



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
 Conservation Halton

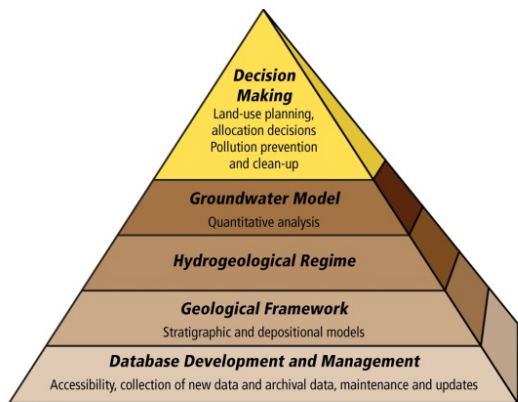


ANNUAL PROGRAM OVERVIEW (2023)
&
WORK PLAN (2024)

TO: ORMGP Executive Steering Team
FROM: Steve Holysh and Rick Gerber
DATE: May 6, 2024
RE: 2023 Overview/2024 Work Plan – Oak Ridges Moraine Groundwater Program (ORMGP)

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.



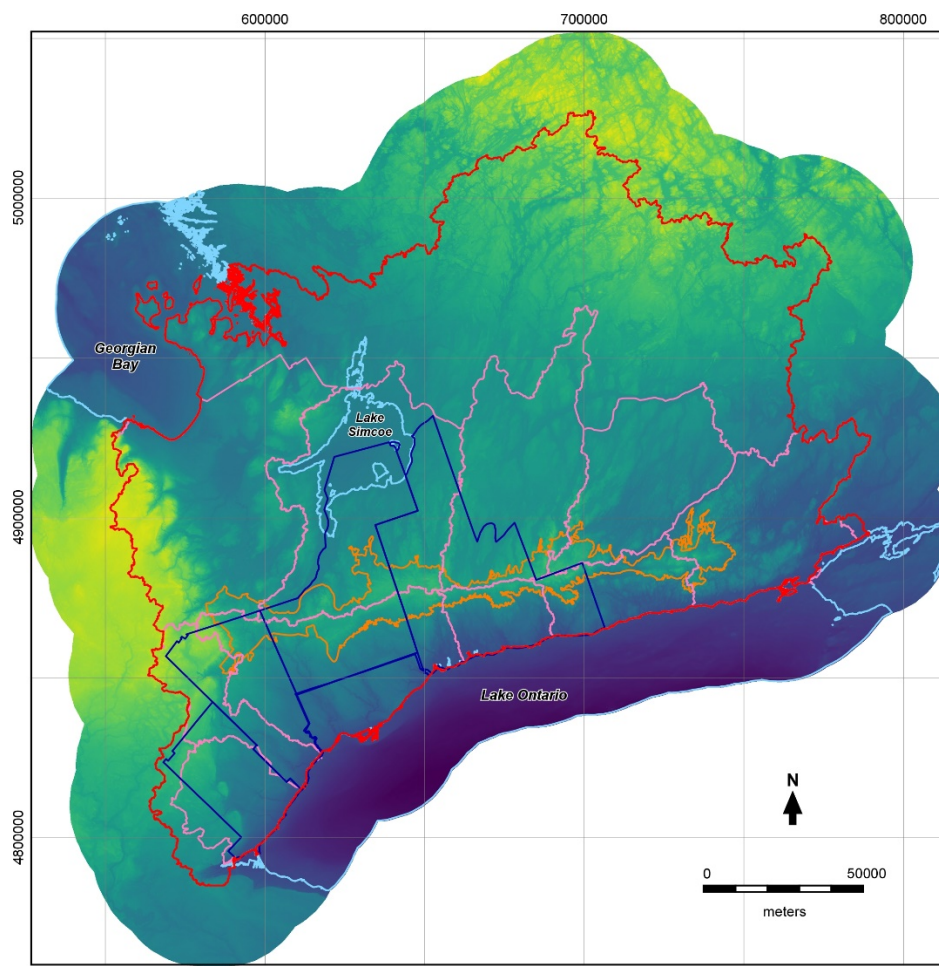
Mandate

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 interpreted 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 current 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: 1) the entirety of three Source Water Protection (SWP) Regions: a) Credit Valley/Toronto and Region/Central Lake Ontario (CTC); b) South Georgian Bay - Lake Simcoe (SGBLS); and c) Trent Conservation Coalition (TCC); and 2) the Halton Region and Conservation Halton portion of the Hamilton Halton SWP area. Focus of work is largely directed to the GTA municipalities (York, Peel, Durham, Halton and Toronto) and their associated Conservation Authorities.

