

# PROTECTION

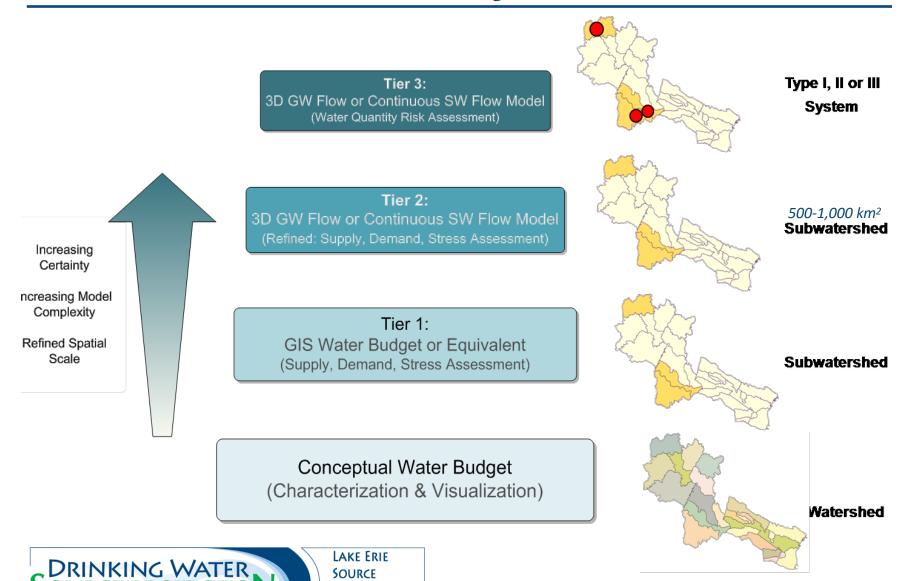
SPC-17-04-03: Region of Waterloo Tier 3 Water Budget and Local Area Risk Assessment

Lake Erie Region Source Protection Committee

April 6, 2017



# **Water Quantity Framework**



**PROTECTION** 

REGION

ACT FOR CLEAN WATER

#### **Tier 3 Risk Assessment**

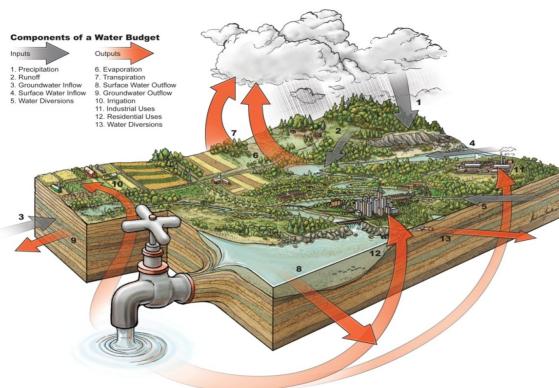
#### Where?

Tier Two Assessment Moderate or Significant stress

#### Goal:

- Assess the ability to meet future water quantity needs under scenarios:
  - 1. increased demand
  - projected land development
  - 3. drought conditions
- Highly detailed numerical models





Focus shifts from subwatershed analysis to wellhead / intake analysis.

# Region of Waterloo Tier 3

- Initiated in 2008 as a pilot before guidance and technical rules were finalized (similar to Guelph – Guelph/Eramosa Township Tier 3)
- Focused on the water supplies for the integrated urban municipal system in Kitchener, Waterloo and Cambridge, and rural well fields New Dundee and Conestogo Plains

