the side closest to the existing Mill Street well).
        - Drill three nested monitoring well groups. Each nest would be composed of three monitoring wells (2” PVC casing) installed to approximate depths of 6 m, 18m, and 27 m below ground surface.
            - Due to the depth of drilling and the need to collect high-quality stratigraphic data, it is proposed that these monitoring wells be installed using sonic drilling methods.
    - Collection and analysis of up to 9 soil samples for grain-size analyses and Atterberg Limits.
    - Measurement of static groundwater levels to determine vertical and lateral hydraulic gradients and interpreted patterns of groundwater flow.
    - Completion of single-well response tests in each monitoring well to characterize hydraulic conductivity of each stratum.
    - Sampling of each monitoring well for a range of Contaminants of Potential Concern associated with landfills, including:
        - PHCs (F1-F4)

        - VOCs
        - General water quality including major anions, dissolved metals and other index parameters (e.g., hardness, alkalinity, pH).
- Preparation of a hydrogeological study report including
    - Presentation of results of subsurface investigation
    - Analysis of collected data to interpret patterns of groundwater flow and seepage rates
    - Preparation of hydrogeological cross-sections of the wellsite and waste disposal site area
    - Evaluation of potential for contaminant transport from the waste disposal site to the source aquifer.

## 2.2. Estimated Costs

Table 2 provides anticipated costs to complete the workplan outlined above for the investigation of the waste disposal area near Mill Street wellfield.

**Table 2. Cost Estimates[1] for Investigations and Hydrogeological Reports for Waste Disposal Area.**

| Task | Engineering Fees and Disbursements | Sub-Contractor Costs |
|---|---|---|
| Project Management and Coordination | $4,000 | ~ |
| Subsurface Investigation, including drilling and laboratory analyses | $27,000 | $65,500 |
| Report Preparation | $8,000 | ~ |
| Column Subtotals | $39,000 | $65,500 |
| **Grand Total** | **$104,500** | |

Notes:
1. Estimated costs do not include HST.
2. It is assumed that all monitoring wells can be placed on municipal property. Additional coordination fees may be incurred if monitoring wells or piezometers must be placed on private property or property for which permission must be obtained from other agencies.

## 2.3. Schedule

To complete this project for the investigation of the waste disposal site near Mill Street wellfield, we anticipate that the duration of the major tasks will be approximately as follows:

- Subsurface Investigation: 2 months
- Report Preparation: 1 to 2 months

Therefore, we anticipate that this project could be completed in approximately 3 to 4 months.

# 3. Increased Water-Taking from Mill Street Well 1

Prior assessments indicate that the existing Mill Street Well 1 may have a capacity of approximately 4,300,000 L/d, approximately 10% more than the current permitted amount of 3,927,774 L/d.

Additional testing would be required to confirm this additional capacity and support approvals applications (e.g., PTTW).

## 3.1. Workplan

The following workplan is proposed:

- Review existing operating conditions (drawdowns, flow rates, total dynamic head) to confirm that an appropriate pump is available to achieve the required increase in flow.
- Conduct a door to door private well survey within 500 m of Mill Street Well 1
- Preparation of a pumping test design report per O.Reg. 63/16 and registration of the pumping test activity to the Environmental Activity and Sector Registry
- Implement a private well monitoring program by installing datalogging pressure transducers in private wells (subject to well owner consent):
    - Assumes up to 4 participants.
- Arrange with a water well drilling contractor to conduct a step-drawdown test (approximate discharge rates of 12 Lps, 25 Lps, 37 Lps, 50 Lps), including:
    - Installation of a datalogger in the pumping well
    - Installation of dataloggers in each of the nine (9) monitoring wells installed during the waste disposal site investigation
    - Collection of one sample of discharge water across the two tests (three from Well A and two from Well 1) and submission to laboratory for analysis of a suite of general water chemistry parameters covering the following parameter suites:
        - Tables 1, 2 and 3 of MECP *Procedure D-5-5* as well as
        - Table 4 of the *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines*.
- Preparation of a pumping test analysis report, including
    - Description of test
    - Presentation of test results
    - Analysis of pumping test data and water level observations in monitoring wells
    - Recommendations regarding further testing.

It is noted that some additional works may be required for the successful completion of this part of the project, including:

- Costs associated with re-commissioning related to the removal/replacement of the service pump
    - The pumping test may require the installation of a higher capacity pump than is currently installed in the well.

## 3.2. Estimated Costs

Table 3 provides anticipated costs to complete the workplan outlined above.

**Table 3. Cost Estimates[1] for Investigations and Hydrogeological Reports for Re-Rating of Mill Street Well 1.**

| Task | Engineering Fees and Disbursements | Sub-Contractor Costs |
|---|---|---|
| Pumping Test, including pumping test design report and well monitoring program | $27,000 | $27,500 |
| Report Preparation and Project Management | $5,500 | ~ |
| Column Subtotals | $32,500 | $27,500 |
| Subtotal, before Allowances | $60,000 | |
| Allowance: Commissioning/Re-Commissioning Costs | $25,000 | |
| **Grand Total** | **$85,000** | |

Notes:
1. Estimated costs do not include HST.

### *3.3. Schedule*

To complete this project in support of the re-rating of the existing Mill Street Well 1, we anticipate that the duration of the major tasks will be approximately as follows:

- Pumping Test: 2 to 3 months
- Report Preparation: 1 to 2 months

The anticipated duration of this project is expected to be approximately 3 to 5 months.

## 4. Installation of a New Well at Mill Street Wellfield

Due to the high yield available at Mill Street Well 1, it is expected that the area could support an additional pumping well.

### *4.1. Workplan*

The workplan will generally involve the following objectives:

1. Pre-consultation and application for Category 2 Permit to Take Water for pumping tests
2. Well installation and pumping tests
3. Application for Permit to Take Water for production well operation

The following is a list of tasks that are expected to be required to achieve the objectives:

- Pre-consultation with the MECP regarding the scope of study and anticipated water-takings, including
    - Preparation of a pre-consultation brief
    - Attendance at a pre-consultation meeting
- Preparation of a pumping test report and Permit to Take Water application

- Installation of up to 4 piezometers using manual means (i.e., hand auger) in the wetland areas near the stream located to the south and east of the Mill Street wellfield.
- Installation of two 2” PVC monitoring wells into the production aquifer (approximate depth 64 m)
- Arrangement with a licensed water well drilling contractor to install Mill Street Well A (total depth of 62.5 m with 14” casing and 12” screen), including:
    - Pilot hole to confirm stratigraphy and collect grain-size samples for well screen sizing
- Undertaking of a step-drawdown test to confirm pumping rates (anticipated discharge rate steps of 12 Lps, 25 Lps, 40 Lps, 55 Lps; total test time of 6 hours)
- Undertaking of a 72 hour pumping test of both Mill Street Well 1 and Mill Street Well A (combined discharge rate of approximately 8,800,000 L/d), including
    - Private well monitoring (subject to well owner consent; 4 participants assumed)
    - Monitoring of drawdowns in existing monitoring wells and piezometers (13 total instruments) using datalogging pressure transducers.
- Collection of a total of 5 samples of discharge water across the two tests (three from Well A and two from Well 1) and submission to laboratory for analysis of a suite of general water chemistry parameters covering the following parameter suites:
    - Tables 1, 2 and 3 of MECP *Procedure D-5-5* as well as
    - Table 4 of the *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines*.
- Preparation of a Permit to Take Water report, including:
    - General characterization of the local hydrogeology based on available reference material (e.g., MECP water well records, Ontario Geological Survey reports and geospatial data, historical hydrogeological reports provided by the client).
    - Results of investigations, water level monitoring activities, and pumping tests.
    - Preparation of hydrogeological cross-sections
    - Hydrogeological impact assessment regarding other water users and/or environmental features (e.g., surface water, wetland areas)
    - Proposed water-taking rates.
- Preparation and submission of a Permit to Take Water application for production well operation.

It is noted that prior to beginning production from the new wells, some additional works may be required such as:

- Environmental Impact Study
    - This may be necessary if the proposed water-taking indicates potential to affect the hydrology of the local wetland areas.
- Additional planning for the selection and setup of discharge works for the pumping tests
- Additional water quality testing of well water
- Source Protection Plan updates, including modeling of new Wellhead Protection Areas.

Rough estimates of allowances for these items will be provided in the cost estimate section below (Section 4.2).

## 4.2. Estimated Costs

Table 4 provides anticipated costs to complete the workplan outlined above.

**Table 4. Cost Estimates[1] for Investigations and Hydrogeological Reports Installation, Testing and Approvals for a New Well at Mill Street Wellfield (Mill Street Well A).**

| Task | Engineering Fees and Disbursements | Sub-Contractor Costs |
|---|---|---|
| Pre-Consultation and Permit to Take Water for Testing | $14,000 | ~ |
| Well Installation and Pumping Tests | $29,000 | $593,000 |
| Permit to Take Water Report and Application | $15,000 | ~ |
| Column Subtotals | $58,000 | $593,000 |
| Subtotal, before Allowances | $651,000 | |
| Allowance: Environmental Impact Study | $100,000 | |
| Allowance: Commissioning/Recommissioning | $25,000 | |
| Allowance: Additional Discharge Works Planning | $15,000 | |
| Allowance: Additional Water Quality Testing[2] | $20,000 | |
| Allowance: Source Protection Plan Updates[3] | $30,000 | |
| **Grand Total** | **$841,000** | |

Notes:
1. Estimated costs do not include HST.
2. Additional testing intended to address all parameters included in Tables 1, 2, and 4 of the *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines* as well as gross alpha and beta radiation.
3. Intended to include for modeling to establish Wellhead Protection Areas and submission of updated Source Protection Plan for approval.

## 4.3. Schedule

To complete this project for the installation, testing and approvals applications in support of the operation of a new well at the Mill Street Wellfield, we anticipate that the duration of the major tasks will be approximately as follows:

- Pre-Consultation and Permit to Take Water for Testing: 3 to 5 months
- Well Installation and Pumping Tests: 2 to 4 months
- Permit to Take Water Report and Applications: 2 months

The anticipated duration of this project is expected to be approximately 6 to 9 months.

# 5. Development of a New Wellfield

Due to the abundant groundwater resources in the Angus area across the three existing wellfields, it is expected that there are opportunities to expand municipal water supply capacity through the development of a new wellfield (i.e., construction of a well at a site other than one of the existing three wellfields).

Development of a new wellfield may require a separate Municipal Class Environmental Assessment (MCEA). However, MCEA services are considered to be outside the scope of this planning document, which is limited to the hydrogeological assessment of well performance, aquifer characterization, and identification of potential impacts.

## *5.1. Workplan*

This project is expected to involve the following tasks:

- Desktop study and consultation with the Township to identify a suitable location for the new wellfield.
- Completion of public and private utility locates at the proposed drilling locations.
- Conduct a door-to-door well survey within 500 m of the wellsite.
- Preparation of pumping test design report and registration of the pumping test activity to EASR.
- Implementation of a private well monitoring program (water level only) through the installation of dataloggers in private wells (subject to well owner consent)
    - Assume 4 participating well owners.
- Arrangement with a licensed well drilling contractor to construct:
    - One 6” test well to an estimated depth of 40 m
    - One 2” monitoring well to an estimated depth of 40 m
- Completion of a step drawdown test to gauge well performance, with estimated pumping rate steps of 1.2 Lps, 2.4 Lps, 3.6 Lps and 5 Lps (estimated test duration of 6 hours). This will include monitoring of water levels in the pumping well and monitoring well using a datalogging pressure transducer.
- Across the two pumping tests, a total of 3 samples of discharge water will be collected and submitted for a suite of general water quality testing, including those parameters listed in:
    - Tables 1, 2 and 3 of MECP *Procedure D-5-5* as well as in
    - Table 4 of the *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines*.
- Completion of a constant rate pumping test at a rate determined by the result of the step drawdown test, including associated water level monitoring.
- Preparation of a pumping test analysis report, including
    - Description of test methodology
    - Presentation of pumping test results (e.g., water quality data, drawdown response data)
    - Analysis of pumping test data to assess aquifer characteristics
    - Recommendations for further investigation and development

It is noted that the workplan described above does not include for the installation of a production well, the completion of detailed investigations and impact assessments or for the preparation of a Permit to Take Water Application. Allowances for these tasks have been provided in the estimated cost section below.

## 5.2. Estimated Costs

Table 5 provides anticipated costs to complete the workplan outlined above.

**Table 5. Cost Estimates[1] for Investigations and Hydrogeological Reports for Development of a New Wellfield.**

| Task | Engineering Fees | Sub-Contractor Costs |
|---|---|---|
| Desktop Study and Preliminary Work, including municipal and MECP consultation | $9,000 | ~ |
| Well Installations | $4,000 | $77,000 |
| Pumping Tests, including well surveys and private well monitoring | $18,500 | $66,000 |
| Report Preparation and Project Management | $10,500 | ~ |
| Column Subtotals | $42,000 | $143,000 |
| Subtotal, before Allowances | $185,000 | |
| Allowance: Additional Discharge Works Planning | $15,000 | |
| Allowance: Production Well Installation[2] | $190,000 | |
| Allowance: Pumping Tests and Impact Assessment Investigations on the Production Well | $125,000 | |
| Allowance: Preparation of PTTW Report and Application | $15,000 | |
| **Grand Total** | **$530,000** | |

Notes:
1. Estimated costs do not include HST.
2. Assumes a 10" well installed to a depth of 40 m (estimated maximum production of approximately 1,900,000 L/d)

## 5.3. Schedule

To complete this project in support of the development of a new wellfield, we anticipate that the duration of the major tasks will be approximately as follows:

- Desktop Study and Preliminary Work: 3 months
- Well Installations: 2 to 3 months
- Pumping Tests: 1 month
- Report Preparation: 1 to 2 months

The anticipated duration of this project is expected to be approximately 5 to 8 months.

## 6. Summary

Below (see Table 6) is a summary of the costs and timelines for each of the projects outlined above.

**Table 6. Summary of Estimated Project Budgets and Timelines**

| Project | Anticipated Budget (excluding HST) | Estimated Schedule[1] | Potential Increase in Water Supply ($m^3$/d) |
|---|---|---|---|
| Replacement of Centre Street Wells | $1,257,000 | 6 to 8 months | 1,900 |
| Investigation of Waste Disposal Area near Mill Street Wellfield | $104,500 | 3 to 4 months | N/A |
| Increased Water-Taking from Mill Street Well 1 | $85,000 | 3 to 5 months | 400 |
| Installation of New Well at Mill Street Wellfield | $841,000 | 7 to 11 months | 4,400 |
| Development of a New Wellfield | $530,000 | 6 to 9 months[2] | 1,900[3] |

Notes:
1. Project Schedules do not account for time preparation of Source Protection Plan updates or for subsequent approval of those updates. In addition, the project "Development of a New Wellfield" does not include for the installation of a production-ready well or for the preparation of a Permit to Take Water for production.
2. There may be additional Municipal Class Environmental Assessment tasks to complete before confirming the selection of a new wellfield location: those tasks are not included in this timeline estimate.
3. Productivity of new wellfield is dependent on the hydrogeological conditions at that wellfield as well as the desired size of well to be installed.

In all cases where a change in pumping rate is proposed or a new well is proposed to be brought online, it should be assumed that 18 to 24 months' time would be required to prepare the necessary Source Protection Plan update submission and subsequently obtain approval from the MECP. It is our understanding that the revision to the Source Protection Plan must be completed and approved by the MECP before beginning to operate the pumps as intended.

It is noted that the scheduling of these projects is more or less independent (i.e., they may be completed in series or in parallel) with the exception of the investigation of the waste disposal area, which should precede the other projects at the Mill Street wellfield.

## 7. Limitations

This set of workplans and cost estimates is provided for planning purposes only. Estimates provided here are based on anticipated effort associated with the listed tasks. Actual tasks may vary from those listed above for a variety of reasons, including but not limited to:

- results of pre-consultation with regulatory agencies (e.g., MECP),

- unforeseen physical or environmental constraints related to the execution of the project (e.g., discharge management),
- results of pumping tests (e.g., subsequent requirement for additional investigation or additional wells and testing),
- changes in chargeout rates, contractor fees, and material costs due to the passage of time.

Though efforts have been made to provide a reasonable scope of work and associated costs to achieve the project goals, this document is not to be construed as a binding fee proposal or agreement to provide services. If the Client would like to proceed with a project involving works such as those described in this document, it is recommended that a formal proposal and/or quote from contractors be obtained.

Based on the large proportion of project cost being related to production and test well installation, it has been assumed that the drilling contractor would act as the Project Contractor and that GEI/consultant would act as the contractor administrator. With this arrangement, the drilling contractor would be retained directly by the municipality under separate contract, while GEI would provide facilitation, documentation, and administration services.

It is reiterated that this set of workplans addresses primarily the hydrogeological aspects of the obtainment of additional municipal water supply from local aquifers. It is not intended to address the following:

- Engineering design of watermains, reservoirs, water treatment systems, or other infrastructure that may be required to deliver and distribute water;
- Fulsome environmental assessment for identification of preferred options or the development of new wellfields.

## 8. Closing

If you have any questions, please feel free to contact me as follows:

- Office: 519.824.8150 x1274
- Mobile: 780.913.9833
- Email: MaLong@geiconsultants.com

Sincerely,

GEI Consultants Canada Ltd.

| | |
|---|---|
| Matthew Long, M.Eng., P.Eng. | Matthew Nelson, P.Eng., P.Geo. |
| Senior Project Engineer | Vice President, Environmental Practice Lead |

ML/mn

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cc: Kristen McFarlane, Greenland Consulting Engineers
Alex Winkelmann, GEI Consultants Canada Ltd.

# APPENDIX 2

## Water Supply Alternatives #2-#4 Conceptual Cost Estimates

| Water Supply - Alternative 2 - Centre Street Refurbishment | | | | | | | | | RVA #237001<br>Concept Development Estimate |
|---|---|---|---|---|---|---|---|---|---|
| October 17, 2024 | | | | | | | | | |
| | | | | | | | | | |
| Cost Estimate | | | | | | | | | |
| ITEM | | | | | | | | | ESTIMATED |
| No. | DESCRIPTION | Unit | Quantity | Options 1/0 | Unit Price | Equipment Cost | Installation % | Installation Cost | AMOUNT |
| 1. SITE WORKS | | | | | | | | | |
| 1 | Architectural | LS | 1.0 | 1 | $270,000.00 | $270,000.00 | 0% | $ - | $270,000.00 |
| 2 | Structural Foundation | m3 | 20.0 | 1 | $1,500.00 | $30,000.00 | 0% | $ - | $30,000.00 |
| 4 | Replacement of Chlorine storage + feed system | LS | 1.0 | 1 | $50,000.00 | $50,000.00 | 0% | $ - | $50,000.00 |
| 5 | Demolition | LS | 1.0 | 1 | $30,000.00 | $30,000.00 | 0% | $ - | $30,000.00 |
| | | **Sub Total** | | | | | | | **$380,000.00** |
| 2. REFURBISHMENT OF EXISITING EQUIPMENT | | | | | | | | | |
| 1 | Diesel Generator | LS | 1.0 | 1 | $260,000 | $260,000.00 | 0% | $ - | $260,000.00 |
| 2 | High Light Pumps | LS | 1.0 | 1 | $50,000 | $50,000.00 | 0% | $ - | $50,000.00 |
| 3 | Piping and Valves | LS | 1.0 | 1 | $100,000 | $100,000.00 | 0% | $ - | $100,000.00 |
| 4 | SCADA Programming + C&I Instrumentation | LS | 1.0 | 1 | $150,000 | $150,000.00 | 0% | $ - | $150,000.00 |
| 5 | Heater + Ventilation + Plumbing | LS | 1.0 | 1 | $50,000 | $50,000.00 | 0% | $ - | $50,000.00 |
| 6 | Electrical Panels | LS | 1.0 | 1 | $280,000.00 | $280,000.00 | 0% | $ - | $280,000.00 |
| 7 | Paint + Misc. Finishes | LS | 1.0 | 1 | $50,000.00 | $50,000.00 | 0% | $ - | $50,000.00 |
| | | **Sub-Total** | | | | | | | **$940,000.00** |
| 3. NEW WELL PUMP | | | | | | | | | |
| 1 | Well Pump | LS | 1.0 | 1 | $150,000 | $150,000.00 | 0% | $ - | $150,000.00 |
| | | **Sub-Total** | | | | | | | **$150,000.00** |
| Capital Cost Estimate Summary | | | | | | | | | |
| | Construction Cost SubTotal | | | | | | | | **$ 1,470,000.00** |
| | General Contractor's Overhead, profit, mob and demob, bonding, temp facilities, etc | 10% | | | | | | | **$ 147,000.00** |
| | Design Development and Pricing Contingency | 30% | | | | | | | **$ 486,000.00** |
| | Engineering Design and Contract Administration | 25% | | | | | | | **$ 526,000.00** |
| | Sub Total Excluding Escalation and HST | | | | | | | | **$ 2,629,000.00** |
| | Class D Estimate (Excluding HST) | -20% | | | | | | | **$ 2,103,000.00** |
| | | 30% | | | | | | | **$ 3,418,000.00** |

| Water Supply Alternative 3 - Increase Capacity of Existing Mill Street Well #1 | | | | | | | | | RVA #237001 Concept Development Estimate |
|---|---|---|---|---|---|---|---|---|---|
| October 17, 2024 | | | | | | | | | |
| | | | | | | | | | |
| **Cost Estimate** | | | | | | | | | |
| ITEM No. | DESCRIPTION | Unit | Quantity | Options 1/0 | Unit Price | Equipment Cost | Installation % | Installation Cost | ESTIMATED AMOUNT |
| 1. NEW GROUND WATER WELL | | | | | | | | | |
| 1 | Well Pump and Pitless Adaptor | L.S. | 1 | 1 | $150,000.00 | $150,000.00 | 0% | $ - | $150,000.00 |
| 2 | Well House Upgrade (including Instrumentation and Controls, electrical upgrades, testing and comissioning, Drop Pipe, Check Valve and Wire,Pitless Adapter Installation etc.) | L.S. | 1 | 1 | $200,000.00 | $200,000.00 | 0% | $ - | $200,000.00 |
| | | **Sub-Total** | | | | | | | **$350,000.00** |
| **Capital Cost Estimate Summary** | | | | | | | | | |
| | Construction Cost SubTotal | | | | | | | | **$ 350,000.00** |
| | General Contractor's Overhead, profit, mob and demob, bonding, temp facilities, etc | 10% | | | | | | | **$ 35,000.00** |
| | Design Development and Pricing Contingency | 30% | | | | | | | **$ 116,000.00** |
| | Engineering Design and Contract Administration | 15% | | | | | | | **$ 76,000.00** |
| | Sub Total Excluding Escalation and HST | | | | | | | | **$ 577,000.00** |
| | **Class D Estimate (Excluding HST)** | **-20%** | | | | | | | **$ 523,000.00** |
| | | **30%** | | | | | | | **$ 751,000.00** |

| Water Supply Alternative 4 - New Mill Street Well #1A | | | | | | | | | RVA #237001<br>Concept Development Estimate |
|---|---|---|---|---|---|---|---|---|---|
| October 17, 2024 | | | | | | | | | |
| | | | | | | | | | |
| Cost Estimate | | | | | | | | | |
| ITEM | | | | | | | | | ESTIMATED |
| No. | DESCRIPTION | Unit | Quantity | Options 1/0 | Unit Price | Equipment Cost | Installation % | Installation Cost | AMOUNT |
| 1. IN GROUND RESERVOIR AND PROCESS COSTS | | | | | | | | | |
| 1 | Well Pump and Pitless Adaptor | LS | 1.0 | 1 | $150,000 | $150,000.00 | 0% | $ - | $150,000.00 |
| 2 | Well House Upgrade (including Instrumentation and Controls, electrical upgrades, testing and comissioning, Drop Pipe, Check Valve and Wire,Pitless Adapter Installation etc.) | LS | 1.0 | 1 | $200,000 | $200,000.00 | 0% | $ - | $200,000.00 |
| 3 | Discharge Water Main (300mm - PVC) | m | 35.0 | 1 | $2,850 | $99,750.00 | 0% | $ - | $100,000.00 |
| | | Sub-Total | | | | | | | $450,000.00 |
| Capital Cost Estimate Summary | | | | | | | | | |
| | Construction Cost SubTotal | | | | | | | | $ 450,000.00 |
| | General Contractor's Overhead, profit, mob and demob, bonding, temp facilities, etc | 10% | | | | | | | $ 45,000.00 |
| | Design Development and Pricing Contingency | 30% | | | | | | | $ 149,000.00 |
| | Engineering Design and Contract Administration | 15% | | | | | | | $ 97,000.00 |
| | Sub Total Excluding Escalation and HST | | | | | | | | $ 741,000.00 |
| | Class D Estimate (Excluding HST) | -20% | | | | | | | $ 593,000.00 |
| | | 30% | | | | | | | $ 964,000.00 |

# APPENDIX 3

## Water Storage Alternative 1 – In Ground Reservoir Cost and Conceptual Design

| Water Storage - Alternative 1 - In Ground Reservoir Cost | | | | | | | | | RVA #237001<br>Concept Development Estimate |
|---|---|---|---|---|---|---|---|---|---|
| October 17, 2024 | | | | | | | | | |
| | | | | | | | | | |
| **Cost Estimate** | | | | | | | | | |
| **ITEM No.** | **DESCRIPTION** | **Unit** | **Quantity** | **Options 1/0** | **Unit Price** | **Equipment Cost** | **Installation %** | **Installation Cost** | **ESTIMATED AMOUNT** |
| **1. SITE WORKS** | | | | | | | | | |
| 1 | 300 mm PVC Watermain | m | 56.3 | 1 | $626.48 | $35,270.82 | 0% | $ 878.00 | $37,000.00 |
| 2 | 300 mm Gate Valves & Box | ea. | 6.0 | 1 | $3,333.07 | $19,998.42 | 20% | $ 3,999.68 | $24,000.00 |
| 4 | Rip Rap protection | LS | 1.0 | 1 | $3,500.00 | $3,500.00 | 20% | $ 700.00 | $5,000.00 |
| 5 | Culvert - Corrugated Steel Pipe 450mm Diameter | m | 15.0 | 1 | $200.00 | $3,000.00 | 20% | $ 600.00 | $4,000.00 |
| 6 | Chain Link Fence and Gates | m | 295.0 | 1 | $200.00 | $59,000.00 | 20% | $ 11,800.00 | $71,000.00 |
| 7 | Light-Duty Silt Fence | m | 295.0 | 1 | $45.00 | $13,275.00 | 0% | $ - | $14,000.00 |
| 8 | Straw Bale Flow Check Dam | ea | 4.0 | 1 | $450.00 | $1,800.00 | 0% | $ - | $2,000.00 |
| 9 | Terraseeding | acre | 0.4 | 1 | $20,000.00 | $8,974.10 | 0% | $ - | $9,000.00 |
| 10 | Mud Mat | LS | 1.0 | 1 | $8,000.00 | $8,000.00 | 0% | $ - | $8,000.00 |
| | | **Sub Total** | | | | | | | **$174,000.00** |
| **2. IN GROUND RESERVOIR AND PROCESS COSTS** | | | | | | | | | |
| 1 | Excavation | $m^3$ | 10679.5 | 1 | $120.00 | $1,281,534.67 | 0% | $ - | $1,282,000.00 |
| 2 | Disposal offsite of soil with exceedances | $m^3$ | 5070.3 | 1 | $50.00 | $253,515.85 | 0% | $ - | $254,000.00 |
| 3 | Estimate of extra sampling by QP | ea. | 1.0 | 1 | $1,600.00 | $1,600.00 | 0% | $ - | $2,000.00 |
| 4 | Dewatering | LS | 1.0 | 1 | $50,000.00 | $50,000.00 | 0% | $ - | $50,000.00 |
| 5 | Backfill | $m^3$ | 5609.1 | 1 | $80.00 | $448,731.08 | 0% | $ - | $449,000.00 |
| 6 | Reservoir - Concrete Walls (Thickness = 400mm) | m3 | 506 | 1 | $2,500.00 | $1,266,243.90 | 0% | $ - | $1,267,000.00 |
| 7 | Reservoir - Base Slab (Thickness = 500mm) | m3 | 525 | 1 | $1,750.00 | $918,750.00 | 0% | $ - | $919,000.00 |
| 8 | Reservoir - Roof (Thickness = 500mm) | m3 | 525 | 1 | $3,500.00 | $1,837,500.00 | 0% | $ - | $1,838,000.00 |
| 9 | Bollards | ea. | 6 | 1 | $1,000.00 | $6,000.00 | 0% | $ - | $6,000.00 |
| 10 | Metal Access Hatches (Aluminium) | ea. | 4 | 1 | $10,000.00 | $40,000.00 | 0% | $ - | $40,000.00 |
| 11 | Ladders (Aluminium) | ea. | 4 | 1 | $10,000.00 | $40,000.00 | 0% | $ - | $40,000.00 |
| 12 | SCADA Programming + C&I Instrumentation | L.S. | 1 | 1 | $30,000.00 | $30,000.00 | 20% | $ 6,000.00 | $36,000.00 |
| 13 | Testing and Commissioning | L.S. | 1 | 1 | $20,000.00 | $20,000.00 | 20% | $ 4,000.00 | $24,000.00 |
| | | **Sub-Total** | | | | | | | **$6,207,000.00** |
| **Capital Cost Estimate Summary** | | | | | | | | | |
| | Construction Cost SubTotal | | | | | | | | **$ 6,381,000.00** |
| | General Contractor's Overhead, profit, mob and demob, bonding, temp facilities, etc | 10% | | | | | | | **$ 638,100.00** |
| | Design Development and Pricing Contingency | 30% | | | | | | | **$ 2,106,000.00** |
| | Engineering Design and Contract Administration | 15% | | | | | | | **$ 1,369,000.00** |
| | Sub Total Excluding Escalation and HST | | | | | | | | **$ 10,495,000.00** |
| | **Class D Estimate (Excluding HST)** | **-20%** | | | | | | | **$ 8,396,000.00** |
| | | **30%** | | | | | | | **$ 13,644,000.00** |