1. Database

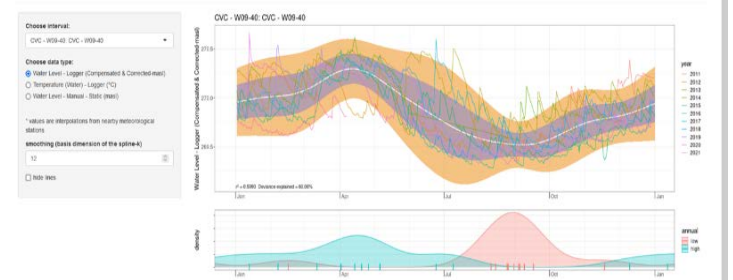


- added this year – nearly 19,000 borehole records; 970 reports; 17 million temporal records;
- 2023 website mapping sessions: Consultants = 7,390; Agency Staff = 2,335; Public = 3,581
- drought susceptible wells flagged in database and added to website;
- chemistry data from City of Barrie imported in preparation for modelling study;

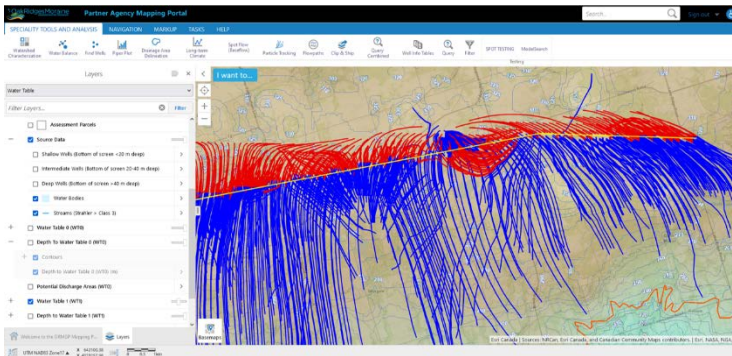
2. Analysis & Modelling

- assist with technical input into modelling studies in Halton, Orangeville, Erin, Springwater, and Barrie;
- environmental flow statistics for streams added to SW statistical package;
- “Areas of Concern” mapping finalized in Stouffville and Uxbridge;
- within TRCA, preliminary mapping of areas with higher potential for geothermal energy development;

Annual variability/High-Low Occurrence



3. Other



- invited to speak at the Commonwealth Study Conference for high level international guests;
- added high resolution DEM to website;
- synthesized and presented GW variability data snapshot to IAH mtg;
- continued collaborative partnerships with consultants (23 firms in 2023);
- story map on silt discharge to Gages Ck added to website;

4. Budget

- program delivered within available funds - no planned increase for 2024;

Program Component	2023
Staff Costs (Wages + Benefits)	\$764,324
Office Costs + Disbursements	\$73,922
Computer + Software	\$34,702
Consultant/Services	\$61,875
Administration	\$34,783
Total	\$969,606



Review – 2023 (Detailed Summary)

The following provides a more detailed overview of activities undertaken through the Oak Ridges Moraine Groundwater Program through 2023.

1. DATABASE/WEBSITE

Through 2023 the program's database structure/schema remained robust. The information contained within the database was refined and improved through 2023 with continued use of SQL 2016 to facilitate database management. 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 March 2023 from the MECP and 18,954 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 about March 2022;
- New boreholes: i) from City of Barrie; and ii) a few newly drilled or newly discovered wells added in Halton, Peel, Durham and/or York Region; in addition to the MECP wells, approximately 130 additional wells/boreholes were added in 2023;
- 969 new documents were brought into the library over 2023;
- Nearly 33 new surface water locations were added, most of them being stations supplied by Lake Simcoe Conservation Authority;
- In total approximately 17.6 million temporal records (chemistry, water levels, climate, stream flow, etc.) were added in 2023 – this number reflects the import of regional data (from York, Peel, Durham and Halton), updating of the PGMN water levels and chemistry, as well as the updating of climate and stream flow data from Environment and Climate Change Canada;
- Surface water quality data from the Provincial Water Quality Monitoring Network (PWQMN) was a part of the above data import into the database;