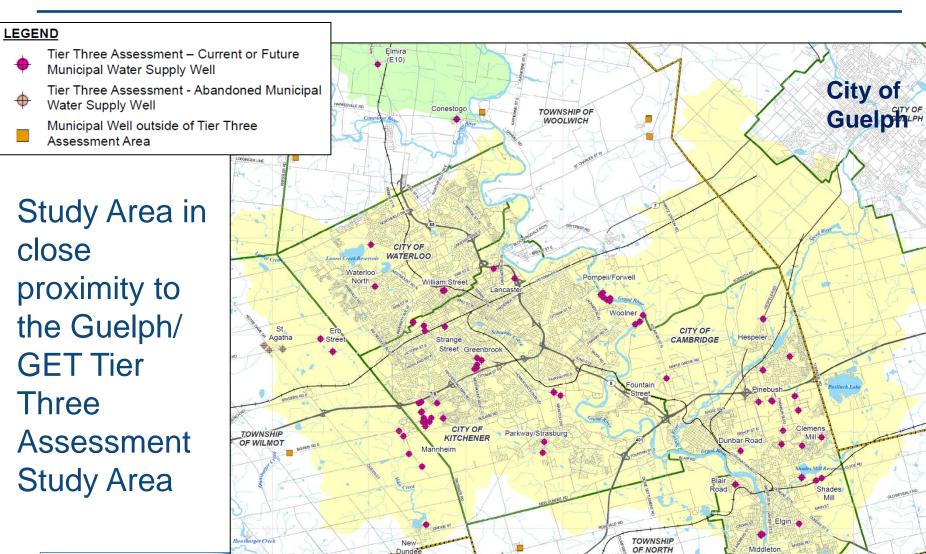








# Region of Waterloo Tier 3 Study Area



SOURCE PROTECTION REGION

DRINKING WATER

ACT FOR CLEAN WATER

#### Scale of the ROW Tier Three Assessment

- Largest municipal system assessed in the Province. Involved review and analysis of:
  - > 450 technical reports
  - > 40 years of water level data from hundreds of monitoring wells
  - > 40 years of pumping data from 80+ municipal wells
  - Other related data;
    - Water quality data
    - Streamflow/ baseflow data
    - Geophysical data







#### **Tier 3 Risk Assessment**

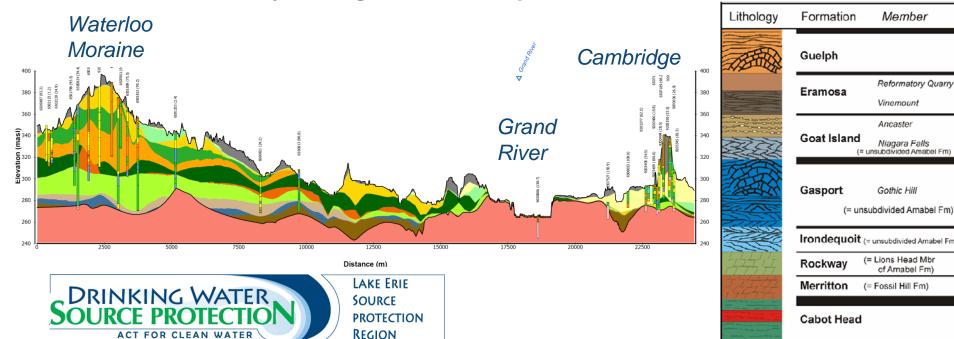
- Characterize
  - Hydrology
  - Hydrogeology
  - Demand (municipal and non-municipal)
- Modelling Tools
  - Surface Water & Groundwater
- Delineate "Water Quantity Protection Areas"
  - WHPA-Q
- Risk Assessment Scenarios
  - Assign semi-quantitative 'RISK'
  - Evaluate hydrogeologic uncertainty
- **➤**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



