



Credit Valley Conservation
Nottawasaga Valley Conservation
Toronto and Region Conservation
Lake Simcoe Region Conservation
Central Lake Ontario Conservation
Kawartha Conservation
Ganaraska Region Conservation
Otonabee Conservation
Lower Trent Conservation

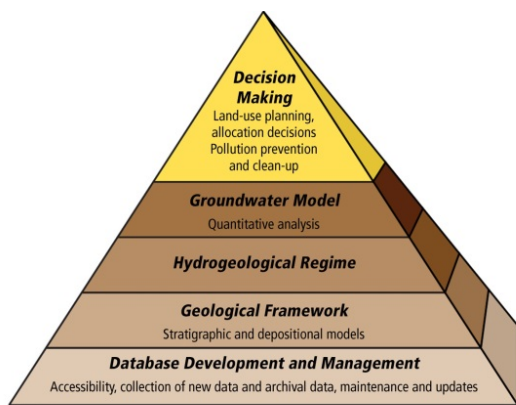


ANNUAL PROGRAM OVERVIEW (2020) **&** **WORK PLAN (2021)**

TO: YPDT Executive Steering Team
FROM: Steve Holysh & Rick Gerber
DATE: April 7, 2021
RE: **2020 Overview/2021 Work Plan – Oak Ridges Moraine Groundwater Program (ORMGP; formerly YPDT-CAMC)**

Background

The Oak Ridges Moraine Groundwater Program (ORMGP) was initiated in 2001, driven by the encroachment of development onto the Oak Ridges Moraine and the recognition of an absence of high quality environmental data and analyses, particularly with respect to groundwater. Since inception, the program has provided partner agencies with an actively managed water-related database and the regional geological and groundwater context for on-going day-to-day water resource management activities (e.g. development review, PTTW review, watershed management, source water protection, etc.). The framework for the program is succinctly summarized in the adjacent figure, taken from the Council of Canadian Academies 2009 report: The Sustainable Management of Groundwater in Canada.



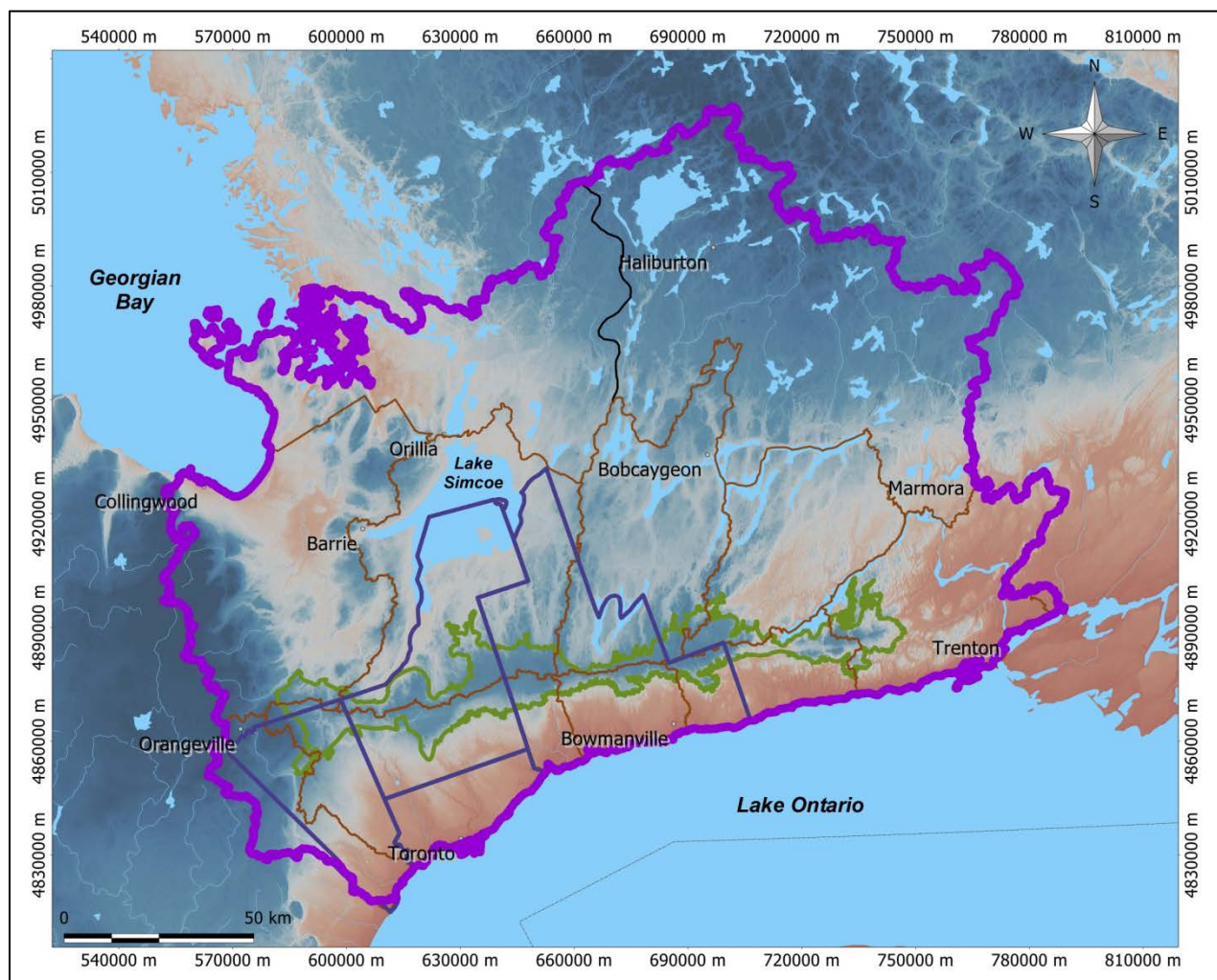
Mandate

The mandate of the ORMGP partnership is to provide a multi-agency, collaborative approach to collecting, analyzing and disseminating water resource data as a basis for effective stewardship of water resources. The ORMGP builds, maintains and provides to partnered agencies the regional geological and hydrogeological context for ongoing groundwater studies and management initiatives within the partnership area.