1b Corrections

- In moving forward with a review and update of the geological and hydrogeological 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; iii) checking to ensure decommissioning records were properly identified (not misidentified as wells) and iv) 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. This task emphasizes an important aspect of the ORMGP program and that is the use of data – errors and the resultant corrections are only found when staff make use of the data. If the data is not used then no errors would be found or corrected.

1c Accessibility

- Through 2023, 23 consultant companies were partnered with the ORMGP under consultant agreements (Azimuth, WSP, exp, GEMS, Dillon, Burnside, Hatch, IBI, Jacobs, Gaman, Terraprobe, Soil Engineers, Matrix Solutions, SLR, Aqua Insight, Salas O'Brien, Thurber, Watermark, GW Environmental Management, GHD, Bara Group, Toronto Inspection, Geo Process);
- 585 individual accounts now exist for consultant partners this is an increase from 455 last year);
- user accounts for partner/technical agency staff also jumped slightly up to 427 accounts compared with 384 last year - several staff turnovers/moves have resulted in a small number of accounts deleted and others created; several staff from local municipalities, primarily in York Region (Vaughan, Richmond Hill, etc.) have requested accounts to the ORGMP website and have been periodically using the site;
- similar to past years, the 2nd year engineering course in Water Resources Engineering at the University of Guelph used the ORMGP website for required hydrology assignments. Temporary student accounts were created so that students could access the site to complete assignments. Staff continue to investigate ways to expand this student/University interaction;
- Tracking website use, with a focus on the mapping portal, was undertaken through 2023. In total, the consultants logged into the ORMGP website 2,463 times, and had a total of 7,390 mapping sessions on the website, with a total of 120,825 map 'requests'. Technical staff from the partner agencies had 888 logins to the ORMGP website, with a total of 2,335 mapping sessions and a total of 77,927 map 'requests'. The public mapping portal was accessed 3,581 times in 2023. The website continues to be used by a wide range of technical staff to acquire data and information needed to inform decision making.
- 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, around 2,080 new PDFs were uploaded and added in 2023 with the total of available non-MECP BH logs now reaching 5,019. This initiative allows for these consultant logs and other older logs from GSC or OGS staff to be readily accessed on the website;
- In 2023, the process of building a new tool to allow for staff at partner agencies to import logger data into the master database was completed. Testing with logger files has been successful and the tool is now being used to import ORMGP logger files into the database. Some minor refinements to the code are planned for 2024.
- The many 'R' based statistical tools available for groundwater level hydrograph analyses, 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. Of particular note was the addition, at the request of Lake Simcoe CA, of a large suite of Stream Analysis and Assessment Software (SAAS) tools that allow users to quickly gain insights into stream behaviour across the study area;
- The Citrix Xendesktop platform, which allows for partner agency staff and ORMGP staff to access the program's database and ORMGP files continues to be one of the main ways for staff to interact and update the ORMGP database.
- 2023 also saw continued development of metadata and information sheets (built in GitHub to allow for easy updating and editing) that describe maps and analyses available on the ORMGP website (see [ORMGP Metadata and Information](#)).

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. The many software licences required to maintain the program were all renewed as required throughout 2023.

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 2023 calendar year. As in the past, the backing up of the database continues to be a focus of the program and was unchanged in 2023:
 - 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 fileserver (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) is held on 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 partner agencies can review/access/QA/evaluate their data held in the ORMGP database, a cut of each partner agency data set is distributed (in SQL and/or Access format) at the ORMGP technical meetings (i.e., usually twice per year or more often if requested). In 2023 this database access was provided remotely using Drop Box.

2. ANALYSIS & MODELLING

Technical Modelling Contributions

Through 2023, 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 Geocortex, GSFLOW, HydroGeoSphere, Raven, and CSHS HyDRology).