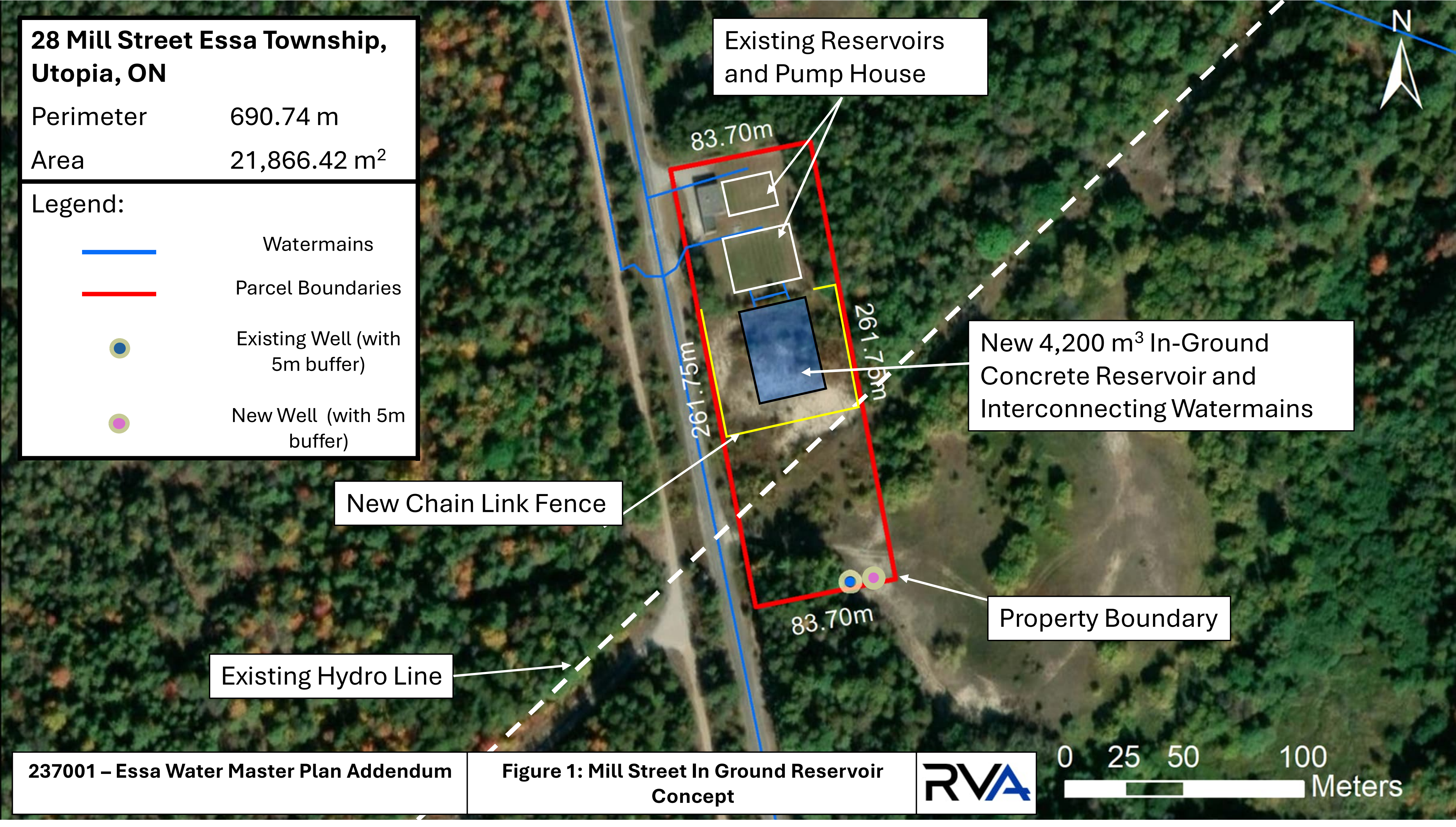



**Figure 1: Mill Street In Ground Reservoir Concept**

# APPENDIX 4

## Water Storage Alternative 2 – Elevated Storage Tank Cost and Conceptual Design

| Water Storage - Alternative 2 -Elevated Storage Tank Cost | | | | | | | | | RVA #237001<br>Concept Development Estimate |
|---|---|---|---|---|---|---|---|---|---|
| October 17, 2024 | | | | | | | | | |
| | | | | | | | | | |
| **Cost Estimate** | | | | | | | | | |
| **ITEM No.** | **DESCRIPTION** | **Unit** | **Quantity** | **Options 1/0** | **Unit Price** | **Equipment Cost** | **Installation %** | **Installation Cost** | **ESTIMATED AMOUNT** |
| **1. SITE WORKS** | | | | | | | | | |
| 1 | Driveway (Granular, Asphalt, 1m depth Excavation) | m2 | 2871 | 1 | $35 | $100,485.00 | 0% | $ - | $101,000.00 |
| 2 | 300 mm PVC Watermain | m | 56.3 | 1 | $626.48 | $35,270.82 | 0% | $ 878.00 | $37,000.00 |
| 3 | 300 mm Gate Valves & Box | ea. | 6.0 | 1 | $3,333.07 | $19,998.42 | 20% | $ 3,999.68 | $24,000.00 |
| 5 | Rip Rap protection | LS | 1.0 | 1 | $3,500.00 | $3,500.00 | 20% | $ 700.00 | $5,000.00 |
| 6 | Culvert - Corrugated Steel Pipe 450mm Diameter | m | 15.0 | 1 | $200.00 | $3,000.00 | 20% | $ 600.00 | $4,000.00 |
| 7 | Chain Link Fence and Gates | m | 295.0 | 1 | $200.00 | $59,000.00 | 20% | $ 11,800.00 | $71,000.00 |
| 8 | Light-Duty Silt Fence | m | 295.0 | 1 | $45.00 | $13,275.00 | 0% | $ - | $14,000.00 |
| 9 | Straw Bale Flow Check Dam | ea | 4.0 | 1 | $450.00 | $1,800.00 | 0% | $ - | $2,000.00 |
| 10 | Terraseeding | acre | 0.4 | 1 | $20,000.00 | $8,000.00 | 0% | $ - | $8,000.00 |
| 11 | Mud Mat | LS | 1.0 | 1 | $8,000.00 | $8,000.00 | 0% | $ - | $8,000.00 |
| | **Sub-Total** | | | | | | | | **$274,000.00** |
| **2. ELEVATED TANK AND PROCESS COSTS** | | | | | | | | | |
| 1 | Composite Elevated Tank, including foundations, excavation, electrical and controls, site works pre and post tank construction, HVAC and plumbing. Excludes excess soil disposal - assume reuse on site | L.S. | 1 | 1 | $6,930,000.00 | $0.00 | 0% | $ - | $6,930,000.00 |
| 2 | SCADA Programming | L.S. | 1 | 1 | $20,000.00 | $20,000.00 | 0% | $ - | $20,000.00 |
| | **Sub-Total** | | | | | | | | **$6,950,000.00** |
| **Capital Cost Estimate Summary** | | | | | | | | | |
| | Construction Cost SubTotal | | | | | | | | **$ 7,224,000.00** |
| | General Contractor's Overhead, profit, mob and demob, bonding, temp facilities, etc | 10% | | | | | | | **$ 723,000.00** |
| | Design Development and Pricing Contingency | 30% | | | | | | | **$ 2,385,000.00** |
| | Engineering Design and Contract Administration | 15% | | | | | | | **$ 1,550,000.00** |
| | Sub Total Excluding Escalation and HST | | | | | | | | **$ 11,882,000.00** |
| | **Class D Estimate (Excluding HST)** | **-20%** | | | | | | | **$ 10,746,000.00** |
| | | **30%** | | | | | | | **$ 15,447,000.00** |

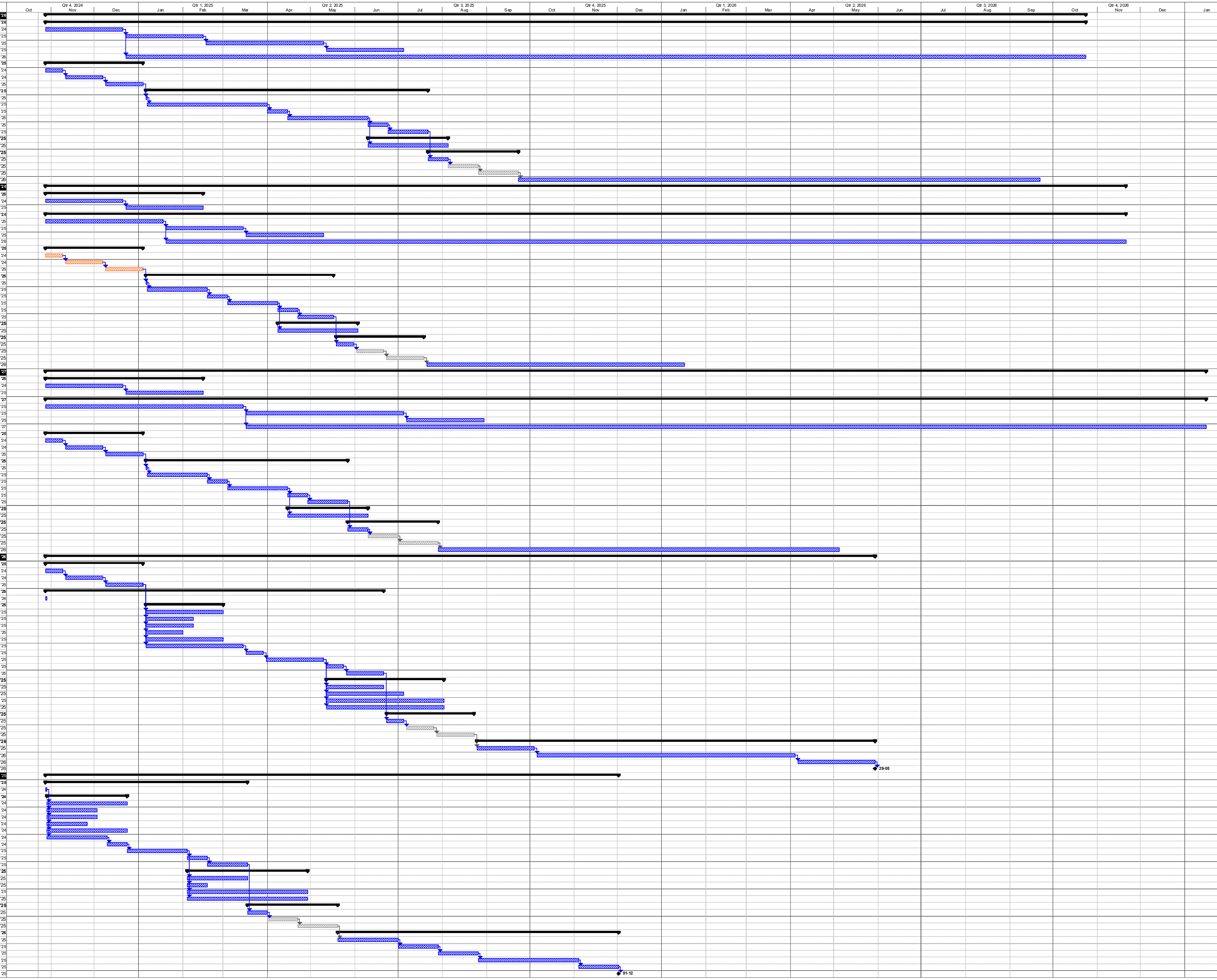

237001 – Essa Water Master Plan Addendum

**Figure 2: Mill Street Elevated Storage Tank Concept**

# APPENDIX 5

## Draft Project Schedule

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | **Supply Option 2 - Replace Centre Street Well** | **520 days?** | **28 Oct '24** | **23 Oct '26** |
| 2 | **Replacement of Centre Street Well - Hydrogeological Works** | **520 days** | **28 Oct '24** | **23 Oct '26** |
| 3 | Pre - Consultation | 2 mons | 28 Oct '24 | 20 Dec '24 |
| 4 | Monitoring Network Setup | 2 mons | 23 Dec '24 | 14 Feb '25 |
| 5 | Installation and Testing of Pumping Wells (Including pump test design report) | 3 mons | 17 Feb '25 | 09 May '25 |
| 6 | Preperation of Permit to Take Water | 2 mons | 12 May '25 | 04 Jul '25 |
| 7 | Source Water Protection Plan Update | 24 mons | 23 Dec '24 | 23 Oct '26 |
| 8 | **Engineering Design Procurement** | **50 days** | **28 Oct '24** | **03 Jan '25** |
| 9 | Prepare RFP | 2 wks | 28 Oct '24 | 08 Nov '24 |
| 10 | Bidding Period | 4 wks | 11 Nov '24 | 06 Dec '24 |
| 11 | Council Award | 4 wks | 09 Dec '24 | 03 Jan '25 |
| 12 | **Detailed Design** | **141 days?** | **06 Jan '25** | **21 Jul '25** |
| 13 | Kick Off | 1 day? | 06 Jan '25 | 06 Jan '25 |
| 14 | 30% Design Preparation | 12 wks | 07 Jan '25 | 31 Mar '25 |
| 15 | Township Review Period | 2 wks | 01 Apr '25 | 14 Apr '25 |
| 16 | 75% Design Preparation | 8 wks | 15 Apr '25 | 09 Jun '25 |
| 17 | Township Review Period | 2 wks | 10 Jun '25 | 23 Jun '25 |
| 18 | Issued for Tender Documents | 4 wks | 24 Jun '25 | 21 Jul '25 |
| 19 | **Approvals** | **40 days** | **10 Jun '25** | **04 Aug '25** |
| 20 | DWWP amendments | 8 wks | 10 Jun '25 | 04 Aug '25 |
| 21 | **Tender Period Assistance** | **45 days** | **22 Jul '25** | **22 Sep '25** |
| 22 | Procurement processing | 2 wks | 22 Jul '25 | 04 Aug '25 |
| 23 | Tender period and site meeting | 3 wks | 05 Aug '25 | 25 Aug '25 |
| 24 | Township award of construction contract | 4 wks | 26 Aug '25 | 22 Sep '25 |
| 25 | **Construction** | 52 wks | 23 Sep '25 | 21 Sep '26 |
| 26 | **Supply Option 3 - Increase Capacity of Mill St. Well #1** | **540 days?** | **28 Oct '24** | **20 Nov '26** |
| 27 | **Water Storage - Investigation of Waste Disposal Area near Mill Street Wellfield** | **80 days** | **28 Oct '24** | **14 Feb '25** |
| 28 | Subsurface Investigation | 2 mons | 28 Oct '24 | 20 Dec '24 |
| 29 | Report Preperation | 2 mons | 23 Dec '24 | 14 Feb '25 |
| 30 | **Hydrogeological Works** | **540 days** | **28 Oct '24** | **20 Nov '26** |
| 31 | Pumping Test | 3 mons | 28 Oct '24 | 17 Jan '25 |
| 32 | Report Preperation | 2 mons | 20 Jan '25 | 14 Mar '25 |
| 33 | Preperation of Permit to Take Water | 2 mons | 17 Mar '25 | 09 May '25 |
| 34 | Source Water Protection Plan Update | 24 mons | 20 Jan '25 | 20 Nov '26 |
| 35 | **Engineering Design Procurement** | **50 days** | **28 Oct '24** | **03 Jan '25** |
| 36 | Prepare RFP | 2 wks | 28 Oct '24 | 08 Nov '24 |
| 37 | Bidding Period | 4 wks | 11 Nov '24 | 06 Dec '24 |
| 38 | Council Award | 4 wks | 09 Dec '24 | 03 Jan '25 |
| 39 | **Detailed Design** | **95 days?** | **06 Jan '25** | **16 May '25** |
| 40 | Kick Off | 1 day? | 06 Jan '25 | 06 Jan '25 |
| 41 | 30% Design Preparation (Electrical, C&I, Process Upgrades) | 6 wks | 07 Jan '25 | 17 Feb '25 |
| 42 | Township Review Period | 2 wks | 18 Feb '25 | 03 Mar '25 |
| 43 | 75% Design Preparation | 5 wks | 04 Mar '25 | 07 Apr '25 |
| 44 | Township Review Period | 2 wks | 08 Apr '25 | 21 Apr '25 |
| 45 | Issued for Tender Documents | 3.8 wks | 22 Apr '25 | 16 May '25 |
| 46 | **Approvals** | **40 days** | **08 Apr '25** | **02 Jun '25** |
| 47 | DWWP amendments | 8 wks | 08 Apr '25 | 02 Jun '25 |
| 48 | **Tender Period Assistance** | **45 days** | **19 May '25** | **18 Jul '25** |
| 49 | Procurement processing | 2 wks | 19 May '25 | 30 May '25 |
| 50 | Tender period and site meeting | 3 wks | 02 Jun '25 | 20 Jun '25 |
| 51 | Township award of construction contract | 4 wks | 23 Jun '25 | 18 Jul '25 |
| 52 | **Construction** | 26 wks | 21 Jul '25 | 16 Jan '26 |
| 53 | **Supply Option 4 - Construct New Mill St. Well #1A** | **580 days** | **28 Oct '24** | **15 Jan '27** |
| 54 | **Water Storage - Investigation of Waste Disposal Area near Mill Street Wellfiel** | **80 days** | **28 Oct '24** | **14 Feb '25** |
| 55 | Subsurface Investigation | 2 mons | 28 Oct '24 | 20 Dec '24 |
| 56 | Report Preperation | 2 mons | 23 Dec '24 | 14 Feb '25 |
| 57 | **Hydrogeological Works** | **580 days** | **28 Oct '24** | **15 Jan '27** |
| 58 | Pre-Consultation and Permit to Take Water for Testing | 5 mons | 28 Oct '24 | 14 Mar '25 |
| 59 | Well Installation and Pumping Tests | 4 mons | 17 Mar '25 | 04 Jul '25 |
| 60 | Permit to Take Water Report and Applications | 2 mons | 07 Jul '25 | 29 Aug '25 |
| 61 | Source Water Protection Plan Update | 24 mons | 17 Mar '25 | 15 Jan '27 |
| 62 | **Engineering Design Procurement** | **50 days** | **28 Oct '24** | **03 Jan '25** |
| 63 | Prepare RFP | 2 wks | 28 Oct '24 | 08 Nov '24 |
| 64 | Bidding Period | 4 wks | 11 Nov '24 | 06 Dec '24 |
| 65 | Council Award | 4 wks | 09 Dec '24 | 03 Jan '25 |
| 66 | **Detailed Design** | **101 days** | **06 Jan '25** | **26 May '25** |
| 67 | Kick Off | 1 day | 06 Jan '25 | 06 Jan '25 |
| 68 | 30% Design Preparation (Electrical, C&I, Process Upgrades) | 6 wks | 07 Jan '25 | 17 Feb '25 |
| 69 | Township Review Period | 2 wks | 18 Feb '25 | 03 Mar '25 |
| 70 | 75% Design Preparation | 6 wks | 04 Mar '25 | 14 Apr '25 |
| 71 | Township Review Period | 2 wks | 15 Apr '25 | 28 Apr '25 |
| 72 | Issued for Tender Documents | 4 wks | 29 Apr '25 | 26 May '25 |
| 73 | **Approvals** | **40 days** | **15 Apr '25** | **09 Jun '25** |
| 74 | DWWP amendments | 8 wks | 15 Apr '25 | 09 Jun '25 |
| 75 | **Tender Period Assistance** | **45 days** | **27 May '25** | **28 Jul '25** |
| 76 | Procurement processing | 2 wks | 27 May '25 | 09 Jun '25 |
| 77 | Tender period and site meeting | 3 wks | 10 Jun '25 | 30 Jun '25 |
| 78 | Township award of construction contract | 4 wks | 01 Jul '25 | 28 Jul '25 |
| 79 | **Construction** | 40 wks | 29 Jul '25 | 04 May '26 |
| 80 | **Storage Option 1 - In Ground Reservoir** | **415 days?** | **28 Oct '24** | **29 May '26** |
| 81 | **Engineering Design Procurement** | **50 days** | **28 Oct '24** | **03 Jan '25** |
| 82 | Prepare RFP | 2 wks | 28 Oct '24 | 08 Nov '24 |
| 83 | Bidding Period | 4 wks | 11 Nov '24 | 06 Dec '24 |
| 84 | Council Award | 4 wks | 09 Dec '24 | 03 Jan '25 |
| 85 | **Detailed Design (Reservoir)** | **170 days?** | **28 Oct '24** | **20 Jun '25** |
| 86 | Kick Off | 1 day? | 28 Oct '24 | 28 Oct '24 |
| 87 | **Investigations** | **40 days** | **06 Jan '25** | **28 Feb '25** |
| 88 | Geotechnical and HydroG Investigation | 8 wks | 06 Jan '25 | 28 Feb '25 |
| 89 | Topo survey, SUE | 5 wks | 06 Jan '25 | 07 Feb '25 |
| 90 | Archaeological Assessment | 5 wks | 06 Jan '25 | 07 Feb '25 |
| 91 | Natural Environmental Assesment | 4 wks | 06 Jan '25 | 31 Jan '25 |
| 92 | Utilities Coordination | 8 wks | 06 Jan '25 | 28 Feb '25 |
| 93 | 30% Design Preparation | 10 wks | 06 Jan '25 | 14 Mar '25 |
| 94 | Township Review Period | 2 wks | 17 Mar '25 | 28 Mar '25 |
| 95 | 75% Design Preparation | 6 wks | 31 Mar '25 | 09 May '25 |
| 96 | Township Review Period | 2 wks | 12 May '25 | 23 May '25 |
| 97 | Issued for Tender Documents | 4 wks | 26 May '25 | 20 Jun '25 |
| 98 | **Approvals** | **60 days** | **12 May '25** | **01 Aug '25** |
| 99 | Site Plan Approval | 6 wks | 12 May '25 | 20 Jun '25 |
| 100 | DWWP amendments | 8 wks | 12 May '25 | 04 Jul '25 |
| 101 | Construction Permit to Take Water | 12 wks | 12 May '25 | 01 Aug '25 |
| 102 | Nottawasaga Valley Conservation Authority (typically 90 days) | 12 wks | 12 May '25 | 01 Aug '25 |
| 103 | **Tender Period Assistance** | **45 days** | **23 Jun '25** | **22 Aug '25** |
| 104 | Procurement processing | 2 wks | 23 Jun '25 | 04 Jul '25 |
| 105 | Tender period and site meeting | 3 wks | 07 Jul '25 | 25 Jul '25 |
| 106 | Township award of construction contract | 4 wks | 28 Jul '25 | 22 Aug '25 |
| 107 | **Construction - In-Ground Concrete Reservoir** | **200 days** | **25 Aug '25** | **29 May '26** |
| 108 | Mobilization, Shop drawings and site preparation | 6 wks | 25 Aug '25 | 03 Oct '25 |
| 109 | Reservoir concrete work | 26 wks | 06 Oct '25 | 03 Apr '26 |
| 110 | Exterior work, landscaping paving | 8 wks | 06 Apr '26 | 29 May '26 |
| 111 | Substantial Performance | 0 days | 29 May '26 | 29 May '26 |
| 112 | Storage Option 2 - Elevated Tank | 286 days? | 28 Oct '24 | 01 Dec '25 |
| 113 | **Detailed Design** | **101 days?** | **28 Oct '24** | **17 Mar '25** |
| 114 | Kick Off | 1 day? | 28 Oct '24 | 28 Oct '24 |
| 115 | **Investigations** | **40 days** | **29 Oct '24** | **23 Dec '24** |
| 116 | Geotechnical and HydroG Investigation | 8 wks | 29 Oct '24 | 23 Dec '24 |
| 117 | Topo survey, SUE | 5 wks | 29 Oct '24 | 02 Dec '24 |
| 118 | Archaeological Assessment | 5 wks | 29 Oct '24 | 02 Dec '24 |
| 119 | Natural Environmental Assesment | 4 wks | 29 Oct '24 | 25 Nov '24 |
| 120 | Utilities Coordination | 8 wks | 29 Oct '24 | 23 Dec '24 |
| 121 | 30% Design Preparation | 6 wks | 29 Oct '24 | 09 Dec '24 |
| 122 | Township Review Period | 2 wks | 10 Dec '24 | 23 Dec '24 |
| 123 | 75% Design Preparation | 6 wks | 24 Dec '24 | 03 Feb '25 |
| 124 | Township Review Period | 2 wks | 04 Feb '25 | 17 Feb '25 |
| 125 | Issued for Tender Documents | 4 wks | 18 Feb '25 | 17 Mar '25 |
| 126 | **Approvals** | **60 days** | **04 Feb '25** | **28 Apr '25** |
| 127 | Site Plan Approval | 6 wks | 04 Feb '25 | 17 Mar '25 |
| 128 | MECP amendments | 2 wks | 04 Feb '25 | 17 Feb '25 |
| 129 | Construction Permit to Take Water | 12 wks | 04 Feb '25 | 28 Apr '25 |
| 130 | Nottawasaga Valley Conservation Authority (typically 90 days) | 12 wks | 04 Feb '25 | 28 Apr '25 |
| 131 | **Tender Period Assistance** | **45 days** | **18 Mar '25** | **19 May '25** |
| 132 | Procurement processing | 2 wks | 18 Mar '25 | 31 Mar '25 |
| 133 | Tender period and site meeting | 3 wks | 01 Apr '25 | 21 Apr '25 |
| 134 | Township award of construction contract | 4 wks | 22 Apr '25 | 19 May '25 |
| 135 | **Construction - Elevated Tank** | **140 days** | **20 May '25** | **01 Dec '25** |
| 136 | Mobilization, Shop drawings and site preparation | 6 wks | 20 May '25 | 30 Jun '25 |
| 137 | Foundation Construction | 4 wks | 01 Jul '25 | 28 Jul '25 |
| 138 | Concrete Pedestal | 4 wks | 29 Jul '25 | 25 Aug '25 |
| 139 | Tank Construction | 10 wks | 26 Aug '25 | 03 Nov '25 |
| 140 | Exterior work, landscaping paving | 4 wks | 04 Nov '25 | 01 Dec '25 |
| 141 | Substantial Performance | 0 days | 01 Dec '25 | 01 Dec '25 |




Mill St Reservoir
Date: 23 Oct '24

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Path Predecessor Milestone Task | Path Driving Predecessor Milestone Task | Path Predecessor Summary Task | Path Driving Predecessor Summary Task | Path Predecessor Normal Task | Path Driving Predecessor Normal Task | Progress | Deadline

## Appendix D

WaterGEMS Model
Output & Schematics
for Short-listed Options

GREENLAND®

## Angus Water Distribution System

## WaterGEMS Model -Proposed System Results

| Node | Elevation (m) | Pressure (psi) Servicing Strategy WS-1.2 | Pressure (psi) Servicing Strategy WS-1.1 | Pressure (psi) Servicing Strategy WS-1.4 |
|---|---|---|---|---|
| | | New Elevated Storage at the Mill Street Site | Additional in ground resevoirs at the Mill Street Site | New Elevated Storage at a Greenfield Site (South of Angus) |
| | | MDD | MDD | MDD |
| J-8042 | 198 | 91 | 80 | 90 |
| J-8041 | 198 | 91 | 80 | 90 |
| J-8040 | 197.4 | 92 | 81 | 91 |
| J-8030 | 197.4 | 92 | 81 | 91 |
| J-8020 | 197.4 | 92 | 81 | 91 |
| J-8010 | 197.4 | 92 | 81 | 91 |
| J-8000 | 196.3 | 94 | 82 | 93 |
| J-7000 | 196.9 | 88 | 81 | 89 |
| J-6070 | 201.2 | 81 | 73 | 83 |
| J-6060 | 205 | 76 | 68 | 78 |
| J-6050 | 195 | 90 | 82 | 93 |
| J-6040 | 196 | 89 | 81 | 92 |
| J-6030 | 197 | 88 | 79 | 91 |
| J-6020 | 200 | 83 | 75 | 87 |
| J-6010 | 199.5 | 84 | 76 | 88 |
| J-6000 | 195 | 91 | 82 | 94 |
| J-3560 | 201.5 | 82 | 72 | 84 |
| J-3550 | 195.6 | 91 | 82 | 93 |
| J-3540 | 195.6 | 91 | 82 | 93 |
| J-3530 | 195.5 | 91 | 82 | 93 |
| J-3510 | 192.5 | 95 | 85 | 97 |
| J-3500 | 190.6 | 97 | 88 | 99 |
| J-3490 | 203.2 | 79 | 71 | 79 |
| J-3480 | 203.2 | 79 | 71 | 79 |
| J-3470 | 187.5 | 99 | 90 | 100 |
| J-3460 | 187 | 99 | 91 | 100 |
| J-3350 | 192.5 | 93 | 85 | 94 |
| J-3340 | 198.8 | 85 | 77 | 86 |
| J-3330 | 201 | 82 | 74 | 83 |
| J-3320 | 203 | 79 | 71 | 80 |
| J-3310 | 190.9 | 95 | 87 | 97 |
| J-3300 | 202.4 | 80 | 72 | 81 |

## Angus Water Distribution System

## WaterGEMS Model -Proposed System Results

| Node | Elevation (m) | Pressure (psi) Servicing Strategy WS-1.2 | Pressure (psi) Servicing Strategy WS-1.1 | Pressure (psi) Servicing Strategy WS-1.4 |
|---|---|---|---|---|
| | | New Elevated Storage at the Mill Street Site | Additional in ground resevoirs at the Mill Street Site | New Elevated Storage at a Greenfield Site (South of Angus) |
| | | MDD | MDD | MDD |
| J-3290 | 203.2 | 79 | 71 | 79 |
| J-3280 | 199.5 | 84 | 76 | 85 |
| J-3270 | 200.8 | 82 | 74 | 83 |
| J-3260 | 201.5 | 81 | 73 | 82 |
| J-3250 | 202.2 | 80 | 72 | 81 |
| J-3240 | 201.6 | 81 | 73 | 82 |
| J-3230 | 201.3 | 81 | 73 | 82 |
| J-3220 | 201.6 | 81 | 73 | 82 |
| J-3210 | 201 | 82 | 74 | 83 |
| J-3200 | 201.7 | 81 | 73 | 82 |
| J-3190 | 201.8 | 80 | 73 | 81 |
| J-3180 | 202.61 | 79 | 72 | 80 |
| J-3170 | 203.1 | 79 | 71 | 80 |
| J-3160 | 203.51 | 78 | 70 | 79 |
| J-3150 | 204.6 | 76 | 69 | 77 |
| J-3140 | 204.6 | 76 | 69 | 77 |
| J-3130 | 202.90 | 79 | 71 | 80 |
| J-3120 | 202.10 | 80 | 72 | 81 |
| J-3110 | 200.60 | 82 | 74 | 83 |
| J-3100 | 204.00 | 77 | 70 | 78 |
| J-3090 | 201.50 | 81 | 73 | 82 |
| J-3080 | 204.50 | 77 | 69 | 78 |
| J-3070 | 199.50 | 84 | 76 | 85 |
| J-3060 | 199.50 | 84 | 76 | 85 |
| J-3050 | 200.00 | 83 | 75 | 84 |
| J-3040 | 200.60 | 82 | 74 | 83 |
| J-3030 | 201.10 | 81 | 74 | 83 |
| J-3020 | 201.30 | 81 | 73 | 82 |
| J-3010 | 200.40 | 82 | 75 | 84 |
| J-2950 | 199.00 | 85 | 76 | 89 |
| J-2870 | 196.00 | 88 | 80 | 89 |
| J-2860 | 197.50 | 86 | 78 | 87 |

## Angus Water Distribution System

## WaterGEMS Model -Proposed System Results

| Node | Elevation (m) | Pressure (psi) Servicing Strategy WS-1.2<br>New Elevated Storage at the Mill Street Site<br>MDD | Pressure (psi) Servicing Strategy WS-1.1<br>Additional in ground resevoirs at the Mill Street Site<br>MDD | Pressure (psi) Servicing Strategy WS-1.4<br>New Elevated Storage at a Greenfield Site (South of Angus)<br>MDD |
|---|---|---|---|---|
| J-2830 | 196.00 | 88 | 81 | 89 |
| J-2820 | 196.00 | 88 | 81 | 89 |
| J-2810 | 194.80 | 90 | 82 | 91 |
| J-2800 | 199.90 | 83 | 75 | 84 |
| J-2782 | 198.61 | 85 | 77 | 86 |
| J-2781 | 198.90 | 84 | 77 | 85 |
| J-2780 | 199.20 | 84 | 76 | 85 |
| J-2770 | 192.10 | 94 | 86 | 95 |
| J-2760 | 192.10 | 94 | 86 | 95 |
| J-2750 | 198.30 | 85 | 77 | 86 |
| J-2740 | 197.90 | 86 | 78 | 87 |
| J-2730 | 197.00 | 87 | 79 | 88 |
| J-2720 | 200.80 | 82 | 74 | 83 |
| J-2710 | 200.00 | 83 | 75 | 84 |
| J-2700 | 201.30 | 81 | 73 | 82 |
| J-2690 | 200.70 | 82 | 74 | 83 |
| J-2680 | 199.80 | 83 | 75 | 84 |
| J-2670 | 198.80 | 84 | 77 | 85 |
| J-2660 | 199.10 | 84 | 76 | 85 |
| J-2650 | 200.30 | 82 | 75 | 83 |
| J-2600 | 194.60 | 90 | 83 | 91 |
| J-2590 | 193.5 | 92 | 84 | 93 |
| J-2541 | 195.8 | 89 | 81 | 90 |
| J-2540 | 194 | 91 | 83 | 92 |
| J-2530 | 201.5 | 81 | 74 | 82 |
| J-2520 | 199.5 | 84 | 76 | 85 |
| J-2510 | 199 | 84 | 76 | 85 |
| J-2490 | 198.3 | 85 | 77 | 86 |
| J-2472 | 196.6 | 88 | 80 | 89 |
| J-2470 | 197 | 87 | 79 | 88 |
| J-2460 | 194 | 91 | 83 | 92 |
| J-2450 | 191.8 | 94 | 86 | 95 |