As such the program will:

- Build and maintain a master database of water-related information that is accessible to all partner agencies;
- Build and maintain a digital geological construction of the subsurface layers that is accessible to all partner agencies;
- Build, maintain and disseminate numerical groundwater flow models that can be used to address any number of issues that arise at any of the partner agencies;
- Coordinate and lead investigations that will acquire new field data that will strategically infill key data gaps;
- Provide technical support to Drinking Water Source Protection teams to ensure that interpretations used in source protection technical work are consistent with the regional understanding;
- Provide technical support to planning authorities to ensure that Official Plan policies are developed in a manner which makes them consistent with up to date groundwater science as derived from the project;
- Provide technical support to all partnered agencies for addressing other Provincial legislation.

Further information regarding the program can be found at oakridgeswater.ca.



Program area - Note that for data management purposes the program area comprises the entirety of three Source Water Protection (SWP) Regions: 1) Credit Valley/Toronto and Region/Central Lake Ontario (CTC); 2) South Georgian Bay - Lake Simcoe (SGBLS); and 3) Trent Conservation Coalition (TCC). Focus of work is largely directed to the GTA municipalities (York, Peel, Durham, and Toronto) and their associated Conservation Authorities (CAs).

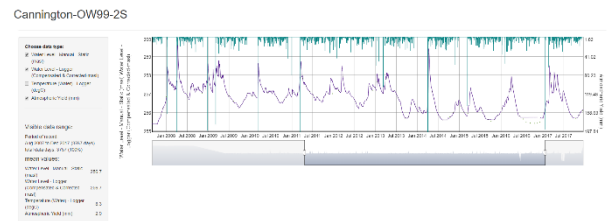


1. Database

- added this year – over 12,000 boreholes; 625 reports; 1.5 million temporal records;
- 2020 logins to website: Consultants = 3,921; Agency Staff = 4,960; Public = 3,392;
- Work continued on the updating of ORMGP Database Manual;
- Continued addition of “Groundwater Knowledge/Insight” and Supplementary BH logs to database and website;

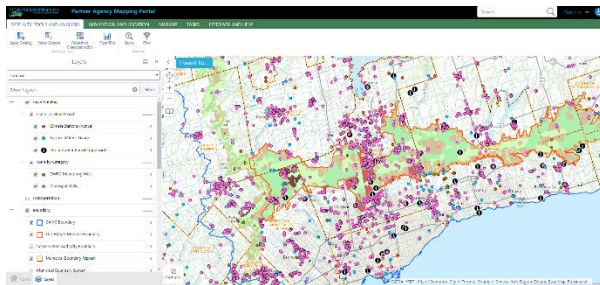
2. Analysis & Modelling

- Incorporated “atmospheric yield” into GW hydrographs allowing for WL response to rainfall/snowmelt events to be evaluated;
- ‘Area of Concern’ mapping in Peel, and York Region (Aurora and Vaughan);
- Continued work on geology ‘harmonization’
- Invited to lead work on Oak Ridges Moraine focused chapter for an international Groundwater eBook;
- technical insights and contributions to modelling studies for Durham, Peel and CVC;



3. Other

- four, one hour long, on-line ORMGP Website training sessions held in summer 2020;
- continued enhancements to mapping section of website (oakridgeswater.ca);
- continued collaborative partnerships with consultant firms (18 firms in total);



- contribution to City of Toronto GW strategy;
- work with PGO to review bottled water PTTW moratorium;
- technical collaboration with various agencies including MECP; GSC; OGS; Hydro One; PGO, Canadian Standards Association;
- Communications – invited to speak at various on-line forums including: SoSmart, IAH-CNC; GSC/OGS Open House.

4. Budget

- Program delivered within available funds - no planned increase for 2021;

Program Component	2020
Staff Costs (Wages + Benefits)	\$689,500
Office Costs + Disbursements	\$49,200
Computer + Software	\$21,900
Consultant/Services	\$25,600
Administration	\$17,700
Total	\$803,900



Review – 2020 (Detailed Summary)

The following provides a more detailed overview of activities undertaken through the Oak Ridges Moraine Groundwater Program through 2020.

1. DATABASE/WEBSITE

Through 2020 the program's database structure/schema remained robust. The information contained within the database was refined and improved through 2020 with continued use of SQL 2016 to facilitate database management. As in previous years, the discussion of database and website issues has been broken into four categories: Additions; Corrections; Accessibility and Software/Hardware Management.