Town of Erin, Springwater, City of Barrie, Town of Orangeville, Halton Tier 3 Update Numerical Modelling studies

Through various partner agencies, ORMGP staff have been asked to assist several numerical modelling studies that are taking place across the study area. The studies are all being led by various consulting firms, with ORMGP staff assisting to provide technical input and direction by serving on the technical steering committees for these studies. These modelling initiatives will carry on into 2024, and the modeling files will be imported and managed through the numerical model custodianship program.

Storage of Gridded Data (FEWS)

Work within the Delft-FEWS environment progressed through 2023 with efforts advanced in refining water budgets in preparation for updates to the water budget tool, and in being able to directly read/display FEWS results via the website. The program's ability to manage gridded sets of information continued to improve in 2023.

Time Series/sHydrology Analyses

Through 2023 the groundwater, surface water and climate time series analysis packages, including the graphs and statistics, 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 (ECC) website continues to be regularly uploaded into the program's database. In 2023, the ORMGP program has accessed various partner (e.g. CVC, LSRCA, TRCA, York, Peel,) datasets through API development, thus allowing for automated data import into the program's database. 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.).

LSRCA also sought the assistance of the ORMGP to incorporate additional stream analysis and assessment tools into the statistical package available through the ORMGP website. The expanded analyses replaced a set of tools that were previously available through Trent University and includes the addition of baseflow, subsistence flow, high flow pulse, channel forming flow, riparian flow, and rate of change of flow statistics to the surface water statistical package.

Through the FEWS work, and the incorporation of radar data into the analyses, interpolated climate is also available, even at locations distant from climate stations. One example of the applicability of this work is the ability of website visitors to now quickly determine whether, at any given location, the previous month was either hotter/colder or wetter/drier than the long-term average. To assist with improving hydrologic model calibration in the Bay of Quinte area, in 2023, ECC and LTRCA sought the assistance of ORMGP staff to expand the FEWS climate analyses system slightly east of the ORMGP boundary.

Geological Layer Harmonization

Continued work on the geological surfaces in 2023 was aimed at regenerating the geological surfaces in Surfer software, with a focus on regenerating the bedrock surface, the completion of which is expected in 2024.

Groundwater eBook

Through 2023 work continued on an Oak Ridges Moraine focused eBook to be submitted to an international entity known as the “Groundwater Project” (see [Groundwater Project](#)). The Oak Ridges Moraine will be the only Canadian contribution to the Aquifers of the World section of the Project. The Groundwater Project is an international effort led by Dr. John Cherry to provide free educational groundwater related materials to the global community. The eBook provides an opportunity to showcase the collective ORMGP efforts to a broad global audience. In 2023, the eBook underwent a comprehensive review from an external reviewer. Contributed sections, particularly related to the geological write-up were in need of revisions to synchronize with other parts of the book. Although delayed by this review, it is expected that the eBook will benefit considerably from the review and will be submitted for final review in 2024. Depending upon the feedback, it is hoped that the book will be finalized in 2024.

“Areas of Concern” Mapping/Analyses

In 2023 work continued on the “Areas of Concern” mapping (see [ORMGP - Areas of Concern](#)). Work in Whitchurch-Stouffville and Uxbridge was finalized in 2023. In general, this work has a focus on the artesian conditions that naturally exist on the slopes of the Oak Ridges Moraine. This condition occurs as a result of the pinching out of the Oak Ridges Moraine aquifer sediments in moving away from the crest of the moraine as the elevation declines. The Oak Ridges Aquifer pinches out between the overlying surficial aquitard layers (e.g., Halton Till) and the underlying Newmarket Till. Excavations or wells drilled along this part of the moraine, should they breach the upper confining aquitard, can lead to considerable groundwater problems that frequently cost significant time and money to resolve. Mapping is prepared that shows areas where proposed developments/excavations might result in ‘unexpected’ groundwater problems (and by extension, associated increased costs). There is interest in having the City of Markham being worked on in 2024. In 2024, staff will also investigate the possibility of capturing some elements of the Area of Concern work onto the website mapping.

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 2023.

