SOURCE WATER PROTECTION

SPC-17-04-04: Guelph/Guelph-Eramosa Tier 3 Water Budget and Local Area Risk Assessment

The Technical Pieces

Lake Erie Region Source Protection Committee

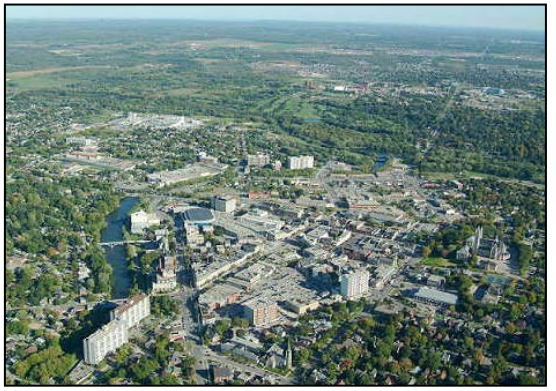
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

LAKE ERIE SOURCE PROTECTION REGION

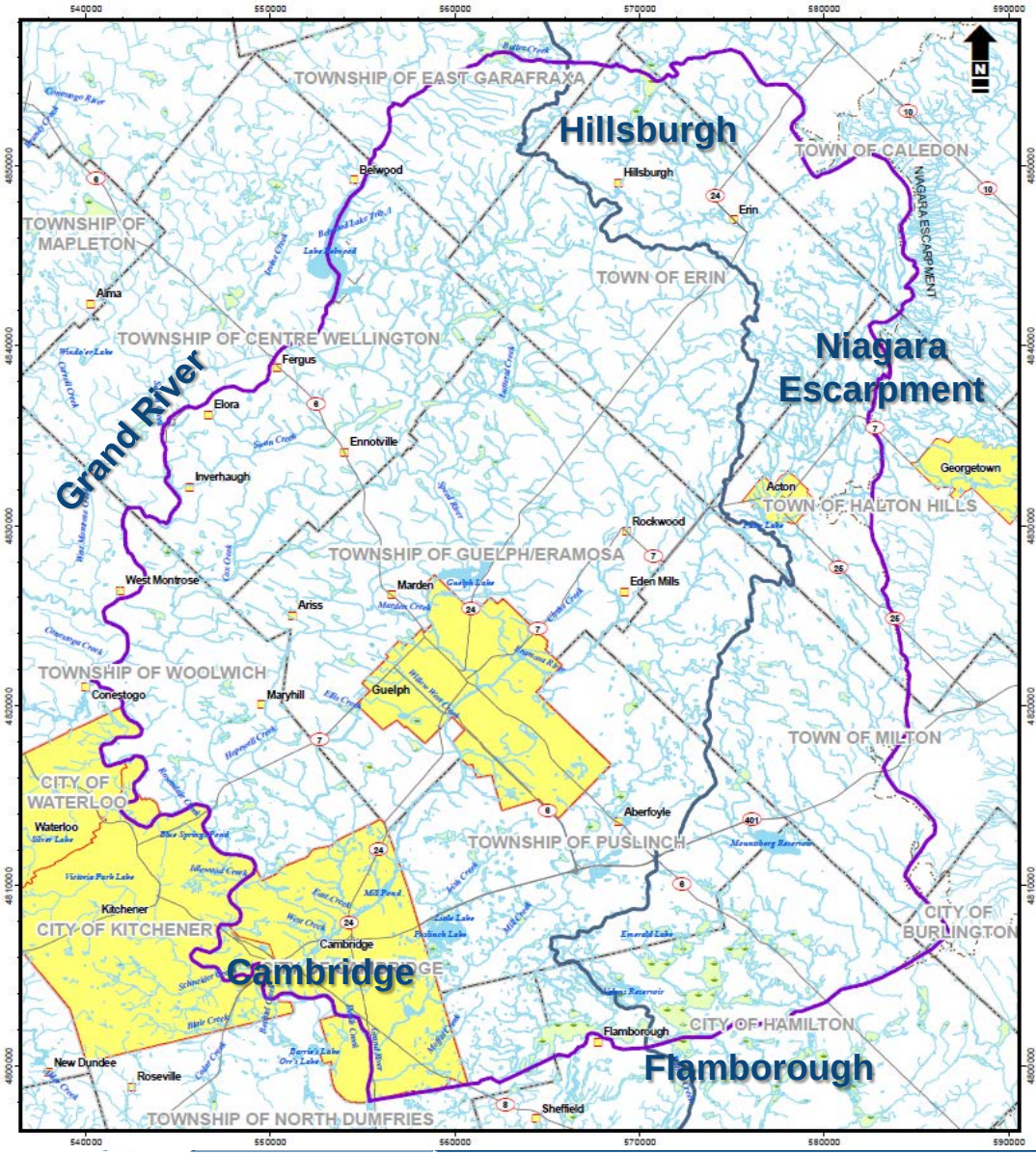
April 6, 2017

Guelph – Guelph/Eramosa Tier 3

- Initiated in 2008 as a pilot before guidance and technical rules finalized (similar to ROW Tier 3)
- Focused on the municipal water supplies for the City of Guelph (2008-2014) and the Township of Guelph-Eramosa (in Rockwood and Hamilton Drive) (2014-2017)



Guelph-GET Tier 3 Study Area



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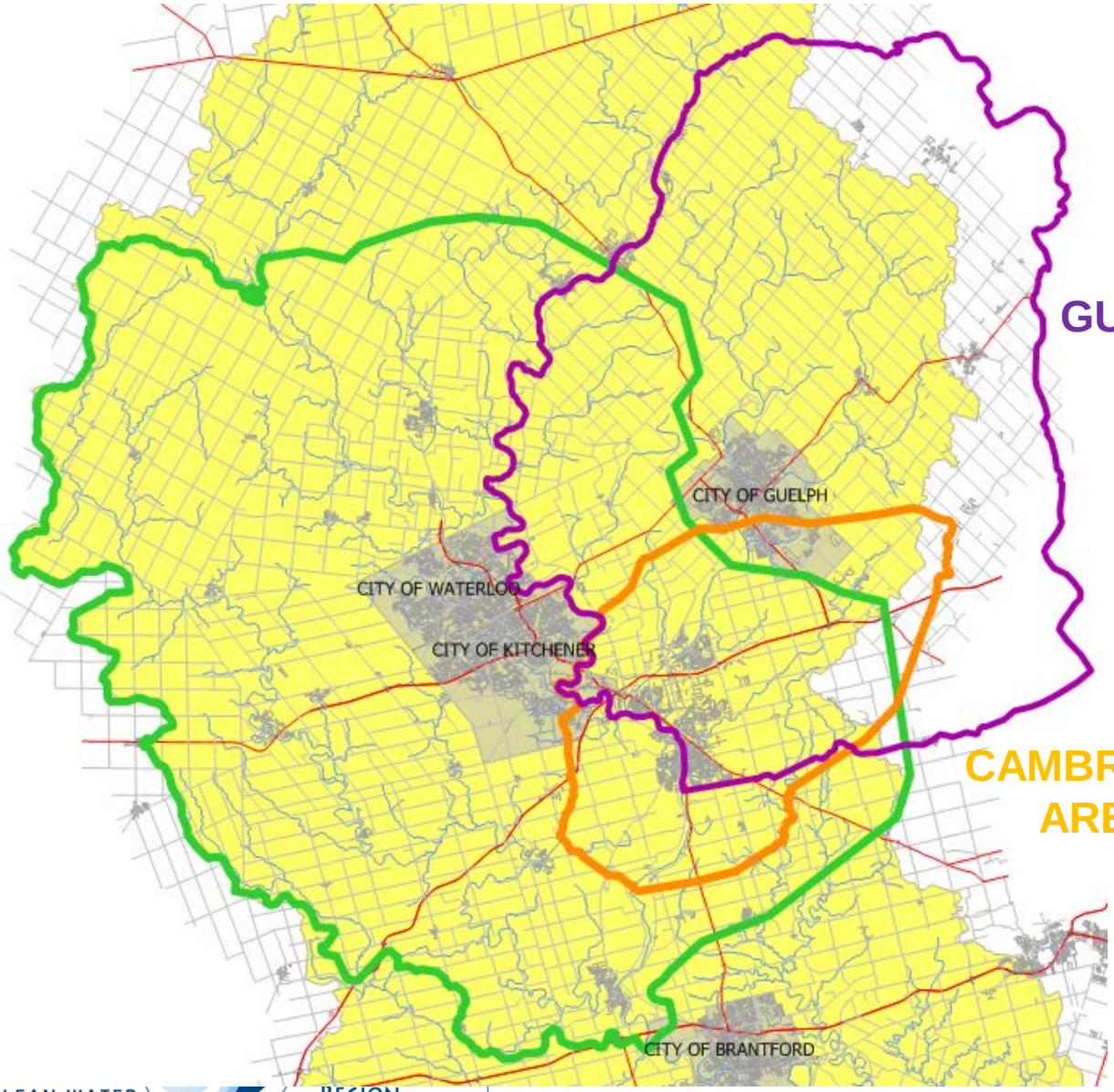
Adjacent Tier 3 Studies