1a Additions

- An updated WWIS database was obtained in summer 2020 from the MECP and about 11,700 new well records (including decommissioning records and well upgrades) were brought into the database – at the time of this import the MECP wells were up to date as of September 2019;
- New boreholes: i) tied to recent TTC activities (e.g. Scarborough Subway extension); ii) tied to the City of Toronto Don River/Central Waterfront project; and iii) many miscellaneous BHs entered from documents in the report library were added to the database over 2020. In addition to the MECP wells, approximately 670 additional wells/boreholes were added in 2020;
- Approximately 625 new documents were brought into the library over 2020, this process was slowed down due to the difficulty in obtaining hard copy reports during the Covid shut down;
- In total approximately 1.5 million temporal records (chemistry, water levels, stream flow, etc.) were added in 2020 – this number reflects the import of regional data, as well as the updating of climate and stream flow data from Environment and Climate Change Canada;
- The “Atmospheric Yield” (i.e. precipitation for days above freezing temperatures and water available from melt events during winter months) data was added to the database and made available on the website alongside the groundwater level hydrographs; and
- The database manual was revised/updated over 2020 with a new release scheduled for 2021.

1b Corrections

- In moving forward with a review and update of the geological surfaces, program staff continued to review and correct MECP wells with respect to: i) discrepancy between metric and imperial units and ii) poor geological interpretations; and iii) incorrect locations. Most of the unit issues have been corrected, however it is expected that future wells with more subtle unit issues will reveal themselves as they are inspected.

1c Accessibility

- 18 consultant companies are partnered with the ORMGP under consultant agreements (up from 14 at the end of 2019); to address the increase in number, 70 new consultant accounts were created in 2020 bringing the total to 315 consultant user accounts;
- user accounts for technical agency staff remained relatively stable at 321 accounts - several staff turnover moves resulting in a small number of accounts deleted and others created;
- 53 temporary accounts were created for the University of Guelph where the website was the focus of several required hydrology assignments for a 2nd year engineering course;
- On the public side of the website, the number of visits increased from 1865 to 2693 indicating that the website is gaining traction for general users looking for water related information;

- In 2020, building upon the introduction of non-MECP (MOE) BH logs in .PDF format (go to Boreholes Map – choose “Boreholes with Supplementary Log”) to the website, many new PDFs were uploaded and added in 2020 with the total of available non-MECP BH logs reaching 2,358 – this allows for these consultant logs and other older logs from GSC or OGS staff to be readily accessed on the website;
- The many ‘R’ based statistical tools available for piper plots, as well as for climate and surface water analyses on the website have continued to be adjusted and refined to deliver high quality analyses to technical staff visiting the ORMGP website;
- in 2020 a new Groundwater Hydrograph tool was introduced that allows for users to examine the water levels at any long-term groundwater monitoring location; the tool allows for users to see several statistical elements related to the groundwater level as well as the “atmospheric yield” (precipitation in summer and available snow melt water in winter) alongside the groundwater level; the response of the groundwater system to events as well as to seasonal water availability is now readily available from the new hydrograph;
- The Citrix Xendesktop platform, which allows for partner agency staff and ORMGP staff to access the program’s database and ORMGP files is performing up to expectations.

1d Software/Hardware Management

In order to keep the database up-to-date and readily accessible to the partner agencies there is continual maintenance and review of the program’s software and hardware capabilities. No new purchases were required in 2020.

With the onset of the Covid pandemic in March 2020, ORMGP staff were already well positioned to work remotely as the offices at TRCA and CLOCA were temporarily closed. Remote access to the Program’s servers, which are now largely operated out of CLOCA’s offices, was smooth and unhindered as remote work was the order of the day through much of 2020.

In 2020, the following tasks continue to be undertaken with respect to the program’s software and hardware management:

- database management workflows that were reconfigured to work within Citrix platform in 2017 have continued to be used through the 2020 calendar year. As in the past, the backing up of the database continues to be a focus of the program and was unchanged in 2020:
 - The database resides on a server at CLOCA which is continually backed up through VEEAM backup system server software – should there be a power failure or database glitch, the database can be restored from a short term backup in very short order; the VEEAM software stores multiple versions of the database which are eventually overwritten with subsequent, more recent backups;
 - on a weekly basis (every Sunday) the following steps are automatically transacted:
 - the database is backed up to a separate CLOCA based file-server (this copy is dubbed the “weekly database”) and is subsequently made available: i) for use via the program’s website to share data with the outside community; and ii) as the ‘weekly’ database which may be accessed by the partners through the ORMGP Citrix machines. This database has both read and write access and can be used for training and testing purposes.
 - a copy of this backup is placed on a separate ORMGP server (newly introduced at CLOCA) that functions as a central storage facility holding database versions dating back in time. These older backups are available on a monthly basis. The previous eight weekly backups are also stored here.

- this database is automatically transferred/written to an ORMGP server at TRCA's offices (used by ORMGP staff to interact with, review and check the database);
 - over the long term, backup copies of the database are held off-site (along with backups at CLOCA) should they be required;
 - The primary numerical model archive (part of the model custodianship program) has been relocated to a server at CLOCA. A duplicate archive is kept off site and synchronized regularly. For added redundancy, two additional copies of the archive are also kept in separate locations off-site, however they are synchronized less regularly.
- To ensure partners have the ability at their own offices to use software products (e.g. Viewlog, Sitefx, and others) and to review/access/QA/evaluate their data held in the ORMGP database, a cut of each partner agency data set is usually distributed (in SQL and/or Access format) at the ORMGP technical meetings (i.e. usually twice per year or more often if requested). This did not occur in 2020 due to Covid workplace meeting restrictions.

2. ANALYSIS & MODELLING

The following initiatives were undertaken through 2020.