York

- Rick – add in anything you did with York here.....also anything with Richmond Hill or Vaughan – or other local municipalities
- Generated SAAT and SWAT analyses for Nobleton from numerical models for internal York work;
- Assisted in review of core samples from Nobleton BHs;
- Assisted staff from local municipalities (Vaughan and Richmond Hill) to access key information from the ORMGP website;
- Updated recently drilled Nobleton and Ballantrae wells in the ORMGP database.

Peel

- Meeting held to discuss data coordination as region integrates new real time monitoring system into their process;
- Along with Peel staff, coordinated the review, correction and updating of pumping/chemistry/water level data for Peel’s groundwater-based communities;
- Provided overview of ORMGP and website to new student staff;
- Assisted Town of Caledon with data for a study in Bolton;
- Meeting to discuss bedrock valleys in Inglewood area;
- Presentation of ORMGP website to Town of Caledon staff;

Durham

- Helped to characterize Cannington area by plotting numerical model particle tracks in preparation for study to look at the water supply;

- 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;

Toronto

- assist City staff in a project to look at groundwater pollution potential by providing water table data;

Halton

- continued to sort through Halton files to ensure correct naming and positioning of Halton's important municipal wells;
- imported chemistry data from old files and recent files provided by regional staff;
- assisted in reviewing paper on Limehouse bedrock valley prepared for the Ontario Geoscience Open House;
- provided comment on potential drill locations to investigate Limehouse bedrock valley;

TRCA

- worked on project to highlight potential areas for geothermal development within TRCA jurisdiction;
- assisted with technical insights to TRCA geothermal project at Shoreham Dr.
- adjusted the estimated recharge layer from the expanded TRCA Model to encompass the Humber River Watershed and undertook modelling work to assist in preparation of updated Humber Watershed study;
- advised on reviewing the requirements for SWP protocols of soil testing with respect to agricultural lands for SWP;
- assisted with revising the Significant Recharge Area delineation for s. 36 ammendment
- continued to link to TRCA database thus allowing all TRCA surface water stations to have statistical analyses performed via the program website;

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;
- assisted with technical input for Section 36 SWP Report;

CVC

- assisted in technical committee for Town of Erin modelling study;
- reviewed data and naming of key Town of Erin wells so that they are readily found in the ORMGP database;
- supported Huttonville Watershed salt loading modelling by providing groundwater data to investigate seasonal groundwater influxes might affect results;
- supported a Credit Watershed wide study to delineate areas that might be unsuitable for LID development;
- provided data from ORMGP to support initial risk mapping for groundwater

NVCA

- added the Midhurst model to the model custodianship program
- undertook a pilot HEC_HMS modelling study of the Mad River watershed to help investigate flood potential in the Town of Creemore. The goal of the pilot study was to deliver a template for future modelling studies within the Nottawasaga Watershed.

LSRCA

- incorporated environmental flow statistics into ORMGP website;
- enable particle tracking from Oro-Medonte model onto the ORMGP website;
- reviewed TofR documents and contributed as member of technical steering committee to the Willow Creek/Springwater Township modelling initiative;
- presented overall ORMGP program to LSRCA staff;
- technical contributions to LSRCA infiltration discussions.

Barrie

- provided technical support and technical Terms of Reference document to assist in starting a renewed modelling initiative within the City;
- imported many key wells and associated data into the ORMGP database so that information is available to the modelling consultants that will update the City of Barrie numerical modelling.

3. OTHER PROGRAM INITIATIVES

Over the course of 2023 several other initiatives also formed part of the overall ORMGP work program.

Website – Partnership agreements with consulting firms were initiated in early 2018 and have continued, with the end of 2023 marking the fifth year of this program. Through 2023 there were twenty three consulting firms partnered with the ORMGP whose staff are now actively using the password protected side of the website to aide in their consulting practice. 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.