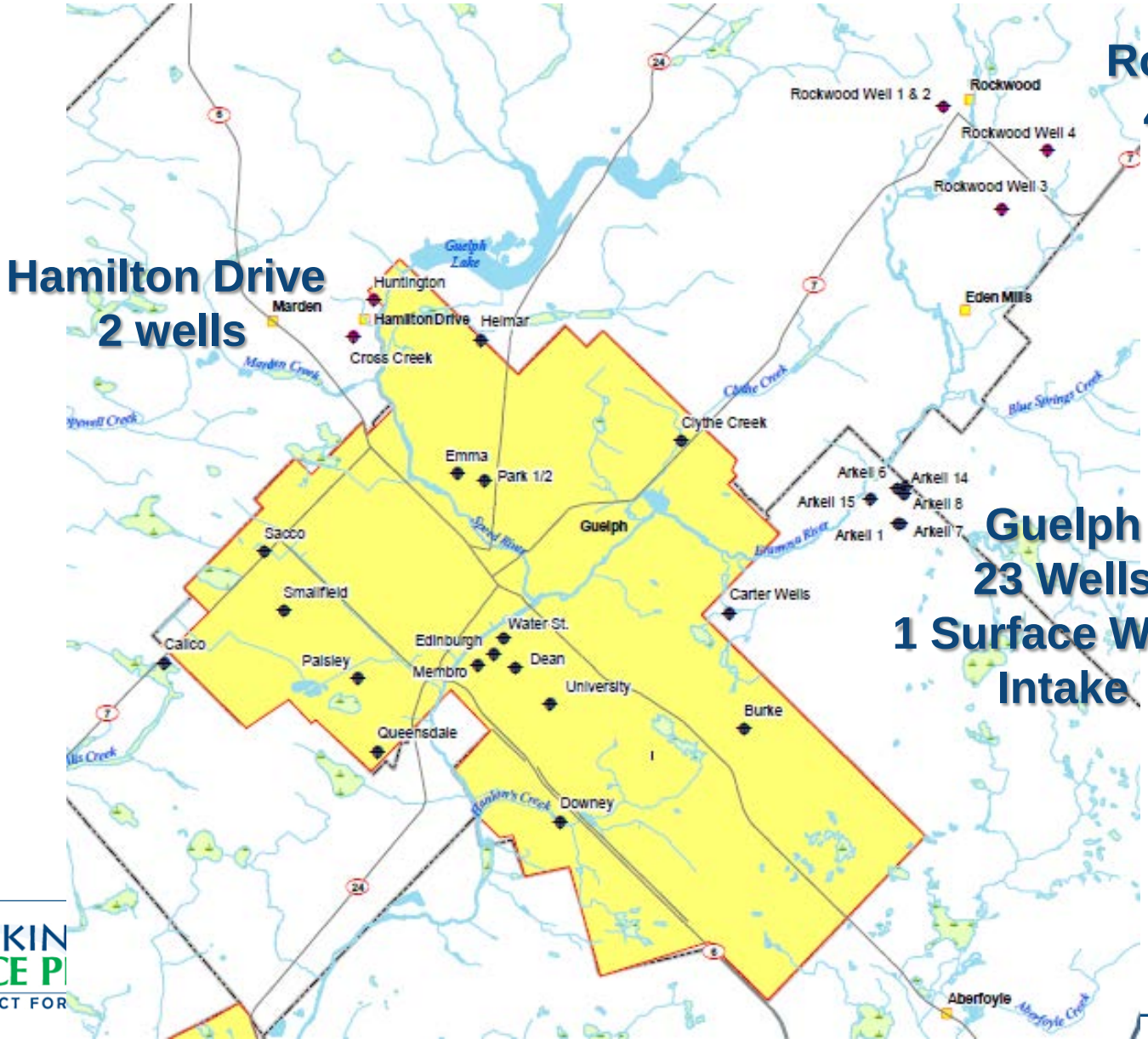


REGION OF WATERLOO

GUELPH/GET

CAMBRIDGE AREA

Tier 3 Municipal Wells / Intake



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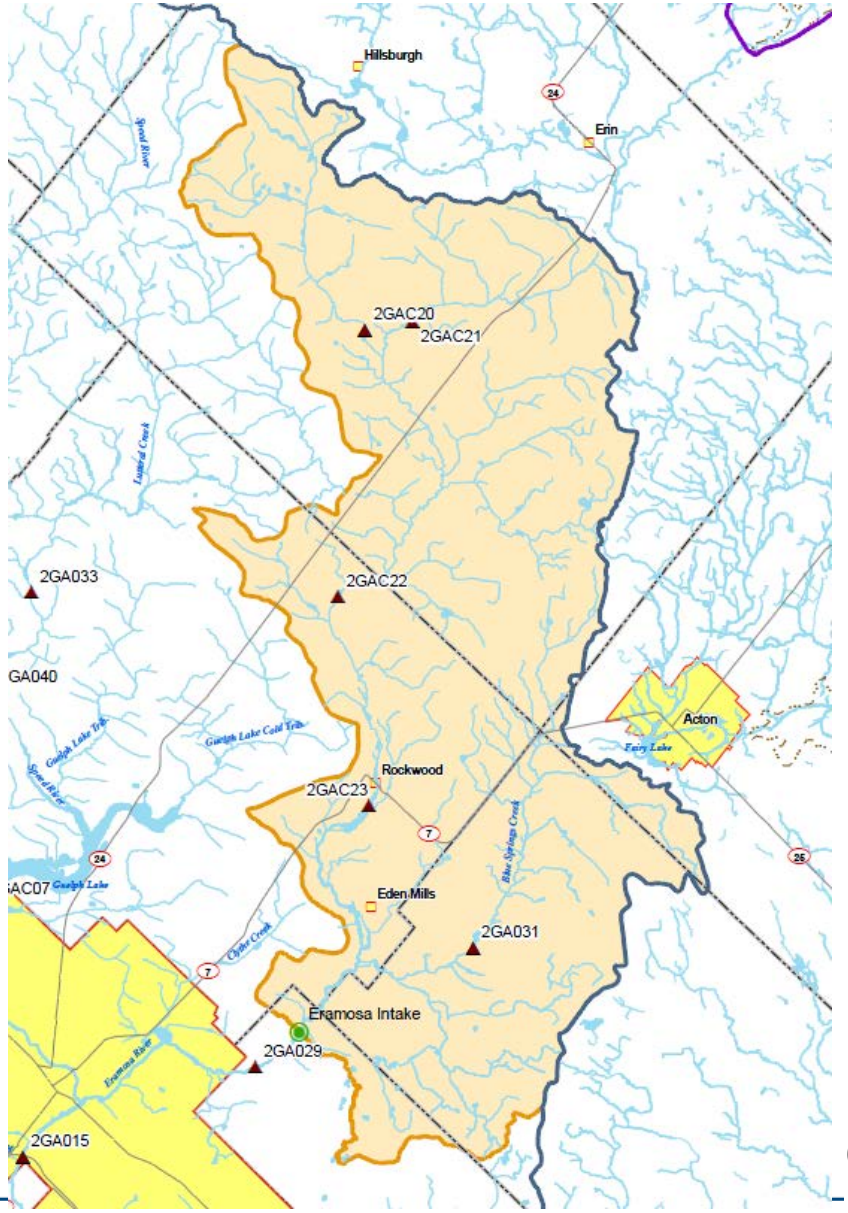
Eramosa River Surface Water Intake and Contributing Area

- City of Guelph
  - Surface water intake on the Eramosa River
  - Supplies water to Arkell Artificial Recharge/Glen Collector system
  - Upstream contributing area stretches to Hillsburgh



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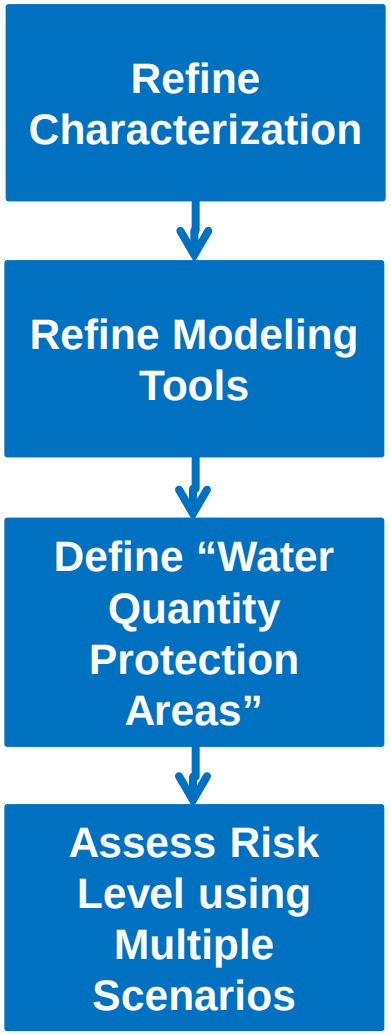
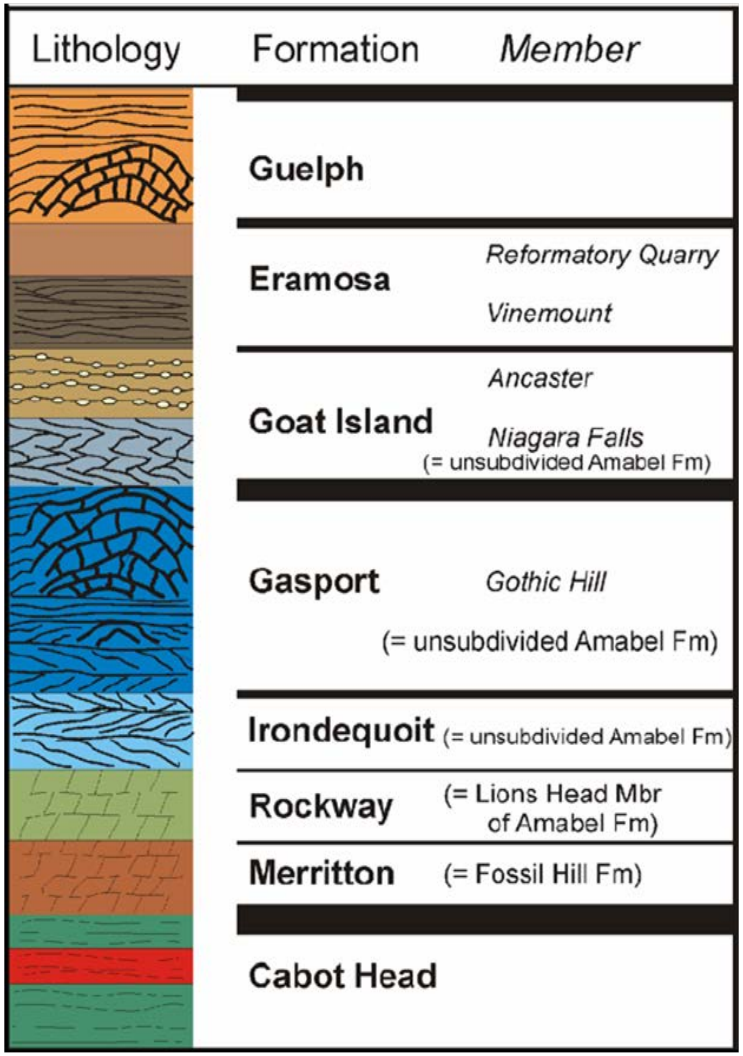
Tier 3 Risk Assessment