Technical Model Contributions

Through 2020, in addition to the numerous analyses highlighted below, ORMGP staff continue to communicate with software developers to discuss modelling code, at a high technical level, and to provide input regarding suggested fixes and/or improvements to existing software codes (e.g. discussions continue to be held with the developers of GSFLOW, HydroGeoSphere, Raven, and CSHS HydRology).

Durham Region Numerical Model

Ongoing through 2020 ORMGP staff worked with Durham Region staff to attend meetings and to review key deliverables from the numerical model, in particular the community focused summary reports that were prepared. ORMGP staff communicated regularly as required with the technical consultant and with Durham staff to ensure that the modelling was proceeding as per the submitted proposal.

Peel Region Numerical Model

Peel Region's numerical modelling project was also ongoing throughout most of 2020. However, several unexpected events resulted in the shortening of the project with a focus in 2020 shifting to a completion of the numerical groundwater model report. The remainder of the project, namely the integration of the groundwater model to incorporate shallow surface water flows and water budgeting has been removed as part of the projected work. This integration work will be re-scoped, and along with Credit Valley Conservation, decisions regarding future paths will be made in 2021. ORMGP staff assisted Peel as required during these unanticipated events.

Storage of Gridded Data (FEWS)

Although the ORMGP has, for many years now, successfully organized data that is tied to individual stations (e.g. wells, surface water, climate, etc.) with the growing availability of large-scale historical grid-based meteorological datasets applicable to running and managing transient numerical models, there has been an ever-increasing need to effectively manage these data. In addition, transient models output gridded data sets that are very large in size and difficult to manage (as an example, think of gridded precipitation inputs to a 25 year model with daily time steps). Staff have been working to address this need, and in 2020 the adoption and configuration of a FEWS (see <https://www.deltares.nl/en/software/flood-forecasting-system-delft-fews-2/>) based system was introduced. Although primarily built and used for flood forecasting (which can now also be undertaken through this system) the ORMGP's primary use of the FEWS software is currently for the effective management of temporal gridded data, complimentary to the ORMGP database.

Specific Capacity, Hydraulic Conductivity and Transmissivity

In 2020 work continued on implementing a database routine that determines the transmissivity (T) and hydraulic conductivity (K) of aquifers from Specific Capacity estimates. The routine makes use of the interpreted screened aquifer unit, based on the ORMGP geological model(s), coupled with the short term pumping data obtained from the MECP/MOE water well records and the geological models. Using an iterative routine, the K and T are calculated. 2021 will see the incorporation of this information onto the website.

Groundwater Knowledge/Insight Locations

2020 saw continued work with Ross Hodgins (retired MOECC/MECP) to capture historical knowledge into the program's files and onto the website.

Surface Water and Climate Analyses

Through 2020 the surface water and climate analysis packages that are currently running on the program's website have been continually enhanced and refined, based on the recommendations and needs of partner agencies. Stream flow and climate data from Environment and Climate Change Canada's website is regularly being uploaded into the program's database and various statistical analyses have been added to the website. As new data are regularly added nightly, the statistical analyses are automatically updated. Users continue to be able to select a stream gauge or climate station location and then undertake a wide variety of analyses of the data (e.g. seasonal and monthly trend analyses, baseflow analysis, return period, flow frequency, etc.). As an example of the applicability, website visitors can now quickly determine whether the previous month was either hotter/colder or wetter/drier than the long-term average. Users are able to change the selection of the range of days for which any analysis will be undertaken and the statistics are updated dynamically as the date range is changed.

Geological Layer Harmonization

2020 saw advancement in the harmonization of geological layering across the study area with work undertaken to re-interpret the bedrock valleys and also on refining geological layering. In addition to assisting with the reworking of the geological layers in Durham through the modelling initiatives, ORMGP staff also began to examine and make new picks at recently added wells.

Groundwater eBook

ORMGP staff were invited to lead and contribute an Oak Ridges Moraine focused chapter (the only Canadian contribution) to an international Groundwater eBook that is slated to be an anchor for the "Groundwater Project" This is an international effort led by Dr. John Cherry to provide educational groundwater related materials to the global community. This will provide an opportunity to showcase the collective ORMGP efforts to a broad audience.

Peel and York (Vaughan and Aurora) "Areas of Concern" Mapping/Analyses

In 2020 work continued on the "Areas of Concern" mapping with evaluations of areas in southern Caledon and in Vaughan. Work in Aurora was also finalized in 2020. In general, this work has a focus on the artesian conditions that naturally exist on the south slope of the Oak Ridges Moraine. This condition occurs as a result of the pinching out of the Oak Ridges Moraine aquifer sediments in moving from north to south as the elevation declines from the crest of the moraine. The Oak Ridges Aquifer pinches out between the overlying Halton Till and the underlying Newmarket Till and excavations or wells drilled along this part of the moraine, should they breach the upper confining Halton Till aquitard, can lead to considerable groundwater problems that cost significant time and money to resolve. Mapping is prepared that shows areas where proposed developments/excavations might result in 'unexpected' groundwater problems (and associated costs). Note that these areas are independent of, and have no relation to, Areas of Concern (AOC) that have historically been identified through the Great Lakes Water Quality Agreement.

Miscellaneous technical support

Due to the Covid work at home directives, support and communication with partner agency staff was conducted via phone and/or on-line through much of 2020.

York

- Provide technical support on Aurora and Vaughan “Areas of Concern” mapping;
- attended liaison meeting with York staff to exchange ideas and hear of ongoing work plans at York Region;
- imported monitoring) data from York database into ORMGP Database.