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 2023, some of the more significant updates to the website included the following:

- pilot study incorporation of high resolution DEM into mapping;
- a new ‘Story Map’ was prepared to discuss a significant natural groundwater phenomena that occurred in Gages Creek on the south flank of the Oak Ridges Moraine [Story Map - Gages Ck silt discharge](#));
- update to the Document Theme map to present additional legend items that allow users to gain an indication of which documents still need to have their data processed and entered into the ORMGP database;
- Printing template was adjusted such that the Print template only shows legend items that are visible in the print selection window; public printing was also adjusted and improved;
- The water quality theme map was adjusted with several new legend items being added – users can now see the MECP classification of driller reported water quality (i.e.Fresh, Salty, Sulphur, Mineral, Gas and Iron). In addition, users can now see those wells where different groupings of water quality parameters have been analysed (e.g. wells with isotope, metals, pesticides, volatile organics, etc.);
- The viewing of streams has been given more flexibility with users being able to display each order/class of stream individually;
- A new Wetland layer was added to the Surface Water and Land Use Theme Maps;
- The “Drought Susceptible” wells (water level close to pump setting or water level close to base of well) were added to the Boreholes Theme Map and to the “Groundwater Levels Theme Map;
- On the Location Theme Map - the PTTW information was adjusted to show those PTTW locations where the MECP has reported water taking data (this was available for 2019 and 2020 only);

- Additional environmental flow statistics added to the surface water statistical package;

Report Library – Some 900 reports were added to the program library over 2023.

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. Some of these monitoring locations have continuous measurements extending back to 1994.

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 2023 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.

Communications/Analyses

In 2023 ORMGP staff were invited to present or meet with various external agencies on behalf of the partner agencies.

- ORMGP staff assisted with the overall organization, led a panel discussion, and presented at the annual Ontario Geological Survey (OGS)/Geological Survey of Canada (GSC)/Conservation Authority Open House held in February 2023;
- Continued to be active in SoSmart, a collective that looks to make stream related data available to practitioners working on southern Ontario streams;
- Assisted with TA training and set up ORMGP website accounts for students at University of Guelph enrolled in a fall 2023 engineering hydrology course;
- Provided in person or on-line ‘Lunch and Learn’ or similar talks to the following groups to promote increased use of the ORMGP website: Ontario Clean Water Agency, Metrolinx, SLR Consulting, Ratio City, Environment and Climate Change Canada, Tatham Engineering, Toronto Inspection, BaraGroup, Terraprobe, Town of Orangeville, Town of Caledon;
- Invited to presented to CTC source water committee;
- Invited to present at the Ministry of Environment, Conservation and Parks training day for technical staff from across the province;
- Invited to present to the Canadian Chapter of the International Association of Hydrogeologists evening lecture series;
- Provided technical overviews and training on the ORMGP program and its products to staff at: i) Lake Simcoe Conservation Authority; ii) Nottawasaga Conservation Authority;
- Presented at a forum on the Bay of Quinte water issues with respect to climate data and its use in surface water modelling;
- Presented a paper that summarized the salt loading into Lake Ontario study, at the International Association for Great Lakes Research (IAGLR) conference;
- Met on several occasions with City of Ottawa staff to provide technical support to their Geological Information Project (GIP);
- Invited to present to the Duke of Edinburgh’s Commonwealth Study Conference, an initiative that brought to Canada some 300 emerging leaders from business, government, labour and the community sectors, to share insights on various aspects of Canadian national and regional affairs on various topics including the environment;
- Invited to attend an Urban Catchment Science Research Workshop at Toronto Metropolitan University;
- Continued to contribute to the Greenbelt Foundation by serving on the Advisory Committee that reviews incoming proposals;
- Continued participation in 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

In 2023 the five senior partners (City of Toronto, Regional Municipalities of York, Peel, Durham, and Halton) each contributed \$175,000, and in addition, the program received \$91,200 from consultant subscriptions to the ORMGP website, resulting in a total revenue of \$966,000 to the program. The program's expenses for the 2023 are summarized below. 2022 costs, as well as estimated 2024 costs are also provided.

Program Component	2022	2023	2024 (est.)
Staff Costs (Wages + Benefits)	\$736,534	\$764,324	\$790,000
Office + Disbursements	\$43,358	\$73,922	\$54,500
Computer + Software	\$36,513	\$34,702	\$35,000
Consultant/Services	\$51,058	\$61,875	\$110,000
Administration	\$25,220	\$34,783	\$32,000
Total	\$892,684	\$969,606	\$1,021,500

The program was completed within an acceptable budget in 2023. Program costs were similar in 2023 to 2022. The cost estimate for 2024 is projecting an increase in Consultant/Services as additional hours have been projected for a recently added consultant staff member to contribute more significantly to the program.