## Angus Water Distribution System

## WaterGEMS Model -Proposed System Results

| Node | Elevation (m) | Pressure (psi) Servicing Strategy WS-1.2 | Pressure (psi) Servicing Strategy WS-1.1 | Pressure (psi) Servicing Strategy WS-1.4 |
|---|---|---|---|---|
| | | New Elevated Storage at the Mill Street Site | Additional in ground resevoirs at the Mill Street Site | New Elevated Storage at a Greenfield Site (South of Angus) |
| | | MDD | MDD | MDD |
| J-2440 | 191.5 | 95 | 87 | 96 |
| J-2430 | 191.4 | 95 | 87 | 96 |
| J-2420 | 190 | 97 | 88 | 98 |
| J-2410 | 188.5 | 99 | 90 | 100 |
| J-2400 | 190 | 97 | 88 | 98 |
| J-2390 | 188.1 | 99 | 91 | 100 |
| J-2380 | 188.9 | 98 | 90 | 99 |
| J-2370 | 189.2 | 98 | 89 | 99 |
| J-2350 | 189.6 | 97 | 89 | 98 |
| J-2330 | 188.2 | 99 | 91 | 100 |
| J-2320 | 189 | 98 | 90 | 99 |
| J-2310 | 188.7 | 98 | 90 | 100 |
| J-2300 | 189.9 | 97 | 88 | 98 |
| J-2290 | 187.5 | 100 | 92 | 100 |
| J-2280 | 188.4 | 99 | 91 | 100 |
| J-2270 | 190.66 | 96 | 87 | 97 |
| J-2260 | 190.5 | 96 | 88 | 97 |
| J-2250 | 189.9 | 97 | 88 | 98 |
| J-2240 | 190.4 | 96 | 88 | 97 |
| J-2230 | 191.6 | 94 | 86 | 96 |
| J-2220 | 191 | 95 | 87 | 96 |
| J-2210 | 189 | 97 | 88 | 98 |
| J-2200 | 189.2 | 98 | 89 | 99 |
| J-2190 | 190 | 97 | 88 | 98 |
| J-2180 | 190.1 | 97 | 88 | 98 |
| J-2170 | 190.7 | 96 | 87 | 97 |
| J-2160 | 189.5 | 97 | 89 | 99 |
| J-2150 | 190 | 97 | 88 | 98 |
| J-2140 | 190 | 97 | 88 | 99 |
| J-2130 | 190.2 | 96 | 88 | 99 |
| J-2120 | 190.7 | 96 | 87 | 98 |
| J-2110 | 191.4 | 95 | 86 | 97 |

## Angus Water Distribution System

## WaterGEMS Model -Proposed System Results

| Node | Elevation (m) | Pressure (psi) Servicing Strategy WS-1.2<br>New Elevated Storage at the Mill Street Site<br>MDD | Pressure (psi) Servicing Strategy WS-1.1<br>Additional in ground resevoirs at the Mill Street Site<br>MDD | Pressure (psi) Servicing Strategy WS-1.4<br>New Elevated Storage at a Greenfield Site (South of Angus)<br>MDD |
|---|---|---|---|---|
| J-2100 | 190.5 | 97 | 88 | 99 |
| J-2090 | 189 | 98 | 89 | 99 |
| J-2080 | 188.9 | 98 | 89 | 99 |
| J-2070 | 188.9 | 98 | 89 | 99 |
| J-2060 | 189.3 | 97 | 88 | 98 |
| J-2050 | 189.7 | 96 | 87 | 98 |
| J-2040 | 190 | 96 | 87 | 97 |
| J-2030 | 190.8 | 94 | 86 | 96 |
| J-2020 | 191.5 | 93 | 85 | 95 |
| J-2010 | 188.5 | 98 | 89 | 99 |
| J-2000 | 187.5 | 99 | 90 | 100 |
| J-1990 | 187.8 | 98 | 90 | 100 |
| J-1980 | 189.2 | 96 | 88 | 98 |
| J-1820 | 198.8 | 84 | 77 | 85 |
| J-1810 | 198.1 | 85 | 78 | 86 |
| J-1800 | 198.5 | 85 | 77 | 86 |
| J-1790 | 199.8 | 83 | 75 | 84 |
| J-1780 | 197 | 87 | 79 | 88 |
| J-1770 | 196 | 88 | 80 | 89 |
| J-1760 | 199 | 84 | 76 | 85 |
| J-1730 | 189 | 97 | 88 | 98 |
| J-1710 | 190.7 | 96 | 87 | 97 |
| J-1700 | 189.4 | 98 | 89 | 99 |
| J-1690 | 190.3 | 96 | 88 | 98 |
| J-1680 | 191.3 | 95 | 86 | 96 |
| J-1670 | 190.5 | 96 | 87 | 98 |
| J-1660 | 190 | 97 | 88 | 98 |
| J-1650 | 190.3 | 96 | 88 | 98 |
| J-1640 | 189.8 | 97 | 88 | 99 |
| J-1630 | 188.7 | 99 | 90 | 100 |
| J-1620 | 187.9 | 98 | 90 | 100 |
| J-1610 | 187.5 | 99 | 91 | 100 |

## Angus Water Distribution System

## WaterGEMS Model -Proposed System Results

| Node | Elevation (m) | Pressure (psi) Servicing Strategy WS-1.2 | Pressure (psi) Servicing Strategy WS-1.1 | Pressure (psi) Servicing Strategy WS-1.4 |
|---|---|---|---|---|
| | | New Elevated Storage at the Mill Street Site | Additional in ground resevoirs at the Mill Street Site | New Elevated Storage at a Greenfield Site (South of Angus) |
| | | MDD | MDD | MDD |
| J-1600 | 189.4 | 98 | 89 | 99 |
| J-1590 | 188.9 | 98 | 90 | 100 |
| J-1580 | 188.6 | 99 | 90 | 100 |
| J-1570 | 192 | 94 | 85 | 97 |
| J-1560 | 190.5 | 97 | 88 | 99 |
| J-1550 | 193.4 | 92 | 83 | 95 |
| J-1540 | 194.2 | 93 | 84 | 95 |
| J-1530 | 194 | 91 | 83 | 92 |
| J-1520 | 192.8 | 93 | 85 | 94 |
| J-1510 | 195.6 | 89 | 81 | 90 |
| J-1500 | 188.4 | 98 | 89 | 99 |
| J-1495 | 188.8 | 97 | 88 | 98 |
| J-1490 | 188.2 | 98 | 89 | 99 |
| J-1485 | 188.5 | 97 | 89 | 99 |
| J-1480 | 188.8 | 97 | 88 | 99 |
| J-1475 | 188.9 | 97 | 88 | 98 |
| J-1470 | 188.8 | 97 | 88 | 99 |
| J-1465 | 188.9 | 97 | 88 | 98 |
| J-1460 | 189 | 97 | 88 | 98 |
| J-1455 | 189.2 | 96 | 88 | 98 |
| J-1450 | 189.4 | 96 | 88 | 98 |
| J-1445 | 188.9 | 97 | 88 | 98 |
| J-1440 | 188.5 | 97 | 89 | 99 |
| J-1435 | 189.1 | 97 | 88 | 98 |
| J-1430 | 189.4 | 96 | 88 | 98 |
| J-1425 | 191 | 94 | 85 | 95 |
| J-1420 | 190.4 | 95 | 86 | 96 |
| J-1415 | 190 | 95 | 87 | 97 |
| J-1410 | 189.7 | 96 | 87 | 97 |
| J-1406 | 189.7 | 96 | 87 | 97 |
| J-1405 | 189.7 | 96 | 87 | 97 |
| J-1400 | 192.5 | 92 | 83 | 93 |

## Angus Water Distribution System

## WaterGEMS Model -Proposed System Results

| Node | Elevation (m) | Pressure (psi) Servicing Strategy WS-1.2 | Pressure (psi) Servicing Strategy WS-1.1 | Pressure (psi) Servicing Strategy WS-1.4 |
|---|---|---|---|---|
| | | New Elevated Storage at the Mill Street Site | Additional in ground resevoirs at the Mill Street Site | New Elevated Storage at a Greenfield Site (South of Angus) |
| | | MDD | MDD | MDD |
| J-1395 | 191.6 | 93 | 84 | 95 |
| J-1390 | 190.4 | 95 | 86 | 96 |
| J-1385 | 189.9 | 95 | 87 | 97 |
| J-1380 | 190.7 | 94 | 86 | 96 |
| J-1375 | 192.1 | 92 | 84 | 94 |
| J-1370 | 192.9 | 91 | 83 | 93 |
| J-1365 | 192.7 | 92 | 83 | 93 |
| J-1360 | 193.1 | 91 | 82 | 93 |
| J-1355 | 193 | 91 | 83 | 93 |
| J-1350 | 192.3 | 92 | 84 | 94 |
| J-1345 | 191.1 | 94 | 85 | 95 |
| J-1341 | 191.05 | 94 | 85 | 96 |
| J-1340 | 191 | 94 | 85 | 96 |
| J-1338 | 190.8 | 94 | 86 | 96 |
| J-1337 | 190.65 | 95 | 86 | 96 |
| J-1336 | 190.45 | 95 | 86 | 96 |
| J-1335 | 190.4 | 95 | 86 | 97 |
| J-1333 | 190.3 | 95 | 87 | 97 |
| J-1332 | 190.2 | 95 | 87 | 97 |
| J-1331 | 190.05 | 96 | 87 | 97 |
| J-1330 | 189.9 | 96 | 87 | 97 |
| J-1327 | 189.7 | 96 | 87 | 98 |
| J-1326 | 189.25 | 97 | 88 | 98 |
| J-1325 | 188.9 | 97 | 89 | 99 |
| J-1320 | 187.8 | 99 | 90 | 100 |
| J-1315 | 188.2 | 98 | 89 | 100 |
| J-1310 | 188.1 | 98 | 90 | 100 |
| J-1305 | 187.4 | 99 | 91 | 100 |
| J-1300 | 188.1 | 98 | 90 | 100 |
| J-1295 | 187.5 | 99 | 90 | 100 |
| J-1290 | 187.6 | 99 | 90 | 100 |
| J-1285 | 187.4 | 99 | 91 | 100 |

## Angus Water Distribution System

## WaterGEMS Model -Proposed System Results

| Node | Elevation (m) | Pressure (psi) Servicing Strategy WS-1.2 | Pressure (psi) Servicing Strategy WS-1.1 | Pressure (psi) Servicing Strategy WS-1.4 |
|---|---|---|---|---|
| | | New Elevated Storage at the Mill Street Site | Additional in ground resevoirs at the Mill Street Site | New Elevated Storage at a Greenfield Site (South of Angus) |
| | | MDD | MDD | MDD |
| J-1280 | 187.5 | 99 | 90 | 100 |
| J-1275 | 187.4 | 99 | 90 | 100 |
| J-1270 | 188 | 98 | 90 | 100 |
| J-1265 | 187.7 | 99 | 90 | 100 |
| J-1260 | 190.2 | 96 | 88 | 98 |
| J-1255 | 191 | 95 | 87 | 96 |
| J-1250 | 190.9 | 95 | 87 | 97 |
| J-1245 | 191.6 | 94 | 86 | 96 |
| J-1240 | 191 | 95 | 87 | 96 |
| J-1235 | 190.1 | 96 | 88 | 98 |
| J-1230 | 190 | 97 | 88 | 98 |
| J-1225 | 190.7 | 96 | 87 | 97 |
| J-1220 | 190.6 | 96 | 88 | 97 |
| J-1215 | 189.7 | 97 | 89 | 98 |
| J-1210 | 190.4 | 96 | 88 | 97 |
| J-1206 | 191.4 | 95 | 87 | 96 |
| J-1205 | 190.8 | 96 | 87 | 97 |
| J-1200 | 195.6 | 89 | 81 | 90 |
| J-1195 | 195.4 | 89 | 81 | 90 |
| J-1190 | 194.8 | 90 | 82 | 91 |
| J-1185 | 194.3 | 91 | 83 | 92 |
| J-1180 | 193.3 | 92 | 84 | 93 |
| J-1175 | 191.4 | 95 | 87 | 96 |
| J-1170 | 191.3 | 95 | 87 | 96 |
| J-1160 | 189.7 | 97 | 88 | 99 |
| J-1155 | 188.6 | 99 | 90 | 100 |
| J-1150 | 186.7 | 100 | 93 | 100 |
| J-1145 | 187.3 | 100 | 92 | 100 |
| J-1140 | 188.7 | 99 | 90 | 100 |
| J-1135 | 190.3 | 96 | 88 | 98 |
| J-1130 | 190.4 | 97 | 88 | 99 |
| J-1125 | 195.5 | 89 | 81 | 93 |

## Angus Water Distribution System

## WaterGEMS Model -Proposed System Results

| Node | Elevation (m) | Pressure (psi) Servicing Strategy WS-1.2 | Pressure (psi) Servicing Strategy WS-1.1 | Pressure (psi) Servicing Strategy WS-1.4 |
|---|---|---|---|---|
| | | New Elevated Storage at the Mill Street Site | Additional in ground resevoirs at the Mill Street Site | New Elevated Storage at a Greenfield Site (South of Angus) |
| | | MDD | MDD | MDD |
| J-1120 | 195.4 | 89 | 81 | 93 |
| J-1115 | 195.3 | 90 | 81 | 93 |
| J-1110 | 195.1 | 90 | 81 | 93 |
| J-1105 | 195 | 90 | 81 | 93 |
| J-1100 | 195 | 90 | 81 | 93 |
| J-1095 | 194.9 | 90 | 81 | 93 |
| J-1090 | 194.5 | 91 | 82 | 93 |
| J-1085 | 194.7 | 90 | 82 | 93 |
| J-1080 | 195 | 90 | 81 | 93 |
| J-1075 | 195 | 90 | 81 | 93 |
| J-1070 | 195 | 90 | 81 | 92 |
| J-1065 | 191.7 | 94 | 85 | 97 |
| J-1060 | 191.5 | 94 | 86 | 97 |
| J-1055 | 191.7 | 94 | 85 | 97 |

## Angus Water Distribution System

## WaterGEMS Model -Proposed System Results

| Node | Elevation (m) | Pressure (psi) Servicing Strategy WS-1.2 | Pressure (psi) Servicing Strategy WS-1.1 | Pressure (psi) Servicing Strategy WS-1.4 |
|---|---|---|---|---|
| | | New Elevated Storage at the Mill Street Site | Additional in ground resevoirs at the Mill Street Site | New Elevated Storage at a Greenfield Site (South of Angus) |
| | | MDD | MDD | MDD |
| J-1050 | 195 | 89 | 81 | 92 |
| J-1045 | 194.6 | 90 | 81 | 93 |
| J-1040 | 191.9 | 94 | 85 | 97 |
| J-1035 | 190.7 | 97 | 88 | 99 |
| J-1030 | 188.2 | 98 | 90 | 100 |
| J-1025 | 188.2 | 98 | 90 | 100 |
| J-1020 | 188.3 | 98 | 90 | 100 |
| J-1016 | 187.7 | 100 | 91 | 100 |
| J-1015 | 187.6 | 100 | 91 | 100 |
| J-1010 | 190.8 | 97 | 88 | 99 |
| J-1005 | 193.1 | 94 | 85 | 96 |
| J-980 | 190.5 | 95 | 86 | 96 |
| J-970 | 198.7 | 85 | 77 | 86 |
| J-950 | 188.75 | 97 | 89 | 99 |
| J-940 | 188.75 | 97 | 89 | 99 |
| J-930 | 188.4 | 98 | 89 | 99 |
| J-880 | 197.4 | 87 | 78 | 91 |
| J-870 | 198.5 | 85 | 77 | 90 |
| J-860 | 197.7 | 87 | 78 | 91 |
| J-850 | 189.4 | 98 | 89 | 99 |
| J-840 | 189.7 | 97 | 88 | 99 |
| J-825 | 197.4 | 87 | 78 | 91 |
| J-820 | 197.5 | 87 | 78 | 91 |
| J-815 | 197 | 87 | 79 | 92 |
| J-810 | 197 | 87 | 79 | 92 |
| J-47 | 197.43 | 86 | 79 | 87 |
| J-33 | 196.64 | 89 | 81 | 90 |
| J-29 | 195.37 | 94 | 83 | 94 |
| J-26 | 187 | 100 | 91 | 100 |
| J-25 | 195.6 | 88 | 80 | 89 |
| J-24 | 197.5 | 86 | 77 | 89 |
| J-20 | 189.75 | 96 | 87 | 98 |

## Angus Water Distribution System

## WaterGEMS Model -Proposed System Results

| Node | Elevation (m) | Pressure (psi) Servicing Strategy WS-1.2 | Pressure (psi) Servicing Strategy WS-1.1 | Pressure (psi) Servicing Strategy WS-1.4 |
|---|---|---|---|---|
| | | New Elevated Storage at the Mill Street Site | Additional in ground resevoirs at the Mill Street Site | New Elevated Storage at a Greenfield Site (South of Angus) |
| | | MDD | MDD | MDD |
| J-18 | 190.35 | 95 | 86 | 97 |
| J-17 | 190.85 | 94 | 86 | 96 |

## Angus Water Distribution System

## WaterGEMS Model - Proposed System Fire Flow Results

| Node | Servicing Strategy WS-1.2 | | | Servicing Strategy WS-1.1 | | | Servicing Strategy WS-1.4 | | |
|---|---|---|---|---|---|---|---|---|---|
| | New Elevated Storage at the Mill Street Site | | | Additional in ground reservoir at the Mill Street Site | | | New Elevated Storage at a Greenfield Site (South of Angus) | | |
| | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) |
| J-8040 | 100 | 300.00 | 20 | 100.00 | 300.00 | 20 | 100.00 | 300.00 | 20 |
| J-8030 | 100.00 | 300.00 | 20 | 100.00 | 300.00 | 20 | 100.00 | 300.00 | 20 |
| J-8020 | 100.00 | 300.00 | 20 | 100.00 | 300.00 | 20 | 100.00 | 300.00 | 20 |
| J-8010 | 100.00 | 300.00 | 20 | 100.00 | 300.00 | 20 | 100.00 | 300.00 | 20 |
| J-1820 | 100.22 | 300.22 | 20 | 100.22 | 300.22 | 20 | 100.22 | 300.22 | 20 |
| J-1810 | 100.57 | 280.13 | 20 | 100.57 | 261.48 | 20 | 100.57 | 300.57 | 20 |
| J-1800 | 100.47 | 203.07 | 20 | 100.47 | 188.68 | 20 | 100.47 | 218.65 | 20 |
| J-1790 | 100.31 | 121.32 | 20 | 100.31 | 116.42 | 20 | 100.31 | 125.21 | 20 |
| J-1780 | 100.63 | 256.59 | 20 | 100.63 | 239.60 | 20 | 100.63 | 282.60 | 20 |
| J-1770 | 100.75 | 300.75 | 20 | 100.75 | 290.07 | 20 | 100.75 | 300.75 | 20 |
| J-1760 | 100.19 | 300.19 | 20 | 100.19 | 300.19 | 20 | 100.19 | 300.19 | 20 |
| J-1206 | 100.25 | 261.32 | 20 | 100.25 | 245.18 | 20 | 100.25 | 285.11 | 20 |
| J-1406 | 100.28 | 117.72 | 20 | 100.28 | 113.08 | 20 | 100.28 | 123.41 | 20 |
| J-1530 | 100.00 | 273.07 | 20 | 100.00 | 256.13 | 20 | 100.00 | 300.00 | 20 |
| J-1520 | 102.50 | 265.52 | 20 | 102.50 | 249.47 | 20 | 102.50 | 289.98 | 20 |
| J-1730 | 100.54 | 135.52 | 20 | 100.54 | 130.44 | 20 | 100.54 | 141.54 | 20 |
| J-1710 | 100.27 | 188.71 | 20 | 100.27 | 176.64 | 20 | 100.27 | 192.38 | 20 |
| J-1700 | 100.20 | 205.74 | 20 | 100.20 | 192.06 | 20 | 100.20 | 210.56 | 20 |
| J-1690 | 100.48 | 176.03 | 20 | 100.48 | 166.01 | 20 | 100.48 | 180.43 | 20 |
| J-1680 | 100.36 | 171.07 | 20 | 100.36 | 161.58 | 20 | 100.36 | 175.88 | 20 |
| J-1670 | 100.37 | 190.72 | 20 | 100.37 | 178.34 | 20 | 100.37 | 194.19 | 20 |
| J-1660 | 100.15 | 181.15 | 20 | 100.15 | 170.46 | 20 | 100.15 | 185.33 | 20 |
| J-1650 | 100.21 | 179.61 | 20 | 100.21 | 169.10 | 20 | 100.21 | 183.92 | 20 |
| J-1640 | 100.17 | 192.74 | 20 | 100.17 | 180.24 | 20 | 100.17 | 196.17 | 20 |
| J-1630 | 100.52 | 203.47 | 20 | 100.52 | 190.11 | 20 | 100.52 | 207.76 | 20 |
| J-1016 | 200.46 | 299.38 | 20 | 200.46 | 276.90 | 20 | 200.46 | 338.37 | 20 |
| J-1620 | 100.47 | 103.31 | 20 | 101.06 | 124.46 | 20 | 100.47 | 107.60 | 20 |
| J-1610 | 101.06 | 128.88 | 20 | 100.13 | 206.59 | 20 | 101.06 | 134.72 | 20 |
| J-1600 | 100.13 | 221.24 | 20 | 100.13 | 217.59 | 20 | 100.13 | 228.79 | 20 |
| J-1590 | 100.13 | 232.82 | 20 | 100.17 | 229.67 | 20 | 100.13 | 242.93 | 20 |
| J-1580 | 100.17 | 245.59 | 20 | 100.28 | 245.27 | 20 | 100.17 | 258.91 | 20 |
| J-1570 | 100.28 | 263.50 | 20 | 100.37 | 239.30 | 20 | 100.28 | 286.45 | 20 |
| J-1560 | 100.37 | 256.45 | 20 | 200.11 | 350.11 | 20 | 100.37 | 273.14 | 20 |
| J-1540 | 200.11 | 350.11 | 20 | 100.16 | 294.94 | 20 | 200.11 | 350.11 | 20 |
| J-1510 | 100.16 | 300.16 | 20 | 100.22 | 239.95 | 20 | 100.16 | 300.16 | 20 |
| J-1550 | 100.22 | 259.23 | 20 | 100.12 | 137.92 | 20 | 100.22 | 285.50 | 20 |
| J-1500 | 100.12 | 143.90 | 20 | 100.45 | 155.93 | 20 | 100.12 | 149.73 | 20 |
| J-1495 | 100.45 | 164.41 | 20 | 100.14 | 144.02 | 20 | 100.45 | 169.59 | 20 |
| J-1490 | 100.14 | 150.73 | 20 | 100.50 | 114.20 | 20 | 100.14 | 156.37 | 20 |
| J-1485 | 100.50 | 118.63 | 20 | 100.19 | 125.81 | 20 | 100.50 | 124.22 | 20 |
| J-1480 | 100.19 | 130.49 | 20 | 100.16 | 120.23 | 20 | 100.19 | 136.52 | 20 |
| J-1475 | 100.16 | 124.63 | 20 | 100.14 | 134.10 | 20 | 100.16 | 130.66 | 20 |
| J-1470 | 100.14 | 139.67 | 20 | 100.18 | 122.87 | 20 | 100.14 | 145.63 | 20 |
| J-1465 | 100.18 | 127.39 | 20 | 100.35 | 127.01 | 20 | 100.18 | 133.42 | 20 |
| J-1460 | 100.35 | 131.78 | 20 | 100.13 | 129.56 | 20 | 100.35 | 137.83 | 20 |
| J-1455 | 100.13 | 134.66 | 20 | 100.34 | 110.60 | 20 | 100.13 | 140.72 | 20 |
| J-1450 | 100.34 | 115.25 | 20 | 100.51 | 106.45 | 20 | 100.34 | 120.64 | 20 |

## Angus Water Distribution System

## WaterGEMS Model - Proposed System  Fire Flow Results

| Node | Servicing Strategy WS-1.2 New Elevated Storage at the Mill Street Site | | | Servicing Strategy WS-1.1 Additional in ground reservoir at the Mill Street Site | | | Servicing Strategy WS-1.4 New Elevated Storage at a Greenfield Site (South of Angus) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) |
| J-1445 | 100.51 | 111.15 | 20 | 100.15 | 147.16 | 20 | 100.51 | 116.13 | 20 |
| J-1440 | 100.15 | 154.33 | 20 | 100.16 | 143.73 | 20 | 100.15 | 159.93 | 20 |
| J-1435 | 100.16 | 150.52 | 20 | 100.14 | 128.00 | 20 | 100.16 | 156.31 | 20 |
| J-1430 | 100.14 | 132.99 | 20 | 100.20 | 120.71 | 20 | 100.14 | 139.12 | 20 |
| J-1425 | 100.37 | 100.37 | 20 | 100.11 | 125.93 | 20 | 100.37 | 104.72 | 20 |
| J-1420 | 100.40 | 104.95 | 20 | 100.28 | 113.08 | 20 | 100.40 | 109.61 | 20 |
| J-1415 | 100.20 | 125.29 | 20 | 100.26 | 100.90 | 20 | 100.20 | 131.53 | 20 |
| J-1410 | 100.11 | 130.76 | 20 | 100.33 | 107.37 | 20 | 100.11 | 136.95 | 20 |
| J-1405 | 100.28 | 117.71 | 20 | 100.19 | 130.48 | 20 | 100.28 | 123.41 | 20 |
| J-1400 | 100.26 | 106.15 | 20 | 100.45 | 120.63 | 20 | 100.26 | 111.13 | 20 |
| J-1390 | 100.33 | 112.25 | 20 | 100.39 | 112.78 | 20 | 100.33 | 117.53 | 20 |
| J-1385 | 100.19 | 135.82 | 20 | 100.24 | 106.56 | 20 | 100.19 | 142.00 | 20 |
| J-1380 | 100.45 | 125.27 | 20 | 100.17 | 111.09 | 20 | 100.45 | 131.57 | 20 |
| J-1375 | 100.39 | 117.70 | 20 | 100.33 | 164.47 | 20 | 100.39 | 123.66 | 20 |
| J-1355 | 100.24 | 111.76 | 20 | 100.35 | 170.80 | 20 | 100.07 | 101.15 | 20 |
| J-1350 | 100.17 | 116.15 | 20 | 100.68 | 184.48 | 20 | 100.16 | 103.09 | 20 |
| J-1345 | 100.33 | 174.67 | 20 | 100.69 | 191.85 | 20 | 100.24 | 117.25 | 20 |
| J-1340 | 100.35 | 182.09 | 20 | 100.39 | 213.34 | 20 | 100.17 | 121.96 | 20 |
| J-1335 | 100.68 | 198.19 | 20 | 100.30 | 115.87 | 20 | 100.33 | 179.72 | 20 |
| J-1330 | 100.69 | 206.67 | 20 | 100.14 | 153.75 | 20 | 100.35 | 186.67 | 20 |
| J-1325 | 100.39 | 229.34 | 20 | 100.25 | 142.67 | 20 | 100.68 | 201.52 | 20 |
| J-1320 | 100.30 | 120.32 | 20 | 100.30 | 133.02 | 20 | 100.69 | 210.26 | 20 |
| J-1315 | 100.14 | 161.66 | 20 | 100.29 | 128.34 | 20 | 100.39 | 237.98 | 20 |
| J-1310 | 100.25 | 149.08 | 20 | 100.24 | 133.98 | 20 | 100.30 | 125.85 | 20 |
| J-1305 | 100.30 | 138.21 | 20 | 100.12 | 113.27 | 20 | 100.14 | 166.94 | 20 |
| J-1300 | 100.29 | 133.12 | 20 | 100.13 | 108.72 | 20 | 100.25 | 154.74 | 20 |
| J-1295 | 100.24 | 139.32 | 20 | 100.26 | 107.35 | 20 | 100.30 | 143.98 | 20 |
| J-1290 | 100.12 | 117.69 | 20 | 104.29 | 116.62 | 20 | 100.29 | 138.92 | 20 |
| J-1285 | 100.13 | 113.25 | 20 | 100.12 | 139.57 | 20 | 100.24 | 145.09 | 20 |
| J-1280 | 100.26 | 111.99 | 20 | 100.17 | 156.77 | 20 | 100.12 | 123.08 | 20 |
| J-1275 | 104.29 | 121.14 | 20 | 100.12 | 114.02 | 20 | 100.13 | 118.25 | 20 |
| J-1270 | 100.12 | 145.63 | 20 | 100.20 | 112.93 | 20 | 100.26 | 116.92 | 20 |
| J-1265 | 100.17 | 165.01 | 20 | 100.14 | 140.51 | 20 | 104.29 | 126.51 | 20 |
| J-1250 | 100.12 | 117.49 | 20 | 100.11 | 131.51 | 20 | 100.12 | 151.42 | 20 |
| J-1240 | 100.20 | 116.26 | 20 | 100.13 | 140.15 | 20 | 100.17 | 170.13 | 20 |
| J-1230 | 100.14 | 147.39 | 20 | 100.08 | 182.54 | 20 | 100.12 | 122.50 | 20 |
| J-1225 | 100.11 | 137.14 | 20 | 100.16 | 192.66 | 20 | 100.24 | 104.65 | 20 |
| J-1220 | 100.13 | 147.10 | 20 | 100.10 | 198.04 | 20 | 100.20 | 121.32 | 20 |
| J-1215 | 100.08 | 195.20 | 20 | 100.15 | 158.53 | 20 | 100.13 | 103.37 | 20 |
| J-1210 | 100.16 | 205.92 | 20 | 100.19 | 162.33 | 20 | 100.14 | 150.80 | 20 |
| J-1205 | 100.10 | 211.65 | 20 | 100.24 | 116.58 | 20 | 100.11 | 141.26 | 20 |
| J-1200 | 100.15 | 170.16 | 20 | 100.25 | 116.35 | 20 | 100.13 | 150.50 | 20 |
| J-1195 | 100.19 | 174.19 | 20 | 100.28 | 262.56 | 20 | 100.08 | 200.67 | 20 |
| J-1185 | 100.24 | 120.79 | 20 | 104.64 | 256.19 | 20 | 100.16 | 216.36 | 20 |
| J-1180 | 100.25 | 120.33 | 20 | 100.00 | 167.72 | 20 | 100.10 | 224.96 | 20 |
| J-1175 | 100.28 | 279.03 | 20 | 200.14 | 264.89 | 20 | 100.15 | 175.14 | 20 |
| J-1170 | 104.64 | 272.07 | 20 | 100.21 | 234.44 | 20 | 100.19 | 180.18 | 20 |