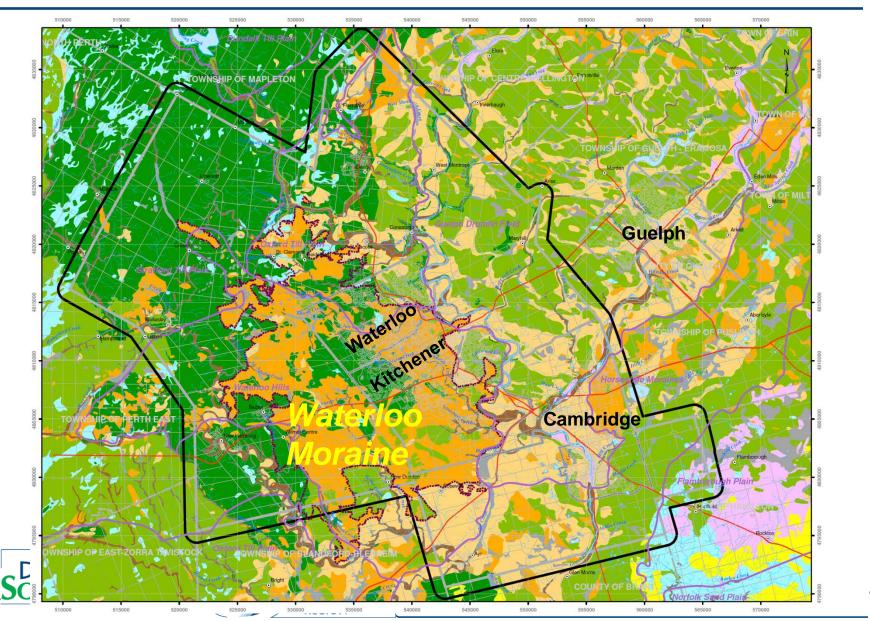


#### **Refine Characterization**

- Conceptual Understanding
  - Refine Conceptual Geologic Model
  - Analyze Data gaps toward Understanding Uncertainty
  - Estimate Water Demand; Allocated Rates
  - Identify Other Uses (coldwater streams)
  - ➤ FINAL PRODUCT 12 Well Field Characterization Reports (2009 to 2011), 8 Technical Memos (2008 to 2010) and a GAWSER Hydrologic Model Report.



# **Surficial Geology**



# **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 Region of Waterloo



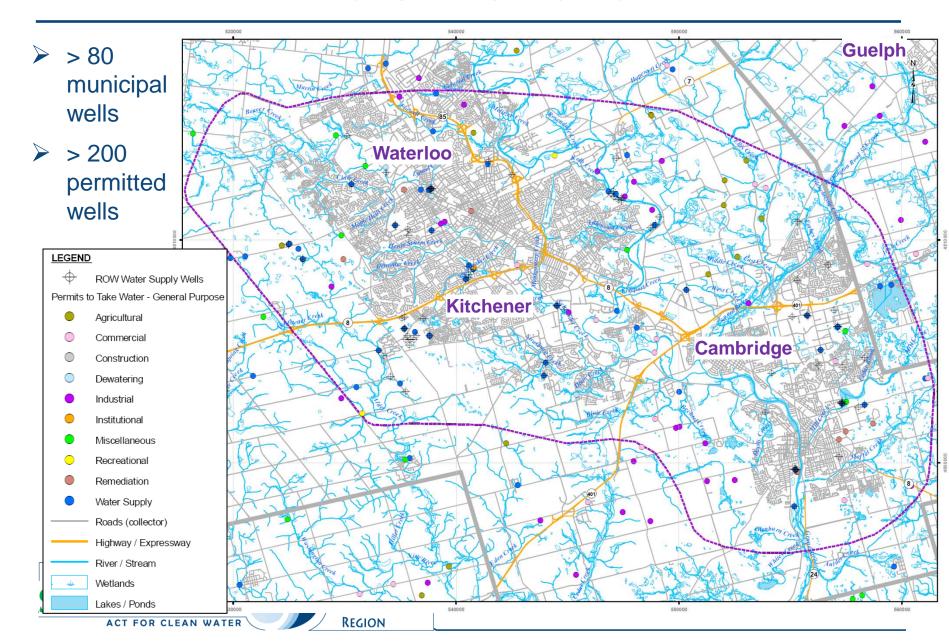
# **Municipal Water Demand**

- > Tier 2 used 2006 municipal data for existing conditions
  - Tier 3 used 2008 data
- Future (2031) water demands refined (and reduced) by the Region in concurrent Water Supply Master Plan.