Given the tight budget conditions in 2020, and that staff costs/benefits rise by a minimum of the cost of living, staff initiated the process of adding a 'cost of living' adjustment to the ORMGP budget for 2024. To date this initiative has not moved forward. Staff will continue to pursue the addition of a cost-of-living adjustment to the requested funds from the funding partners going forward.

2024 WORK PLAN – ONGOING/UPCOMING TASKS

As in previous years, key initiatives for 2024 will relate to enhancing: i) the program's database; and/or ii) communication and outreach. Tasks will generally 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 technical staff in improving decision making. 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 of various individual specialized software packages (e.g., Sitefx, GIS, SQL Management Studio, etc.).

With no suggestions as to the order of importance, through 2024 work will take place on the following aspects of the program.

Work Area 1 - Continued improvement and expansion to the database and report library

The database is now over 100 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 from various partners and input to the database. As updates are made available from the Province, the WWIS, PGMN, PWQMN data and PTTW will be updated through 2024. Temporal data from the partner agencies will also be updated through the year. Once data is added into the database, then all of the statistics available on the website are automatically updated within a week.

In 2024 program staff will continue to input additional reports into the library. In addition, ORMGP staff encourage partner agencies to retain students to process technical consulting reports, and will assist with training and data management of consulting or other relevant reports. Data capture from library reports into the database will also continue through 2024 as time permits.

- **Benefits:** Improved data quality and additional data input to the database is reflected in the long-term statistics available on the website and enhances the overall understanding of subsurface information and flow systems across the program area. This supports one of the program's long term goals, that of striving for data-driven decision making. Work undertaken in the ORMGP area, whether it is in support of partner agency initiatives, Source Water Protection, development, construction activities, or other will benefit from increased access to data.

Work Area 2 – Fostering and Enhancement of Website Use

Over the course of 2024, staff will continue to monitor partner agency use of the program website and encourage further use of the site. This feedback will assist with focussing improvement efforts relating to information accessibility and analysis tools that are made available on the website. In 2024, staff will be exploring means (on-line or face to face) for developing and implementing additional training for technical staff at both consulting companies and partner agencies. Staff will continue to encourage other companies to join the partnership. Partner agency staff are also urged to encourage consulting companies to make use of the ORMGP.

- **Benefits:** 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 information and data available through the website and to contribute back to the program.

Work Area 3 – Numerical Modelling Assistance

Through 2024 several consultant-led numerical modelling projects will be ongoing. By serving on the technical steering committee for several of these projects, ORMGP staff will contribute expertise to ensure that the modelling teams do not overlook any data or analyses that can be gleaned from the ORMGP website.

Modelling studies that will be ongoing through parts of 2024 include studies in Orangeville, Town of Erin, Springwater Township, Halton, and Barrie.

- **Benefits:** By Provides data so that hydrographs, pumping quantities and water quality can be readily accessed/viewed on ORMGP website. Also, improved understanding of groundwater conditions in the upper parts of the Credit River Watershed will improve overall understanding of the watershed down to Lake Ontario.

Work Area 4 – Geological Layer 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. With the consolidation of all the geological picks in 2023, ORMGP staff are now in a better position to bring together geological insights across the broad ORMGP study area. In 2024, it is anticipated that work will be focused on updating the bedrock surface, with a focus on bedrock valleys and their orientation, with a strong focus on a check of water well records and their position, which has been found to potentially alter bedrock valley thalwegs.

In 2024 staff will continue conversations with staff from the Ontario Geological Survey as well as the Geological Survey of Canada to discuss and possibly incorporate geological layers from the 2020 OGS South Simcoe study, as well as the bedrock geological layering from the recent modelling work undertaken by the OGS and the GSC. As needed, OGS and GSC staff will be brought into discussions regarding various partner projects and initiatives; specifically, investigations that have suggested a revision to the local hydrogeological conceptual understanding (e.g., Ballantrae and Nobleton water supply well drilling and testing programs).