Peel

- provided technical support and comments to help address and move forward with regional numerical modelling initiative;
- finalized work to investigate “Areas of Concern” mapping for south part of Town of Caledon;
- assisted Peel staff in ensuring their monitoring data was uploaded to the database throughout the year.

Durham

- continued support to Region and Burnside staff to ensure process for migration of monitoring data into database is working and accessible for uploading of data;
- continued to provide technical support and comments with respect to the regional modelling initiative.

Toronto

- attended meetings to provide continued input on Groundwater Strategy;
- reviewed and provided comments on guideline documents.

TRCA

- continued to link to TRCA database thus allowing all TRCA surface water stations to have statistical analyses performed via the program website;
- assisted staff in ensuring monitoring data was brought into database properly and is accessible on the website;
- provided technical support regarding the potential development of an Aquifer Thermal Energy Storage (ATES) geothermal system at new office building;
- assisted staff in refining their ESGRA mapping and co-authored paper on ESGRAs with TRCA staff;
- reviewed the climate change products prepared by the Ontario Climate Consortium;
- provided surficial geology and depth to water table layer for the Highland Creek watershed work;
- provided input regarding the potential for using numerical flow models to help in assessing in-stream ecological impacts due to climate change.

CLOCA

- continued to provide technical support with respect to the Ontario Hydro One facility (i.e. establishment and operation of long-term groundwater monitoring location) in the Municipality of Clarington.

CVC

- technical support provided for MIKE SHE water quality focused modelling being undertaken in cooperation with University of Guelph;
- assisted with technical insights re groundwater flood mapping for the CVC “Flood Risk Management and Return on Investment Tool”;
- provided depth to water table and groundwater discharge layers.

LSRCA

- developed groundwater drawdown estimates in the Shanty Bay area;

LTRCA

- provided input to help in addressing the modelling discrepancies that UofT Scarborough Ecological Modelling staff and Environment Canada were having in addressing phosphorus loadings into Lake Ontario from the Napanee River and from Wilton Creek.

ORCA

- provided input/data to the consultant (Cambium) working on the Norwood sewer project;

Barrie

- provided temporary staff with an overview of the website so that they could help city staff become more knowledgeable on ORMGP program.
- provided technical support and guidance re the Barrie Tier-3 numerical model.

MECP

- met with MECP staff to address issue of having PGMN wells on private property ‘disappear’ as users zoom in on specific wells – this helps MECP honour their commitment to well holders that wells will not be made available on a public website;
- provided overview of WL availability to MECP Central Region staff so that they could make better use of the data held in ORMGP database – this saves Regional Staff from having to regularly send data to MECP staff so they can investigate well interference issues across the area.

3. OTHER PROGRAM INITIATIVES

Over the course of 2020 a number of other initiatives also formed part of the overall work program.

Website – Partnership agreements with consulting firms were initiated in early 2018 and have continued, with the end of 2020 marking the third full year of this program. At the end of 2020 there were eighteen consulting firms that had partnered with the ORMGP whose staff are now actively using the password protected side of the website. ORMGP staff track the number of consultant logins to the website by each consulting firm and provide that information back to the consulting firm so they can be kept apprised of the value they receive from their ORMGP partnership.

Through July 2020, ORMGP staff held weekly training sessions for all technical staff linked to the program. For each of the four sessions over 100 individuals attended with some sessions nearing 150 attendees. The sessions were deemed to be successful and staff will be looking to implement additional sessions going forward. The ongoing partnership between ORMGP and the GIS staff from Central Lake Ontario Conservation Authority (CLOCA) continued with a focus on enhancing the program’s mapping section of the website. Enhancements to the Geocortex mapping tool on the website continue to improve the ability of users to efficiently explore the vast data and information sets assembled under the program.

In 2020, some of the more significant updates to the website included the following:

- refinement of the Water Table mapping and the addition of “Potential Discharge” mapping to help in highlighting areas along stream valleys of potential active groundwater discharge;
- as mentioned above, borehole logs from non-MECP/MOE wells were added to the website;
- continued addition of Groundwater Knowledge/Insight locations.

Memorandum of Understanding (MOU) – Through 2020 work continued on refining and editing the MOU, with input from technical staff at all partner agencies. The MOU was finalized and circulated for signing in fall 2020 and is expected to be signed by all partner agencies early in 2021. With their decision in December 2020 to join the ORMGP Program, in 2021 the MOU will also be circulated to Halton Region and Conservation Halton as they integrate into the program and so that senior management are aware of the benefits of the program. The MOU will guide the program activities through to the end of 2030.

Report Library – in 2020, with the shut down of office work places, opportunities to hire summer student help for inputting reports and data to the ORMGP were limited. As a result the number of reports that were entered into the library was reduced over 2020, never-the-less, some 625 reports were added to the program library over 2020. Although much reduced owing to Covid, 2020 also saw continued co-operation with Hunter GIS staff to acquire, for incorporation into the program library, a number of consultant reports that the company has

assembled over the years. This partnership is proving fruitful as many older unique reports are being ‘rescued’ and made available via the library.