Groundwater Assessment Area	Municipal Pumping Rates (m³/d)			
	Tier 2 Existing (2006)	Tier 3 Existing (2008)	Tier 2 Future	Tier 3 Future (2031)
Central Grand	112,000	106,000	150,000	120,000
Canagagigue Creek	150	150	150	250

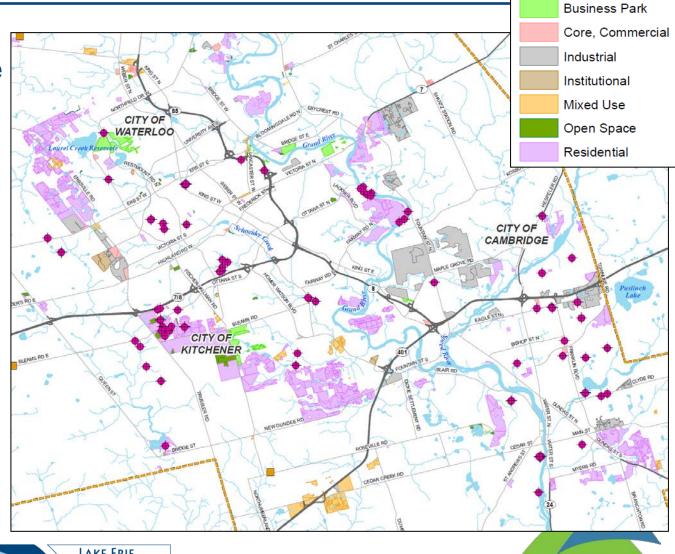


# **Water Demand**



## **Future Land Use**

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





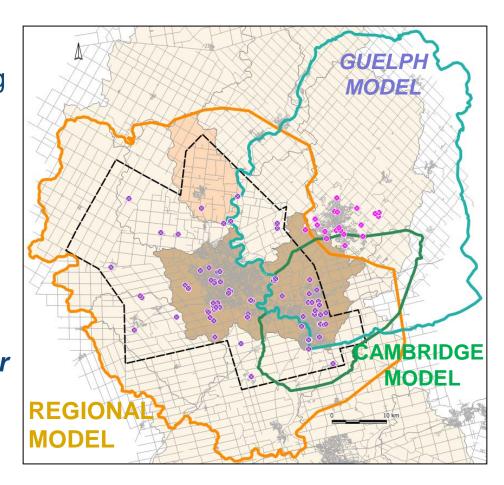
Future Land Use Type

Agricultural

# Refine Modeling Tools

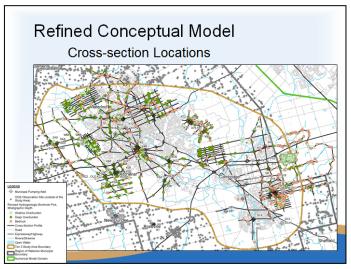
#### Numeric Modelling

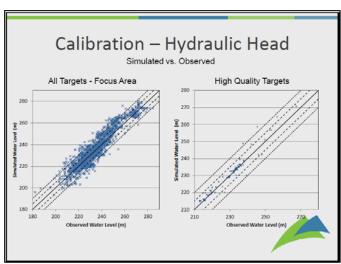
- Utilize a coupled modelling approach to represent SW and GW systems
- Updated 2 FEFLOW
   Models (Regional Model,
   Cambridge Model)
- GAWSER (streamflow generation model)
- FINAL PRODUCT ROW Tier
  Three Water Budget and
  Model Calibration Report
  (2012) + 28 memos/appendices
  (2008 to 2011)