- **Benefits:** This task continues efforts to consolidate geological frameworks from various initiatives 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.

Work Area 5 – Addition/Refinement of Mapping Web Portal

Over the course of 2024 several planned initiatives will be moved forward to enhance the mapping portal on the ORMGP website. Ideas that will be explored include:

- **Chemistry** – although preliminary work has been undertaken on a new tool to better extract and display results of water quality tests, the tool has not been sufficiently developed to enable on the website. Work will continue in 2024 to get this tool website ready.
- **Groundwater Level Variability** – Building upon the Groundwater Level Variability Data Snapshot, ORMGP staff will look to link certain hydrogeologic behaviours observed at different wells situated within various hydrogeological settings. The long-term goal would be to better understand the expected groundwater response in different settings to both seasonal water availability as well as single storm events. These insights would then be transferred to the website either at the well level (different coloured wells) and/or at the landscape scale.
- **Water Budget** – in 2024, making use of newly developed Delft FEWS system, efforts will be extended to work on a renewed water budget tool that will extend water budget coverage westward through the Halton area.
- **Online Model Insights** – With the introduction of the Clip and Ship tool in 2023, interest continues in ensuring that hydrogeological insights from the numerical models developed over recent years are made available for more widespread use. Towards this goal ORMGP will continue to explore additional ways that will allow partners to take advantage of the past investments in numerical modelling. Some ideas to

consider include allowing for users to explore well drawdown via the ORMGP mapping portal. This could allow for non-modellers to gain insights from models for various water management decision-making and quickly assess potential impacts to their water supply

- **Dynamic Maps** – In 2024, expanding upon the introduction of the “Dynamic Data Snapshots”, ORMGP will look to publish more of these maps onto the website.

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.

Work Area 6 – Interpretive Mapping

There has been an indication from partner agencies that interpretive mapping has been beneficial. 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. In 2024 ORMGP will focus on trying to make available on the website some of the key analyses that are synthesized into these reports. This will be on a regional scale across the entirety of the ORMGP study area. At the same time work will begin on mapping the City of Markham.

Also, in past discussions with planners, it has become apparent that the ORMGP mapping portal, 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, for example 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 be accessed on the website.

ORMGP will also look at possibly adding to the website some of the analyses that is currently being utilized in a groundwater risk mapping project that is being coordinated through CTC, working with CVC staff.

- **Benefits:** Understanding subsurface conditions prior to any project commencement, can assist in a wide variety of planning related decisions, providing preliminary input or screening for project design and costing.

Work Area 7 – eBook

In 2024 work will wrap up on the ORMGP eBook contribution to the Groundwater Project. The eBook will synthesize much of the hydrogeology of the Oak Ridges Moraine area and will be unique in that it will directly link to the ORMGP website allowing readers to explore data as they read through the book.

- **Benefits:** As the only Canadian contribution to the Groundwater Project’s overview eBooks on major global aquifers, the opportunity exists to showcase the work of the program and partner agency staff that have contributed to the program over the years.

Work Area 8 – Website Metadata

The past few years have seen the development and build out of ORMGP’s metadata using GitHub. 2024 will see the continued development and refinement of the writeups, and to improve upon the organization of the information.

- **Benefits:** having metadata available on the website allows users to see data sources and how various analytical maps and graphs have been created. This will provide additional confidence and support to website users such that they can rely on, and defend, the use of ORMGP website products.

Work Area 9 – Communication Strategy

With the support of the Greenbelt, in 2024 ORMGP staff will continue to engage with Intent, a marketing/strategic communications firm, to move forward with improvements to the ORMGP's website and overall communication strategy.

- **Benefits:** with stronger more effective communication, both through marketing materials and through the ORMGP website, the program will entice additional companies and individuals to use the program's data and interpretations to improve decision making.

Work Area 10 – Program Succession Planning

In 2024 work will begin on structuring a transition of the program to new leadership. It is envisioned that a multi-year plan will be put in place to oversee the transition of the program to new leadership as the current leadership begins to consider retirement.

- **Benefits:** effective, smooth transitioning of the program to new leadership will help to ensure the long term viability of the program for the benefit of Ontario,