## Angus Water Distribution System

## WaterGEMS Model - Proposed System Fire Flow Results

| Node | Servicing Strategy WS-1.2 New Elevated Storage at the Mill Street Site | | | Servicing Strategy WS-1.1 Additional in ground reservoir at the Mill Street Site | | | Servicing Strategy WS-1.4 New Elevated Storage at a Greenfield Site (South of Angus) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) |
| J-7000 | 100.00 | 176.07 | 20 | 100.14 | 109.24 | 20 | 100.24 | 124.71 | 20 |
| J-1160 | 200.14 | 283.63 | 20 | 100.24 | 164.35 | 20 | 100.25 | 124.21 | 20 |
| J-1155 | 100.21 | 250.71 | 20 | 200.25 | 257.94 | 20 | 100.28 | 300.28 | 20 |
| J-1150 | 100.14 | 113.91 | 20 | 200.28 | 275.34 | 20 | 104.64 | 297.33 | 20 |
| J-1145 | 100.24 | 172.65 | 20 | 200.76 | 300.61 | 20 | 100.00 | 177.81 | 20 |
| J-1140 | 200.25 | 275.91 | 20 | 100.11 | 158.26 | 20 | 200.14 | 310.16 | 20 |
| J-1135 | 200.28 | 295.17 | 20 | 100.20 | 132.81 | 20 | 100.21 | 264.93 | 20 |
| J-1130 | 200.76 | 323.78 | 20 | 100.32 | 107.02 | 20 | 100.14 | 118.56 | 20 |
| J-1125 | 100.11 | 167.56 | 20 | 100.23 | 101.79 | 20 | 100.24 | 177.84 | 20 |
| J-1120 | 100.20 | 139.36 | 20 | 100.29 | 103.17 | 20 | 200.25 | 297.92 | 20 |
| J-1115 | 100.32 | 113.04 | 20 | 100.23 | 110.19 | 20 | 200.28 | 326.78 | 20 |
| J-1110 | 100.23 | 107.80 | 20 | 101.43 | 141.94 | 20 | 200.76 | 350.76 | 20 |
| J-1105 | 100.17 | 104.21 | 20 | 100.10 | 195.07 | 20 | 100.11 | 184.28 | 20 |
| J-1100 | 100.24 | 104.43 | 20 | 101.11 | 182.23 | 20 | 100.20 | 151.73 | 20 |
| J-1095 | 100.29 | 109.18 | 20 | 100.22 | 183.37 | 20 | 100.32 | 121.73 | 20 |
| J-1085 | 100.13 | 100.79 | 20 | 100.48 | 150.47 | 20 | 100.23 | 115.62 | 20 |
| J-1080 | 100.23 | 116.19 | 20 | 100.22 | 176.09 | 20 | 100.17 | 111.45 | 20 |
| J-1075 | 101.43 | 148.98 | 20 | 100.34 | 186.23 | 20 | 100.24 | 111.67 | 20 |
| J-1070 | 100.10 | 210.48 | 20 | 100.50 | 209.89 | 20 | 100.29 | 117.05 | 20 |
| J-1065 | 101.11 | 194.75 | 20 | 200.65 | 337.00 | 20 | 100.15 | 106.10 | 20 |
| J-1055 | 100.48 | 158.08 | 20 | 201.99 | 244.70 | 20 | 100.23 | 125.07 | 20 |
| J-1050 | 100.22 | 188.60 | 20 | 200.68 | 258.12 | 20 | 101.43 | 160.87 | 20 |
| J-1045 | 100.34 | 200.32 | 20 | 200.48 | 280.14 | 20 | 100.10 | 223.30 | 20 |
| J-1040 | 100.50 | 226.02 | 20 | 200.16 | 350.16 | 20 | 101.11 | 210.34 | 20 |
| J-1035 | 200.65 | 350.65 | 20 | 200.62 | 350.62 | 20 | 100.22 | 211.30 | 20 |
| J-1030 | 200.22 | 260.79 | 20 | 100.00 | 300.00 | 20 | 100.48 | 169.87 | 20 |
| J-1025 | 201.99 | 262.57 | 20 | 100.46 | 277.61 | 20 | 100.22 | 203.71 | 20 |
| J-1020 | 200.68 | 276.63 | 20 | 100.39 | 184.41 | 20 | 100.34 | 214.93 | 20 |
| J-1015 | 200.48 | 302.94 | 20 | 100.15 | 196.59 | 20 | 100.50 | 242.58 | 20 |
| J-1010 | 200.16 | 350.16 | 20 | 100.21 | 291.62 | 20 | 200.65 | 350.65 | 20 |
| J-1005 | 200.62 | 350.62 | 20 | 101.31 | 301.09 | 20 | 200.22 | 279.70 | 20 |
| J-8000 | 100.00 | 300.00 | 20 | 200.39 | 224.28 | 20 | 201.99 | 281.39 | 20 |
| J-820 | 100.46 | 300.46 | 20 | 200.38 | 226.80 | 20 | 200.68 | 300.17 | 20 |
| J-840 | 100.39 | 197.79 | 20 | 100.17 | 168.97 | 20 | 200.48 | 343.98 | 20 |
| J-850 | 100.15 | 210.48 | 20 | 100.18 | 300.18 | 20 | 200.16 | 350.16 | 20 |
| J-860 | 100.21 | 300.21 | 20 | 100.14 | 171.75 | 20 | 200.62 | 350.62 | 20 |
| J-870 | 101.31 | 301.31 | 20 | 100.39 | 130.67 | 20 | 100.00 | 300.00 | 20 |
| J-930 | 200.39 | 240.74 | 20 | 100.26 | 117.81 | 20 | 100.46 | 300.46 | 20 |
| J-940 | 200.38 | 243.60 | 20 | 100.09 | 211.02 | 20 | 100.39 | 201.71 | 20 |
| J-950 | 100.17 | 179.49 | 20 | 100.51 | 101.08 | 20 | 100.15 | 216.87 | 20 |
| J-970 | 100.18 | 300.18 | 20 | 100.10 | 206.12 | 20 | 100.21 | 300.21 | 20 |
| J-980 | 100.14 | 183.00 | 20 | 100.33 | 144.64 | 20 | 101.31 | 301.31 | 20 |
| J-1980 | 100.39 | 135.89 | 20 | 100.58 | 134.06 | 20 | 100.19 | 102.49 | 20 |
| J-2020 | 100.26 | 122.48 | 20 | 100.35 | 291.57 | 20 | 200.39 | 253.64 | 20 |
| J-2200 | 100.09 | 225.88 | 20 | 100.35 | 267.20 | 20 | 200.38 | 257.16 | 20 |
| J-2210 | 100.51 | 105.89 | 20 | 100.05 | 263.63 | 20 | 100.17 | 183.71 | 20 |
| J-2220 | 100.10 | 220.25 | 20 | 200.28 | 225.72 | 20 | 100.18 | 300.18 | 20 |

**Angus Water Distribution System**

**WaterGEMS Model - Proposed System Fire Flow Results**

| Node | Servicing Strategy WS-1.2 | | | Servicing Strategy WS-1.1 | | | Servicing Strategy WS-1.4 | | |
|---|---|---|---|---|---|---|---|---|---|
| | New Elevated Storage at the Mill Street Site | | | Additional in ground reservoir at the Mill Street Site | | | New Elevated Storage at a Greenfield Site (South of Angus) | | |
| | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) |
| J-2230 | 100.33 | 152.61 | 20 | 207.98 | 225.87 | 20 | 100.14 | 187.47 | 20 |
| J-2240 | 100.58 | 139.98 | 20 | 100.20 | 134.13 | 20 | 100.39 | 141.93 | 20 |
| J-2430 | 100.35 | 300.35 | 20 | 100.09 | 192.41 | 20 | 100.26 | 128.67 | 20 |
| J-2730 | 100.35 | 285.91 | 20 | 100.17 | 165.44 | 20 | 100.09 | 234.55 | 20 |
| J-3350 | 100.05 | 280.40 | 20 | 100.19 | 114.37 | 20 | 100.51 | 110.42 | 20 |
| J-1990 | 200.28 | 242.03 | 20 | 100.22 | 134.54 | 20 | 100.10 | 235.83 | 20 |
| J-2000 | 207.98 | 241.44 | 20 | 100.58 | 294.67 | 20 | 100.33 | 155.54 | 20 |
| J-2250 | 100.20 | 140.06 | 20 | 100.38 | 300.38 | 20 | 100.58 | 143.92 | 20 |
| J-2260 | 100.09 | 205.68 | 20 | 100.30 | 140.68 | 20 | 100.35 | 300.35 | 20 |
| J-2270 | 100.17 | 177.02 | 20 | 200.48 | 234.57 | 20 | 100.35 | 300.35 | 20 |
| J-2280 | 100.19 | 117.68 | 20 | 100.12 | 116.95 | 20 | 100.05 | 300.05 | 20 |
| J-2290 | 100.22 | 140.19 | 20 | 100.11 | 175.87 | 20 | 200.28 | 255.96 | 20 |
| J-2440 | 100.58 | 300.58 | 20 | 100.25 | 187.10 | 20 | 207.98 | 253.98 | 20 |
| J-2780 | 100.38 | 300.38 | 20 | 100.45 | 200.37 | 20 | 100.20 | 143.97 | 20 |
| J-3310 | 100.30 | 147.79 | 20 | 100.13 | 215.58 | 20 | 100.09 | 216.26 | 20 |
| J-2010 | 200.48 | 251.79 | 20 | 100.05 | 217.18 | 20 | 100.17 | 180.65 | 20 |
| J-2030 | 100.12 | 121.59 | 20 | 100.07 | 142.90 | 20 | 100.19 | 122.48 | 20 |
| J-2040 | 100.11 | 187.75 | 20 | 100.21 | 187.11 | 20 | 100.22 | 143.93 | 20 |
| J-2050 | 100.25 | 201.03 | 20 | 100.29 | 173.87 | 20 | 100.58 | 300.58 | 20 |
| J-2060 | 100.45 | 215.46 | 20 | 100.33 | 113.67 | 20 | 100.38 | 300.38 | 20 |
| J-2070 | 100.13 | 231.42 | 20 | 102.63 | 149.58 | 20 | 100.30 | 151.18 | 20 |
| J-2080 | 100.05 | 233.15 | 20 | 200.29 | 245.07 | 20 | 200.48 | 267.62 | 20 |
| J-2090 | 100.07 | 149.13 | 20 | 100.20 | 238.52 | 20 | 100.12 | 127.60 | 20 |
| J-2100 | 100.21 | 199.12 | 20 | 100.17 | 226.82 | 20 | 100.11 | 191.85 | 20 |
| J-2110 | 100.29 | 184.23 | 20 | 100.35 | 109.42 | 20 | 100.25 | 204.16 | 20 |
| J-2120 | 100.33 | 118.91 | 20 | 100.19 | 168.31 | 20 | 100.45 | 220.29 | 20 |
| J-2130 | 102.63 | 156.32 | 20 | 100.12 | 183.80 | 20 | 100.13 | 239.68 | 20 |
| J-2140 | 200.29 | 262.53 | 20 | 100.21 | 156.14 | 20 | 100.05 | 241.81 | 20 |
| J-2150 | 100.20 | 255.52 | 20 | 100.44 | 116.68 | 20 | 100.07 | 154.94 | 20 |
| J-2160 | 100.17 | 242.90 | 20 | 100.19 | 134.61 | 20 | 100.21 | 206.55 | 20 |
| J-2170 | 100.35 | 114.14 | 20 | 100.26 | 143.65 | 20 | 100.29 | 193.44 | 20 |
| J-2180 | 100.19 | 178.28 | 20 | 100.41 | 127.50 | 20 | 100.33 | 124.85 | 20 |
| J-2190 | 100.12 | 196.60 | 20 | 100.23 | 131.12 | 20 | 102.63 | 164.64 | 20 |
| J-2300 | 100.21 | 166.02 | 20 | 100.22 | 134.68 | 20 | 200.29 | 281.06 | 20 |
| J-2310 | 100.44 | 120.19 | 20 | 100.54 | 106.42 | 20 | 100.20 | 272.06 | 20 |
| J-2320 | 100.19 | 140.48 | 20 | 100.33 | 109.65 | 20 | 100.17 | 255.54 | 20 |
| J-2330 | 100.26 | 150.85 | 20 | 100.41 | 184.40 | 20 | 100.35 | 119.40 | 20 |
| J-2340 | 100.41 | 132.20 | 20 | 100.13 | 114.52 | 20 | 100.19 | 183.10 | 20 |
| J-2350 | 100.23 | 136.54 | 20 | 100.39 | 111.30 | 20 | 100.12 | 200.20 | 20 |
| J-2370 | 100.22 | 140.58 | 20 | 100.24 | 294.40 | 20 | 100.21 | 168.63 | 20 |
| J-2380 | 100.54 | 109.04 | 20 | 100.10 | 292.16 | 20 | 100.44 | 124.92 | 20 |
| J-2390 | 100.33 | 112.46 | 20 | 100.30 | 285.49 | 20 | 100.19 | 144.30 | 20 |
| J-2400 | 100.41 | 197.17 | 20 | 101.03 | 301.03 | 20 | 100.26 | 153.88 | 20 |
| J-2410 | 100.13 | 117.86 | 20 | 100.37 | 300.37 | 20 | 100.41 | 136.39 | 20 |
| J-2420 | 100.39 | 114.39 | 20 | 100.32 | 300.32 | 20 | 100.23 | 140.65 | 20 |
| J-2450 | 100.24 | 300.24 | 20 | 100.30 | 300.30 | 20 | 100.22 | 144.42 | 20 |
| J-2460 | 100.10 | 300.10 | 20 | 100.27 | 300.27 | 20 | 100.54 | 114.08 | 20 |

## Angus Water Distribution System

## WaterGEMS Model - Proposed System Fire Flow Results

| Node | Servicing Strategy WS-1.2 | | | Servicing Strategy WS-1.1 | | | Servicing Strategy WS-1.4 | | |
|---|---|---|---|---|---|---|---|---|---|
| | New Elevated Storage at the Mill Street Site | | | Additional in ground reservoir at the Mill Street Site | | | New Elevated Storage at a Greenfield Site (South of Angus) | | |
| | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) |
| J-2470 | 100.30 | 300.30 | 20 | 100.03 | 300.03 | 20 | 100.33 | 117.36 | 20 |
| J-2480 | 101.03 | 301.03 | 20 | 100.43 | 293.15 | 20 | 100.41 | 203.83 | 20 |
| J-2490 | 100.37 | 300.37 | 20 | 100.45 | 266.55 | 20 | 100.13 | 122.66 | 20 |
| J-2500 | 100.32 | 300.32 | 20 | 100.14 | 197.96 | 20 | 100.39 | 119.44 | 20 |
| J-2510 | 100.30 | 300.30 | 20 | 100.25 | 206.15 | 20 | 100.24 | 300.24 | 20 |
| J-2520 | 100.27 | 300.27 | 20 | 100.17 | 193.80 | 20 | 100.10 | 300.10 | 20 |
| J-2530 | 100.03 | 300.03 | 20 | 100.46 | 200.81 | 20 | 100.30 | 300.30 | 20 |
| J-2540 | 100.43 | 300.43 | 20 | 100.41 | 223.22 | 20 | 101.03 | 301.03 | 20 |
| J-2550 | 100.45 | 283.33 | 20 | 100.11 | 211.66 | 20 | 100.37 | 300.37 | 20 |
| J-2560 | 100.14 | 211.16 | 20 | 104.55 | 286.27 | 20 | 100.32 | 300.32 | 20 |
| J-2570 | 100.25 | 219.87 | 20 | 100.16 | 289.99 | 20 | 100.30 | 300.30 | 20 |
| J-2580 | 100.17 | 207.08 | 20 | 100.08 | 264.63 | 20 | 100.27 | 300.27 | 20 |
| J-2590 | 100.46 | 214.47 | 20 | 100.28 | 266.00 | 20 | 100.03 | 300.03 | 20 |
| J-2600 | 100.41 | 238.47 | 20 | 100.67 | 248.66 | 20 | 100.43 | 300.43 | 20 |
| J-2760 | 100.11 | 225.53 | 20 | 100.62 | 236.94 | 20 | 100.45 | 300.45 | 20 |
| J-2800 | 104.55 | 304.55 | 20 | 100.40 | 254.34 | 20 | 100.14 | 226.27 | 20 |
| J-3320 | 100.16 | 300.16 | 20 | 100.39 | 257.85 | 20 | 100.25 | 236.43 | 20 |
| J-2610 | 100.08 | 282.04 | 20 | 100.79 | 147.24 | 20 | 100.17 | 221.87 | 20 |
| J-2620 | 100.28 | 283.43 | 20 | 100.52 | 222.00 | 20 | 100.46 | 230.36 | 20 |
| J-2640 | 100.67 | 266.98 | 20 | 100.40 | 195.88 | 20 | 100.41 | 259.29 | 20 |
| J-2650 | 100.62 | 255.03 | 20 | 100.57 | 216.15 | 20 | 100.11 | 242.92 | 20 |
| J-2660 | 100.40 | 273.36 | 20 | 100.28 | 119.35 | 20 | 104.55 | 304.55 | 20 |
| J-2670 | 100.39 | 276.53 | 20 | 100.38 | 291.96 | 20 | 100.16 | 300.16 | 20 |
| J-2680 | 100.79 | 159.11 | 20 | 100.35 | 180.59 | 20 | 100.08 | 300.08 | 20 |
| J-2690 | 100.52 | 239.36 | 20 | 100.08 | 194.59 | 20 | 100.28 | 300.28 | 20 |
| J-2700 | 100.40 | 211.82 | 20 | 100.00 | 293.19 | 20 | 100.67 | 297.35 | 20 |
| J-2710 | 100.57 | 232.85 | 20 | 100.00 | 288.40 | 20 | 100.62 | 283.00 | 20 |
| J-2720 | 100.28 | 125.01 | 20 | 100.00 | 189.11 | 20 | 100.40 | 300.40 | 20 |
| J-2740 | 100.38 | 300.38 | 20 | 100.04 | 287.99 | 20 | 100.39 | 300.39 | 20 |
| J-2750 | 100.35 | 194.43 | 20 | 100.20 | 184.33 | 20 | 100.79 | 162.21 | 20 |
| J-2770 | 100.08 | 207.49 | 20 | 100.09 | 264.95 | 20 | 100.52 | 263.65 | 20 |
| J-2810 | 100.00 | 300.00 | 20 | 100.00 | 290.10 | 20 | 100.40 | 230.33 | 20 |
| J-2820 | 100.00 | 300.00 | 20 | 100.00 | 300.00 | 20 | 100.57 | 255.24 | 20 |
| J-2830 | 100.00 | 202.66 | 20 | 100.00 | 300.00 | 20 | 100.28 | 128.51 | 20 |
| J-2860 | 100.04 | 300.04 | 20 | 100.00 | 296.14 | 20 | 100.38 | 300.38 | 20 |
| J-2870 | 100.20 | 197.66 | 20 | 100.00 | 300.00 | 20 | 100.35 | 208.52 | 20 |
| J-6060 | 100.09 | 288.81 | 20 | 100.00 | 300.00 | 20 | 100.08 | 221.88 | 20 |
| J-6050 | 100.00 | 300.00 | 20 | 100.04 | 300.04 | 20 | 100.00 | 300.00 | 20 |
| J-6040 | 100.00 | 300.00 | 20 | 100.04 | 285.99 | 20 | 100.00 | 300.00 | 20 |
| J-6030 | 100.00 | 300.00 | 20 | 100.18 | 289.55 | 20 | 100.00 | 216.77 | 20 |
| J-6020 | 100.00 | 300.00 | 20 | 100.25 | 296.96 | 20 | 100.04 | 300.04 | 20 |
| J-6010 | 100.00 | 300.00 | 20 | 100.15 | 297.24 | 20 | 100.20 | 209.58 | 20 |
| J-2950 | 100.00 | 300.00 | 20 | 100.22 | 298.69 | 20 | 100.09 | 300.09 | 20 |
| J-6000 | 100.04 | 300.04 | 20 | 100.17 | 299.72 | 20 | 100.00 | 300.00 | 20 |
| J-6070 | 100.04 | 300.04 | 20 | 100.13 | 300.13 | 20 | 100.00 | 300.00 | 20 |
| J-3010 | 100.18 | 300.18 | 20 | 100.23 | 300.23 | 20 | 100.00 | 300.00 | 20 |
| J-3020 | 100.25 | 300.25 | 20 | 100.06 | 288.32 | 20 | 100.00 | 300.00 | 20 |

## Angus Water Distribution System

## WaterGEMS Model - Proposed System Fire Flow Results

| Node | Servicing Strategy WS-1.2 | | | Servicing Strategy WS-1.1 | | | Servicing Strategy WS-1.4 | | |
|---|---|---|---|---|---|---|---|---|---|
| | New Elevated Storage at the Mill Street Site | | | Additional in ground reservoir at the Mill Street Site | | | New Elevated Storage at a Greenfield Site (South of Angus) | | |
| | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) |
| J-3030 | 100.15 | 300.15 | 20 | 100.28 | 293.77 | 20 | 100.00 | 300.00 | 20 |
| J-3040 | 100.22 | 300.22 | 20 | 100.15 | 288.91 | 20 | 100.00 | 300.00 | 20 |
| J-3050 | 100.17 | 300.17 | 20 | 100.67 | 215.00 | 20 | 100.04 | 300.04 | 20 |
| J-3060 | 100.13 | 300.13 | 20 | 100.22 | 215.49 | 20 | 100.04 | 300.04 | 20 |
| J-3070 | 100.23 | 300.23 | 20 | 100.25 | 231.41 | 20 | 100.18 | 300.18 | 20 |
| J-3080 | 100.06 | 300.06 | 20 | 100.14 | 227.94 | 20 | 100.25 | 300.25 | 20 |
| J-3090 | 100.28 | 300.28 | 20 | 100.35 | 217.50 | 20 | 100.15 | 300.15 | 20 |
| J-3100 | 100.15 | 300.15 | 20 | 100.59 | 184.14 | 20 | 100.22 | 300.22 | 20 |
| J-3110 | 100.67 | 231.69 | 20 | 100.37 | 185.04 | 20 | 100.17 | 300.17 | 20 |
| J-3120 | 100.22 | 232.89 | 20 | 100.34 | 190.35 | 20 | 100.13 | 300.13 | 20 |
| J-3130 | 100.25 | 250.17 | 20 | 100.00 | 300.00 | 20 | 100.23 | 300.23 | 20 |
| J-3140 | 100.14 | 247.33 | 20 | 100.42 | 148.33 | 20 | 100.06 | 300.06 | 20 |
| J-3150 | 100.35 | 236.17 | 20 | 200.40 | 217.54 | 20 | 100.28 | 300.28 | 20 |
| J-3160 | 100.59 | 199.89 | 20 | 100.00 | 284.11 | 20 | 100.15 | 300.15 | 20 |
| J-3170 | 100.37 | 200.71 | 20 | 100.28 | 228.75 | 20 | 100.67 | 254.78 | 20 |
| J-3180 | 100.34 | 206.22 | 20 | 100.16 | 239.89 | 20 | 100.22 | 257.26 | 20 |
| J-3290 | 100.00 | 300.00 | 20 | 100.44 | 198.50 | 20 | 100.25 | 279.59 | 20 |
| J-3330 | 100.42 | 160.51 | 20 | 100.18 | 217.22 | 20 | 100.14 | 277.15 | 20 |
| J-3460 | 200.40 | 233.04 | 20 | 100.12 | 199.93 | 20 | 100.35 | 262.83 | 20 |
| J-3500 | 100.00 | 300.00 | 20 | 100.22 | 192.33 | 20 | 100.59 | 217.48 | 20 |
| J-3190 | 100.28 | 246.80 | 20 | 100.42 | 178.52 | 20 | 100.37 | 218.32 | 20 |
| J-3200 | 100.16 | 258.59 | 20 | 100.16 | 209.29 | 20 | 100.34 | 224.71 | 20 |
| J-3210 | 100.44 | 214.32 | 20 | 100.32 | 167.98 | 20 | 100.00 | 300.00 | 20 |
| J-3220 | 100.18 | 235.01 | 20 | 100.34 | 191.75 | 20 | 100.42 | 165.18 | 20 |
| J-3230 | 100.12 | 216.15 | 20 | 100.48 | 148.92 | 20 | 200.40 | 245.71 | 20 |
| J-3240 | 100.22 | 208.13 | 20 | 100.24 | 157.95 | 20 | 100.00 | 300.00 | 20 |
| J-3250 | 100.42 | 193.53 | 20 | 206.53 | 207.21 | 20 | 100.28 | 274.50 | 20 |
| J-3260 | 100.16 | 226.21 | 20 | 100.00 | 299.44 | 20 | 100.16 | 289.56 | 20 |
| J-3270 | 100.32 | 181.64 | 20 | 100.00 | 300.00 | 20 | 100.44 | 233.95 | 20 |
| J-3280 | 100.34 | 206.60 | 20 | 100.00 | 246.95 | 20 | 100.18 | 261.38 | 20 |
| J-3300 | 100.48 | 161.56 | 20 | 100.00 | 300.00 | 20 | 100.12 | 237.24 | 20 |
| J-3340 | 100.24 | 170.24 | 20 | 206.69 | 356.69 | 20 | 100.22 | 227.56 | 20 |
| J-3470 | 206.53 | 221.64 | 20 | 100.00 | 195.42 | 20 | 100.42 | 210.20 | 20 |
| J-3480 | 100.00 | 300.00 | 20 | 100.00 | 192.02 | 20 | 100.16 | 249.91 | 20 |
| J-3490 | 100.00 | 300.00 | 20 | 100.00 | 188.91 | 20 | 100.32 | 193.96 | 20 |
| J-3530 | 100.00 | 266.30 | 20 | 100.00 | 185.22 | 20 | 100.34 | 224.38 | 20 |
| J-3540 | 100.00 | 300.00 | 20 | 100.00 | 184.00 | 20 | 100.48 | 166.92 | 20 |
| J-3550 | 206.69 | 356.69 | 20 | 100.00 | 180.36 | 20 | 100.24 | 177.56 | 20 |
| J-1326 | 100.00 | 210.34 | 20 | 100.00 | 174.34 | 20 | 206.53 | 229.62 | 20 |
| J-1327 | 100.00 | 206.84 | 20 | 100.00 | 171.29 | 20 | 100.00 | 300.00 | 20 |
| J-1331 | 100.00 | 203.59 | 20 | 100.00 | 168.12 | 20 | 100.00 | 300.00 | 20 |
| J-1332 | 100.00 | 199.15 | 20 | 100.00 | 213.20 | 20 | 100.00 | 287.20 | 20 |
| J-1333 | 100.00 | 197.74 | 20 | 100.00 | 295.27 | 20 | 100.00 | 300.00 | 20 |
| J-1336 | 100.00 | 193.40 | 20 | 100.00 | 199.25 | 20 | 206.69 | 356.69 | 20 |
| J-1337 | 100.00 | 186.25 | 20 | 100.00 | 267.05 | 20 | 100.00 | 214.57 | 20 |
| J-1338 | 100.00 | 182.68 | 20 | 100.00 | 158.17 | 20 | 100.00 | 210.54 | 20 |
| J-1341 | 100.00 | 179.00 | 20 | 100.00 | 168.60 | 20 | 100.00 | 206.85 | 20 |

## Angus Water Distribution System

## WaterGEMS Model - Proposed System Fire Flow Results

| Node | Servicing Strategy WS-1.2 | | | Servicing Strategy WS-1.1 | | | Servicing Strategy WS-1.4 | | |
|---|---|---|---|---|---|---|---|---|---|
| | New Elevated Storage at the Mill Street Site | | | Additional in ground reservoir at the Mill Street Site | | | New Elevated Storage at a Greenfield Site (South of Angus) | | |
| | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) | Required FF | Available FF | Pressure (psi) |
| J-2472 | 100.00 | 228.59 | 20 | 100.00 | 175.87 | 20 | 100.00 | 202.38 | 20 |
| J-2541 | 100.00 | 300.00 | 20 | 124.47 | 195.91 | 20 | 100.00 | 201.04 | 20 |
| J-2781 | 100.00 | 214.49 | 20 | 110.82 | 230.62 | 20 | 100.00 | 197.08 | 20 |
| J-2782 | 100.00 | 286.21 | 20 | 111.13 | 232.45 | 20 | 100.00 | 190.49 | 20 |
| J-17 | 100.00 | 167.26 | 20 | 100.00 | 300.00 | 20 | 100.00 | 187.18 | 20 |
| J-18 | 100.00 | 179.29 | 20 | 100.00 | 177.78 | 20 | 100.00 | 183.77 | 20 |
| J-20 | 100.00 | 187.73 | 20 | 100.00 | 265.22 | 20 | 100.00 | 248.31 | 20 |
| J-24 | 124.47 | 209.08 | 20 | 100.47 | 98.55 | 20 | 100.00 | 300.00 | 20 |
| J-25 | 110.82 | 247.97 | 20 | 100.37 | 95.27 | 20 | 100.00 | 232.42 | 20 |
| J-26 | 111.13 | 247.57 | 20 | 100.40 | 99.95 | 20 | 100.00 | 300.00 | 20 |
| J-29 | 100.00 | 300.00 | 20 | 100.48 | 85.05 | 20 | 100.00 | 172.64 | 20 |
| J-33 | 100.00 | 188.75 | 20 | 100.07 | 91.58 | 20 | 100.00 | 183.97 | 20 |
| J-47 | 100.00 | 283.94 | 20 | 100.16 | 80.16 | 20 | 100.00 | 191.77 | 20 |
| J-1395 | 100.48 | 90.20 | 20 | 100.16 | 93.34 | 20 | 124.47 | 229.54 | 20 |
| J-1370 | 100.07 | 96.92 | 20 | 100.21 | 73.82 | 20 | 110.82 | 267.66 | 20 |
| J-1365 | 100.16 | 85.36 | 20 | 100.21 | 68.10 | 20 | 111.13 | 263.60 | 20 |
| J-1360 | 100.16 | 98.71 | 20 | 100.24 | 96.87 | 20 | 100.00 | 300.00 | 20 |
| J-1260 | 100.21 | 77.40 | 20 | 100.13 | 95.85 | 20 | 100.00 | 190.87 | 20 |
| J-1255 | 100.21 | 71.74 | 20 | 100.29 | 72.27 | 20 | 100.00 | 300.00 | 20 |
| J-1245 | 100.24 | 99.81 | 20 | 100.17 | 98.21 | 20 | 100.48 | 93.82 | 20 |
| J-1235 | 100.13 | 98.79 | 20 | 100.24 | 98.43 | 20 | 100.16 | 88.71 | 20 |
| J-1190 | 100.29 | 75.45 | 20 | 100.15 | 93.71 | 20 | 100.21 | 80.34 | 20 |
| J-1090 | 100.15 | 99.60 | 20 | 100.13 | 94.86 | 20 | 100.21 | 74.35 | 20 |
| J-810 | 100.05 | 85.17 | 20 | 100.05 | 79.49 | 20 | 100.29 | 78.62 | 20 |
| J-825 | 100.06 | 86.45 | 20 | 100.06 | 80.68 | 20 | 100.05 | 91.71 | 20 |
| J-815 | 100.76 | 77.88 | 20 | 100.76 | 72.46 | 20 | 100.06 | 93.25 | 20 |
| J-3510 | 200.00 | 141.98 | 20 | 200.00 | 135.08 | 20 | 100.76 | 83.30 | 20 |
| J-3560 | 200.00 | 131.57 | 20 | 200.00 | 123.19 | 20 | 200.00 | 146.74 | 20 |
| J-8042 | 100.04 | 51.74 | 20 | 100.04 | 46.86 | 20 | 200.00 | 137.26 | 20 |
| J-880 | 100.19 | 94.41 | 20 | 100.19 | 88.46 | 20 | 100.04 | 50.33 | 20 |
| J-8041 | 100.04 | 54.24 | 20 | 100.04 | 49.13 | 20 | 100.04 | 52.72 | 20 |

## Angus Water Distribution System

WaterGEMS Model - Existing pipe Data sheet

| Pipe | Start node | End Node | Nominal Dia (mm) | Hazen-Williams "C" Factor |
|---|---|---|---|---|
| P-8 | J-8042 | J-8041 | 150 | 100 |
| P-9 | J-8041 | J-8000 | 150 | 100 |
| P-11 | J-2472 | J-2541 | 150 | 100 |
| P-13 | J-2780 | J-2781 | 150 | 100 |
| P-15 | J-2781 | J-2782 | 150 | 100 |
| P-16 | J-1341 | J-17 | 150 | 100 |
| P-18 | J-1337 | J-17 | 150 | 100 |
| P-19 | J-17 | J-1338 | 150 | 100 |
| P-20 | J-1336 | J-18 | 150 | 100 |
| P-21 | J-18 | J-1333 | 150 | 100 |
| P-23 | J-18 | J-1332 | 150 | 100 |
| P-24 | J-1331 | J-20 | 150 | 100 |
| P-26 | J-1327 | J-20 | 150 | 100 |
| P-28 | J-20 | J-1326 | 150 | 100 |
| P-32 | J-820 | J-24 | 200 | 110 |
| P-33 | J-24 | J-1065 | 200 | 110 |
| P-34(1) | J-3460 | J-26 | 300 | 120 |
| P-34(2) | J-26 | J-25 | 300 | 120 |
| P-35 | J-25 | J-1510 | 300 | 120 |
| P-46(1) | T-8 | PRV-11 | 300 | 120 |
| P-46(2) | PRV-11 | J-33 | 300 | 120 |
| P-47(1) | T-7 | PRV-9 | 300 | 120 |
| P-47(2) | PRV-9 | J-29 | 300 | 120 |
| P-48(1) | T-9 | PRV-8 | 300 | 120 |
| P-48(2) | PRV-8 | J-29 | 300 | 120 |
| P-49(1) | T-10 | PRV-7 | 300 | 120 |
| P-49(2) | PRV-7 | J-33 | 300 | 120 |
| P-50(1) | T-11 | PRV-12 | 300 | 120 |
| P-50(2) | PRV-12 | J-3080 | 300 | 120 |
| P-51(1) | T-12 | PRV-10 | 300 | 120 |
| P-51(2) | PRV-10 | J-3080 | 300 | 120 |
| P-53 | T-14 | J-3080 | 150 | 130 |
| P-54 | T-15 | J-29 | 150 | 100 |
| P-55 | T-16 | J-3080 | 150 | 130 |
| P-56 | T-17 | J-33 | 300 | 120 |
| P-57 | T-18 | J-29 | 150 | 100 |