- **Characterize**
  - Hydrology
  - Hydrogeology
  - Demand (municipal and non-municipal)
- **Modelling Tools**
  - Surface Water & Groundwater
- **Delineate "Water Quantity Protection Areas"**
  - WHPA-Q, IPZ-Q
- **Risk Assessment Scenarios**
  - Assign semi-quantitative 'RISK'
  - Evaluate hydrogeologic uncertainty
- **Risk Assessment followed the MOECC Rules**



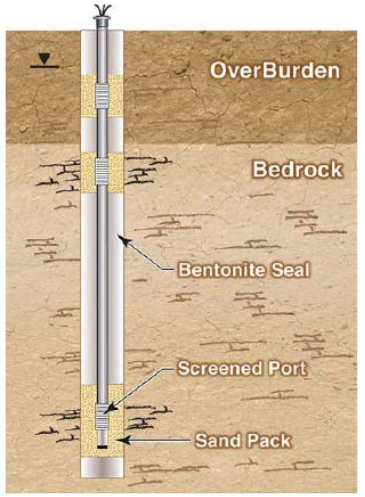
Refine Characterization

- ***Conceptual Understanding***
  - Refine Conceptual Geologic Model
  - Analyze Data gaps toward Understanding Uncertainty
  - Estimate Water Demand; Allocated Rates
  - Identify Other Uses (coldwater streams)
- ***Final Products***
  - 11 High-quality boreholes
  - 2 Characterization reports
- ***Connected to ROW Tier 3***
  - Shared bedrock conceptualization



Field Studies (2008/09)

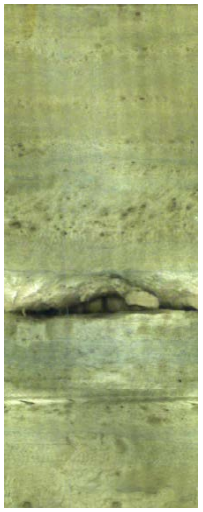
- Streamflow Monitoring (spot baseflow)
  - ~30 locations, 3 rounds
- Drilling
  - 11 locations
- Partnership with OGS and U. of Guelph

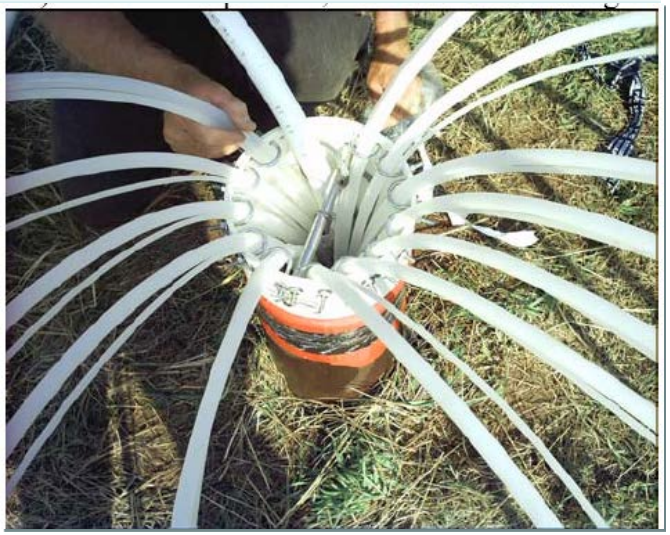


Direct Placement: Sand and Bentonite with Screened Ports

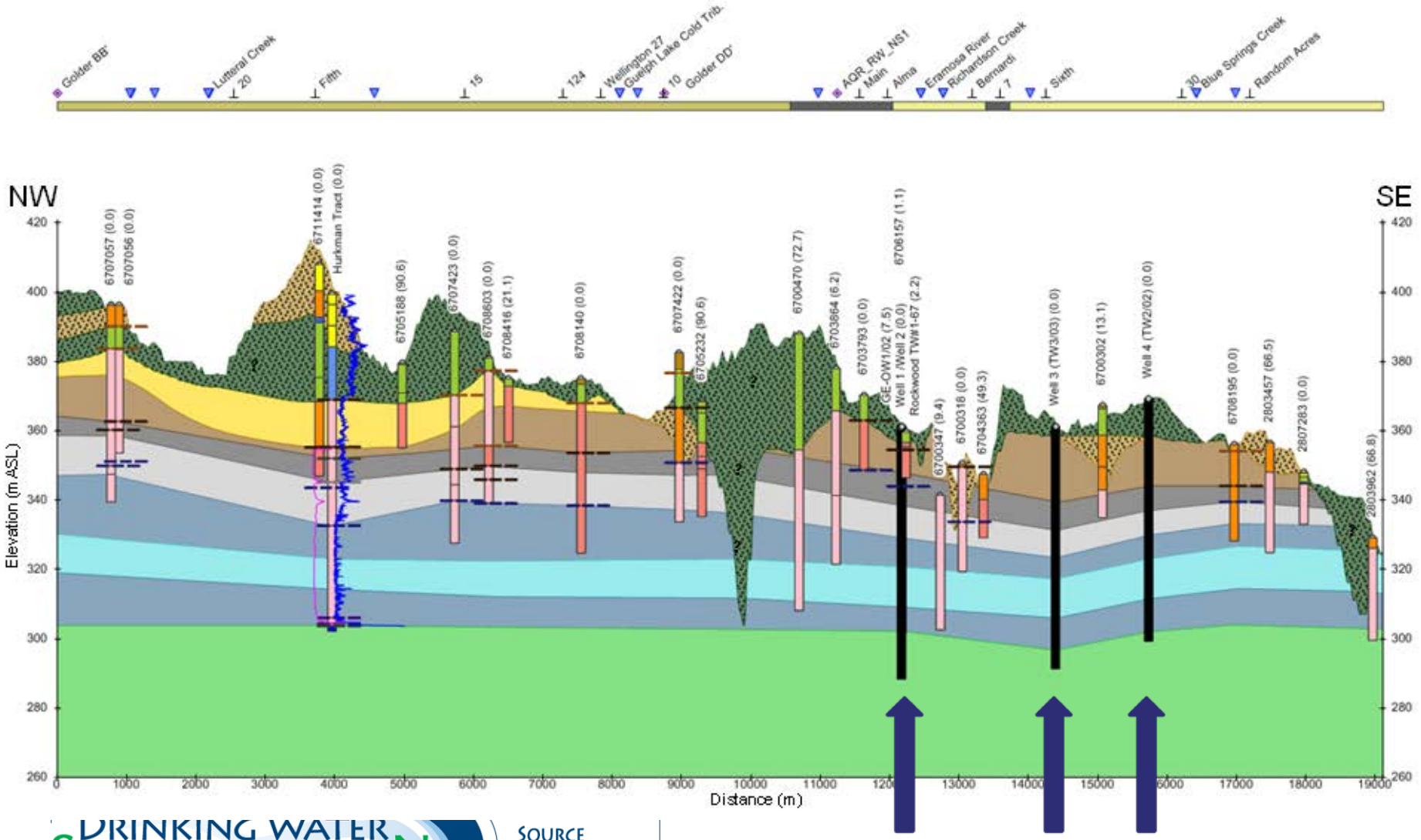
Gasport Formation

Ref. Quarry Member

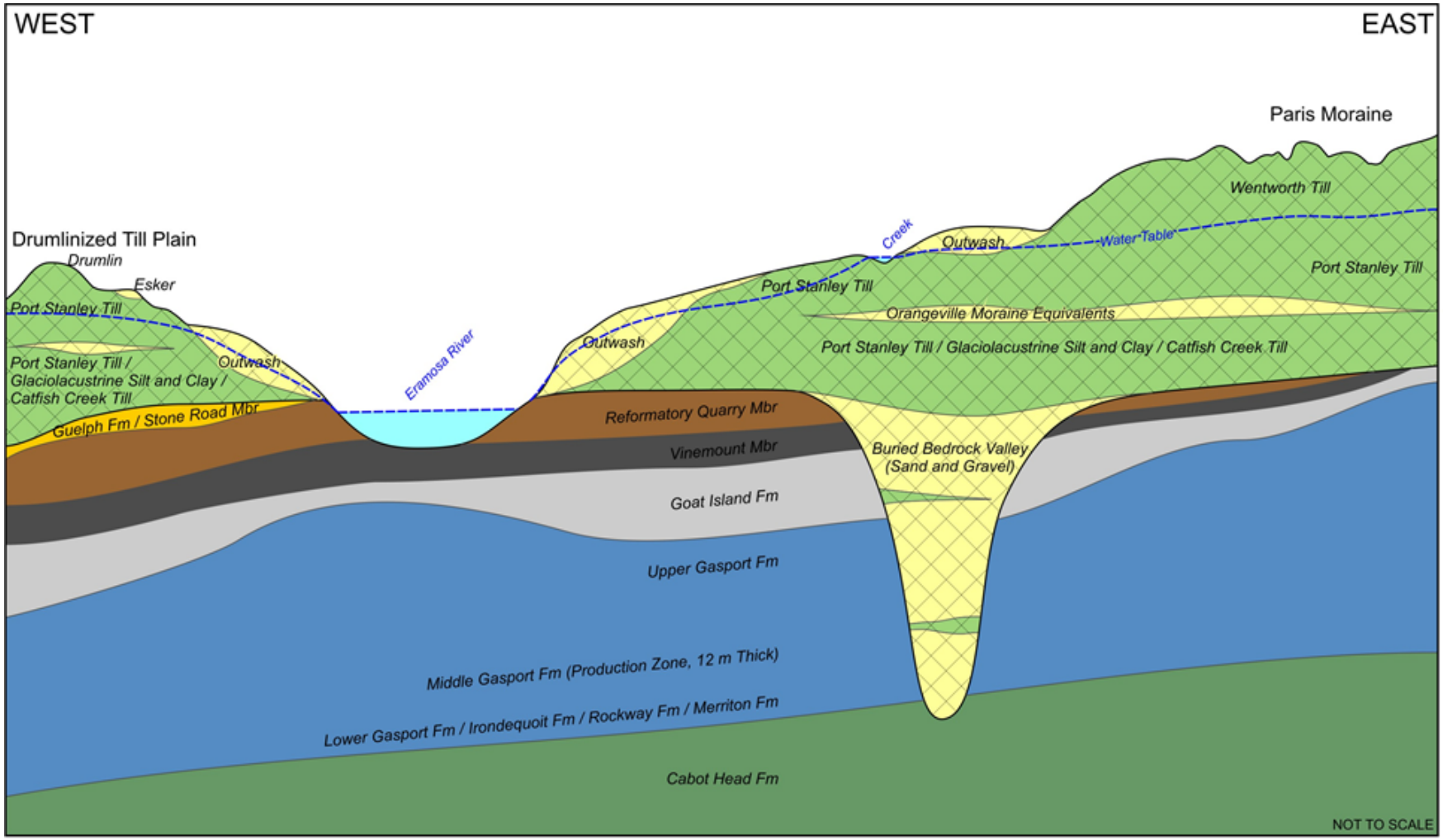




Interpreted Geologic Cross-Section (Rockwood)