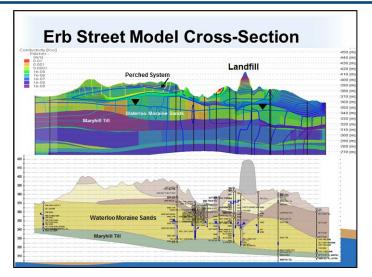


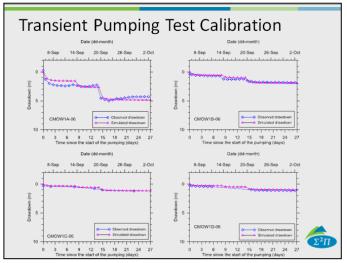


# **Model Development and Calibration**





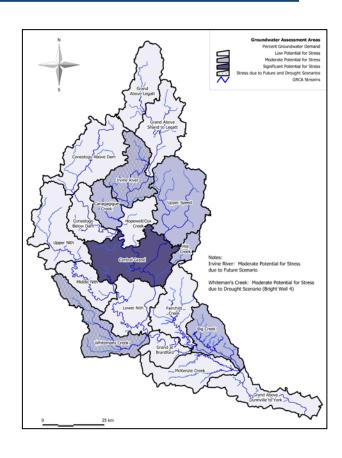






#### Tier 2 / Tier 3 Stress Calculations

- Existing conditions Central Grand
  - Tier 2 "Significant" Potential for Stress (43%)
  - Tier 3 "Significant" Potential for Stress (41%)
- Existing conditions Canagagigue Creek
  - Tier 2 "Moderate" Potential for Stress (16%)
  - Tier 3 "Moderate" Potential for Stress (13%)
- Decrease in percent water demand due to increased recharge in some areas; and lower municipal demand





# Tier 3 Integration with WSMP

- ➤ In 2010, the Region initiated an update to their Water Supply Master Plan for their Integrated Urban System
  - Noted an overall reduction in demand from 2000 to 2010
  - Waited for completion of Water Supply Master Plan to help guide selection of Allocated Rates to be applied in the Tier Three Assessment

Water Supply Master Plan Update Final Report

FINAL REPORT



Prepared for: Region of Waterloo

Prepared by: Stantec Consulting Ltd.

March 2015



#### **Risk Assessment**

#### Steps in the Process

- Design scenarios & prepare data
- Run model scenarios for growth and drought
- Map water quantity protection areas (WHPA-Q)
- Assign risk to protection areas
- Threat identification
- Uncertainty analysis risk assessment & threats
- Data and knowledge gaps identification for future planning phases

FINAL PRODUCT – ROW Tier 3 Water Budget and Local Area Risk Assessment Final Report (Sept 2014)



#### **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

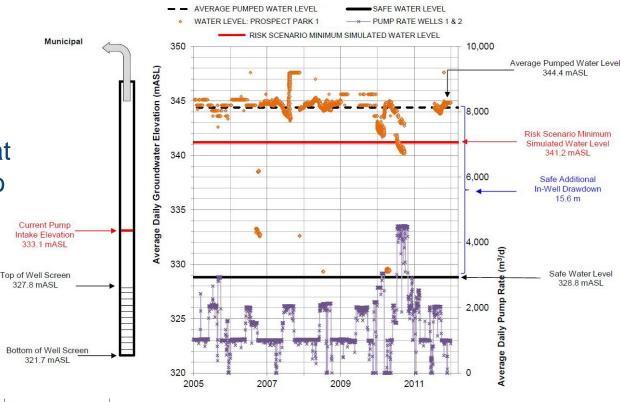
- ➤ Risk Level is **Significant** 
  - Well is not able to meet existing demands
  - Well is not able to meet future needs
- ➤ Risk Level is **Moderate** 
  - Well can meet future needs, but there is a potentially unacceptable impact to other water uses
    - >10% reduction in groundwater discharge to 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)**

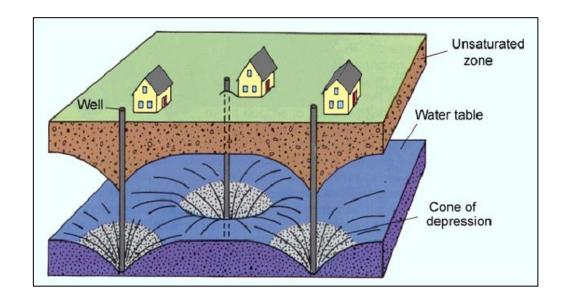
- The maximum amount of drawdown that each municipal well can sustain, while still meeting demand
- Key threshold for assigning Risk
- SAAD determined by municipality
- Simulated drawdown at wells for each scenario is compared to SAAD
- ➤ If drawdown > SAAD
  - Significant Risk Level



# **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 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

<sup>\*</sup> 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.