## Angus Water Distribution System

**WaterGEMS Model - Existing pipe Data sheet**

| Pipe | Start node | End Node | Nominal Dia (mm) | Hazen-Williams "C" Factor |
|---|---|---|---|---|
| P-58 | T-19 | J-29 | 300 | 120 |
| P-59 | T-20 | J-3080 | 300 | 110 |
| P-74(1) | J-2740 | J-47 | 150 | 100 |
| P-74(2) | J-47 | J-2470 | 150 | 100 |
| P-75 | J-2472 | J-47 | 150 | 100 |
| P-77 | T-22 | J-29 | 300 | 120 |
| P-78 | T-23 | J-33 | 300 | 120 |
| P-79 | T-24 | J-33 | 300 | 120 |
| P-80 | T-25 | J-3080 | 300 | 120 |
| P-82 | T-28 | J-2950 | 300 | 120 |
| P-83 | T-29 | J-2950 | 300 | 120 |
| P-84 | T-30 | J-2380 | 300 | 120 |
| P-85 | T-31 | J-2380 | 300 | 120 |
| P-89(1) | R-4 | PMP-4 | 150 | 100 |
| P-89(2) | PMP-4 | J-29 | 150 | 100 |
| P-91 | T-7 | J-8000 | 300 | 120 |
| P-102 | T-32 | J-2130 | 150 | 100 |
| P-400 | J-1405 | J-1620 | 150 | 100 |
| P-410 | J-1620 | J-1406 | 150 | 100 |
| P-440 | J-1580 | J-1155 | 200 | 110 |
| P-450 | J-1125 | J-820 | 150 | 100 |
| P-480 | J-1690 | J-840 | 200 | 110 |
| P-490 | J-840 | J-1670 | 200 | 110 |
| P-500 | J-1700 | J-850 | 200 | 110 |
| P-510 | J-850 | J-1215 | 200 | 110 |
| P-520 | J-840 | J-850 | 200 | 110 |
| P-1080 | J-1270 | J-1275 | 150 | 100 |
| P-1140(1)(2) | J-1326 | J-1327 | 200 | 110 |
| P-1140(2) | J-1327 | J-1330 | 200 | 110 |
| P-1145(1)(1)(1) | J-1330 | J-1331 | 200 | 110 |
| P-1145(1)(1)(2) | J-1331 | J-1332 | 200 | 110 |
| P-1145(1)(2) | J-1332 | J-1333 | 200 | 110 |
| P-1145(2) | J-1333 | J-1335 | 200 | 110 |
| P-1150(1)(1)(1) | J-1335 | J-1336 | 200 | 110 |
| P-1150(1)(1)(2) | J-1336 | J-1337 | 200 | 110 |
| P-1150(1)(2) | J-1337 | J-1338 | 200 | 110 |

# Angus Water Distribution System

**WaterGEMS Model - Existing pipe Data sheet**

| Pipe | Start node | End Node | Nominal Dia (mm) | Hazen-Williams "C" Factor |
|---|---|---|---|---|
| P-1150(2) | J-1338 | J-1340 | 200 | 110 |
| P-1155(1) | J-1340 | J-1341 | 200 | 110 |
| P-1155(2) | J-1341 | J-1345 | 200 | 110 |
| P-1160 | J-1345 | J-1350 | 150 | 100 |
| P-1165 | J-1350 | J-1355 | 150 | 100 |
| P-1170 | J-1355 | J-1370 | 150 | 100 |
| P-1175 | J-1370 | J-1365 | 150 | 100 |
| P-1180 | J-1365 | J-1360 | 150 | 100 |
| P-1185 | J-1360 | J-1350 | 150 | 100 |
| P-1190 | J-1360 | J-1370 | 150 | 100 |
| P-1195 | J-1355 | J-1375 | 150 | 100 |
| P-1200 | J-1375 | J-1380 | 150 | 100 |
| P-1205 | J-1380 | J-1385 | 150 | 100 |
| P-1210 | J-1385 | J-1390 | 150 | 100 |
| P-1215 | J-1395 | J-1390 | 150 | 100 |
| P-1220 | J-1400 | J-1395 | 150 | 100 |
| P-1225 | J-1400 | J-1375 | 150 | 100 |
| P-1230 | J-1400 | J-1390 | 150 | 100 |
| P-1235 | J-1385 | J-1406 | 150 | 100 |
| P-1236 | J-1406 | J-1405 | 150 | 100 |
| P-1240 | J-1405 | J-1410 | 150 | 100 |
| P-1245 | J-1380 | J-1415 | 150 | 100 |
| P-1250 | J-1415 | J-1410 | 150 | 100 |
| P-1255 | J-1410 | J-1430 | 150 | 100 |
| P-1260 | J-1430 | J-1435 | 150 | 100 |
| P-1265 | J-1415 | J-1420 | 150 | 100 |
| P-1270 | J-1420 | J-1425 | 150 | 100 |
| P-1275 | J-1420 | J-1425 | 150 | 100 |
| P-1280 | J-1425 | J-1430 | 150 | 100 |
| P-1285 | J-1435 | J-1345 | 150 | 100 |
| P-1290 | J-1435 | J-1440 | 150 | 100 |
| P-1295 | J-1440 | J-1445 | 150 | 100 |
| P-1300 | J-1445 | J-1450 | 150 | 100 |
| P-1305 | J-1450 | J-1455 | 150 | 100 |
| P-1310 | J-1455 | J-1460 | 150 | 100 |
| P-1315 | J-1455 | J-1465 | 150 | 100 |

## Angus Water Distribution System

**WaterGEMS Model - Existing pipe Data sheet**

| Pipe | Start node | End Node | Nominal Dia (mm) | Hazen-Williams "C" Factor |
|---|---|---|---|---|
| P-1320 | J-1465 | J-1470 | 150 | 100 |
| P-1325 | J-1470 | J-1440 | 150 | 100 |
| P-1330 | J-1470 | J-1475 | 150 | 100 |
| P-1335 | J-1475 | J-1480 | 150 | 100 |
| P-1340 | J-1480 | J-1485 | 150 | 100 |
| P-1345 | J-1485 | J-1490 | 150 | 100 |
| P-1350 | J-1490 | J-1495 | 150 | 100 |
| P-1355 | J-1490 | J-1500 | 150 | 100 |
| P-1360 | J-1500 | J-1480 | 150 | 100 |
| P-1365 | J-1500 | J-1440 | 150 | 100 |
| P-1370 | J-1040 | J-1550 | 200 | 110 |
| P-1380 | J-1005 | J-1540 | 300 | 120 |
| P-1390 | J-1070 | J-1550 | 200 | 110 |
| P-1400 | J-1560 | J-1570 | 200 | 110 |
| P-1410 | J-1550 | J-1570 | 200 | 110 |
| P-1420 | J-1580 | J-1590 | 200 | 110 |
| P-1440 | J-1320 | J-1610 | 150 | 100 |
| P-1450 | J-1600 | J-1700 | 200 | 110 |
| P-1460 | J-1640 | J-1630 | 200 | 110 |
| P-1470 | J-1650 | J-1640 | 200 | 110 |
| P-1480 | J-1640 | J-1660 | 200 | 110 |
| P-1490 | J-1710 | J-1650 | 200 | 110 |
| P-1500 | J-1660 | J-1710 | 200 | 110 |
| P-1510 | J-1710 | J-1670 | 200 | 110 |
| P-1520 | J-1670 | J-1680 | 200 | 110 |
| P-1530 | J-1680 | J-1690 | 200 | 110 |
| P-1590 | J-1760 | J-1820 | 300 | 120 |
| P-1610 | J-1780 | J-1810 | 200 | 110 |
| P-1620 | J-1790 | J-1780 | 150 | 100 |
| P-1630 | J-1800 | J-1790 | 150 | 100 |
| P-1640 | J-1810 | J-1800 | 150 | 100 |
| P-1650 | J-1800 | J-1820 | 150 | 100 |
| P-1950 | J-1385 | J-1980 | 150 | 100 |
| P-1960 | J-1980 | J-1495 | 200 | 110 |
| P-1970 | J-1495 | J-1990 | 200 | 110 |
| P-1980 | J-1990 | J-930 | 250 | 110 |

## Angus Water Distribution System

### WaterGEMS Model - Existing pipe Data sheet

| Pipe | Start node | End Node | Nominal Dia (mm) | Hazen-Williams "C" Factor |
|---|---|---|---|---|
| P-1990 | J-1990 | J-2000 | 250 | 110 |
| P-2000 | J-950 | J-1300 | 150 | 100 |
| P-2010 | J-1030 | J-2010 | 250 | 110 |
| P-2020 | J-2010 | J-940 | 250 | 110 |
| P-2030 | J-2010 | J-1315 | 150 | 100 |
| P-2040 | J-1610 | J-1020 | 150 | 100 |
| P-2050 | J-1340 | J-2020 | 150 | 100 |
| P-2060 | J-2020 | J-2030 | 150 | 100 |
| P-2070 | J-2030 | J-2040 | 150 | 100 |
| P-2080 | J-2040 | J-980 | 200 | 110 |
| P-2090 | J-2040 | J-2050 | 200 | 110 |
| P-2100 | J-2050 | J-2060 | 200 | 110 |
| P-2110 | J-2060 | J-1325 | 150 | 100 |
| P-2120 | J-1330 | J-2050 | 150 | 100 |
| P-2130 | J-2060 | J-2070 | 200 | 110 |
| P-2140 | J-2070 | J-2080 | 200 | 110 |
| P-2150 | J-2080 | J-2090 | 150 | 100 |
| P-2160 | J-2090 | J-2070 | 150 | 100 |
| P-2170 | J-2080 | J-1015 | 200 | 110 |
| P-2180 | J-1010 | J-1130 | 150 | 100 |
| P-2190 | J-1130 | J-2100 | 150 | 100 |
| P-2200 | J-2100 | J-1570 | 150 | 100 |
| P-2210 | J-2100 | J-2110 | 150 | 100 |
| P-2220 | J-2110 | J-1550 | 150 | 100 |
| P-2230 | J-2120 | J-2130 | 150 | 100 |
| P-2240 | J-2130 | J-1040 | 150 | 100 |
| P-2250 | J-2130 | J-2110 | 150 | 100 |
| P-2260 | J-1160 | J-2140 | 200 | 110 |
| P-2270 | J-2140 | J-2150 | 200 | 110 |
| P-2280 | J-2150 | J-2160 | 200 | 110 |
| P-2290 | J-2160 | J-1580 | 200 | 110 |
| P-2300 | J-1155 | J-2150 | 150 | 100 |
| P-2310 | J-2150 | J-2170 | 150 | 100 |
| P-2320 | J-2170 | J-2180 | 150 | 100 |
| P-2330 | J-2180 | J-2190 | 150 | 100 |
| P-2340 | J-2190 | J-2160 | 150 | 100 |

## Angus Water Distribution System

### WaterGEMS Model - Existing pipe Data sheet

| Pipe | Start node | End Node | Nominal Dia (mm) | Hazen-Williams "C" Factor |
|---|---|---|---|---|
| P-2350 | J-2190 | J-1590 | 150 | 100 |
| P-2360 | J-2180 | J-1600 | 150 | 100 |
| P-2370 | J-2120 | J-2140 | 150 | 100 |
| P-2380 | CENTRE | CENTRE-10HP | 150 | 100 |
| P-2400 | J-880 | J-810 | 150 | 100 |
| P-2430 | J-1730 | J-1325 | 150 | 100 |
| P-2470 | J-1590 | J-2200 | 200 | 110 |
| P-2480 | J-2200 | J-1600 | 200 | 110 |
| P-2490 | J-2200 | J-1630 | 200 | 110 |
| P-2500 | J-1460 | J-1730 | 150 | 100 |
| P-2510 | J-1730 | J-2210 | 150 | 100 |
| P-2520 | J-2210 | J-1460 | 150 | 100 |
| P-2530 | J-2220 | J-2230 | 150 | 100 |
| P-2540 | J-2230 | J-2240 | 150 | 100 |
| P-2550 | J-2240 | J-2250 | 150 | 100 |
| P-2560 | J-2260 | J-2270 | 200 | 110 |
| P-2590 | J-2280 | J-2290 | 150 | 100 |
| P-2600 | J-2290 | J-2300 | 150 | 100 |
| P-2610 | J-2300 | J-2270 | 200 | 110 |
| P-2630 | J-2310 | J-2240 | 150 | 100 |
| P-2640 | J-2250 | J-2320 | 200 | 110 |
| P-2660 | J-2330 | J-2300 | 200 | 110 |
| P-2670 | J-2330 | J-2340 | 150 | 100 |
| P-2690 | J-2250 | J-2350 | 200 | 110 |
| P-2710 | J-2250 | J-2380 | 150 | 100 |
| P-2720 | J-2320 | J-2370 | 200 | 110 |
| P-2730 | J-2380 | J-2390 | 150 | 100 |
| P-2740 | J-2390 | J-2340 | 150 | 100 |
| P-2770 | J-2410 | J-2280 | 150 | 100 |
| P-2790 | J-2340 | J-2420 | 150 | 100 |
| P-2800 | J-2420 | J-2290 | 150 | 100 |
| P-2810 | J-1215 | J-2400 | 200 | 110 |
| P-2820 | J-2400 | J-1210 | 200 | 110 |
| P-2830 | J-1210 | J-2260 | 200 | 110 |
| P-2840 | J-2260 | J-1205 | 200 | 110 |
| P-2850 | J-1205 | J-2220 | 200 | 110 |

# Angus Water Distribution System

**WaterGEMS Model - Existing pipe Data sheet**

| Pipe | Start node | End Node | Nominal Dia (mm) | Hazen-Williams "C" Factor |
|---|---|---|---|---|
| P-2860 | J-2220 | J-1206 | 200 | 110 |
| P-2870 | J-1206 | J-2430 | 200 | 110 |
| P-2880 | J-2430 | J-1175 | 200 | 110 |
| P-2890 | J-2430 | J-2440 | 300 | 120 |
| P-2900 | J-2440 | J-2450 | 300 | 120 |
| P-2910 | J-2450 | J-2460 | 300 | 120 |
| P-2920 | J-2460 | J-1770 | 300 | 120 |
| P-2930 | J-1770 | J-2470 | 300 | 120 |
| P-2950 | J-2480 | J-970 | 300 | 120 |
| P-2960 | J-2480 | J-2490 | 300 | 120 |
| P-2970 | J-2490 | J-2500 | 300 | 120 |
| P-2980 | J-2500 | J-2510 | 300 | 120 |
| P-2990 | J-2510 | J-2520 | 300 | 120 |
| P-3020(1) | J-2480 | J-2541 | 300 | 120 |
| P-3020(2) | J-2541 | J-2540 | 300 | 120 |
| P-3030 | J-2540 | J-2550 | 300 | 120 |
| P-3050 | J-2560 | J-2570 | 200 | 110 |
| P-3080 | J-2570 | J-2590 | 200 | 110 |
| P-3090 | J-2590 | J-2600 | 200 | 110 |
| P-3100 | J-2600 | J-2610 | 200 | 110 |
| P-3110 | J-2610 | J-2470 | 200 | 110 |
| P-3120 | J-2610 | J-2620 | 200 | 110 |
| P-3130 | J-2620 | J-2540 | 200 | 110 |
| P-3140 | J-2620 | J-2570 | 150 | 100 |
| P-3160 | J-1820 | J-2640 | 200 | 110 |
| P-3170 | J-2640 | J-2650 | 200 | 110 |
| P-3180 | J-2650 | J-2660 | 200 | 110 |
| P-3190 | J-2660 | J-2510 | 200 | 110 |
| P-3200(1) | J-2490 | J-2782 | 200 | 110 |
| P-3200(2) | J-2782 | J-2670 | 200 | 110 |
| P-3210 | J-2670 | J-970 | 200 | 110 |
| P-3220 | J-2660 | J-2680 | 150 | 100 |
| P-3230 | J-2680 | J-2650 | 150 | 100 |
| P-3240 | J-2650 | J-2690 | 200 | 110 |
| P-3250 | J-2690 | J-2700 | 200 | 110 |
| P-3260 | J-2700 | J-2640 | 200 | 110 |

## Angus Water Distribution System

**WaterGEMS Model - Existing pipe Data sheet**

| Pipe | Start node | End Node | Nominal Dia (mm) | Hazen-Williams "C" Factor |
|---|---|---|---|---|
| P-3270 | J-2660 | J-2710 | 200 | 110 |
| P-3280 | J-2710 | J-2690 | 200 | 110 |
| P-3290 | J-2500 | J-2720 | 150 | 100 |
| P-3310 | J-1780 | J-2730 | 200 | 110 |
| P-3320 | J-2730 | J-1770 | 200 | 110 |
| P-3340 | J-2740 | J-2480 | 300 | 120 |
| P-3350 | J-2740 | J-2750 | 150 | 100 |
| P-3360 | J-2750 | J-2730 | 150 | 100 |
| P-3370 | J-2550 | J-2760 | 200 | 110 |
| P-3380 | J-2760 | J-2580 | 200 | 110 |
| P-3390 | J-2580 | J-2770 | 200 | 110 |
| P-3400 | J-2770 | J-2560 | 200 | 110 |
| P-3410 | J-970 | J-2780 | 300 | 120 |
| P-3420 | J-2780 | J-1820 | 300 | 120 |
| P-3470 | J-2810 | J-1760 | 300 | 120 |
| P-3480 | J-2810 | J-2820 | 300 | 120 |
| P-3490 | J-2820 | J-2800 | 300 | 120 |
| P-3500 | J-2800 | J-2830 | 150 | 100 |
| P-3510 | J-2830 | J-2820 | 150 | 100 |
| P-3520 | J-880 | J-825 | 150 | 100 |
| P-3530 | J-825 | J-815 | 150 | 100 |
| P-3540 | J-815 | J-810 | 150 | 100 |
| P-3550 | J-2800 | J-2860 | 300 | 120 |
| P-3560 | J-2860 | J-1510 | 300 | 120 |
| P-3570 | J-1530 | J-2870 | 150 | 100 |
| P-3580 | J-2870 | J-2860 | 150 | 100 |
| P-3590 | J-2720 | J-2520 | 150 | 100 |
| P-3600 | J-1760 | J-2530 | 300 | 120 |
| P-3640 | J-6050 | J-6040 | 300 | 120 |
| P-3650 | J-6040 | J-6030 | 300 | 120 |
| P-3660 | J-6030 | J-6020 | 300 | 120 |
| P-3670 | J-6020 | J-6010 | 300 | 120 |
| P-3680 | J-2950 | J-6010 | 300 | 120 |
| P-3690 | J-2950 | J-870 | 300 | 120 |
| P-3710 | J-6000 | J-2950 | 300 | 120 |
| P-3740 | BROWNLEY | BROWNLEY1 FF | 150 | 100 |

## Angus Water Distribution System

**WaterGEMS Model - Existing pipe Data sheet**

| Pipe | Start node | End Node | Nominal Dia (mm) | Hazen-Williams "C" Factor |
|---|---|---|---|---|
| P-3990 | J-6060 | J-6070 | 300 | 120 |
| P-4010 | J-3010 | J-6070 | 300 | 120 |
| P-4020 | J-3010 | J-3020 | 300 | 120 |
| P-4030 | J-3020 | J-3030 | 300 | 120 |
| P-4040 | J-3030 | J-3040 | 300 | 120 |
| P-4050 | J-3040 | J-3050 | 300 | 120 |
| P-4060 | J-3050 | J-3060 | 300 | 120 |
| P-4070 | J-3060 | J-3070 | 300 | 120 |
| P-4080 | J-3070 | J-2520 | 300 | 120 |
| P-4090 | J-2530 | J-3080 | 300 | 120 |
| P-4110 | J-3040 | J-3090 | 300 | 120 |
| P-4130 | J-3100 | J-3080 | 300 | 120 |
| P-4140 | J-3070 | J-3110 | 200 | 110 |
| P-4150 | J-3110 | J-3120 | 200 | 110 |
| P-4160 | J-3120 | J-3130 | 200 | 110 |
| P-4170 | J-3130 | J-3100 | 200 | 110 |
| P-4180 | J-3100 | J-3140 | 200 | 110 |
| P-4190 | J-3140 | J-3150 | 200 | 110 |
| P-4200 | J-3150 | J-3160 | 200 | 110 |
| P-4210 | J-3160 | J-3170 | 200 | 110 |
| P-4220 | J-3170 | J-3180 | 200 | 110 |
| P-4230 | J-3180 | J-3190 | 200 | 110 |
| P-4240 | J-3190 | J-3200 | 200 | 110 |
| P-4260 | J-3160 | J-3170 | 150 | 100 |
| P-4270 | J-3200 | J-3090 | 200 | 110 |
| P-4280 | J-3060 | J-3210 | 150 | 100 |
| P-4300 | J-3090 | J-3210 | 150 | 100 |
| P-4310 | J-3030 | J-3220 | 200 | 110 |
| P-4320 | J-3220 | J-3230 | 200 | 110 |
| P-4330 | J-3230 | J-3240 | 200 | 110 |
| P-4340 | J-3240 | J-3250 | 200 | 110 |
| P-4350 | J-3250 | J-3260 | 200 | 110 |
| P-4360 | J-3260 | J-3220 | 200 | 110 |
| P-4370 | J-3230 | J-3270 | 150 | 100 |
| P-4380 | J-3270 | J-3280 | 150 | 100 |
| P-4390 | J-3280 | J-3050 | 150 | 100 |

## Angus Water Distribution System

**WaterGEMS Model - Existing pipe Data sheet**

| Pipe | Start node | End Node | Nominal Dia (mm) | Hazen-Williams "C" Factor |
|---|---|---|---|---|
| P-4400 | J-3280 | J-3270 | 150 | 100 |
| P-4430 | J-3290 | J-2530 | 250 | 110 |
| P-4450 | J-3200 | J-3300 | 150 | 100 |
| P-4460 | J-3300 | J-3140 | 150 | 100 |
| P-4470 | J-2230 | J-3310 | 150 | 100 |
| P-4480 | J-3310 | J-2270 | 150 | 100 |
| P-4490 | J-3310 | J-2310 | 150 | 100 |
| P-4500 | J-2410 | J-2270 | 150 | 100 |
| P-4510 | J-2330 | J-2370 | 200 | 110 |
| P-4520 | J-3090 | J-3320 | 300 | 120 |
| P-4530 | J-3320 | J-3100 | 300 | 120 |
| P-4540 | J-3210 | J-3330 | 150 | 100 |
| P-4550 | J-3330 | J-3130 | 150 | 100 |
| P-4560 | J-3280 | J-3340 | 150 | 100 |
| P-4570 | J-3340 | J-3070 | 150 | 100 |
| P-4750 | J-810 | J-825 | 150 | 100 |
| P-4760 | J-2000 | J-3460 | 300 | 120 |
| P-4770 | J-1520 | J-1530 | 200 | 110 |
| P-4780 | J-3470 | J-2000 | 200 | 110 |
| P-4790 | J-3470 | J-3460 | 250 | 110 |
| P-4800 | J-1530 | J-3350 | 200 | 110 |
| P-4810 | J-3350 | J-1510 | 200 | 110 |
| P-4820 | BROWNLEY | BROWNLEY FF | 150 | 100 |
| P-4830 | BROWNLEY FF | J-3290 | 150 | 100 |
| P-4840 | BROWNLEY | BROWNLEY3 FF | 150 | 100 |
| P-4850 | J-1200 | J-2730 | 150 | 100 |
| P-4860 | BROWNLEY3 FF | J-3480 | 150 | 100 |
| P-4870 | J-3480 | J-3290 | 250 | 110 |
| P-4880 | BROWNLEY1 FF | J-3490 | 150 | 100 |
| P-4890 | J-3490 | J-3290 | 250 | 110 |
| P-4920 | J-6050 | J-6060 | 300 | 120 |
| P-4930 | BROWNLEY WELLS | WELL PMPS | 250 | 110 |
| P-4940 | WELL PMPS | PRV-1 | 250 | 110 |
| P-4950 | PRV-1 | J-3490 | 250 | 110 |
| P-4970 | J-1035 | J-3500 | 200 | 110 |
| P-4980 | J-3500 | J-1560 | 200 | 110 |

## Angus Water Distribution System

**WaterGEMS Model - Existing pipe Data sheet**

| Pipe | Start node | End Node | Nominal Dia (mm) | Hazen-Williams "C" Factor |
|---|---|---|---|---|
| P-5000 | J-3510 | J-1005 | 150 | 100 |
| P-5030 | J-3530 | J-3540 | 200 | 110 |
| P-5040 | J-6000 | J-3550 | 300 | 120 |
| P-5050 | J-3550 | J-1540 | 300 | 120 |
| P-5060 | J-3540 | J-3550 | 200 | 110 |
| P-5070 | J-3500 | J-3560 | 150 | 100 |
| P-5080 | J-3560 | J-3510 | 150 | 100 |
| P-7000 | CENTRE-10HP | J-7000 | 200 | 110 |
| P-7010 | CENTRE-20HP | J-7000 | 200 | 110 |
| P-7015 | CENTRE-20HP | CENTRE | 150 | 100 |
| P-8000 | MILLFIRE | J-8000 | 300 | 120 |
| P-8010 | MILLFIRE | MILL1 | 200 | 110 |
| P-8100 | J-8000 | J-8010 | 300 | 120 |
| P-8110 | J-8020 | J-8030 | 250 | 110 |
| P-8120 | J-8030 | J-8040 | 250 | 110 |
| P-8130 | MILLDUTY1 | J-8020 | 150 | 100 |
| P-8140 | MILLDUTY1 | MILL2 | 150 | 100 |
| P-8150 | MILLDUTY2 | J-8030 | 150 | 100 |
| P-8160 | J-8010 | J-8020 | 250 | 110 |
| P-8170 | MILLDUTY3 | J-8040 | 150 | 100 |
| P-8180 | MILL2 | MILLDUTY3 | 150 | 100 |
| P-8190 | MILL2 | MILLDUTY2 | 150 | 100 |

**Angus Water Distribution System**

**WaterGEMS Model - Proposed pipe Upgrade**

### Servicing Strategy WS-1.2
New Elevated Storage at the Mill Street Site

| Failed Node | Pipe needs to change | Old Diameter (mm) | New Diameter (mm) | Length (scaled) (m) | Priority for pipe upgrade |
|---|---|---|---|---|---|
| J-1190 | P-980 | 150 | 200 | 145 | High |
| J-1260 | P-1035 | 150 | 200 | 144 | High |
| J-1255 | P-1040 | 150 | 200 | 180 | High |
| J-1235 | P-1010 | 150 | 200 | 101 | Low |
| J-1245 | | | | | Low |
| J-815 | P-550 | 150 | 200 | 138 | Low |
| J-810 | | | | | low |
| J-825 | | | | | low |
| J-880 | | | | | Low |
| J-8041 | P-9 | 150 | 200 | 502 | High |
| J-8042 | | | | | High |
| J-1090 | p-450 | 150 | 200 | 79 | Low |
| J-3560 (ICI) | P-5080 | 150 | 200 | 131 | High |
| J-3510 (ICI) | P-5000 | 150 | 250 | 230 | High |
| J-1360 | p-1160 | 150 | 200 | 145 | Low |
| J-1425 | | | | | Low |
| J-1370 | | | | | Low |
| J-1365 | P-1185 | 150 | 200 | 98 | low |
| J-1395 | p-1220 | 150 | 200 | 262 | low |
| **Total length of the proposed Pipe Upgrade (m)** | | | | **2,155** | **1,332** |

### Servicing Strategy WS-1.4
New Elevated Storage at a Greenfield Site (South of Angus)

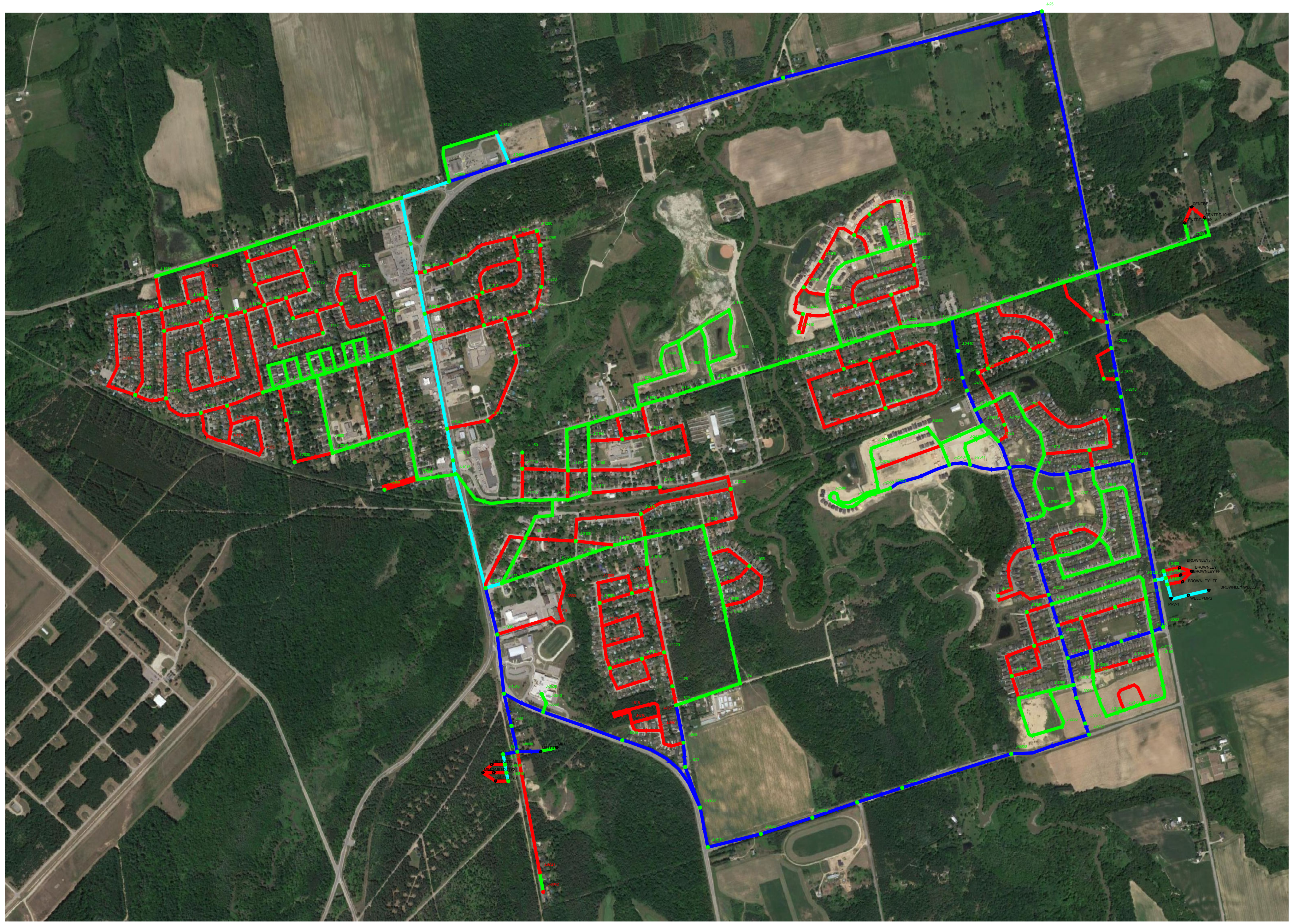
| Failed Node | Pipe needs to change | Old Diameter (mm) | New Diameter (mm) | Length (scaled) (m) | Priority for pipe upgrade |
|---|---|---|---|---|---|
| J-1190 | P-980 | 150 | 200 | 145 | High |
| J-815 | | | | | Low |
| J-810 | | | | | Low |
| J-825 | | | | | Low |
| J-880 | P-550 | 150 | 200 | 138 | Low |
| J-8041 | | 150 | 200 | | High |
| J-8042 | P-9 | | | 502 | High |
| J-3510 (ICI) | P-5000 | 150 | 250 | 230 | High |
| J-3560 (ICI) | P-5080 | 150 | 200 | 131 | High |
| J-1260 | P-1035 | 150 | 200 | 144 | Low |
| J-1255 | P-1040 | 150 | 200 | 180 | High |
| J-1365 | P-1160 | 150 | 200 | 147 | Low |
| J-1395 | p-1220 | 150 | 200 | 262 | Low |
| **Total length of the proposed Pipe Upgrade (m)** | | | | **1,879** | **1,188** |

### Servicing Strategy WS-1.1
Additional in ground reservoir at the Mill Street Site

| Failed Node | Pipe needs to change | Old Diameter (mm) | New Diameter (mm) | Length (scaled) (m) | Priority for pipe upgrade |
|---|---|---|---|---|---|
| J-1190 | P-980 | 150 | 200 | 145 | High |
| J-815 | | | | | High |
| J-810 | | | | | High |
| J-825 | | | | | Low |
| J-880 | P-550 | 150 | 300 | 138 | Low |
| J-1100 | p-450 | 150 | 300 | | Low |
| J-1105 | | | | 79 | Low |
| J-3510 (ICI) | P-5000 | 150 | 300 | 230 | High |
| J-3560 (ICI) | P-5080 | 150 | 300 | 131 | High |
| J-1365 | P-1160 | 150 | 300 | 147 | Low |
| J-1360 | P-1185 | 150 | 200 | | Low |
| j-1370 | | | | 98 | Low |
| J-1395 | p-1220 | 150 | 300 | 262 | Low |
| J-1260 | P-1035 | 150 | 200 | 144 | High |
| J-1255 | P-1040 | 150 | 200 | 180 | High |
| J-1245 | | | | | Low |
| J-1235 | P-1005 | 150 | 300 | 99 | Low |
| J-8041 | | 150 | 200 | | High |
| J-8042 | P-9 | | | 502 | High |
| J-1620 | P-400 | 150 | 200 | 120 | Low |
| J-1085 | | | | | Low |
| J-1090 | P-825 | 150 | 300 | 133 | Low |
| J-1420 | | | | | Low |
| j-1425 | P-1265 | 150 | 200 | 100 | Low |
| **Total length of the proposed Pipe Upgrade (m)** | | | | **2,508** | **1,470** |

**Servicing Strategy WS-1.1**

**Additional in ground reservoir at the Mill Street Site**



Color Coding Legend
Junction: Satisfies Fire Flow Constraints?