Conceptual Model Cross-Section



Municipal Water Demand

- Allocated Demand = Existing + Committed
- Committed Demand
  - Short term increases in supply that the municipality has committed to providing
  - Involves estimating unconnected Registered, Draft Approved lots, or lots that are in the process of being approved.
- Planned demand
  - Demand that the municipality is planning for, but have not yet obtained capacity for.
  - No planned wells in the Study Area

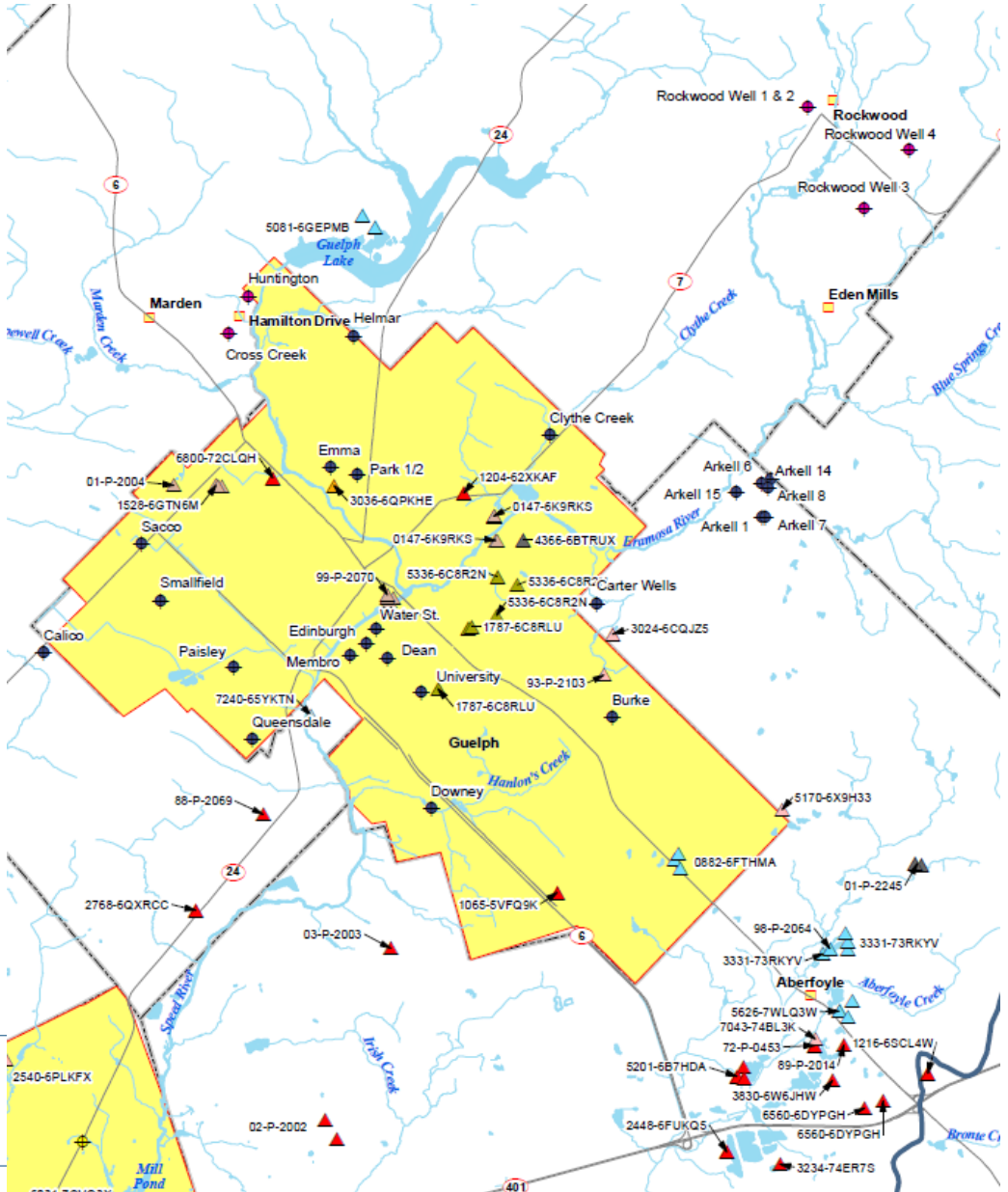
Municipal Water Demand

- Existing demand - 2008 (Guelph) and 2009-2010 (GET)
- Future water demands refined by:
  - Guelph through Water Conservation and Efficiency Strategy Update (2009)
  - GET through Water Use and Infrastructure studies (2011, 2013)

Municipal System	Municipal Pumping Rates (m^3/d)		Time Horizon
	Existing	Future	
City of Guelph	47,700	71,600	2031
Rockwood	970	1,910	2026
Hamilton Drive	179	185	2020

Non-Municipal Water Demand

- Agricultural
- Commercial
- Dewatering
- Industrial
- Institutional
- Miscellaneous
- Recreational
- Remediation
- Water Supply



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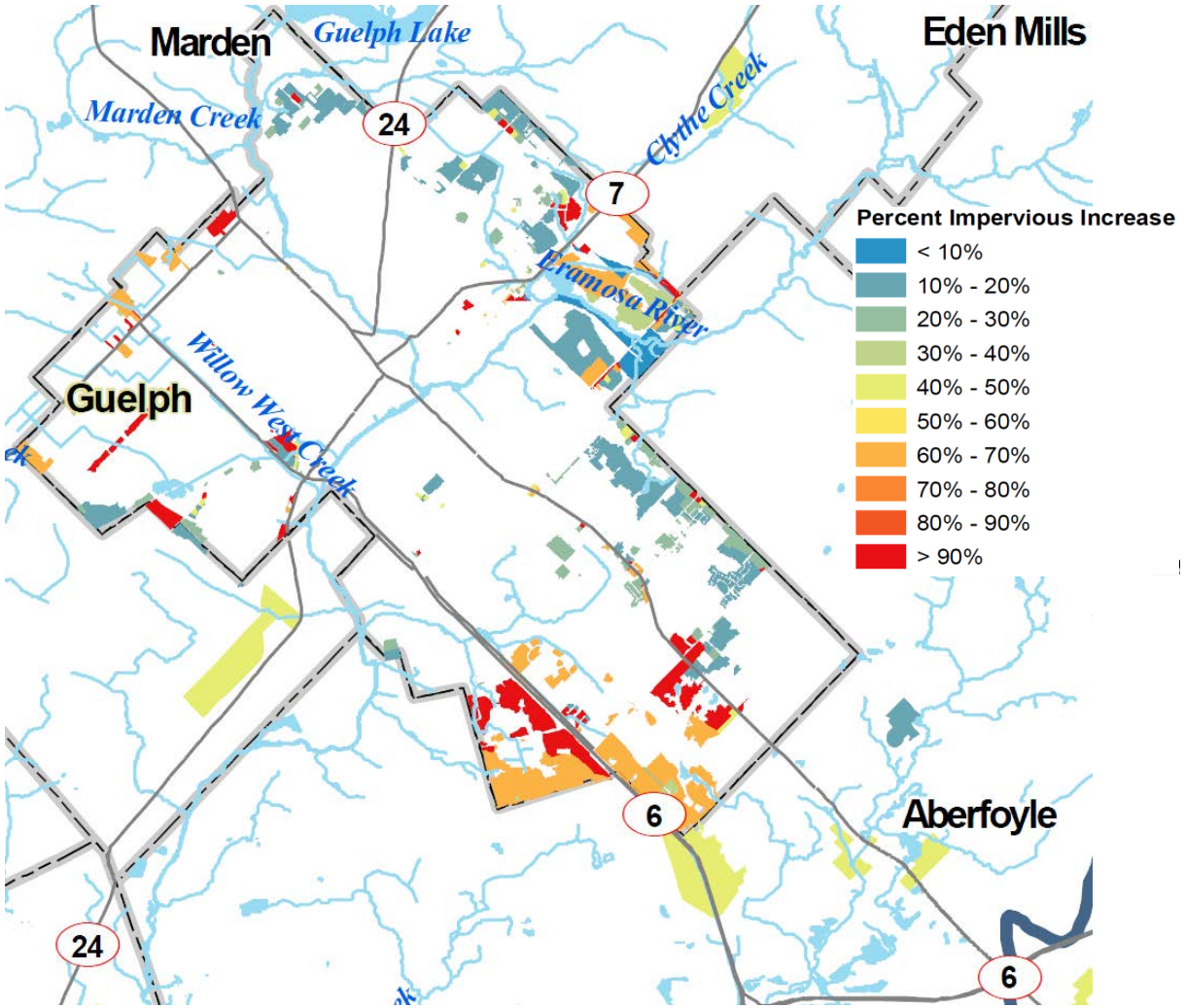
Future Land Use