Field Work – Staff continue to monitor a suite of approximately 40 wells to help in characterizing specific hydrogeological settings that have been identified across the study area. Two new locations (Clairville Conservation Area and West Deane Park) that were no longer being actively monitored by UofT researchers were taken over in fall 2020. In April 2020, staff also attended an unusual discharge even that occurred in Gages Creek., on the south slope of the Oak Ridges Moraine near Port Hope. Artesian conditions in the creek bed of Gages Creek. resulted in a significant natural discharge of silt sediment into Gages Creek temporarily affecting the native Brook Trout population in the creek.

Ontario Climate Advisory Committee – as part of the task of considering the future use and updating of the available groundwater flow models across the program study area, in 2020 staff continued to attend and contribute to this working group that advocates for best management practices in terms of collecting, managing and distributing climate information in Ontario.

PGO Bottled Water Moratorium – ORMGP staff were asked to assist the MECP (via PGO) by sitting on a technical committee charged with helping to review the consultant recommendations and MECP staff direction with respect to lifting the Province’s moratorium on the issuance of bottled water taking permits.

MECP Water Quantity Working Group – ORMGP staff continued to attend the MECP Water Quantity Working Group meetings in 2020, where the focus was on revealing/discussing the results of the consultant/MECP/PGO work to address the removal of the moratorium on bottled water permits;

Standards Council of Canada – Being recognized as leaders in environmental data management, ORMGP staff were invited to serve on the SCC’s committee for climate data standards for managing climate information across Canada. This continued through 2020.

Great Lakes Water Quality Annex – ORMGP staff were invited to assist the Province with the updating of Groundwater Annex report within the Federal Great Lakes Water Quality Agreement. Specific work has focused on the chapter that is addressing urban groundwater issues.

Communications/Analyses

In 2020 ORMGP staff were invited to present or meet with various external agencies on behalf of the partner agencies.

- Annual lecture at University of Toronto Scarborough to fourth year students on water resource management;
- Assisted with the organization of, and presented two papers at, the annual Ontario Geological Survey (OGS)/Geological Survey of Canada (GSC)/Conservation Authority Open House held in February at the University of Waterloo;
- ORMGP also had a booth at the event to showcase the program’s website and the accessibility of data via the program;
- Invited to attend a one day symposium hosted by the Geological Survey of Canada and the Ontario Geological Survey to discuss and contribute input to regional modelling initiatives within the province;
- Met with MPP Mike Schreiner to provide an overview of program;
- Met with Canadian Water Network to exchange ideas on moving forward with water management in Ontario;
- On-line meeting with staff from the Alberta Geological Survey to discuss common initiatives and exchange ideas and software experiences;
- Provided an overview of ORMGP Stream and climate statistical packages to SoSmart and volunteered to assist SoSmart in obtaining stream temperature database from MNR;

- Assisted with TA training and set up ORMGP website accounts for students at University of Guelph enrolled in a fall 2020 on-line engineering hydrology course;
- Met with STORM to assist them with a project aimed at mapping/delineating moraines to the west of the Oak Ridges moraine;
- Provided in person or on-line ‘Lunch and Learn’ or similar talks to the following groups to promote increased use of the ORMGP website: Wood, Isherwood, City of Barrie, Water Gorden Foundation, Dillon, City of Ottawa, Insitu; Ganaraska CA
- Provided a Canada wide on-line talk to the Canadian Chapter of the International Association of Hydrogeologists (IAH-CNC) “Groundwater Infrastructure – Ushering in the Big Data Era on the Oak Ridges Moraine” in December 2020;
- Co-authored climate change paper and the role of groundwater modelling with the University of Guelph;
- Joined Canadian Hydrological Model Stewardship (CHyMS): a Canadian collaboration/web server hosted by the National Research Council Canada to assist in the development of the Raven model.

4. BUDGET SUMMARY

The four senior partners (City of Toronto, Regional Municipalities of York, Peel and Durham) each contributed \$175,000 in 2020 (Total of \$700,000). In addition, the program received \$60,300 from consultant subscriptions to the program. The program’s expenses for the 2020 are summarized below; 2019 costs, as well as estimated 2021 costs are also provided.

Program Component	2019	2020	2021 (est.)
Staff Costs (Wages + Benefits)	\$684,000	\$689,500	\$705,000
Office + Disbursements	\$52,000	\$49,200	\$68,000
Computer + Software	\$53,500	\$21,900	\$36,000
Consultant/Services	\$33,500	\$25,600	\$95,000
Administration	\$14,800	\$17,700	\$18,000
<u>Total</u>	\$837,800	\$803,900	\$922,000

The program was completed within an acceptable budget in 2020. In 2020 a small carryover amount from previous Source Water Protection related work provided accommodation within the program budget to cover the excess expenditures over revenues. Therefore, no budget increase was requested for 2020. Although program staff attempted to increase the program budget in 2021, the Covid emergency precluded any advance in that initiative over 2020. However, with of Halton Region ‘s December 2020 decision join the ORMGP beginning in 2021, and with their financial contribution, the budget should be sufficient to carry out program activities moving forward. For 2021, additional funds have been allocated to having consultants or contract staff assist with helping to bring Halton Region up to the same level of understanding as other parts of the study area.

2021 WORK PLAN – ONGOING/UPCOMING TASKS

With Halton Region's December 2020 decision to join the ORMGP, it is anticipated that a slight preferential focus might be steered towards Halton Region in order to bring their data and interpretations closer to what has been accomplished across the rest of the ORMGP study area. Of course, as in past years, should resources be requested by other partner agencies for specific tasks, ORMGP staff will adjust tasks to assist as required.