= True

= False

Color Coding Legend
Pipe: Diameter (mm)

<= 150.0

<= 200.0

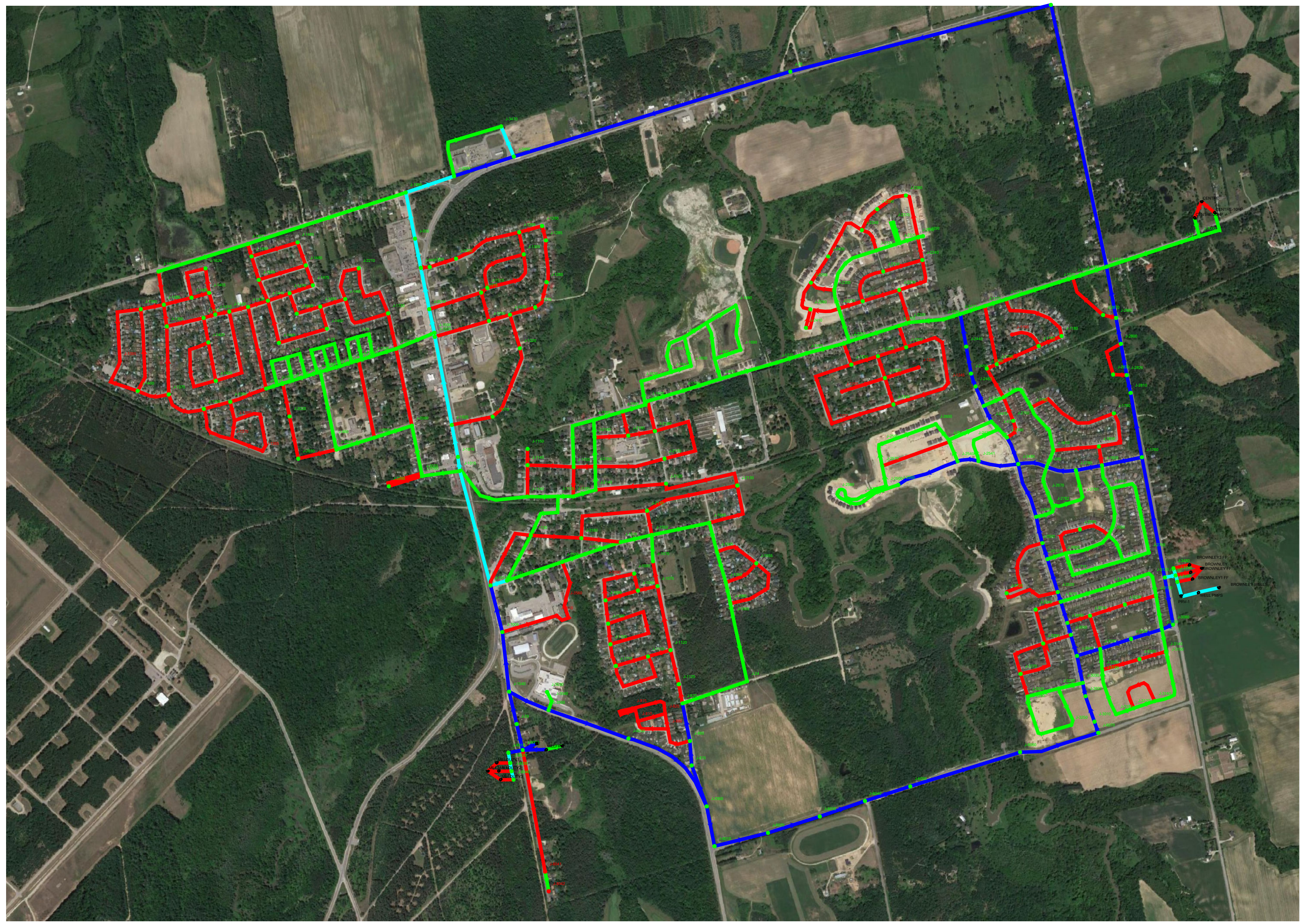
<= 250.0

<= 300.0

Other

**Servicing Strategy WS-1.2**

**New Elevated Storage at the Mill Street Site**



Color Coding Legend
Junction: Satisfies Fire Flow Constraints?

= True

= False

Color Coding Legend
Pipe: Diameter (mm)

<= 150.0

<= 200.0

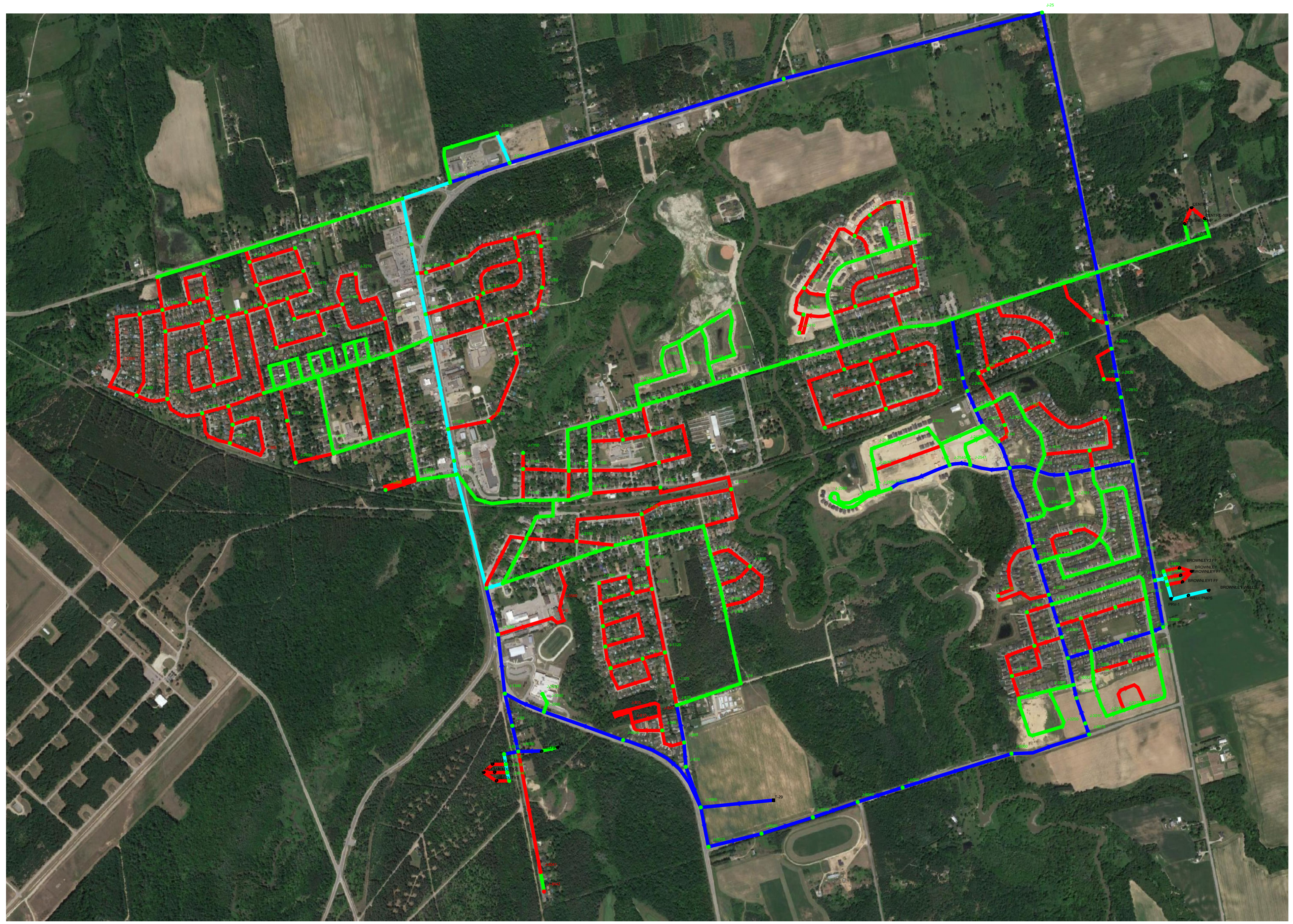
<= 250.0

<= 300.0

Other

**Servicing Strategy WS-1.4**

**New Elevated Storage at a Greenfield Site (South of Angus)**



Color Coding Legend
Junction: Satisfies Fire Flow Constraints?

= True

= False

Color Coding Legend
Pipe: Diameter (mm)

<= 150.0

<= 200.0

<= 250.0

<= 300.0

Other

# Appendix E

Record of Public

Consultation

# Appendix E-1

Public Notices

# Municipal Class Environmental Assessment
# Angus Class EA Addendum - Water Supply and Storage
# Notice of Study Commencement – 10 August 2023

The Township of Essa has initiated a Schedule B Class EA Addendum to the Angus Infrastructure Master Plan for water supply and storage solutions in Angus.

The Township completed an Infrastructure Master Plan (IMP) for the Community of Angus in 2022, identifying preferred solutions for water and wastewater infrastructure to support development over the next 25 years. The Notice of Completion was filed on September 12, 2022. In order to facilitate the Township's progression toward the implementation stage of the EA process for the preferred solutions, a Schedule B EA Addendum to the IMP is being conducted.

The purpose of the Schedule B Class EA Addendum is to verify the feasibility of the preferred water supply and storage solutions identified in the Angus IMP through further detailed background and field investigations. The proposed alternative solutions will be re-evaluated based on the additional information gathered through these investigations.

This study is being conducted in accordance with the Municipal Class EA process, a Schedule B activity as defined by the Municipal Engineers Association Class EA documentation. The Class EA process looks at potential environmental, cultural, and economic effects, develops alternatives, determines preferred measures, and incorporates mitigation methods. This type of EA includes public and agency consultation.

Project updates and notices will be posted on the Township's website (https://www.essatownship.on.ca/) to inform the public of the Class EA's progress. Residents and interested parties are encouraged to regularly visit the website to find out more about the Project.

If you have any questions or concerns, and/or would like to be added to the project mailing list, please contact one of the study representatives listed below via email.

**Michael Mikael, P.Eng.**
**Manager of Public Works**
Township of Essa
Email: mmikael@essatownship.on.ca

**Josh Maitland, P. Eng.**
**Consultant Project Manager**
Greenland Consulting Engineers
Email: jmaitland@grnland.com

# Township of Essa - Angus Infrastructure Master Plan (IMP)
# Municipal Class Environmental Assessment (EA)

## Angus IMP - Class EA Addendum - Water Supply and Storage

## NOTICE OF PUBLIC INFORMATION CENTRE

The Township completed a Schedule B Class EA Infrastructure Master Plan (IMP) for the Community of Angus in 2022, identifying preferred solutions for water and wastewater infrastructure to support development over the next 25 years. The Notice of Completion was filed on September 12, 2022. An Addendum to the IMP is being completed, focused on water supply and storage solutions in Angus. The purpose of this Class EA Addendum is to verify the feasibility of preferred water supply and storage solutions identified in the Angus IMP and prioritize projects for implementation going forward.

**Preliminary Class EA Addendum Report:**
A Preliminary Study Report is completed, identifying technically and economically feasible solutions and project prioritizations to ensure sufficient water supply and storage for the growing Angus community. These proposed solutions are designed to be socially, culturally, and environmentally responsible. The results of this report will be shared with public through a virtual Public Information Centre (PIC) to gather community input and refine the approach before advancing to detailed design and implementation. The PIC will consist of a short presentation (repeated at 7:00PM & 8:00PM), followed by a question-and-answer period.

*Figure 1. Study Area*

Representatives from the project team will be present to provide the presentation and answer questions regarding the preliminary study report. Information will be collected in accordance with the Freedom of Information and Protection of Privacy Act ('FIPPA'). With the exception of personal information, all comments will become part of the public record.

We note that given the status of this project as an EA Addendum, this PIC is an optional point of public contact under the EA process, being completed at the discretion of the Township and their project team. The Preliminary Study Report will be updated based on input received at the PIC and a final version will be issued for a 30-day public review period along with a notice of Addendum in accordance with the EA Process.

**VIRTUAL PUBLIC INFORMATION CENTRE:**
Angus IMP Addendum – Digital PIC Weblink (Zoom):
https://us06web.zoom.us/j/87289638001
Meeting ID: 872 8963 8001 - Passcode: 123456

**Thursday November 21st, 2024**
**7:00 PM TO 9:00 PM**
Zoom Room Opens @ 6:45 PM

**If you are unable to attend or require further information, please contact or provide any comments in writing (either before, during, or after the PIC) to:**


**Josh Maitland, P. Eng.**
**Consultant Project Manager**
Greenland Consulting Engineers
120 Hume Street
Collingwood, Ontario L9Y 1V5
Email: jmaitland@grnland.com

**John Kolb,**
**Manager of Public Works**
Township of Essa
5786 Simcoe County Road 21
Utopia, ON L0M 1T0
Email: jkolb@essatownship.on.ca


07 November 2024

# Angus Infrastructure Master Plan (IMP) Municipal Class Environmental Assessment (EA) - Notice of Addendum Water Supply & Storage - 05 December 2024

Greenland Consulting Engineers and the Township of Essa have completed an Addendum to the Schedule 'B' Class EA Infrastructure Master Plan (IMP) for the Community of Angus, focusing on Water Supply and Storage solutions in Angus. The IMP identified preferred water and wastewater infrastructure solutions to support development over the next 25 years which was completed in 2022. The purpose of the Class EA Addendum was to complete additional technical analysis and background investigations to verify the feasibility of preferred water supply and storage solutions identified in the Angus IMP and to re-evaluate and prioritize solutions and associated projects for implementation going forward.

The Class EA Addendum was completed in accordance with the Municipal Class EA process for Schedule 'B' projects as defined by the Municipal Engineers Association (MEA) Class EA documentation. The report documents the process of developing technically and economically feasible solutions and project prioritizations to ensure adequate water supply and storage for the growing Angus community. These proposed solutions were also assessed in terms of their social, cultural, and environmental impacts.

The updated preferred solutions include construction of an elevated storage reservoir and development of a new well, both at the existing Township owned Mill St. well site.

Additional details are provided in the Class EA Addendum report, which is posted on the Township's website (https://www.essatownship.on.ca/) for public review for a duration of approximately thirty (30) days, ending 10th January 2024.

To provide comments on the project, or if you require alternative accommodations to view the Addendum report, please contact either of the project representatives listed below via email before 5:00 PM local time on 10th January 2024.

**John Kolb**
**Manager of Public Works**
Township of Essa
Email: jkolb@essatownship.on.ca

**Josh Maitland, P. Eng.**
**Consultant Project Manager**
Greenland Consulting Engineers
Email: jmaitland@grnland.com

If there are concerns regarding potential impacts to constitutionally protected Aboriginal and Treaty rights, a request for a Part II order in writing should be addressed to the Minister of Environment Conservation and Parks as well as the Director of the Environmental Assessments Branch. Requests on any other grounds will not be considered in accordance with current regulations. Above noted requests are to be sent no later than 5:00 PM local time on 10th January 2024.

Information collected will be done in accordance with the Municipal Freedom of Information and Protection of Privacy Act. With the exception of personal information, all comments will become part of the public record.

This notice was issued at the Township of Essa on December 5th, 2024.

## Appendix E-2

Presentation Slides

# Angus Infrastructure Master Plan Class EA Addendum - Water Supply and Storage

Public Information Centre

November 21st, 2024

# Background

The Township of Essa completed an Infrastructure Master Plan (IMP) for the community of Angus in 2022, identifying preferred solutions for Water, Wastewater, Transportation, and Stormwater infrastructure to support development over the next 25 years. The Notice of Completion was filed on September 12, 2022.

Angus currently has a water supply capacity shortfall of approximately 350 equivalent residential units (ERU) relative to the remaining wastewater system capacity, along with inadequate fire-flows in numerous areas.

**There is a total water supply deficit of 4,635 $m^3/d$ and water storage deficit of 4,200 $m^3$ to meet population demands to 2046.**

To prioritize the Township's progression toward implementing the preferred solutions, an EA Addendum to the Schedule 'B' Class EA IMP is being completed. This Addendum specifically focuses on water supply and storage, while leaving other components of the IMP unchanged.

# Background

**IMP Recommended Water Supply and Storage Servicing Solutions:**

- Short term: Increase the current PTTW and well capacity to supply as much of the ultimate demand increase of 4.64 million L/d as possible; Long term: develop new well(s) at an existing location with expanded treatment, booster pumps, storage, and fire protection.
- Construct water storage facilities (elevated, in-ground, or at grade) at three (3) locations (the Southwest, Northwest, and Northeast areas) of the study region.
- The IMP required additional technical analysis to validate and confirm details of the preferred solutions. This has been completed during the EA Addendum.

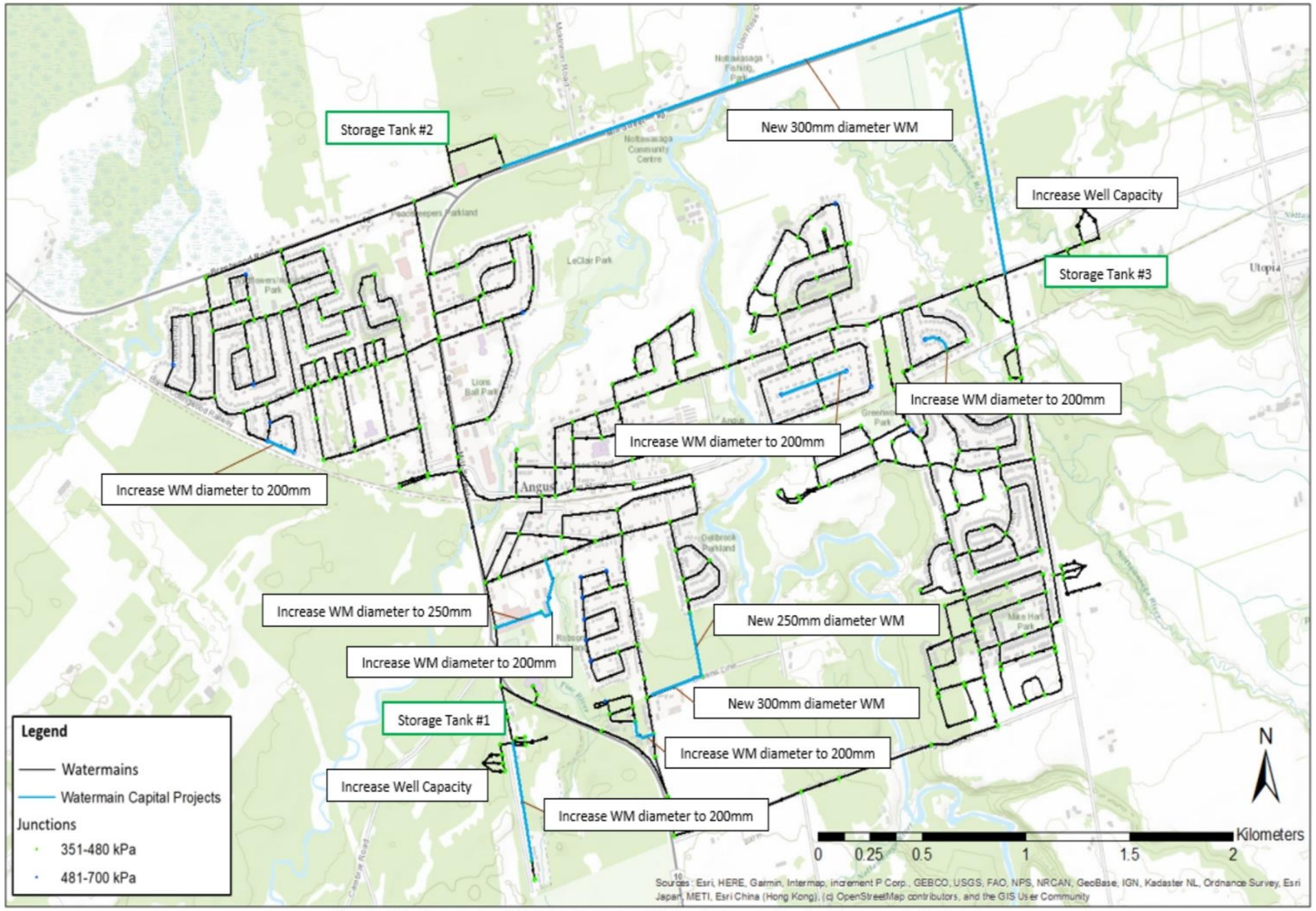



Figure 9-1 Water System Preferred Master Servicing Strategy (Note: Precise storage tank locations to be confirmed at Pre-Design)

# EA Addendum Study Purpose

- Prioritize and validate water supply and storage strategies to address immediate growth demands in Angus.
- Revisits and re-evaluates IMP water supply and storage solutions, incorporating additional data, field studies, and concept designs for effective implementation
- Conduct additional investigations to assess well capacity expansion and determine feasibility for the ultimate build-out of Angus.
- Assess the appropriateness of different water storage solutions (e.g., in-ground vs. elevated tanks, multiple tanks) and determine the best fit for the municipality's near-term and ultimate needs.
- Complete site evaluations for shortlisted options to confirm space for required infrastructure.
- Address current servicing gaps in water supply and storage capacity to meet the growing needs of the community.

# Problem / Opportunity Statement

The 2022 Infrastructure Master Plan (IMP) identified several water supply and storage options, acknowledging that no single solution could fully address Angus's long-term needs. This Addendum focuses on prioritizing and evaluating immediate water supply and storage strategies to support current growth. It includes additional hydrogeological studies to assess well capacity expansion, examines potential water storage solutions, and confirms the pre-design and technical requirements for near-term municipal servicing.

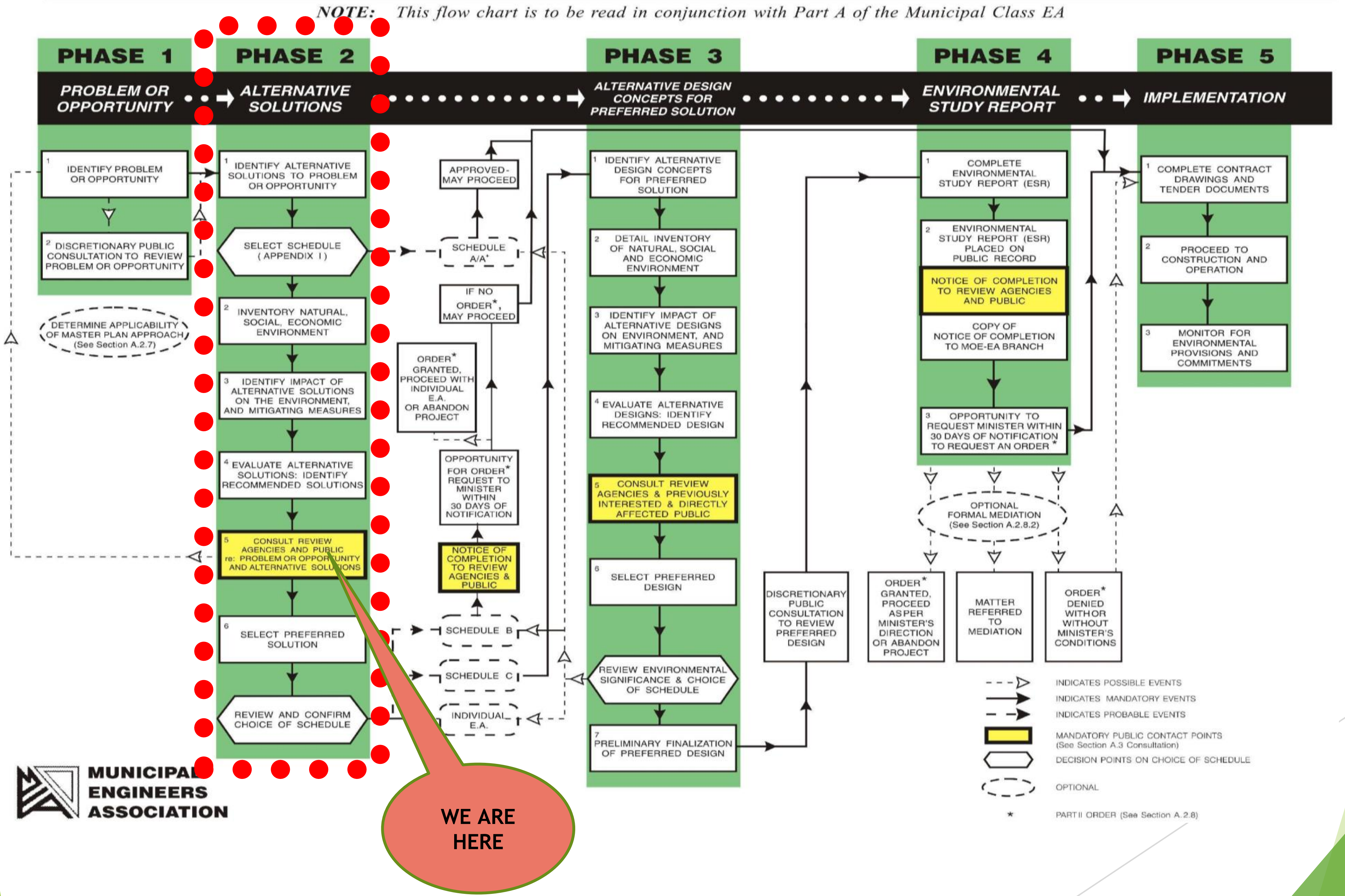
# EA Process

The IMP was a Schedule "B" Environmental Assessment prepared in accordance with the requirements of the Municipal Class Environmental Assessment (Class EA) process. Alternative Solutions were evaluated, selected, and recommended for implementation. The Addendum revisits and expands on this evaluation process.

**Schedule "B" Projects**

- Generally, include improvements and minor expansions to existing facilities where there is potential for some environmental impacts.
- These projects require screening of alternatives for their environmental impacts and completion of Phases 1 and 2 of the Class EA planning process.
- Provided no significant impacts are identified, Schedule "B" projects are approved and may proceed directly to Phase 5.

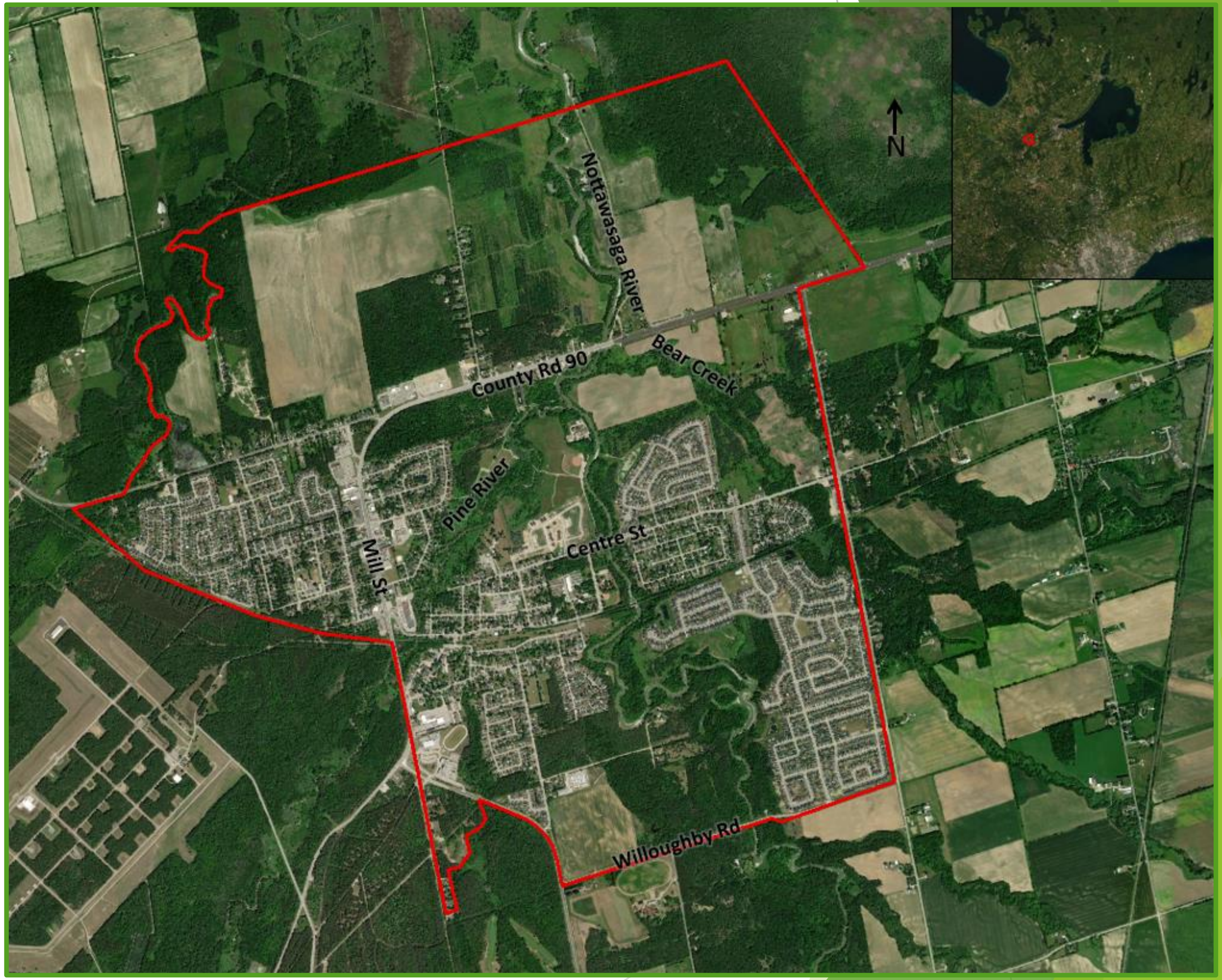
# EA Process



NOTE: This flow chart is to be read in conjunction with Part A of the Municipal Class EA
PHASE 1
PROBLEM OR OPPORTUNITY
PHASE 2
ALTERNATIVE SOLUTIONS
PHASE 3
ALTERNATIVE DESIGN CONCEPTS FOR PREFERRED SOLUTION
PHASE 4
ENVIRONMENTAL STUDY REPORT
PHASE 5
IMPLEMENTATION
1 IDENTIFY PROBLEM OR OPPORTUNITY
2 DISCRETIONARY PUBLIC CONSULTATION TO REVIEW PROBLEM OR OPPORTUNITY
DETERMINE APPLICABILITY OF MASTER PLAN APPROACH (See Section A.2.7)
1 IDENTIFY ALTERNATIVE SOLUTIONS TO PROBLEM OR OPPORTUNITY
SELECT SCHEDULE ( APPENDIX I )
2 INVENTORY NATURAL, SOCIAL, ECONOMIC ENVIRONMENT
3 IDENTIFY IMPACT OF ALTERNATIVE SOLUTIONS ON THE ENVIRONMENT, AND MITIGATING MEASURES
4 EVALUATE ALTERNATIVE SOLUTIONS: IDENTIFY RECOMMENDED SOLUTIONS
5 CONSULT REVIEW AGENCIES AND PUBLIC re: PROBLEM OR OPPORTUNITY AND ALTERNATIVE SOLUTIONS
6 SELECT PREFERRED SOLUTION
REVIEW AND CONFIRM CHOICE OF SCHEDULE
APPROVED - MAY PROCEED
SCHEDULE A/A+
IF NO ORDER*, MAY PROCEED
ORDER* GRANTED, PROCEED WITH INDIVIDUAL E.A. OR ABANDON PROJECT
OPPORTUNITY FOR ORDER* REQUEST TO MINISTER WITHIN 30 DAYS OF NOTIFICATION
NOTICE OF COMPLETION TO REVIEW AGENCIES & PUBLIC
SCHEDULE B
SCHEDULE C
INDIVIDUAL E.A.
1 IDENTIFY ALTERNATIVE DESIGN CONCEPTS FOR PREFERRED SOLUTION
2 DETAIL INVENTORY OF NATURAL, SOCIAL AND ECONOMIC ENVIRONMENT
3 IDENTIFY IMPACT OF ALTERNATIVE DESIGNS ON ENVIRONMENT, AND MITIGATING MEASURES
4 EVALUATE ALTERNATIVE DESIGNS: IDENTIFY RECOMMENDED DESIGN
5 CONSULT REVIEW AGENCIES & PREVIOUSLY INTERESTED & DIRECTLY AFFECTED PUBLIC
6 SELECT PREFERRED DESIGN
REVIEW ENVIRONMENTAL SIGNIFICANCE & CHOICE OF SCHEDULE
7 PRELIMINARY FINALIZATION OF PREFERRED DESIGN
DISCRETIONARY PUBLIC CONSULTATION TO REVIEW PREFERRED DESIGN
1 COMPLETE ENVIRONMENTAL STUDY REPORT (ESR)
2 ENVIRONMENTAL STUDY REPORT (ESR) PLACED ON PUBLIC RECORD
NOTICE OF COMPLETION TO REVIEW AGENCIES AND PUBLIC
COPY OF NOTICE OF COMPLETION TO MOE-EA BRANCH
3 OPPORTUNITY TO REQUEST MINISTER WITHIN 30 DAYS OF NOTIFICATION TO REQUEST AN ORDER *
OPTIONAL FORMAL MEDIATION (See Section A.2.8.2)
ORDER* GRANTED, PROCEED AS PER MINISTER'S DIRECTION OR ABANDON PROJECT
MATTER REFERRED TO MEDIATION
ORDER* DENIED WITH OR WITHOUT MINISTER'S CONDITIONS
1 COMPLETE CONTRACT DRAWINGS AND TENDER DOCUMENTS
2 PROCEED TO CONSTRUCTION AND OPERATION
3 MONITOR FOR ENVIRONMENTAL PROVISIONS AND COMMITMENTS
INDICATES POSSIBLE EVENTS
INDICATES MANDATORY EVENTS
INDICATES PROBABLE EVENTS
MANDATORY PUBLIC CONTACT POINTS (See Section A.3 Consultation)
DECISION POINTS ON CHOICE OF SCHEDULE
OPTIONAL
* PART II ORDER (See Section A.2.8)
MUNICIPAL ENGINEERS ASSOCIATION
WE ARE HERE