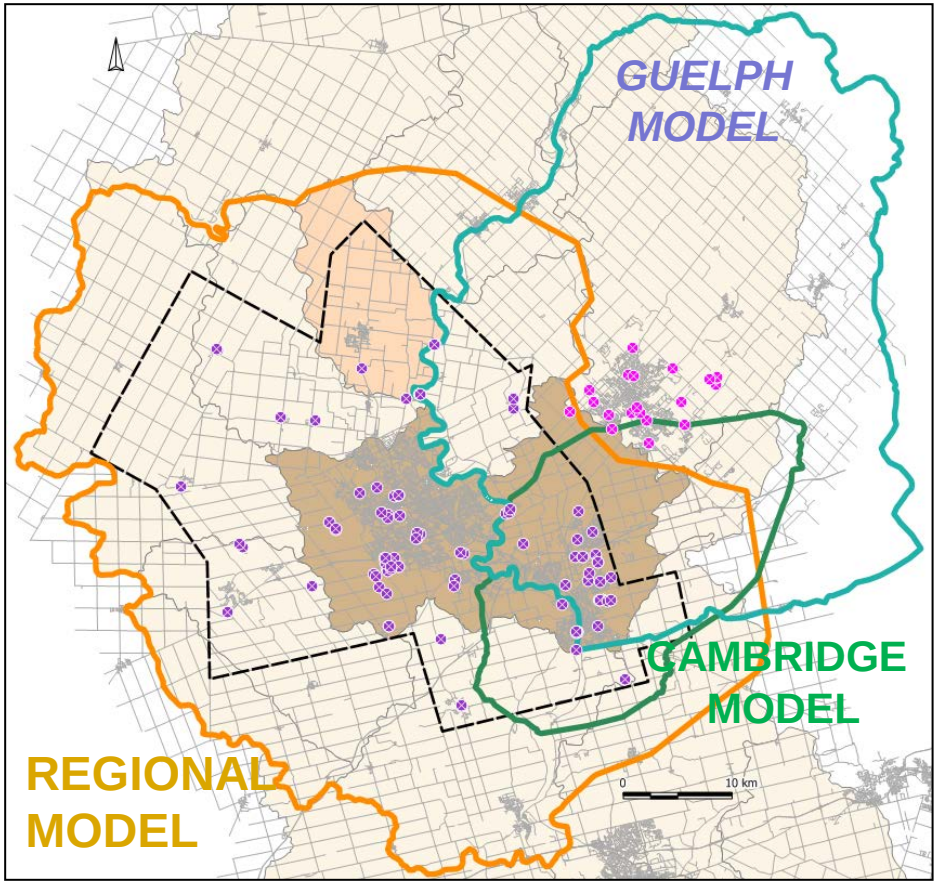
- Assess possible reductions in groundwater recharge
- Assume full development as per Official Plan
- Map illustrates areas of future development



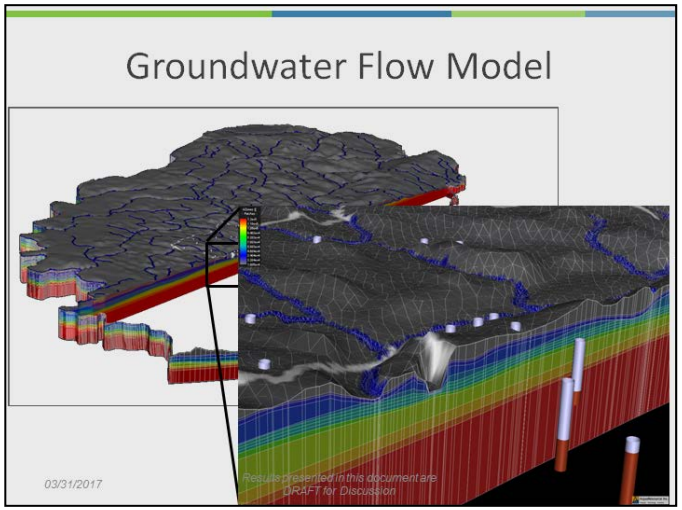
Refine Modeling Tools

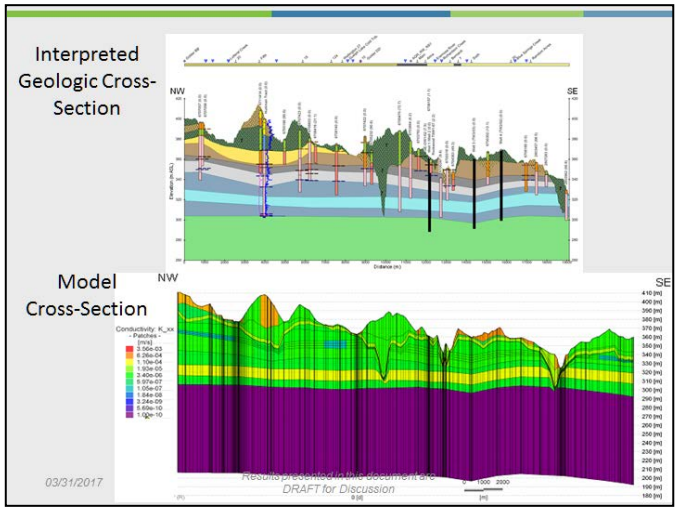
➢ *Numerical Modelling*

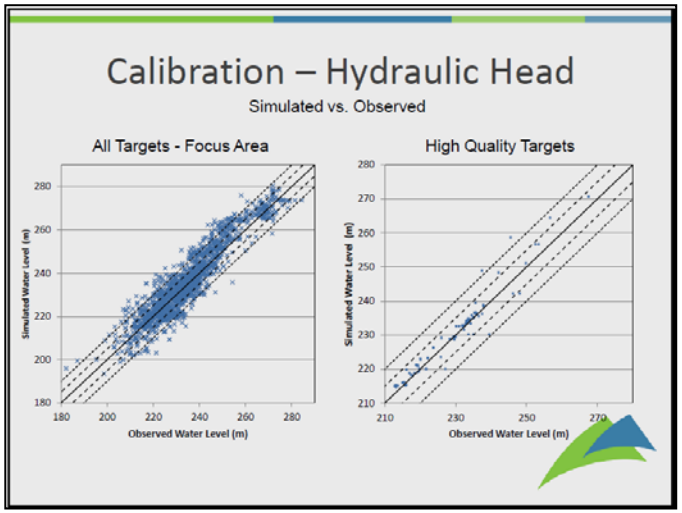
- Utilize a coupled modelling approach to represent SW and GW systems
- Built upon previous Guelph work including the Guelph-Puslinch groundwater FEFLOW model (2006)
- Updated Grand River GAWSER (streamflow generation) Model
- According to funding agreement, City owns the model

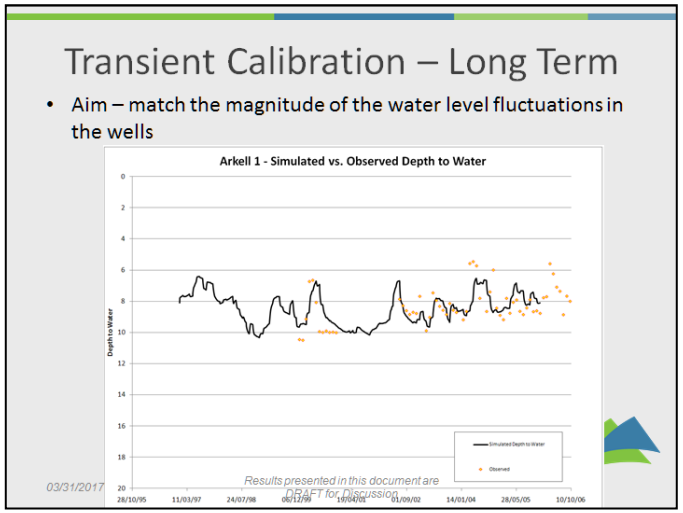


Model Development and Calibration









Risk Assessment

- **Steps in the Process:**
  - Design scenarios & prepare data
  - Run model scenarios for growth and drought
  - Map water quantity protection areas (IPZ-Q, WHPA-Q)
  - Assign Risk to protection areas
  - Threat identification
  - Uncertainty analysis - risk assessment & threats

- **FINAL PRODUCT – Guelph-GET Tier 3 Water Budget and Local Area Risk Assessment Final Report (March 2017)**

Risk Assessment Scenarios

Risk assessment scenarios were used to test different situations, e.g.:

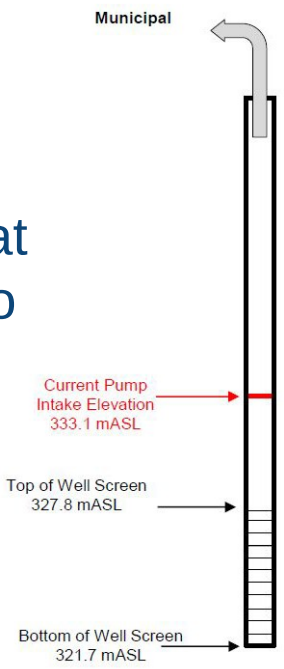
- Can the wells meet existing needs under normal climate conditions (1960-2005) and existing land cover?
- Can the wells meet future needs during a 10 year drought period and future land cover (Official Plan build out)?