1. DATABASE RELATED

Task 1.1 – Report Library Capture

In 2021 program staff will continue to work with Hunter GIS staff to input additional reports into the library. The reports cover a broad geographic range and will help to infill many areas where no previous work has yet been made available. If Covid workplace protocols are lifted sometime in 2021, and if students are retained, ORMGP staff will also assist any agency's students with the processing of consulting or other relevant reports. Data capture from these documents into the database will also continue.

- **Benefits:** Improved access to and availability of subsurface information across program area.
- **Estimated Timeline:** Ongoing through 2021.

Task 1.2 – Fostering and Enhancement of Consultant Partnerships

Over the course of 2021 staff will continue to monitor external partner agency use of the program website and encourage further use of the site. Tracking of consultant website use continues to show disparity in the utilization of the website by different consultants. In 2021 staff will continue to put forward means of increasing traffic to the website and encouraging existing users to provide feedback. Depending upon how office openings take place in 2021, ORMGP staff will explore means (on-line or face to face) for developing and implementing additional training for technical staff at both consulting agencies and partner agencies. A training/educational one-day workshop is planned for the late spring 2020. Staff will continue to encourage other companies to join the partnership.

- **Benefits:** This task, especially training/education initiatives, will help to ensure that consultant partners remain engaged in the program in a meaningful way, allowing them to maximize their use of the website and to contribute to the program.
- **Estimated Timeline:** Ongoing through 2021.

Task 1.3 – Knowledge Management Capture

2021 will see the continued input of new "Groundwater Knowledge/Insight" locations (through discussions with consultants and agency technical staff) to document more water stories/lessons (e.g. flowing conditions, buried valleys, areas of poor water quality, etc.) and add them to the database and website. These locations are an important way of transferring key groundwater knowledge from the past to current and future groundwater practitioners.

- **Benefits:** This exercise builds on the types of data and knowledge capture activities that are already undertaken through the program. To date, the type of information collated into these locations is either not found in any of the ORMGP library reports, or the information is not readily apparent without detailed reading and review of many specific reports. Having a mapped layer of such 'cautionary locales' where a synthesized story is readily available via the ORMGP website benefits the overall understanding and improves management of water resources across the study area.
- **Estimated Timeline:** Ongoing through 2021.

Task 1.4 - Continued improvement and expansion to the database

The database is now about 80 gigabytes in size and continues to grow as new information is appended. Up-to-date climate and streamflow data are regularly acquired from Environment and Climate Change Canada and

input to the database. As updates are made available from the Province the WWIS, PGMN data and PTTW will be updated in 2021. Data from various partner agencies will continue to be imported into the database.

- **Benefits:** Improved data quality and additional data input to the database will enhance any work undertaken in the ORMGP area, whether it is in support of development, construction activities, or other.
- **Estimated Timeline:** Ongoing through 2021.

2. WEBSITE, ANALYSIS & NUMERICAL MODEL RELATED

As in previous years, key initiatives for 2021 will relate to communication and outreach and will focus on continued enhancement of the program's website to deliver data, information and knowledge in an easily accessible manner. The long term goal for the website is to build upon earlier successes by offering newer and better ways to access, view and analyze data, all to benefit partner agency and consultant staff in making decisions. Towards this end, staff are routinely exploring additional opportunities that SQL 2016 presents in terms of its linkage with the "R" statistical software package (additional charts, graphs, etc.). The technical content currently available on the website will continue to be enhanced by providing additional insight pieces that succinctly summarize different hydrogeological analyses that have made effective use of the vast store of data in the database. An ongoing goal of the program's website continues to be to reduce the need for extensive knowledge regarding how to use various individual specialized software packages (e.g. Sitefx, GIS, SQL Management Studio).

Task 2.1 - Model Harmonization

With over 80 numerical models having been generated across the geographical study area of the program, staff continue to work towards a single "authoritative" geological framework across the study area by incorporating insights from these models. The work involves incorporating new well/geological data as well as examining the interpretations from existing numerical models to re-build a revised geological framework. In 2021 work will focus on: i) the review and incorporation of geological layering from recent modelling work undertaken in Peel and Durham Regions; ii) the review, refinement and incorporation of existing Halton Region geological layers into the regional geological model; and iii) the strategic revising of picks (largely in Toronto and/or associated with the bedrock surface) and the geological interpretation/picking at wells that have been newly added to the database.

- **Benefits:** This task seeks to consolidate the many numerical model geological frameworks as well as new data into an "authoritative" set of surfaces that will extend across the entirety of the study area. For each agency, this will continue to prove to be a significant benefit in that they can confidently provide a set of interpretive geological layers to any ongoing capital works project that involves subsurface excavation or tunneling. When provided to consultants, the set of layers allows for all parties (including staff and consultants working in adjacent agencies) to speak with a common language when referring to the subsurface stratigraphy.
- **Estimated Timeline:** Ongoing through 2021

Task 2.2 – Addition of Time Series Analyses for Groundwater Monitoring Wells

Further work is planned to better summarize and analyze the data tied to long term pumping and monitoring wells. Whereas 2020 work was focused on individual wells, allowing users to investigate water level response on a both seasonal and event scale, in 2021 the intent is to categorize wells based on their event/seasonal responses and their hydrogeological setting. The intent is to be able to determine which monitoring wells reflect similar water level behaviour and to use this information to predict water level behaviour in similar settings that might not have existing monitoring wells.