# Study Area

- Angus has an existing population of ~13,669 people
- Primary Settlement Area for Essa Township
  - Complete community providing full municipal services and a full range and mix of services and facilities
  - Majority of future growth in Essa Township will be directed toward Angus

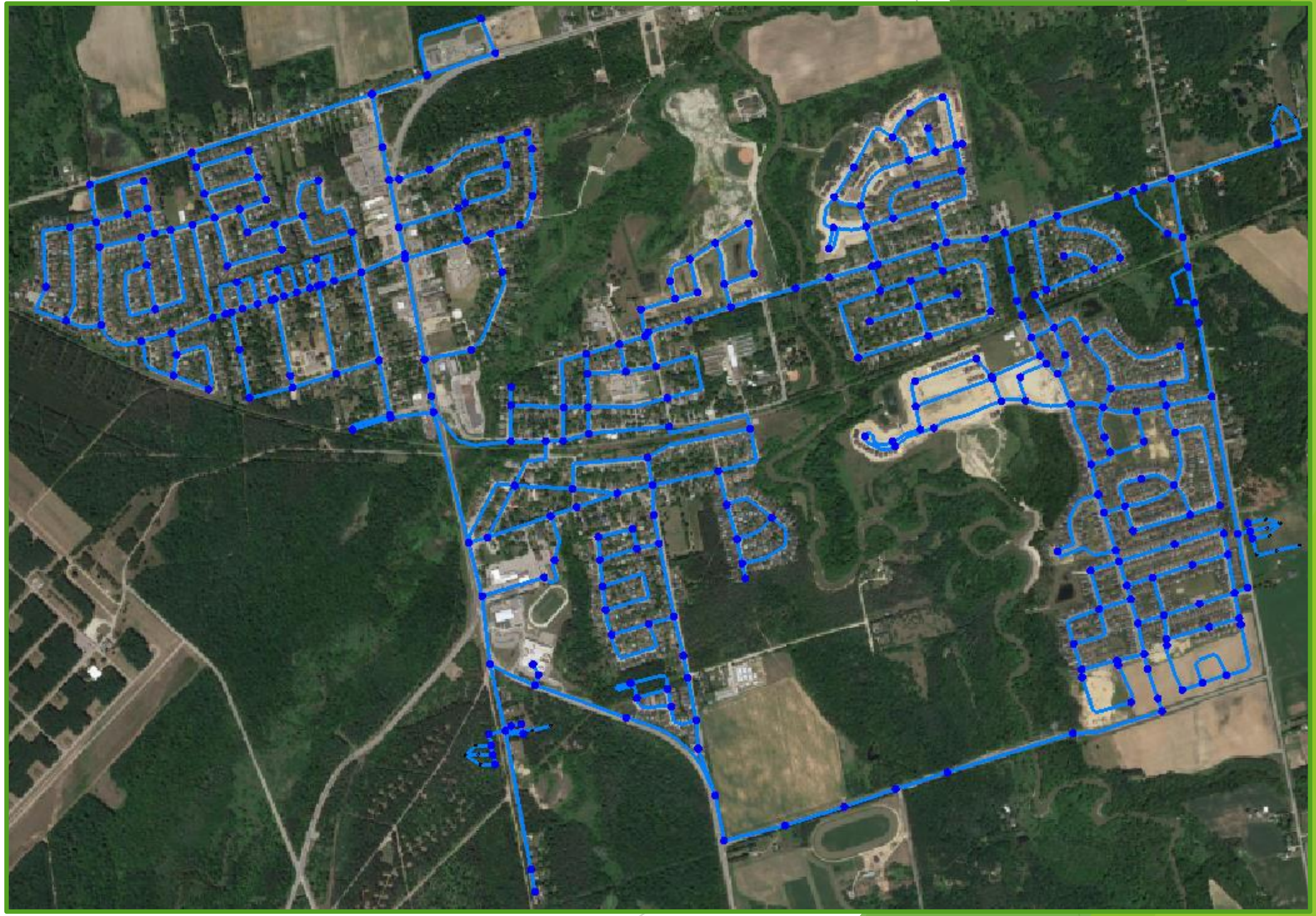


# Study Area - Existing & Proposed (Ultimate) Population & Servicing Demands Summary

| | Residential Units | Residential Population (Persons) |
|---|---|---|
| Existing Population | 4,581 | 13,669 |
| Ultimate Population (2046) | 7,390 | 22,096 |

# Existing Municipal Systems Water

- 62 KM of watermain
- 3 well sites, each containing a pump station and reservoir
  - Water supply residual capacity of 789 $m^3$/d or 599 Equivalent Residential Units
  - Water storage is beyond 80% of total capacity (1,010 $m^3$ residual capacity)



# Ultimate Conditions - Water

- Ultimate Water supply shortfall of 4,635 $m^3/d$
- Ultimate Water Storage shortfall of 4,199 $m^3$
- Meeting the new 150 L/s fire flow standard for all of Angus was technically unfeasible without major infrastructure upgrades, as existing systems were originally designed to a lower 37 L/s standard.
- At a 100 L/s fire flow standard for existing and future residential areas, 24 out of 312 locations still fail to meet pressure requirements in a fire flow scenario (shown in Red)

# Evaluation Process

As part of the final evaluation process, “short listed” alternative solutions will be ranked against one another in relative terms for each of the evaluation criteria presented below.

**Natural Environment Impacts:**

- Impacts of the option to vegetation, wildlife & the Natural Environment; and,
- Surface/groundwater quality and quantity implications;

**Social/Cultural Environment Impacts:**

- Land Use & Archaeological Considerations (Including First Nations);
- Required Inter-Municipal agreements & infrastructure; and,
- Visual landscape/aesthetic impacts and Interruption to residents.

**Technical/Operational Considerations:**

- Difficulty to construct/implement the Option relative to other alternatives; and
- Operation & Maintenance Efficiency.

**Economic Impacts:**

- Capital/construction costs, flexibility & phasing; and,
- Long term/operation & maintenance cost burden.

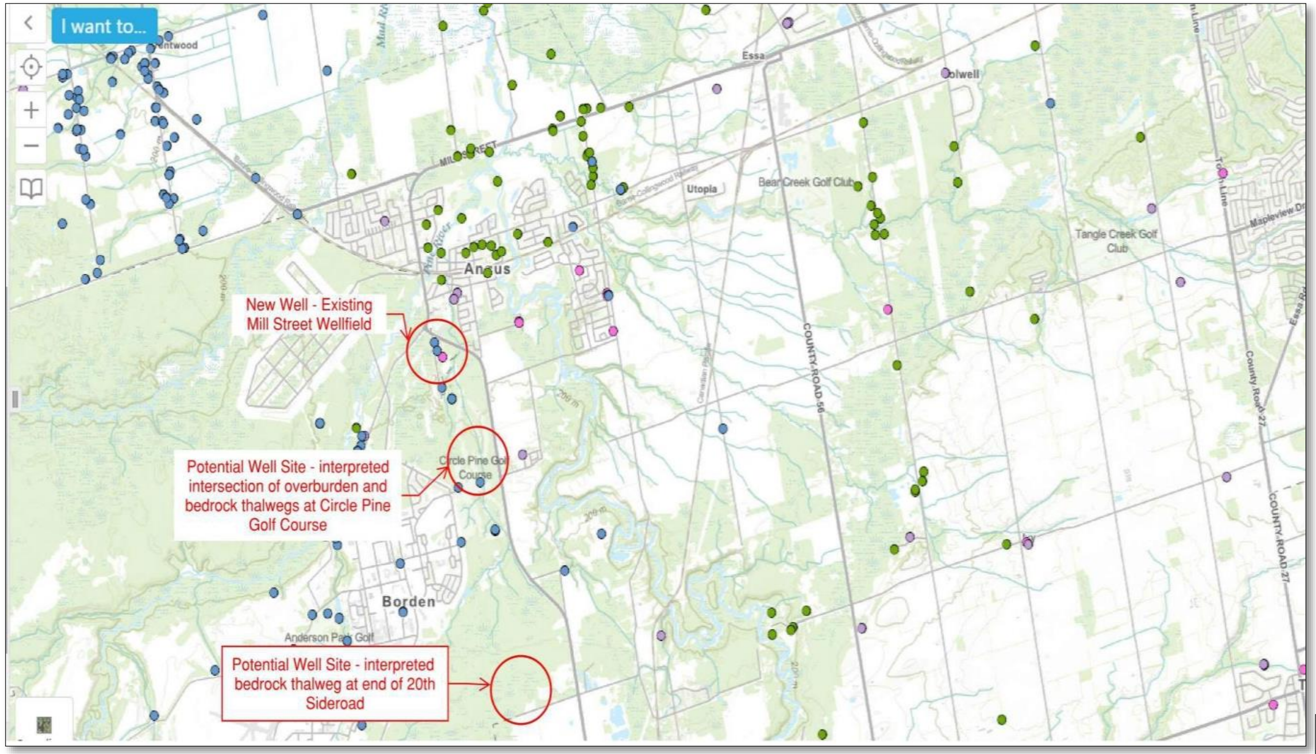
# Evaluation Process

- Preliminary screening of servicing options for the IMP included high-level review of all alternative solutions against the following criteria within the updated context of new Hydrogeological & Technical Review completed as part of the Addendum.
- Any solution which did not satisfy one or more of these criteria were eliminated without further detailed analysis.
- Alternative solutions that appeared to be feasible within the context of these criteria were selected as potential “short-listed” alternative solutions and evaluated further in terms of their relative advantages and disadvantages within each evaluation criteria category.

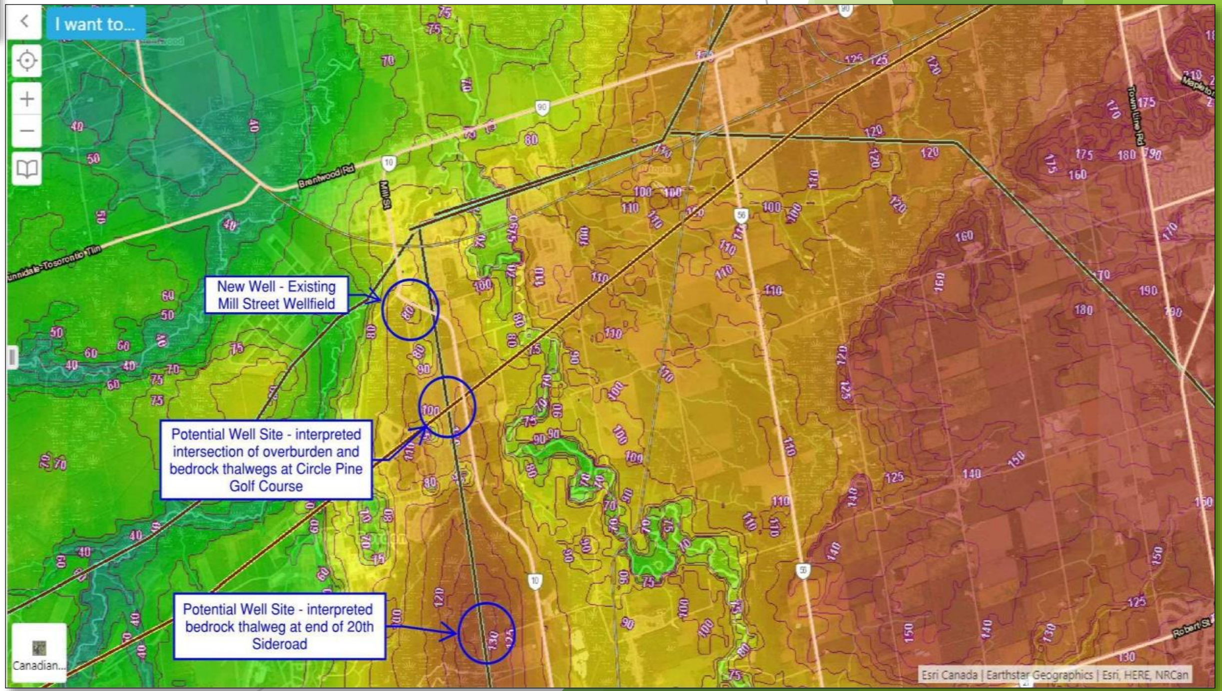
| Screening Question | Screening Decision By Answer | |
|---|---|---|
| | Pass | Fail |
| 1. Can the proposed solution satisfy the Class EA Problem Statement? | Proceed | Eliminate |
| 2. Does the solution have detrimental environmental, social, technical or economic impacts (i.e. prohibitive costs, agreement or land requirements, or technical difficulty)? | Proceed | Eliminate |
| 3. Can impacts associated with the solution be mitigated? | Proceed | Eliminate |

# Long List of Servicing Strategies Water Supply

| Servicing Strategy Alternative | Description |
|---|---|
| **Option W-1 - Increase Capacity Of Mill Street Well 1** | • Increase capacity from 3,928 $m^3/d$ to 4,300 $m^3/d$.<br>• Upgrade Pump, distribution Treatment system, and Electrical components.<br>• Conduct additional landfill investigation. |
| **Option W-2 - Rehabilitate the Center Street Well 2 and 3** | • Estimated capacity increase of 335,000 L/d. Maintenance options like wire brushing and acid flushing may be limited due to artesian conditions.<br>• Eliminated from further evaluation due to minimal gains vs. similar Option W-3. |
| **Option W-3 - Replace the Center Well 2 and 3** | • Increase capacity of each well from 1,296 $m^3/d$ to 2,246 $m^3/d$. Refurbish/replace equipment in the well pumphouse, Assess the reservoir for potential refurbishment, rebuild chemical storage, and Replace diesel generator. |
| **Option W-4 - Increase Water Taking from Brownley Well 5** | • Maximize water extraction from Brownley Well 5, increasing capacity from 654,000 L/d to 1,086,000 L/d. Challenges include potential sand production, limited pump size due to well casing, and insufficient space for a new well.<br>• Eliminated from further evaluation due to feasibility challenges identified above. |
| **Option W-5 - Develop a New Well (1A) at the Mill Street Wellfield** | • Increase current discharge rate from 3,928 $m^3/d$ to a potential maximum of 8,328 $m^3/d$.<br>• Conduct additional landfill investigation.<br>• New Pumps, Expand Treatment, Replace/Refurbish electrical components. |
| **Option W-6 - Develop a new well field at a new site** | • New well, new pumphouse & pumps, additional storage capacity, treatment system and potentially extensive distribution infrastructure.<br>• Requires a sodium silicate system and chlorine contact tank. |



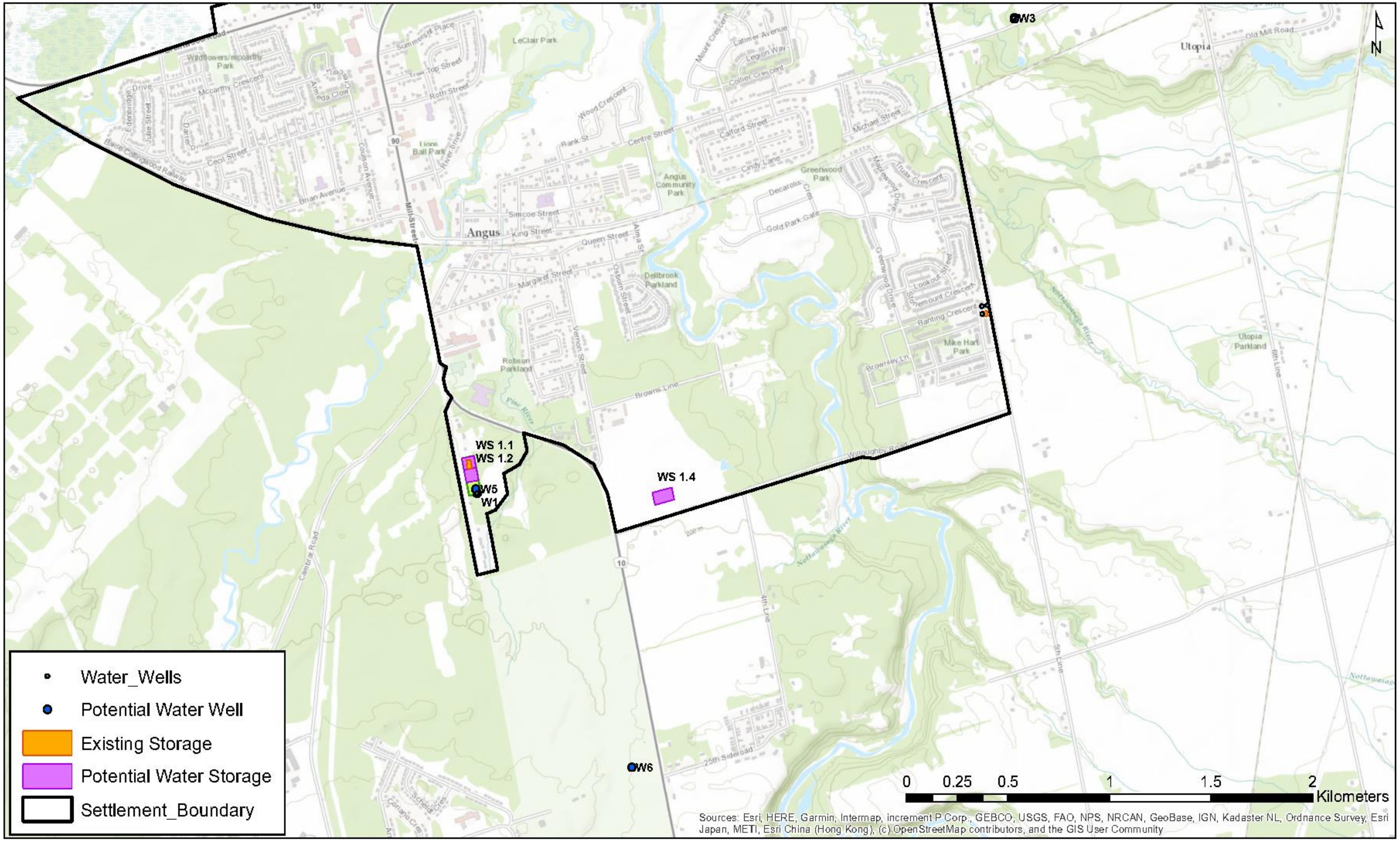

# Potential New Wellfield Location (West & East Angus)



# Water Supply Short List Options

| Ultimate Buildout Additional Capacity Required | 4,635,000 L/d | | |
|---|---|---|---|
| Options | Additional Capacity (L/d) | Timeline to Approved | Capital Cost |
| Option W-1 - Increase Capacity Of Mill Street Well 1 | 400,000 | 2.1 years (25 months) | $ 1,219,500 |
| Option W-3 - Replace the Centre St Wells 2 and 3 | 950,000-1,900,000 | 2 years (24 months) | $ 4,653,750 |
| Option W-5 - Develop a New Well (1A) at the Mill Street Wellfield | 4,400,000 | 2.25 years (27 months) | $ 2,227,500 |
| Option W-6 - Develop a New Well Field at a New Site | TBD | TBD | TBD |
| Total (W1 and W5 may be combined) | 5,750,000– 6,700,000; + capacity from W6 | 2-5+ Years to implement all options (longer for W6) | |

# Water Supply Short List Options



| Evaluation Criteria | **Option W1** Increase Capacity of Mill Street Well 1 | **Option W3** Replace Centre Street Well 2 and 3 | **Option W5** Construct Additional Mill Street Well 1A | **Option W6** Development of a New Wellfield(s) |
|---|---|---|---|---|
| **Natural Environment Impacts** | | | | |
| Impacts of the option to vegetation, wildlife & the Natural Environment | Low to medium, minimal change in impact area vs. existing conditions. | Low impact. Reuse of existing site. | Low to medium. The area of potential impact would increase vs. W1 but would provide higher overall supply. | Low to medium, but will require changes to a greenfield site, making this the highest potential impact of all four choices.. Higher uncertainty. |
| Surface/groundwater quality & quantity implications | Low impact, but only minimal increase in water supply. Site has highest yield potential. Former landfill impact assessment needed. | Low impact given this will be a replacement project on an existing site. Flow testing needed to confirm viable yield of increase (i.e. 950 m3/d one well vs.1900 m3/d for two) | Slightly higher potential impact than W1 but provides significantly more supply as site has highest yield potential. Former landfill impact assessment needed. | Likely the highest impact of all four options as groundwater would be coming from an as-yet untapped source (unknown yield potential). Additional studies required to confirm. |
| **Natural Environment Overall Rating** | | | | |
| **Social / Cultural Environment Impacts** | | | | |
| Land Use & Archaeological Considerations (Including First Nations) | Minimal, project is contained to existing, previously disturbed municipal lands. Former landfill impact assessment needed | Minimal as project is contained to existing, previously disturbed municipal lands. | Similar Impacts to Option W1. | Archaeological study will be required for any new well site. Higher land use requirement due to creation of an additional well site at a new location. |
| Visual landscape/Aesthetic impacts, Traffic impacts & interruption to residents | Low impacts due to maximizing use of existing systems. Low to Moderate potential for service interruptions during upgrades. | Low impacts due to maximizing use of existing systems. Moderate potential for service interruptions during well replacement. | Similar impacts to W1, with less potential for service interruptions (no replacement of existing systems to bring online). Lowest impact option. | Low to Medium impact, uncertainty introduced due to unconfirmed site location. |
| Required Intermunicipal Agreements & Infrastructure | No Intermunicipal Infrastructure or Agreements Required. | No Intermunicipal Infrastructure or Agreements Required. | No Intermunicipal Infrastructure or Agreements Required. | No Intermunicipal Infrastructure required. Land acquisition or agreement required for new site. |
| **Social / Cultural Environment Overall Rating** | | | | |
| **Technical/Operational Considerations** | | | | |
| Difficulty to construct or implement the Option relative to other alternatives & additional supply provided. | Medium. Requires landfill investigation. May require pump and distribution upgrades. Exiting treatment may require some changes. Replacement or refurbishment of electrical components might be required.<br><br>This option enhances the current capacity from 3,928 m³/d to 4,300 m³/d, resulting in a potential increase in water supply of 400 m³/d. | Medium to High. Option may require full replacement of pumphouse and all equipment and structure. Structural condition assessment of reservoir required. Water quality and quantity testing required.<br><br>This option increases the current capacity of each well from 1,296 m³/d to 2,246 m³/d, resulting in a combined potential increase in water supply of 1900 m³/d, with an initial increase of 950 m³/d assuming conservatively that only one well may be increased. | Medium, but with higher ROI potential than other options. Requires landfill investigation. New pump and infrastructure required to connect to the existing system. Water Quality & Quantity testing required. Equipment and treatment system upgrades potentially needed.<br><br>This option could increase the current discharge rate by 4,400 m3/d. Highest potential yield. 50% of this yield increase would more than close the servicing gap between water and wastewater systems and provide water for anticipated near term growth. | High due to uncertainty. Requires new pumphouse, pumps, storage capacity, treatment systems, and potentially extensive distribution infrastructure to connect new wellfield to existing system. Capacity available at the most likely candidate site (1.4 km away from the existing water system) is currently unknown and would require field investigations to confirm.<br><br>This option is viewed as a "long term" solution for further investigation per the original IMP, to be explored once all other viable options have been exhausted. |
| Operation & Maintenance Efficiency | Minimal changes to O&M burden vs. existing conditions. Slightly higher costs due to higher pumping for additional supply. | Minimal changes to O&M burden vs. existing conditions. Slightly higher costs due to higher pumping for additional supply. | Slighly higher than W1 due to addition of another well at an existing site, however overall difference is still minimal. | Highest maintenance burden of any option due to addition of a completely new well & treatment system in a new location. |
| **Technical/Operational Considerations Rating** | | | | |

| Evaluation Criteria | **Option W1**<br>Increase Capacity of Mill St. Well 1 | **Option W3**<br>Replace Centre Street Well 2 and 3 | **Option W5**<br>Construct Additional Mill St. Well 1A | **Option W6**<br>Development of a New Wellfield(s) |
|---|---|---|---|---|
| **Economic Impacts** | | | | |
| Capital / Construction costs & Potential ROI | Low Capital cost, but lowest estimated ROI (i.e. highest cost per m3/d) at $3,049 per m3/d of additional water supply. The estimated capital Cost for this option is $1,219,500. | Lower estimated ROI of $2,449 per m3/d of additional water supply and relatively high capital cost.<br><br>The estimated capital Cost for this option is $4,653,750, based on replacing both wells and the pumphouse.<br><br>Capital cost may decrease by approximately $1,000,000 if only a single well is replaced, but ROI would also be lower ($3,846 per m3/d of additional supply). | Best overall ROI water supply option at $506 per m3/d of additional water supply.<br><br>The estimated capital Cost for this option is $2,227,500. | Estimated to have similar costs per m3 to W3 for installation of new wells, pumps and treatment, plus the added cost of connecting to the distribution system.<br><br>GEI's estimate for the nearest potentially viable source would also require 1.41 km of pipe to connect to the existing system. |
| Long term/operation & maintenance cost burden | Minimal changes to O&M burden vs. existing conditions. Slightly higher costs due to higher pumping for additional supply. | Minimal changes to O&M burden vs. existing conditions. Slightly higher costs due to higher pumping for additional supply. | Slightly higher maintenance burden than W1 due to addition of another well at an existing site, however overall difference is still minimal. | Highest O&M. More costly maintenance due to the addition of an additional physical well site vs. existing. |
| Payment structure, cost recovery options for Municipality, Phasing Priority / Flexibility. | This option is expected to take 25 months, including the 3-month investigation of waste disposal area, a 2-month approval process for the Drinking Water Works Permit Amendment, a 2-month Permit to Take Water Amendment, a 2-year updates to the Source Water Protection Plan (concurrent with rest of project), and 26 weeks for construction. No agreements are required. | This option is expected to take 24 months, including the 2-month approval process for the Drinking Water Works Permit Amendment, a 2-month Permit to Take Water Amendment, 2 years for updates to the Source Water Protection Plan (concurrent with rest of project), and 52 weeks of construction. No agreements are required. | This option is expected to take 27 months, including the 2-month subsurface investigation, a 2-month approval process for the Drinking Water Works Permit Amendment, a 2-month Permit to Take Water Amendment, 2 years for updates to the Source Water Protection Plan (concurrent with rest of project), and 40 weeks of construction. No agreements are required. | Longest lead time due to the reliance on an unconfirmed water source. Preliminary investigations suggest that the most viable site for the new wellfield is near the Circle Pine Golf Course, requiring approximately 1.41 kilometers of piping to connect to the existing infrastructure. As such, it is considered the lowest priority project. Agreements or land acquisition required to facilitate this option. |
| **Economic Ranking** | | | | |
| | | | | |
| **Overall Ranking:** | **Second Priority After Option W5** | **Third Priority After Option W1** | **Highest Priority Option** | **Lowest Priority** |

# Preferred Solution: Water Supply

- The preferred solution involves a phased approach: Options W1, W3, and W5 were selected for further exploration to meet Angus's future water capacity needs, with Option W6 considered for future supply once existing sources are fully expanded.
- Further detailed investigations and technical analysis were carried out on all options carried forward from the IMP, and Addendum Evaluations for water supply were focused on prioritization of the identified preferred solution projects.
- **Immediate Solution:** Based on evaluation criteria, **Option W5**—Developing a New Well (1A) at the Mill Street Wellfield—was identified as the preferred immediate solution for additional water supply.