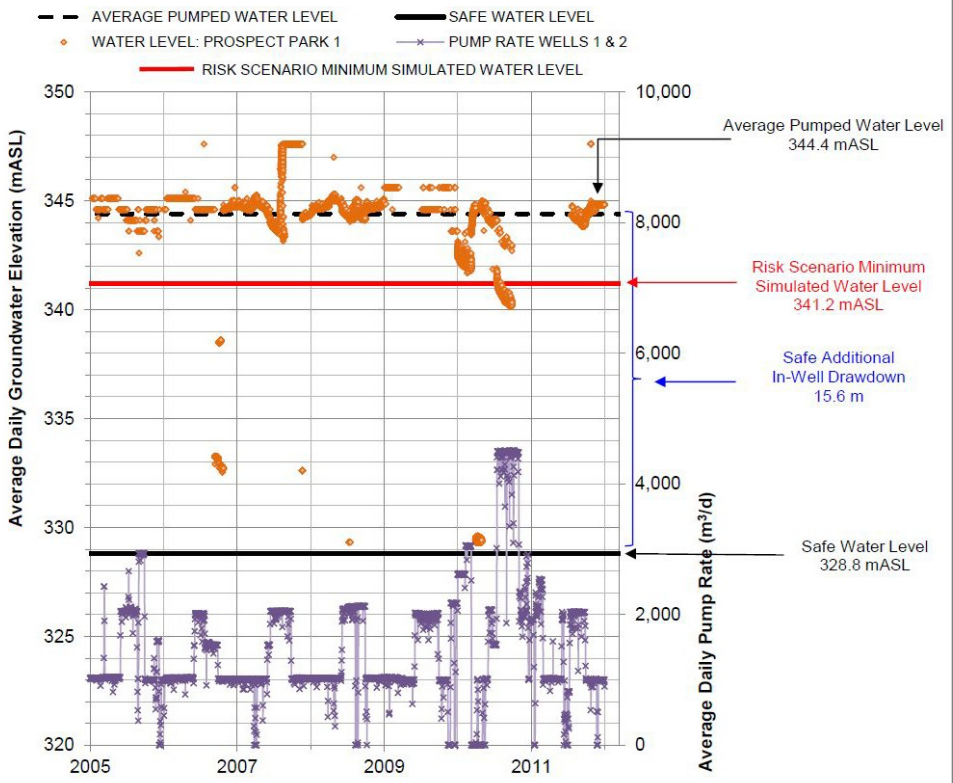
Risk Assignment Criteria

- Risk Level is **Significant**
  - Well is not able to meet existing demands
  - Well is not able to meet future needs
- Risk Level is **Moderate**
  - Well can meet future needs, but there is a potentially unacceptable impact to other water uses
    - >10% reduction in groundwater discharge to coldwater fisheries from existing conditions
    - A reduction in flows or water level (e.g. under Provincially Significant Wetland)
- Risk level is **Low**
  - no circumstances are triggered

Wells - Safe Additional Available Drawdown (SAAD)

- The maximum amount of drawdown that each municipal well can sustain, while still meeting demand
- Key threshold for assigning Risk
- SAAD determined by municipality
- Simulated drawdown at wells for each scenario is compared to SAAD
- If drawdown > SAAD
  - Significant Risk Level





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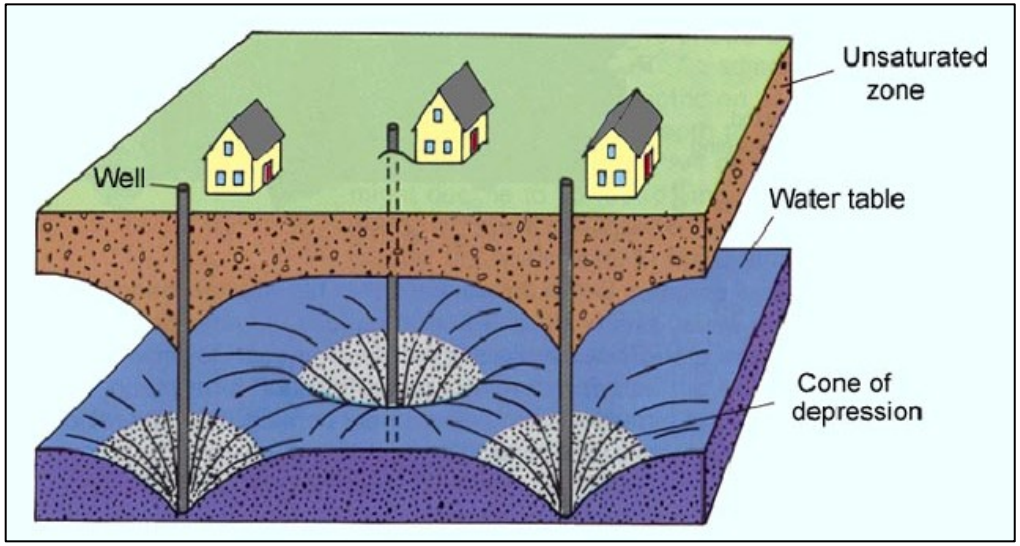
Water Quantity Protection Areas

- WHPA-Q
  - Determined using current municipal pumping rates



  - Combines the area where municipal wells lower the aquifer (cone of influence AND the cones of influence or other permitted water takings that intersect.

Water Quantity Threats

For a WHPA-Q or IPZ-Q with a Significant Risk Level, the following activities are identified as being a significant risk:

- All permitted water uses* (includes municipal and non-municipal takings)
- Land use activities that reduce groundwater recharge

* The Technical Rules identify all water takings, i.e., including private residential wells as a significant risk, but no management measures are required for private residential wells.

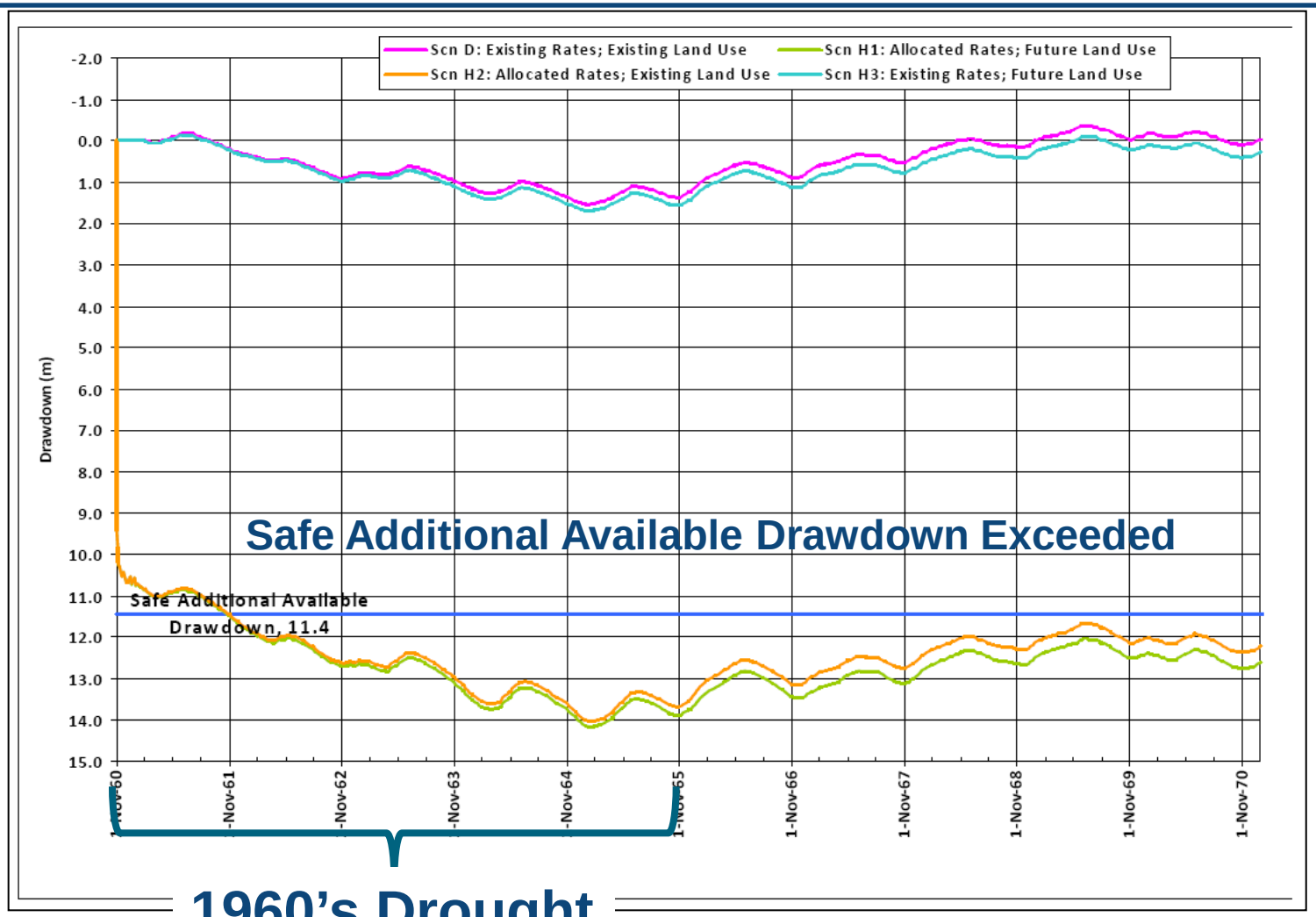
Guelph-Guelph/Eramosa

TIER THREE RESULTS

Drawdown at Municipal Wells

- Queensdale Well
  - Drawdown exceeds Safe Water Level -> Significant Risk Level
- Arkell Well 1 has high uncertainty level
  - Would also result in Significant Risk Level
- SAAD at eight wells < 1 m during drought scenarios:
  - Arkell Well 1, Arkell Well 14, Arkell Well 15, Arkell Well 8, Burke Well, Carter Well, Emma Well, and Rockwood Well 3

Queensdale – Drought Scenarios



1960's Drought

Guelph-GET Tier 3 Results

- Drawdown threshold exceeded at Queensdale Well and eight other wells have less than 1 meter of additional available drawdown
- Tier 3 Local Area Risk Assessment Scenarios predicted a *Significant* Risk Level to the Local Area of the City of Guelph and Township of Guelph-Eramosa (Hamilton Drive Wells)
- MOECC accepted the Guelph-GET Tier 3 Water Budget and Local Area Risk Assessment Report on March 23, 2017, following provincial peer reviewers sign-off.