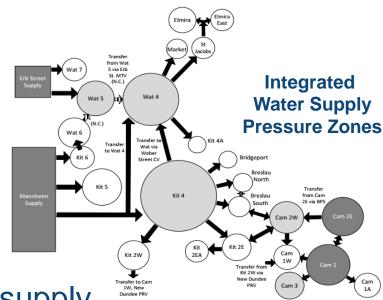


# Region of Waterloo TIER THREE RESULTS



# **Integrated System**

- ➤ Tier 3 Scenarios evaluates predicted change in water levels at municipal wells and discharge to surface water features, due to
  - changes in land development,
  - pumping at Allocated Rates and
  - drought.
- Integrated nature of the Region's supply system gave great flexibility in assigning Allocated Rates to supply wells
- Integrated system was also a technical challenge interpreting data due to interference from the large number of supply wells within the urban area



Stantec 2015 (Water Supply Master Plan)



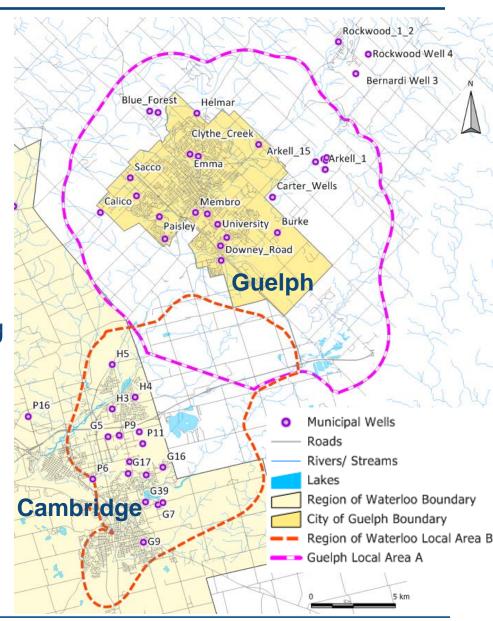
#### **LEGEND** WHPA-Q Municipal Pumping Wells WHPA-Q1: ROW Tier Three Assessment WHPA-Q1: City of Guelph Tier Three Assessment ---- Railroad WHPA-Q1D Road TOWNSHIP OF WELLESLEY - Highway / Expressway Rivers/Streams Open Water Region of Waterloo Municipal Boundary Municipal Boundary CITY OF WATERLOO Refer to City of Guelph Tier Three Assessment William Street for additional details Woolner CITY OF CAMBRIDGE Pompeii/Forwell St. Agatha Strange Street Greenbrook Erb Street P16 WHPA-Q1B TOWNSHIP OF WILMOT Parkway/Strasburg unbar Road CITY OF KITCHENER WHPA-Q1A WHPA-Q1C TOWNSHIP OF NORTH **DUMFRIES**