- **Benefits:** The calculation and presentation of this type of analyses will help to better understand how watersheds behave in terms of groundwater level response and how water moves through the subsurface

- **Estimated Timeline:** End of 2021

Task 2.3 - Mapping of Known Groundwater Problem Areas

Mapping of groundwater “Areas of Concern”, i.e. those areas where subsurface construction works could lead to considerable problems and excessive costs, was initiated in 2019 and has been ongoing since. In 2021 mapping will continue in Vaughan, Stouffville and in Toronto. There has been an indication from partner agencies that this kind of mapping is beneficial.

- **Benefits:** By having an understanding of subsurface conditions prior to project commencement, partner agency staff (both consultants and government) can provide preliminary knowledge regarding overall project cost and necessary efforts. Such regional maps can provide a screening tool prior to the detailed work necessary for project design.
- **Estimated Timeline:** Ongoing through 2021.

Task 2.4 – Investigation into Online Model Executables

Although put forward for initiation in the past, this task was not tackled owing to other priorities and lack of technical staff to assist with coding. There has been an interest in ensuring that the numerical models developed over recent years are made available for more widespread use than is currently the case. A possible solution is to develop on-line executables (e.g. input pumping rate, location, and aquifer – model run would return drawdown at a municipal well; run particle tracking routines, etc.) that would allow for non-modellers to gain insights from models for various water management decision-making and quickly assess potential impacts to their water supply.

- **Benefits:** Such tools would allow for technical staff from partner agencies to gain insights from already constructed models thus extending the benefit of the models into the future.
- **Estimated Timeline:** Tentative for late 2021/early 2022.

Task 2.5 –Website Metadata

As more practitioners from consultants and partner agencies visit and make use of the website, there is a need to provide additional information as to how specific maps, datasets, layers, analyses tools have been developed. Metadata has been collated for some components of the website (e.g. water table/depth to water table) but additional work is needed on this front. Generating additional metadata will continue in 2021.

- **Benefits:** having metadata available on the website will allow users to see data sources and how specific maps and analyses that are available on the website were created. This will provide additional confidence and support to website users such that they are more reliant on using the website’s products.
- **Estimated Timeline:** Ongoing through 2021.

Task 2.6 – Ongoing Website Improvement

In addition to the mapping section of the website, there is a considerable amount of scientific and background information available over several dozen web pages. This information is not often used by visitors to the website. Some advances were made in 2020 as the program developed and posted an initial story board that presents ORMGP data management. Over the course of 2021 work will continue to make the program website more modernized and to take advantage of newer web formats (e.g. story boards, better graphics, newer templates, etc.).

- **Benefits:** Fresher modern look to website that will attract users to view and learn more about the ORMGP and its products, and by extension, the water resources of south-central Ontario.
- **Estimated Timeline:** Ongoing through 2021.

Task 2.7 – Enhanced/New Mapping Tools

As the website is used by staff from various public and private sector agencies, we will be seeking input and ideas for improving upon the maps and tools currently available on the website. As time permits, through 2021 staff will be working to develop a number of additional tools including the following:

- **Integrated Planning Map**

In discussions with planners over the past couple of years, it has become apparent that the ORMGP Geocortex website, with its many different themed maps, offers the possibility to assist planners with making better land use change decisions from a water management perspective. By overlaying maps such as the surficial geology, depth to water table, and flowing wells it may be possible to colour code certain areas as being either more or less suitable for different types of land use change proposals. ORMGP staff will investigate the possibility of developing an effective planning themed map that can sit on the Geocortex website.

- **Updated Water Budget Tool**

The website currently holds a water budget tool that allows for users to select an area of interest and run a water budget analysis. Work that has been ongoing (on and off) for the past two years, will continue with a 2021 goal of updating and refining the water budget tool. Once completed, the most significant change will be the conveyance to the user of the uncertainty involved in the main water budget components (recharge, Runoff, ET, precipitation), and how the various estimates vary seasonally and from year-to-year. The water budget model will be run 1000s of times with slightly modified input parameters to derive a suite of ensemble model results that will reflect all reasonable model runs. Ideally, when the user clicks on a cell they will be able to see, (for that cell) a monthly-average bar graph displaying the maximum and minimum of expected model results (e.g. recharge). Gaining an appreciation for the uncertainty associated with the water budget components will allow practitioners to reflect more reasonable estimates when providing water budget numbers and will give reviewers an acceptable range of water budget components when reviewing development proposals.

- **“Clip and Ship” or File Export Tool**

Staff plan to develop a tool that will allow users to clip layers and data from the website into an exportable package that can then be used external from the ORMGP website. The exported layers could be used for a number of purposes, for example to create cross-sections or to build localized numerical models.

- **Drainage Delineation Tool**

Work will be undertaken to develop a tool that will allow users to select a point on the map and have the drainage area to that point be delineated on the map. Such a tool would be linked to the water budget tool. In addition, the characterization tool would also be linked such that these drainage areas could be readily characterized in terms of water budget components, land use, soils, etc.

Benefits: all actions directed to the website will be focused on providing smarter and easier ways to explore the data within the database and associated analyses/estimates, thereby reducing the time needed to acquire data for decision making.

Estimated Timeline: Ongoing through 2021.

3. OTHER

Task 3.1 – Renewal of Memorandum of Understanding (MOU)

2021 will see the signing and completion of the third MOU for the ORMGP. The MOU will run through to December 2030 and will help to guide program activities over the next several years.

- **Benefits:** The program benefits from the structure and administrative understanding that will come through an agreement between the partner organizations within the ORMGP.
- **Timeline:** Spring 2021