Municipal Peer Review

- Tier 3 study was reviewed by local municipalities and their consultants
- Local municipalities participated as municipal peer reviewers:
  - Provided data and information on local systems
  - Provided comments on the draft report
  - Worked with the Tier 3 consultant to address issues and concerns and to improve the model
  - Participated in numerous technical and administrative meetings with the project team
- Raised technical concerns that were presented to the Provincial peer reviewers
- Concerns were evaluated and addressed, where required, through model revisions

Provincial Peer Review

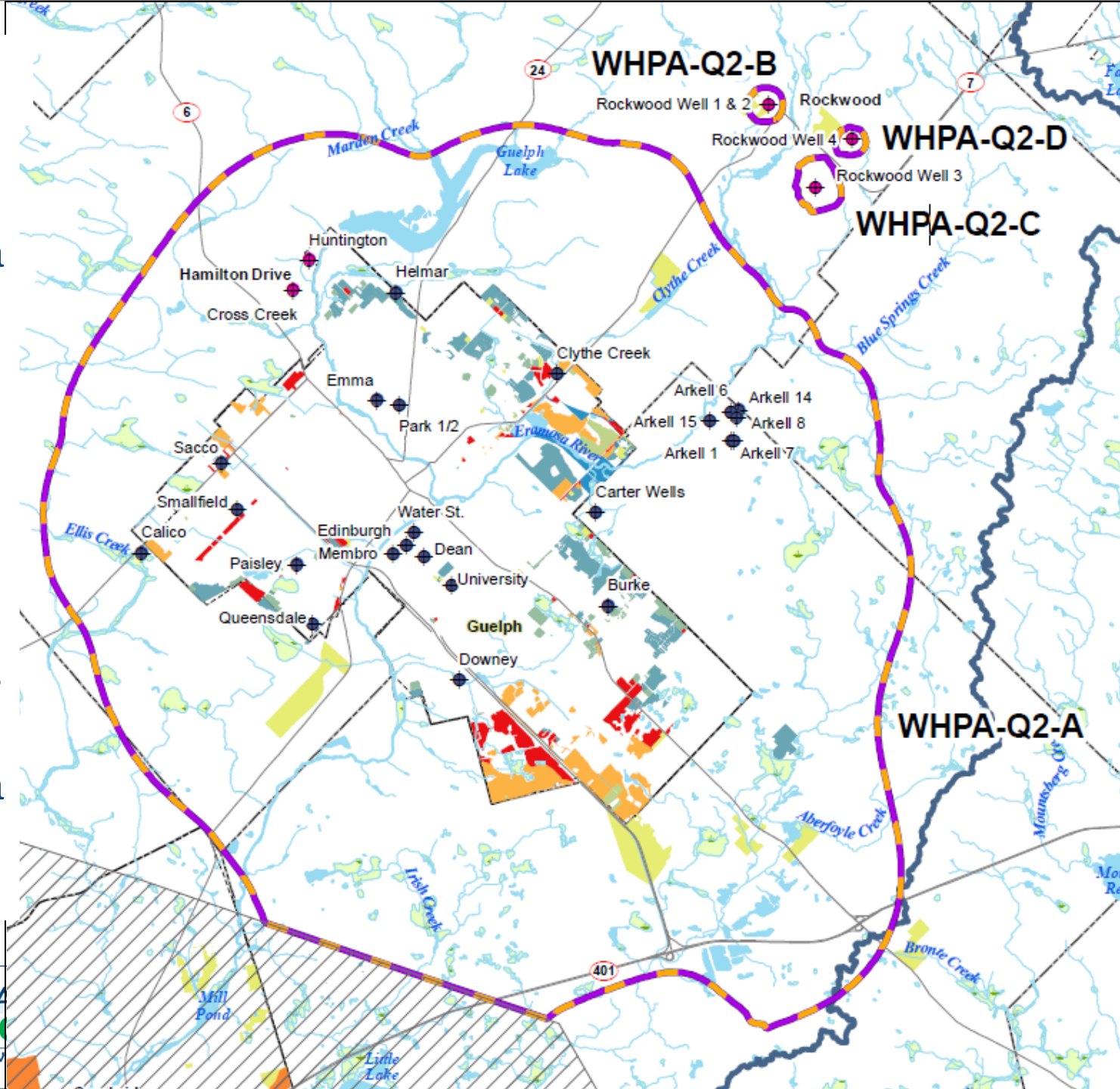
- Tier 3 study was peer reviewed on behalf of the province by a team of highly qualified third party technical experts working in both academia and private consulting
- Provincial peer reviewers considered concerns raised by municipalities
- Provincial peer reviewers deemed model “fit for purpose”
- Provincial peer reviewers accepted Tier 3 study
- Addressing outstanding municipal concerns could be considered in future work plans

WHPA-Q

For City of Guelph and Guelph/Eramosa Township (Hamilton Drive Wells)

Assigned *significant* risk level

Low risk level for WHPA-Qs for Guelph/Eramosa Township Rockwood Wells



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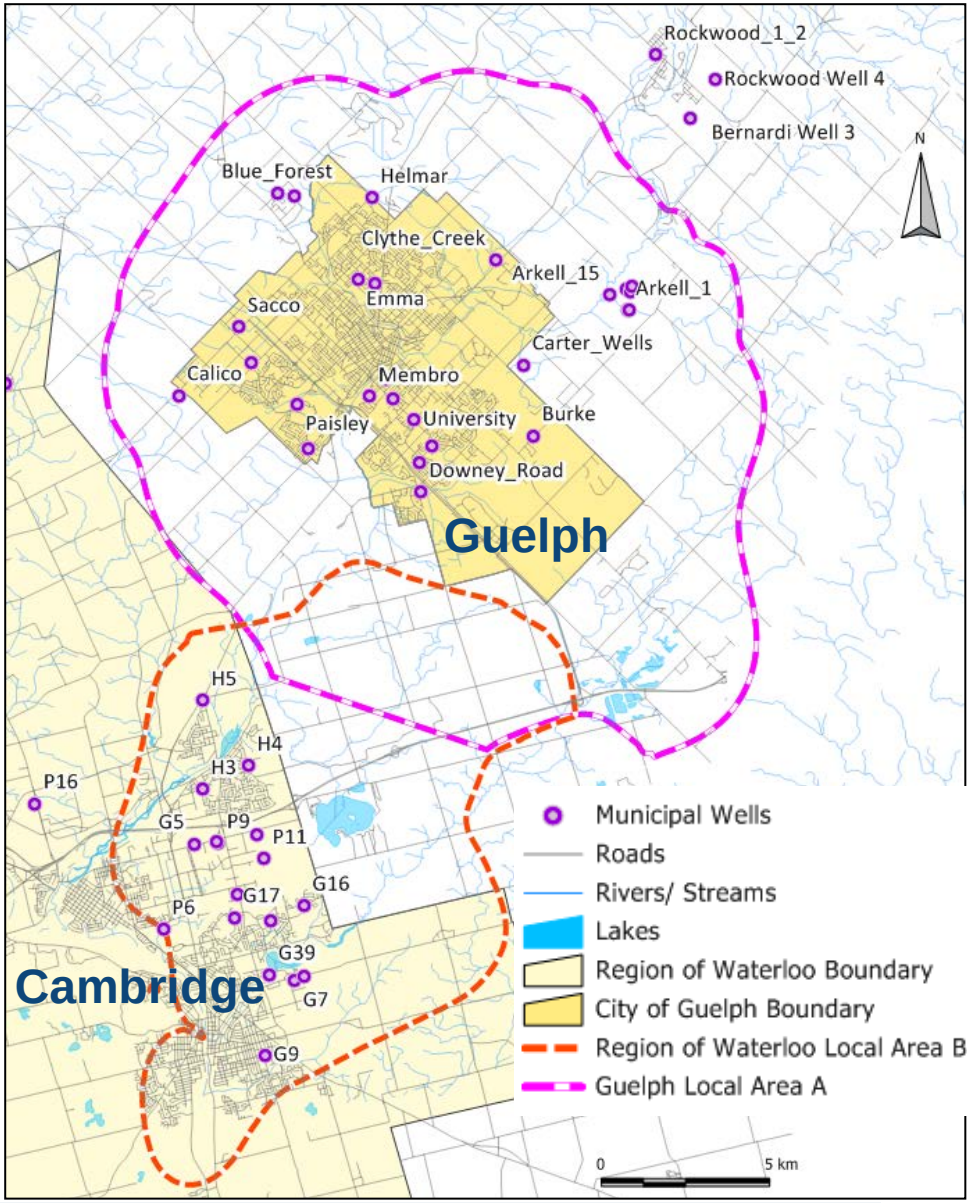
Guelph-GET & ROW WHPA-Q Overlap

- Most municipal wells in Cambridge and Guelph draw water from the same bedrock aquifers (Guelph and Gasport Formation)
  - When wells in Cambridge and Guelph pump at current rates - predicted drawdown cones will extend beneath Cambridge and Guelph
  - Led to one WHPA-Q
  - Professional judgement was applied to separate the WHPA-Q using a groundwater flow divide