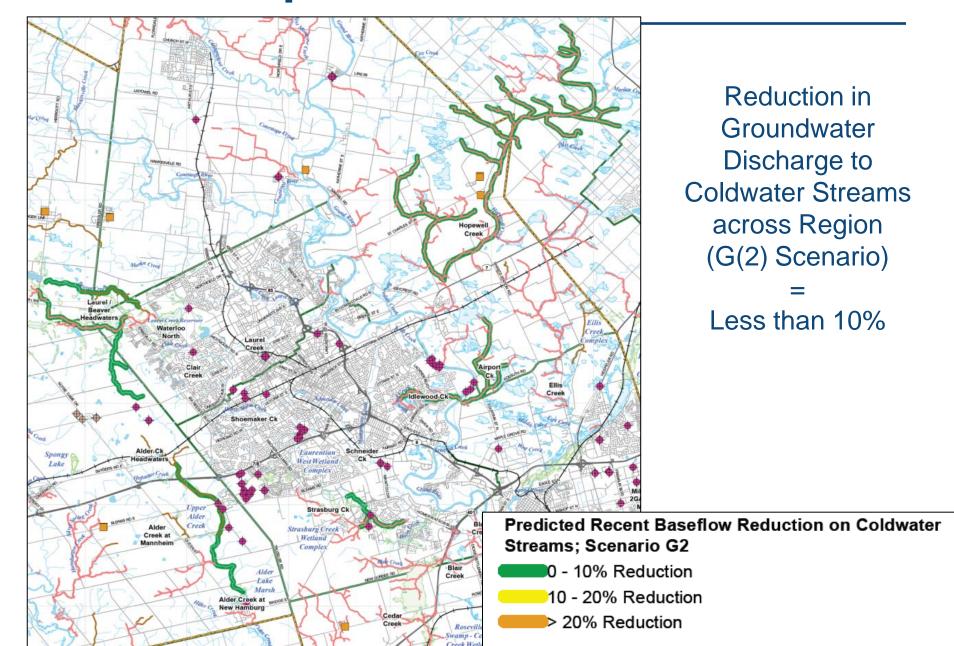
# ROW/ Guelph-GET WHPA-Q Overlap

- 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 the 1 m drawdown cones (relative to non-pumping condition) will extend beneath Cambridge and Guelph
  - Led to one WHPA-Q
  - Professional judgement was applied to separate the QHPA-Q using a groundwater flow divide

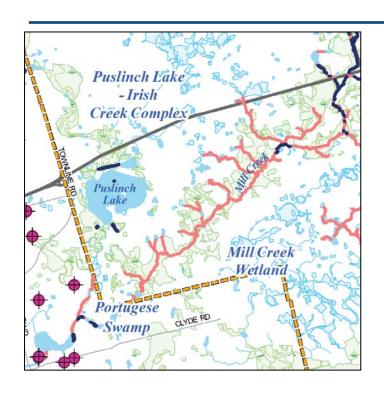


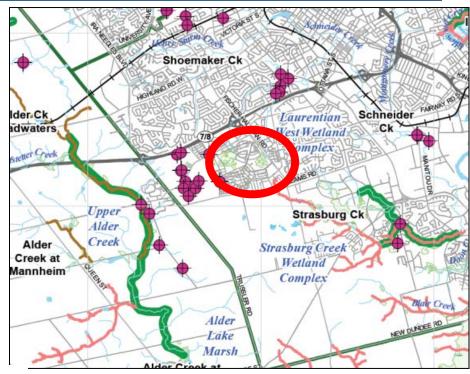


# **ROW - Impacts to Other Water Uses**

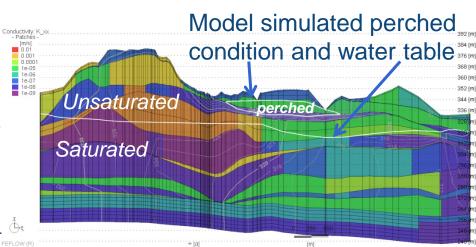


#### Water Level Decline Below Provincially Sign. Wetlands





< 1 m of drawdown predicted beneath Laurentian West wetlands in Kitchener, and Mill Creek wetlands in Cambridge due to pumping at Allocated Rates. Both wetlands interpreted to be perched above water table and fed by surface water. Reduction in water table under wetlands - not expected to impact the wetland ecosystem.



# **Risk Assessment - Summary**

- Well drawdown Drawdown threshold exceeded in uncertainty cases during drought; wells are part of integrated system, other wells have meters of additional available drawdown. Can revise pumping during drought to maintain demand.
- Groundwater discharge No significant reductions due to increased pumping (< 10%)</li>
- Impacts to PSWs No issue
- Impacts to downstream water uses No issue
- Risk Level to WHPA-Q (A to D) Low



# Region of Waterloo Tier 3 Results

- Tier 3 Local Area Risk Assessment Scenarios predicted a <u>low risk level</u> associated with the urban integrated supply wells and wells in the rural well fields.
- ➤ MNRF accepted the ROW Tier 3 Water Budget and Local Area Risk Assessment Report on March 29, 2017



# **Next Steps**

➤ Region of Waterloo Tier 3 Water Budget and Local Area Risk Assessment information to be included in the Grand River Assessment Report



#### Recommendation

THAT the Lake Erie Region Source Protection Committee direct staff to incorporate the components of the report entitled *Region of Waterloo Tier 3 Water Budget and Local Area Risk Assessment: Final Report (Matrix Solutions Inc., September 2014)* into an Updated Grand River Source Protection Area Assessment Report.