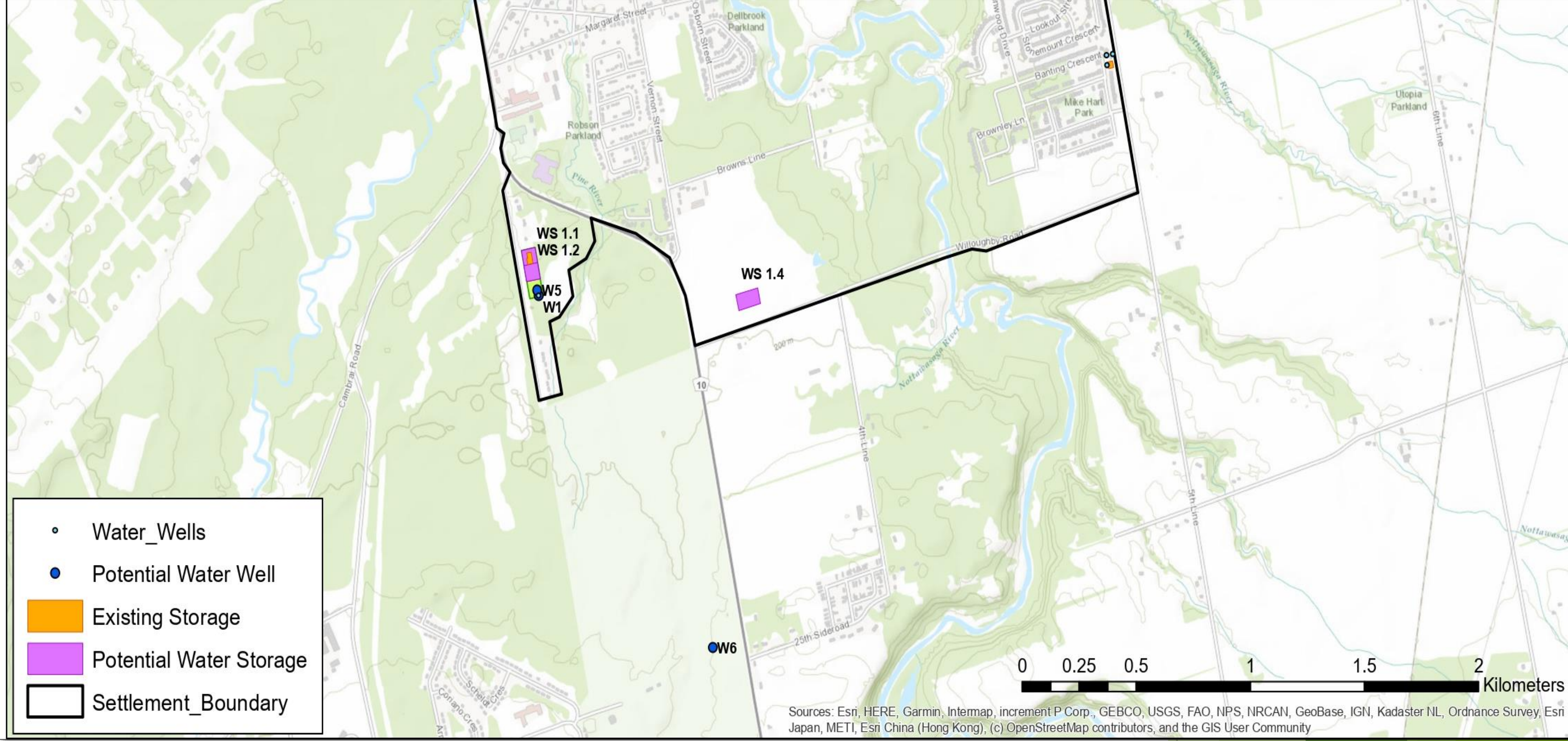
# Long List of Servicing Strategies Water Storage & Fire Flow

| Servicing Strategy Alternative | Description |
| --- | --- |
| Option WS-1 - Storage at a Single Location | • Construct a storage system (elevated, in-ground or at grade) at a single site, preferably at (or adjacent to) an existing reservoir location.<br>• Option carried forward into multiple specific site evaluations (see next slide) |
| IMP Option WS-3 - Storage at Two (2) Locations | • Construct two (2) storage systems (elevated, in-ground or at grade) located at two (2) sites, preferably at (or adjacent to) existing municipal well locations in the Brownley (1), Center (1), Mill (1) areas of Angus.<br>• Option eliminated from further evaluation due to high capital costs, O&M and insufficient space at two of the available sites (Brownley and Centre) |
| IMP Option WS-4 - Storage at Three (3) Locations | • Construct three (3) storage systems (elevated, in-ground, or at grade) located at three (3) sites, preferably at (or adjacent to) existing municipal well locations in the Brownly, Center (1) and Mill (1) areas of Angus.<br>• Option eliminated from further evaluation due to high capital costs, O&M and insufficient space at two of the available sites (Brownley and Centre) |

# Long List of Storage at Single Location Options

| Servicing Strategy Alternative | Description |
|---|---|
| Option WS-1.1 – Additional in-ground Storage at the Mill Street Site | • Construct new 4,200 $m^3$ in-ground reservoir at the Mill Street property, including site works<br>• Upgrade approximately 2,508 m of watermain to achieve 100 L/s fireflow in all areas |
| Option WS-1.2 – Additional Elevated Storage at the Mill Street Site | • Construct a 4,200 $m^3$ elevated storage tank at Mill Street, including site works<br>• Upgrade approximately 2,157 m of watermain to achieve >100 L/s fireflow in all areas |
| Option WS-1.3 – Additional Elevated Storage at the Brownley Site | • Construct a new 4,200 $m^3$ elevated storage tank at the Brownley Street property<br>• Upgrade approximately 2,056 m of watermain to achieve >100 L/s fireflow in all areas<br>• Eliminated after site review due to insufficient space at the Brownley site for additional storage |
| Option WS-1.4 – New Storage at a Greenfield Site (South Angus) | • Construct a 4,200 $m^3$ elevated storage tank at new site (TBD) in southern Angus, including site works<br>• Upgrade Approximately 1,879 m of watermain to achieve >100 L/s fireflow in all areas<br>• Acquire land for new storage site and/or execute agreements for land use |
| Option WS-1.5 – New Storage at a Greenfield Site (Northeast Angus) | • Similar to WS-1.4 but with greater limitations and land acquisition requirements<br>• Eliminated from further evaluation due to inferiority vs. similar option |
| Option WS-1.6 – Additional Elevated Storage at the Centre Street | • Construct a 4,200 $m^3$ elevated storage tank at Centre Street,<br>• Upgrade Approximately 2,547 m of watermain to achieve >100 L/s fireflow in all areas<br>• Eliminated after site review due to insufficient space at the Centre St. site for additional storage |

# Water Storage Short List Options




| Additional Storage Required | 4,199 m³ | | |
|---|---|---|---|
| Options | Additional Storage (m3) | Timeline to Approval | Capital Cost |
| Option WS-1.1 - Additional in-ground Storage at the Mill Street Site | 4,200 | 2.5 years (31 months) | $ 10,485,125 |
| Option WS-1.2 - Additional Elevated Storage at the Mill Street Site | 4,200 | 2.25 years (26 months) | $ 11,876,750 |
| Option WS-1.4 - New Storage at a Greenfield Site (South Angus) | 4,200 | 2.25 years + Unknown Land Acquisition Time | $ 11,876,750 + Land & TBD Costs |

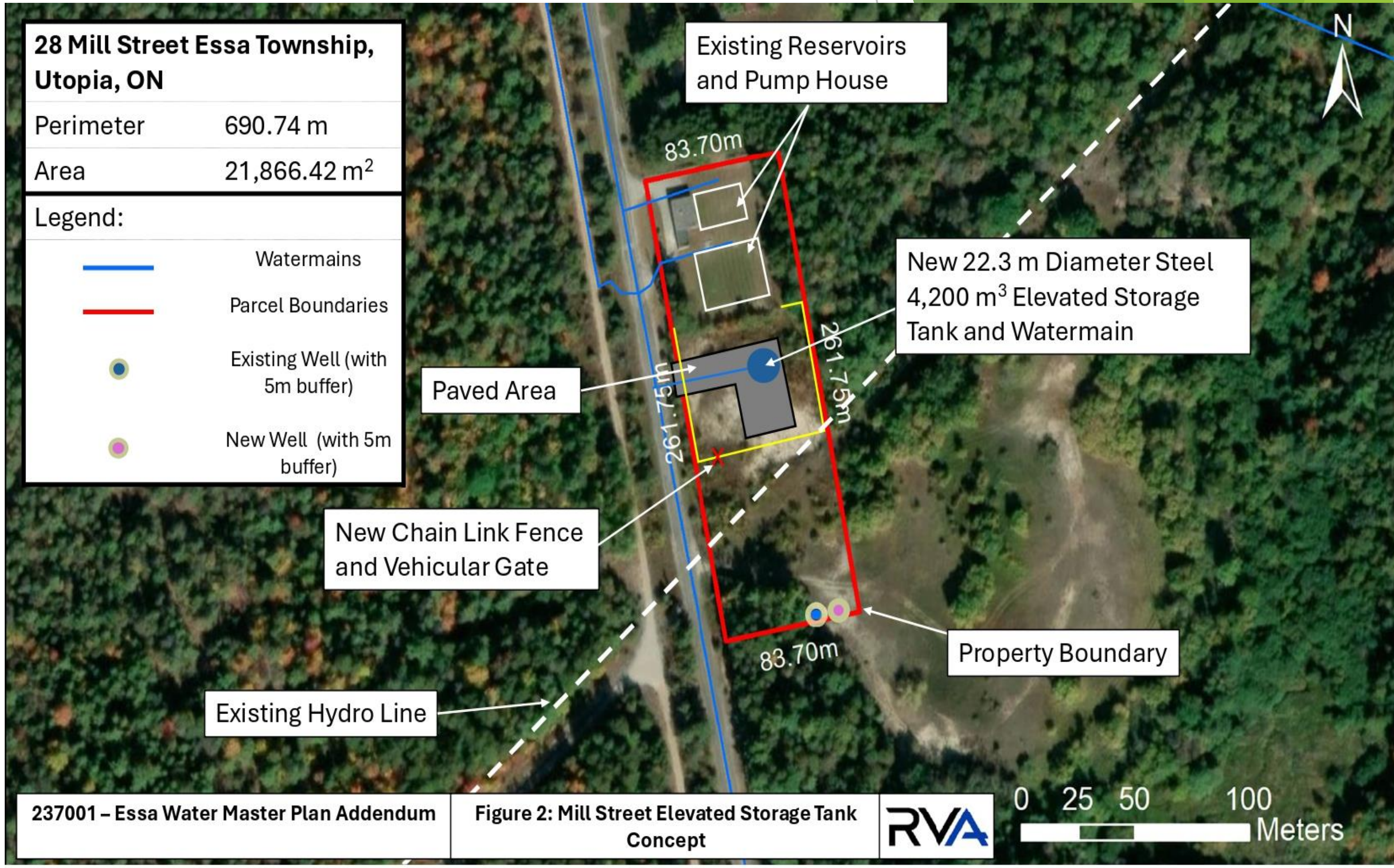
| Evaluation Criteria | **Servicing Strategy WS-1.1**<br>Additional in ground reservoirs at the Mill St. Site | **Servicing Strategy WS-1.2**<br>New Elevated Storage at the Mill Street Site | **Servicing Strategy WS-1.4**<br>New Elevated Storage at New Site (South Angus) |
|---|---|---|---|
| **Natural Environment Impacts** | | | |
| Impacts of the option to vegetation, wildlife & the Natural Environment | Low due to use of existing site. | Low due to use of existing site. | High due to uncertainty of using a new, undisturbed site. |
| Surface/groundwater quality implications | Minimal, aside from construction dewatering for WM replacements.. | Slightly less than WS1.1, due to less WM replacement requirements | Potentially less WM replacement requirements than WS-1.2 but higher uncertainty with new Greenfield site. |
| **Natural Environment Overall Rating** | | | |
| **Social / Cultural Environment Impacts** | | | |
| Land Use & Archaeological Considerations (Including First Nations) | Minimal – All work in previously disturbed municipal lands & ROW's | Minimal – All work in previously disturbed municipal lands & ROW's | Higher potential for issues due to use of TBD Greenfield Site. |
| Visual landscape/Aesthetic impacts, Traffic impacts & interruption to residents | Minimal visual or traffic impacts, Mill St. location is somewhat remote, and no above ground storage. Potential construction interruptions due to WM replacement and potential need to take existing storage offline. | Slightly more visual impact with above ground reservoir. Less impact to residents due to use of a separate storage system vs. augmenting existing, and less WM replacement requirements than WS-1.1. | Potential for interruption to residents due to WM replacement requirement. Some uncertainty on visual / traffic impacts, subject to ultimate site selection, but likely similar to WS-1.2. |
| Required Intermunicipal Agreements & Infrastructure | No Intermunicipal Infrastructure or Agreements Required | No Intermunicipal Infrastructure or Agreements Required | No Intermunicipal Infrastructure, but Agreements may be Required for acquisition of a new storage site. |
| **Social / Cultural Environment Overall Rating** | | | |
| **Technical/Operational Considerations** | | | |
| Difficulty to construct or implement the Option relative to other alternatives | Medium. Approximately 2,508 l.m. of WM upgrades req'd for adequate fire flows & pressure in addition to in-ground storage. | Medium. Approximately 2,508 l.m. of WM upgrades req'd for adequate fire flows & pressure in addition to elevated storage. | Similar to Option WS1.2 but with added field investigations, and associated uncertainties. Total WM installation requirement is likely similar to or slightly higher than Option WS1.2 when accounting for internal site servicing. |
| Operation & Maintenance Efficiency | Inspections and cleaning every few years to check for cracks and/or remove iron/manganese deposits. More burden on pumping systems under this option vs. an elevated tank which provides static pressure. | Overcoating of exterior and re-touching of interior at year 10 & full recoating in at year 25. Due to the elevated tank, this option will have less maintenance overall than WS1.1 which relies more heavily on existing pumps for system flow & pressure. | Maintenance will be similar to WS1.2. |
| **Technical/Operational Considerations Rating** | | | |
| **Economic Impacts** | | | |
| Capital/construction costs | The estimated Capital Cost is $ 10,485,125. | The estimated Capital Cost is $ 11,876,750. | Min. cost of $12 Million plus land acquisition, studies and connection to existing system (approx. 100-200m of pipe) |
| Long term/operation & maintenance cost burden | Minimal maintenance requirements other than inspections and cleaning every few. More burden on pumping vs. an elevated tank. Higher associated energy cost. | Overcoating of exterior and re-touching of interior at year 10 & full recoating in at year 25. Less maintenance overall than WS1.1. | Maintenance will be similar to WS1.2. |
| Payment structure, cost recovery options for Municipality, Phasing Priority & Flexibility. | Good flexibility given the project is on existing municipal lands - Estimated time to completion: 31 months, with 3 months. | Good flexibility given the project is on existing municipal lands - Estimated time to completion: 26 months. | Least flexible and longest lead time to a shovel ready solution as agreements would need to be made with private owners in the required pressure zone - timing to achieve this is unknown. |
| **Economic Ranking** | | | |
| | | | |
| **Overall Ranking:** | **Less Preferred Option** | **Most Preferred Option** | **Less Preferred Option** |

# Preliminary Preferred Alternative: Water Storage

## Construct New, Elevated Storage Tank at Mill Street Site: Option WS-1.2

The recommended overall preferred servicing strategy for water storage in Angus includes the following components:

- Increase available storage by 4,200 $m^3$
- Supports the 25-year growth projection, providing scalable storage capacity that can be adjusted as demand increases.



# Preferred Servicing Option Projected Capital Costs (Near- Term Implementation)

- **Increase Angus' water supply by adding a new well at Mill Street (W5),** providing an estimated capacity of 4,400 $m^3/d$ (supporting approximately 1,590 residential units)
- **Construct an elevated storage system at Mill Street (WS-1.2)** with a capacity of 4,200 $m^3$ to support a 25-year buildout, initially filled to 50% for maintenance until further capacity is needed.
- Option W5's new well at Mill Street will support around 1,590 homes, matching (and exceeding) current wastewater capacity to accommodate near-term growth.
- Other supply options are not suggested now and may have higher costs later when further wastewater upgrades are required.

| Project Description | Option of Probable Capital Cost |
|---|---|
| Option W5 - Construct Additional Mill Street Well 1A (incl. hydrogeological & environmental testing/studies) | $ 2,227,500 |
| Option WS 1.2 - Construct New, Elevated Storage Tank at Mill Street Site (Cost does not include WM Upgrades in existing areas) | $11,876,750 |

# Next Steps

- Incorporate PIC and Agency comments into the Final Design Concept Selection;
- Finalize the water supply and storage Addendum Summary Report and Publish Notice of Study Completion; and,
- Place the Class EA Addendum Report on file with the MECP and Township for public review and comment for a period of 30 days.
- If no Part II Order Requests are received during the ESR 30-day review period, the Class EA Addendum would be concluded and the project would proceed to the next stage of approvals following the 30-day review period.
- Initiate hydrogeological investigation and environmental testing for the final Water Supply Solution
- Initiate detailed design for the final water supply & storage solutions

# THANK YOU FOR ATTENDING

## Please direct any comments via email to the project representatives within 10 business days of this PIC


**Josh Maitland, P. Eng.**
**Consultant Project Manager**
Greenland Consulting Engineers
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Email: jmaitland@grnland.com

**John Kolb,**
**Manager of Public Works**
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Utopia, ON L0M 1T0
Email: jkolb@essatownship.on.ca


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# Appendix E-3

Public Comments

and Responses

**Public Comments Received**

| Format | Question | Response |
|---|---|---|
| PIC – Member of the Public | Will the additional well and storage be constructed concurrently? | The intended implementation process is to design and construct the upgrades to storage and well capacity at Mill St. concurrently, although this will be dependent upon budget constraints and agency approvals. |
| PIC – Member of the Public | Assuming all goes well, when would you estimate both be constructed by? | See Table 1 and Table 5 of the Addendum Report. We would expect construction to be complete in 2027, although this is tentative based on approvals and budget. |
| PIC – Member of the Public | Based on current capacity, will development be halted until then? | Residual capacity of the system is assessed with each development application, through water and sanitary modelling to ensure that there is sufficient capacity in the system. At this time, there is no pause on development, nor is a complete halt anticipated, although this is at the Town's discretion based on new data as it is received. |
| PIC – Member of the Public | Understanding that this presentation is specific to water, how many units are left for sanitary capacity | There are currently about 350 units of WWTP capacity over and above existing water supply capacity. Please refer to the Angus IMP for more detailed information on sanitary capacity. It is anticipated that upgrades required will be staggered against water upgrades, for budgetary purposes. A Schedule 'C' Class EA will be required prior to WWTP upgrades. |
| PIC – Member of the Public | If the class EA for wastewater starts next year, any idea on timing for implementation? | Timing for the Schedule 'C' WWTP Class EA is unknown at this time. |
| PIC – Member of the Public | If there were upcoming developments, would you want to know about these for the EA or does this just lead back to working with the Township to get allocation? | The EA has consideration for all proposed development that the Township is aware of, in various stages of planning to a 'full build-out' scenario for the current Angus boundary. However, each specific development will be modelled as applications are received, and receive allocation from the Township at their discretion. |
| PIC – Member of the Public | Calculations for proposed water and wastewater demands are conservative at times, have there been any studies done to look at revising values to allow for more units? | The Township's development standards were recently updated, and the IMP & Addendum calculations were based on these values. No studies have been completed with demand values other than the approved standards. Flow data from OCWA was utilized to validate existing usage and for model calibration. |

| | |
|---|---|
| **From:** | Kirsten McFarlane |
| **To:** | Abby LaForme |
| **Cc:** | Craig King; Josh Maitland; jkolb@essatownship.on.ca; |
| **Subject:** | RE: Notice of Public Information Centre - Angus Infrastructure Master Plan Addendum - Nov 21, 2024 |
| **Sent:** | 2024-11-14 3:53:53 PM |

Thank you very much for your response, Abby. We will update our consultation list and use the provided map as a reference for future projects that fall within the MCFN treaty and traditional lands.

Sincerely,

**Kirsten McFarlane**
Project Coordinator
Tel: (705) 444-8805 ext. 267

GREENLAND® Consulting Engineers
A member of the Greenland Group of Companies
120 Hume Street, Collingwood, Ontario, Canada L9Y 1V5
tel: 705 444 8805 • fax: 705 444 5482
web: www.grnland.com
water resources • municipal infrastructure • environmental management
monitoring • information systems • research & development



---

**From:** Abby LaForme <Abby.LaForme@mncfn.ca>
**Sent:** November 14, 2024 3:44 PM
**To:** Kirsten McFarlane <kmcfarlane@grnland.com>
**Cc:** Craig King <Craig.King@mncfn.ca>; Josh Maitland <jmaitland@grnland.com>; jkolb@essatownship.on.ca
**Subject:** RE: Notice of Public Information Centre - Angus Infrastructure Master Plan Addendum - Nov 21, 2024

Good Afternoon Kirsten,

Thank you for contacting the Mississaugas of the Credit First Nation (MCFN), Department of Consultation and Accommodation (DOCA) regarding the Angus Infrastructure Master Plan Addendum.

Unfortunately, Angus falls outside the MCFN Treaty and Traditional lands and therefore cannot provide comments regarding the IMP.

Please see the attached map for future reference.

Thank you

**Abby (LaForme) Lee**
**Consultation Coordinator**

**Mississaugas of the Credit First Nation (MCFN)**
**Department of Consultation & Accommodation (DOCA)**
**4065 Highway 6, Hagersville, ON N0A 1H0**
**Ph: (905) 768 – 4260**
**Email: Abby.LaForme@mncfn.ca**

**Please Note- If a digital copy of your notification has been sent, please be environmentally conscious and do not send a physical, copy. Thank you!**

---

**From:** Kirsten McFarlane <kmcfarlane@grnland.com>
**Sent:** Thursday, November 7, 2024 3:04 PM
**Cc:** Josh Maitland <jmaitland@grnland.com>; jkolb@essatownship.on.ca
**Subject:** Notice of Public Information Centre - Angus Infrastructure Master Plan Addendum - Nov 21, 2024

Good Afternoon,

Please be advised that the Township of Essa (Township) is hosting a virtual Public Information Centre (PIC) for the Water Supply and Storage Addendum to the Angus Infrastructure Master Plan. The Infrastructure Master Plan was completed in 2022 in accordance with the Municipal Class Environmental Assessment (EA) process. The PIC will present the results from the Addendum Preliminary Study Report, which identifies and prioritizes proposed solutions for water supply and storage infrastructure to support development over the next 25 years.

The PIC is being held at 7:00 PM on November 21, 2024 via Zoom. Presentation slides will be posted on the Township website (https://www.essatownship.on.ca/) following the PIC.

Within approximately 2 weeks of the PIC, the Preliminary EA Addendum Study Report will be finalized and issued for a 30-day public review period, along with a Notice of Addendum in accordance with the EA Process.

The Notice of Public Information Centre is attached, with details on how to connect to the PIC.

We look forward to any feedback you may have on this important project. Please do not hesitate to contact the undersigned and/or the contacts listed on the notice with any comments or questions either before, during or after the PIC.

Sincerely,

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Please consider the environment before printing this e-mail

| | |
|---|---|
| **From:** | Liu, Chunmei (MECP) |
| **To:** | Kirsten McFarlane; Josh Maitland; jkolb@essatownship.on.ca; |
| **Cc:** | EA Notices to CRegion (MECP); Mazzuca, Marco (MECP); Hyde, Chris (MECP); Mattson, Aaron (MECP); |
| **Subject:** | RE: Notice of Public Information Centre - Angus Infrastructure Master Plan Addendum - Nov 21, 2024 |
| **Attachments:** | Supporting Attachment - Proponent's Intro to Delegation of Procedural Aspects of Consultation with Aboriginal Communities.pdf;Supporting Attachment - Species at Risk Proponents Guide to Preliminary Screening (May 2019).pdf;MECP Acknowledgement of NOC-Angus IMP Addendum, Essa.pdf; |
| **Sent:** | 2024-11-08 10:24:03 AM |

Good morning,

Attached please find the ministry acknowledgement letter and relevant supporting information for the above noted project. If you have any questions regarding the information shared, please feel free to contact us for further discussion.

Warm regards,

Chunmei Liu (she/her) | Regional Environmental Planner
Environmental Assessments Branch, Ontario Ministry of the Environment, Conservation and Parks
7th Flr, 135 St Clair Ave W, Toronto, ON M4V 1P5 | Chunmei.Liu@ontario.ca | 437-249-3102

---

**From:** Kirsten McFarlane <kmcfarlane@grnland.com>
**Sent:** Thursday, November 7, 2024 3:04 PM
**Cc:** Josh Maitland <jmaitland@grnland.com>; jkolb@essatownship.on.ca
**Subject:** Notice of Public Information Centre - Angus Infrastructure Master Plan Addendum - Nov 21, 2024



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Project Coordinator
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| | |
|---|---|
| **From:** | Greg Marek |
| **To:** | Kirsten McFarlane |
| **Cc:** | Josh Maitland; jkolb@essatownship.on.ca; Ben Krul; Dalia Al-Ali; Chris Hibberd; |
| **Subject:** | Fw: Notice of Public Information Centre - Angus Infrastructure Master Plan Addendum - Nov 21, 2024 NVCA ID 47160 [19-NOV-2024] |
| **Attachments:** | 07-11-2024-Angus IMP Addendum Notice of PIC - FINAL.pdf |
| **Sent:** | 2024-11-19 1:43:45 PM |

Good afternoon Kirsten,

Thank you for notifying the NVCA of the upcoming PIC for the Angus Infrastructure Master Plan Class EA Addendum - Water Supply and Storage.

Following the PIC, please circulate a copy of the Notice of Addendum and Preliminary EA Addendum Study Report to the NVCA at planning@nvca.on.ca.

Thank you.

**Greg Marek, RPP, MCIP**
**Senior Planner**

**Nottawasaga Valley Conservation Authority**
8195 8th Line, Utopia, ON L0M 1T0
**T** 705-424-1479 x242
gmarek@nvca.on.ca | nvca.on.ca



---

**From:** Chris Hibberd <c.hibberd@nvca.on.ca>
**Sent:** Thursday, November 7, 2024 3:09 PM
**To:** Planning Dept <Planning@nvca.on.ca>
**Cc:** Ben Krul <bkrul@nvca.on.ca>; Dalia Al-Ali <dal-ali@nvca.on.ca>
**Subject:** FW: Notice of Public Information Centre - Angus Infrastructure Master Plan Addendum - Nov 21, 2024

---

**From:** Kirsten McFarlane <kmcfarlane@grnland.com>
**Sent:** Thursday, November 7, 2024 3:04 PM
**Cc:**

**Subject:** Notice of Public Information Centre - Angus Infrastructure Master Plan Addendum - Nov 21, 2024

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Please be advised that the Township of Essa (Township) is hosting a virtual Public Information Centre (PIC) for the Water Supply and Storage Addendum to the Angus Infrastructure Master Plan. The Infrastructure Master Plan was completed in 2022 in accordance with the Municipal Class Environmental Assessment (EA) process. The PIC will present the results from the Addendum Preliminary Study Report, which identifies and prioritizes proposed solutions for water supply and storage infrastructure to support development over the next 25 years.

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Sincerely,

**Kirsten McFarlane**
Project Coordinator
Tel: (705) 444-8805 ext. 267

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| | |
|---|---|
| **From:** | Josh Maitland |
| **To:** | Kirsten McFarlane |
| **Subject:** | FW: Hydro One Response: 20241129-NoticeOfPIC1-Angus Infrastructure Master Plan |
| **Attachments:** | 20241129-NoticeOfPIC1-Angus Infrastructure Master Plan.pdf |
| **Sent:** | 2024-12-02 9:48:15 AM |

---

FYI from Hydro

Sincerely,

Josh Maitland, P.Eng.
Project Manager
[redacted]



-----Original Message-----
From: SUN Hongxia <Susan.SUN@HydroOne.com> On Behalf Of SECONDARY LAND USE Department
Sent: November 29, 2024 10:32 AM
To: Josh Maitland <jmaitland@grnland.com>
Cc: SECONDARY LAND USE Department <Department.SecondaryLandUse@hydroone.com>
Subject: Hydro One Response: 20241129-NoticeOfPIC1-Angus Infrastructure Master Plan

Please see the attached for Hydro One's Response.

Hydro One Networks Inc

SecondaryLandUse@HydroOne.com

**Hydro One Networks Inc.**

483 Bay Street
8th Floor South Tower
Toronto, Ontario M5G 2P5

**HydroOne.com**

November 29, 2024

Re: Angus Infrastructure Master Plan

Attention:
Josh Maitland, P. Eng.
Consultant Project Manager
Greenland Consulting Engineers

Thank you for sending us notification regarding Angus Infrastructure Master Plan. In our preliminary assessment, we confirm there are no existing Hydro One Transmission assets in the subject area. Please be advised that this is only a preliminary assessment based on current information.

If plans for the undertaking change or the study area expands beyond that shown, please contact Hydro One to assess impacts of existing or future planned electricity infrastructure.

Any future communications are sent to Secondarylanduse@hydroone.com.

Be advised that any changes to lot grading and/or drainage within proximity to Hydro One transmission corridor lands must be controlled and directed away from the transmission corridor.

Sent on behalf of,

***Secondary Land Use***
***Asset Optimization***
***Strategy & Integrated Planning***
***Hydro One Networks Inc.***

| Organization | First Name | Last Name | Personal Title | Title | Email | Notes |
|---|---|---|---|---|---|---|
| **Local Government & Other Agencies** | | | | | | |
| Nottawasaga Valley Conservation Authority | Chris | Hibberd | Mr. | Director, Watershed Management Services | c.hibberd@nvca.on.ca | send report to: planning@nvca.on.ca |
| Nottawasaga Valley Conservation Authority | Ben | Krul | Ms. | Manager, Planning Services | bkrul@nvca.on.ca | |
| Nottawasaga Valley Conservation Authority | Doug | Hevenor | Mr. | Chief Administration Officer | dhevenor@nvca.on.ca | |
| Township of Essa | Michael | Mikael | Ms. | Chief Administration Officer | mmickael@essatownship.on.ca | |
| Township of Essa | John | Kolb | Mr. | Manager of Public Works | jkolb@essatownship.on.ca | |
| Township of Essa | Samuel | Haniff | Mr. | Manager of Planning | shaniff@essatownship.on.ca | |
| Township of Essa | Sandie | Macdonald | Ms. | Mayor | smacdonald@essatownship.on.ca | |
| Township of Essa | Michael | Smith | Mr. | Deputy Mayor | msmith@essatownship.on.ca | |
| Township of Essa | Peter | Kiezebrink | Mr. | Councillor - Ward 1 | pkiezebrink@essatownship.on.ca | |
| Township of Essa | Henry | Sander | Mr. | Councillor - Ward 2 | hsander@essatownship.on.ca | |
| Township of Essa | Liana | Maltby | Ms. | Councillor - Ward 3 | lmaltby@essatownship.on.ca | |
| Ontario Clean Water Agency | Kristen | Tilotta | Ms. | Manager, Safety, Process & Compliance (A) | ktilotta@ocwa.com | |
| Ontario Clean Water Agency | Mark | Yandt | Mr. | Senior Operations Manager | myandt@ocwa.com | |
| Ontario Clean Water Agency | Charles | Bowler | Mr. | Operations Supervisor Water and Wastewater | cbowler@ocwa.com | |
| County of Simcoe | Mark | Aitken | Mr. | Chief Administration Officer | cao@simcoe.ca | |
| County of Simcoe | Nathan | Westendorp | Mr. | Director of Planning, | nathan.westendorp@simcoe.ca | |
| County of Simcoe | Dan | Amadio | Mr. | Manager of Planning (South/East) | dan.amadio@simcoe.ca | |
| County of Simcoe | Tiffany | Thompson | Ms. | Manager of Planning (North/West) | tiffany.thompson@simcoe.ca | |
| Ontario Provincial Police | To Whom It May Concern | | | | opp.nottawasaga@opp.ca | |
| **Provincial & Federal Agencies** | | | | | | |
| | To Whom It May Concern | | | Consultation | enviropermissions@ontario.ca | |
| | To Whom It May Concern | | | Consultation | moeccpermissions@ontario.ca | |
| Ontario Ministry of Environment, Conservation, and Parks | Steven | Carrasco | Mr. | Assistant Deputy Minister | steven.carrasco@ontario.ca | |
| Ontario Ministry of the Environment and Climate Change | Kathleen | O'Neill | Ms. | Director, Environmental Assessment | kathleen.oneill@ontario.ca | |
| Ontario Ministry of Environment, Conservation, and Parks | Chunmei | Liu | Mr. | Environmental Resource Planner & EA Coordinator | chunmei.liu@ontario.ca | |
| Ontario Ministry of Environment, Conservation, and Parks | Chris | Hyde | Mr. | District Manager (Barrie) | chris.hyde@ontario.ca | |
| Ontario Ministry of Environment, Conservation, and Parks | Aziz | Ahmed | Mr. | Manager, Municpal Water and Wastewater | aziz.ahmed@ontario.ca | |
| Ontario Ministry of Natural Resources and Forestry | John | Almond | Mr. | Resource Operations Supervisor | john.almond@ontario.ca | |
| Ontario Ministry of Infrastructure | Brian | Hao | Mr | Senior Policy Advisor and Manager of Stakeholder Relations | brian.hao@ontario.ca | |
| Ontario Ministry of Agriculture, Food and Rural Affairs | Michele | Doncaster | Ms. | Manager, Land Use Policy and Stewardship | michele.doncaster@ontario.ca | |
| Ontario Ministry of Municipal Affairs and Housing | Tim | Haldenby | Mr. | Team Lead | tim.haldenby@ontario.ca | |
| **Indigenous Communities** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Alderville First Nation | David | Mowat | | Chief | dmowat@alderville.ca | |
| Beausoleil First Nation (Christian Island) | Joanne | Sandy | | Chief | jsandy@chimnissing.ca | |
| Chippewas of Georgina Island | Donna | Big Canoe | | Chief | donna.bigcanoe@georginaisland.com | |
| Chippewas of Rama First Nation | Ted | Williams | | Chief | tedw@ramafirstnation.ca | |
| Chippewas of Rama First Nation | Annette | Sharpe | | | Annettes@ramafirstnation.ca | |
| Chippewas of Nawash First Nation | Veronica | Smith | | Chief | chief@nawash.ca | |
| Curve Lake First Nation | Keith | Knott | | Chief | keithk@curvelake.ca | |
| Georgian Bay Metis Council | To Whom It May Concern | | | Consultation | gbmccontact@gmail.com | |
| Hiawatha First Nation | Laurie | Carr | | Chief | chiefcarr@hiawathafn.ca | |
| Metis Nation of Ontario | To Whom It May Concern | | | Consultation | contactus@metisnation.org | |
| Mississauga's of Scugog Island First Nation | Kelly | Larocca | | Chief | klarocca@scugogfirstnation.com | |
| Mississaugas of the Credit | To Whom It May Concern | | | Consultation | communications@mncfn.ca | Outside of Treaty territory, do not circulate on further communications |
| Saugeen Ojibway Nation | To Whom It May Concern | | | Consultation | manager.ri@saugeenojibwaynation.ca | |
| Saugeen First Nation | Conrad | Ritchie | | Chief | conrad.ritchie@saugeen.org; sfn@saugeen.org | |
| **Utilities** | | | | | | |
| Hydro One | To Whom It May Concern | | | Consultation | regulatory@hydroone.com | update to: secondarylanduse@hydroone.com |
| **Home Owners / Other** | | | | | | |
| | Darren | Vella | | | [redacted] | |
| | Vanessa | Simpson | | | [redacted] | |
| | Tyler | Kawall | | | [redacted] | |
| | Melissa | Haw | | | [redacted] | |
| | Brandi | Clement | | | [redacted] | |
| | Brent | Yanch | | | [redacted] | |
| | Brian | Goodreid | | | [redacted] | |
| | Preya | Balgobin | | | [redacted] | |
| | Marie | Leroux | | | [redacted] | |