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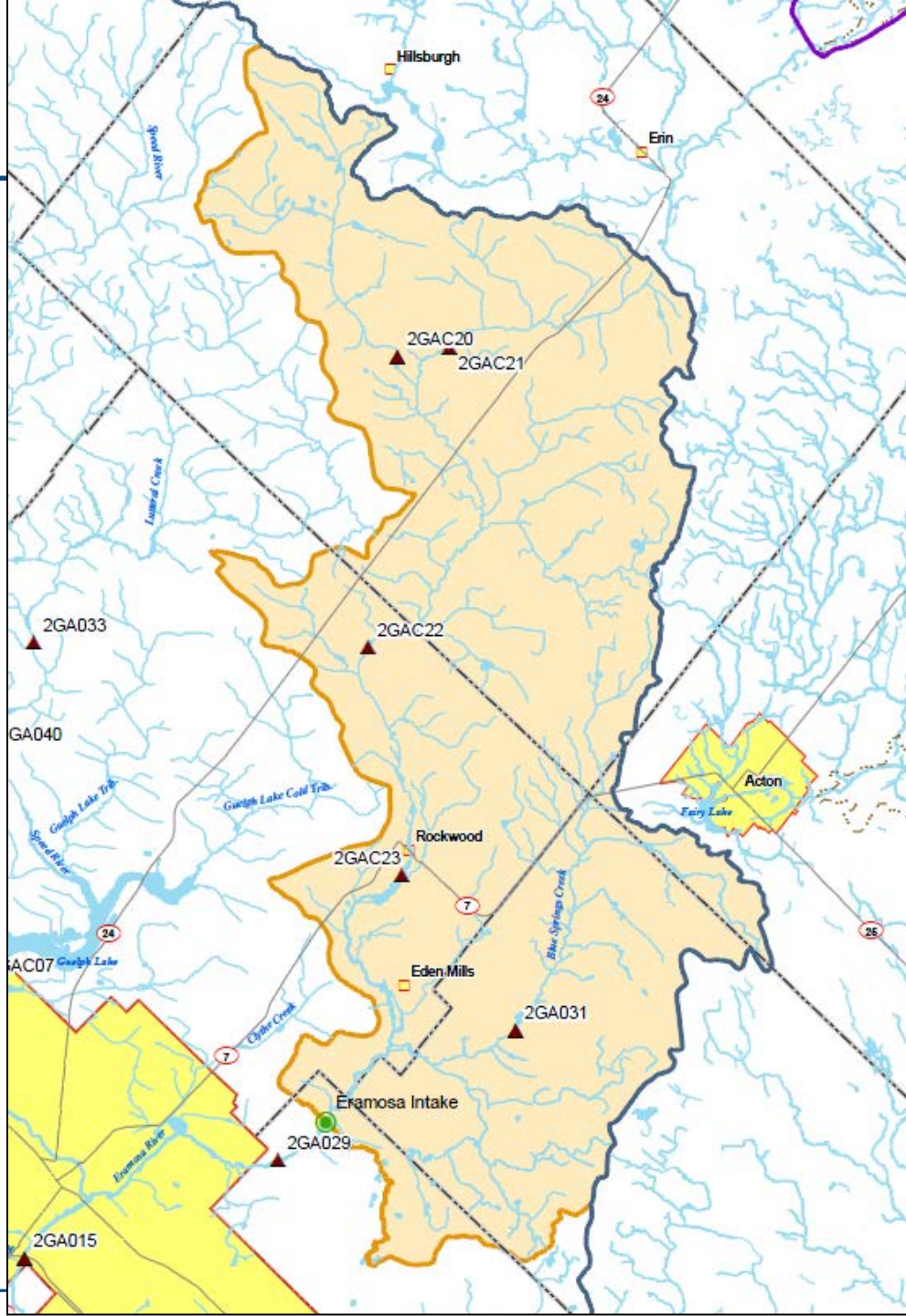
IPZ-Q

- Area upstream of the surface water intake on the Eramosa River
- Risk level was adopted from WHPA-Q because of interconnection through Arkell System
- Assigned *significant* risk level



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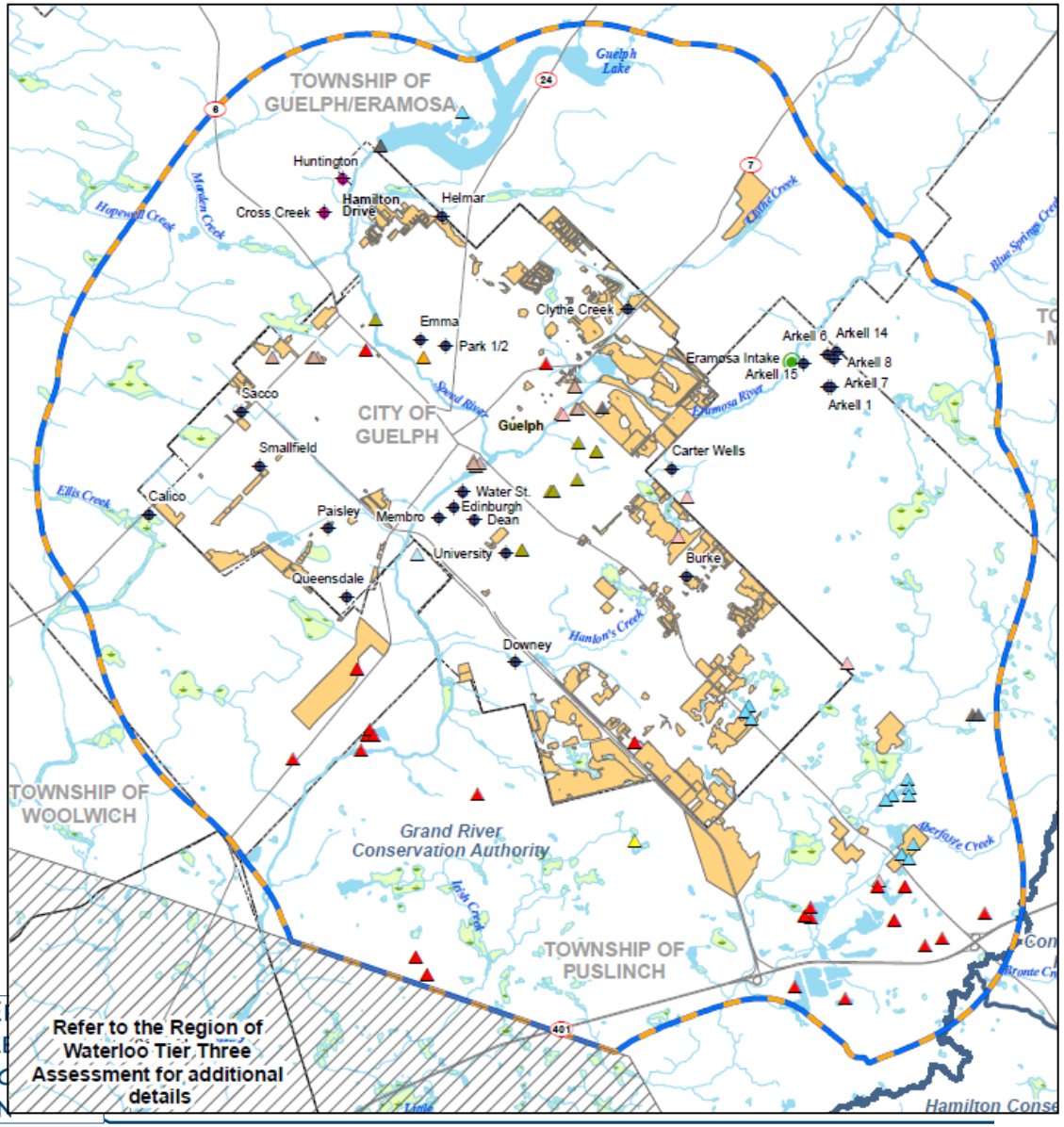
Drinking Water Quantity Threats

Water Quantity Wellhead Protection Area (WHPA-Q)

- **28 Municipal**
- **71 Non-Municipal, Permitted**
- **16 km² Recharge Reductions**
  - **5% of area**



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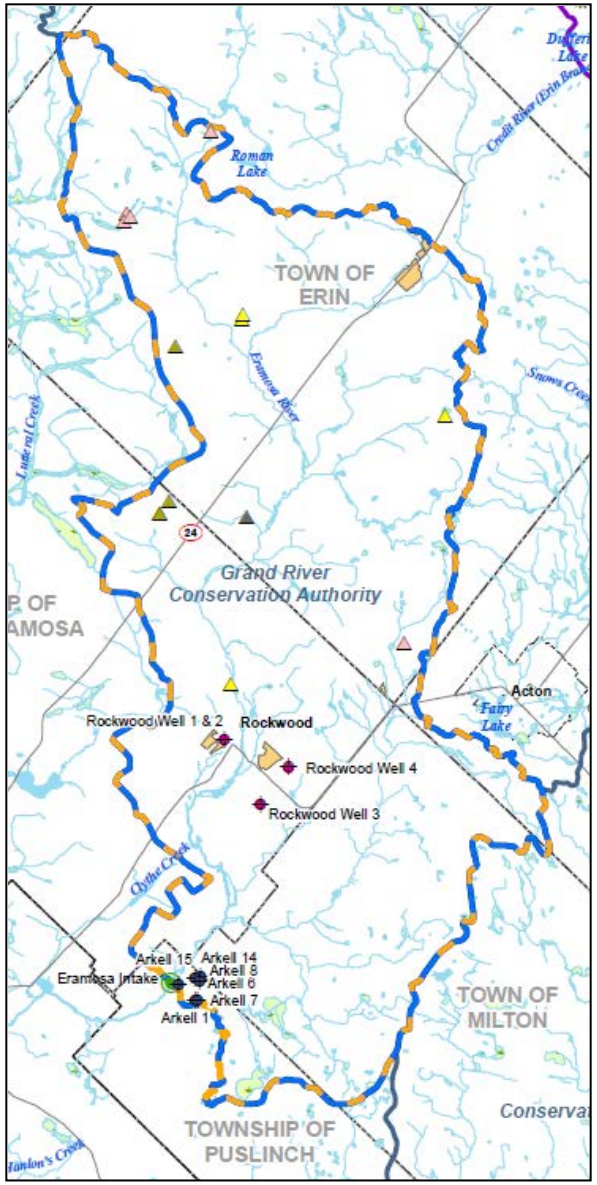
Drinking Water Quantity Threats

Water Quantity Intake Protection Zone (IPZ-Q)

- **11 Municipal**
- **13 Non-Municipal, Permitted**
- **1.0 km² Recharge Reductions**
  - **0.4% of area**



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Next Steps

- Undertake Risk Management Measures Evaluation Process (MOECC funding in place)
  - Evaluate and determine water takings with greatest impact on municipal supplies – risk ranking
  - Exploring effective risk management measures (e.g., optimised pumping, water loss management, water conservation)
- Process will help guide development of Source Protection Plan policies
- Process will be collaborative project amongst municipal partners and the Lake Erie Region

Next Steps

- Develop water quantity policies for incorporation into the Source Protection Plan
  - Based on results of RMMEP
  - Policy development will be collaborative process amongst municipal partners and the Lake Erie Region
  - Significant public consultation process similar to water quality policy development
  - Will include public and stakeholder meetings, comments on policy approaches and draft policies, formal public consultation and requirement for municipal council resolutions
- Lake Erie Region will request extension of submission date (currently December 2017)

Conclusion

- Tier 3 Water Budget provides state of the art tool (Tier 3 Model) to develop sustainable groundwater management solutions for the benefit of everyone
- Lake Erie Region committed to moving forward in collaborative fashion to protect water for everyone

Recommendation

THAT the Lake Erie Region Source Protection Committee direct staff to incorporate the components of the report entitled *City of Guelph and Township of Guelph/Eramosa Tier Three Water Budget and Local Area Risk Assessment (Matrix Solutions Inc., March 2017)* into the Updated Grand River Source Protection Area Assessment Report.