Introduction
There are few studies that feature simultaneous analysis of groundwater and surface water quality and processes in agriculturally dominant watersheds. The understanding of nutrient transport through surface water and groundwater is important for the sustainability of acceptable water quality for human and ecological health especially within the Great Lakes Basin.

Objectives
- Examine spatial and temporal dynamics of nitrate and phosphorus in surface water and groundwater
- Relate the dynamics to hydrologic and geologic characteristics, land use and meteorological conditions within the sub-watershed
- Develop a conceptual model to illustrate the processes and variations of nutrient transport and surface water and groundwater relationships

Study Location
- The Upper Parkhill Watershed is approximately 150 km²
- It is a clay based agriculturally dominant area
- The main research site is located near Parkhill, Ontario within the jurisdiction of the Ausable Bayfield Conservation Authority
- It is at an Integrated Water and Climate Monitoring Station developed by the Ministry of Environment and Climate Change (MOECC) for a Great Lakes Basin monitoring project

Sampling Methods

<table>
<thead>
<tr>
<th>Name</th>
<th>Purpose</th>
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</thead>
<tbody>
<tr>
<td>Satlink</td>
<td>Two setups are installed to power equipment and log data from EXO and SUNA every 15 minutes for surface water and groundwater</td>
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<tr>
<td>Telemetry System</td>
<td>Measures EC, DO, pH, temperature, turbidity and water depth and sensor set up for long term deployment in well</td>
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<tr>
<td>Sensor Enclosure</td>
<td>8.5 meters deep</td>
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<tr>
<td>YSI EXO™ Water Quality Sonde</td>
<td>Measures EC, DO, pH, temperature, turbidity and water depth and sensor set up for long term deployment in well</td>
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<tr>
<td>Discrete Sampling Set Up</td>
<td>Monthly collection of groundwater and surface water samples for ion chromatography analysis and lab analysis for soluble reactive phosphorus, total dissolved phosphorus</td>
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<tr>
<td>Lysimeter</td>
<td>Three lysimeters are installed on conservation land and used to collect root zone water samples for ion chromatography analysis of nitrate</td>
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</table>

Results

Continuous Sampling in Groundwater and Surface Water
- Concentrations in the groundwater range from 0 to 0.3 mg/L nitrate-N and 0.1 to 25 mg/L nitrate-N in surface water
- Concentrations of soluble reactive phosphorus range from 0 to 0.069 mg/L in groundwater and 0 to 0.099 mg/L in surface water
- Concentrations of total dissolved phosphorus are below the detection limited of 0.07 mg/L in groundwater and range from 0 to 0.079 mg/L in surface water
- Concentrations of plant available phosphorus range from 2.55 to 38.0 mg/L in dried streambed sediment

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Summary
- Nitrate values regularly exceed the Canadian Drinking Water Standard of 10 mg/L and the Canadian Environmental Quality Guidelines for aquatic life of 13 mg/L of nitrate-N in surface water
- High concentrations of nitrate and phosphate can influence the growth of algae blooms in Parkhill Creek which is a tributary to Lake Huron
- The pH in surface water ranges from 7.5-8.8 and 6.5-8.5 in groundwater at the main site

Next Steps
- Continue discrete monthly sampling and continuous sampling for one year
- Install lysimeters in agricultural fields as well as conservation authority land
- Survey land owners about agricultural practices and pesticide use and application

Acknowledgments
- Davin Heinback and Alec Scott from the Ausable Bayfield Conservation Authority
- Scott MacKichie from the MOECC
- Haley Wallace and Clare Robinson from The University of Western Ontario
- Rebecca Beutel, Scott Gardner, Graeme MacDonald, David Browne from the University of Guelph