

GROUNDWATER MANAGEMENT THROUGH COOPERATION – AN EXAMPLE OF LOCAL GOVERNMENT LEADERSHIP FROM THE OAK RIDGES MORAINES – SOUTHERN ONTARIO

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Abstract

In an effort to advance an understanding and management of the groundwater system across a large part of southern Ontario, a partnership was developed between three regional municipal governments (York, Peel, Durham - YPD), the City of Toronto and the nine conservation authorities located along the Oak Ridges Moraine. The study, known as the YPD Groundwater Management Strategy Study, has the Oak Ridges Moraine as a common physiographical element of interest to all partner agencies. In 2000 – 2001, the study completed a Phase 1 investigation largely consisting of an inventory of groundwater initiatives carried out in the southern Ontario area. More recently, the partnership has spearheaded a series of technical studies, including regional numerical groundwater modeling investigations, as well as strategic data acquisition initiatives. A significant component of the study is to set up consistency across the study area in terms of guidelines and policies for managing and protecting groundwater resources. The study provides an example of how local government agencies can combine limited resources to foster strong ties and achieve a sound technical understanding of the groundwater resource across a significant geographical area.

Resumé

Dans un effort pour avancer la compréhension et la gestion du système d'eau souterraine à travers une grande partie de l'Ontario méridional, un partenariat a été développé entre trois gouvernements municipaux régionaux (le York, Peel, Durham - YPD), la Ville de Toronto et les neuf autorités de conservation localisées le long du «Oak Ridges Moraine». L'étude, connue sous le nom de l'Étude de Stratégie de Gestion d'Eau souterraine de YPD, a le «Oak Ridges Moraine» comme un élément de physiographie d'intérêt commun à toutes les agences partenaires. En 2000 - 2001, l'étude a complété la première phase d'investigation qui était composée principalement d'un inventaire d'initiatives d'eau souterraine qui ont été exécutées en Ontario méridional. Plus récemment, le partenariat a mené une série d'études techniques, incluant les investigations de modelages d'eau souterraine numériques régionales, de même que les initiatives de saisie des données stratégiques. Une composante significative de l'étude devra démontrer une homogénéité dans l'ensemble du domaine d'étude sur le plan des lignes directrices et des politiques, cela afin de gérer et protéger les ressources d'eau souterraine. L'étude fournit un exemple sur la façon dont les agences de gouvernement locales peuvent combiner des ressources limitées pour encourager des liens forts et atteindre une compréhension technique solide de la ressource d'eau souterraine dans l'ensemble du domaine géographique significatif.

1 BACKGROUND

The Oak Ridges Moraine stretches some 160 km across southern Ontario from the vicinity of Trenton in the east to the Niagara Escarpment in the west (Figure 1). The moraine serves as the height of land separating southward flowing drainage towards Lake Ontario from northward flowing drainage into Lake Simcoe and other northern Kawartha Lakes. The moraine is recognized as a regional groundwater recharge area, providing a source

of groundwater to numerous aquifers and to the streams having headwaters on the flanks of the moraine.

The Oak Ridges Moraine has long been the focus of significant attention by the Provincial Government as well as by the public owing to the pressing land development pressure imposed from the rapidly growing communities surrounding Toronto. In the early 1990's a study on the hydrogeological significance of the Oak Ridges Moraine was prepared to investigate the role of the moraine in the hydrogeology of the Toronto area (Intera Kenting, 1990).

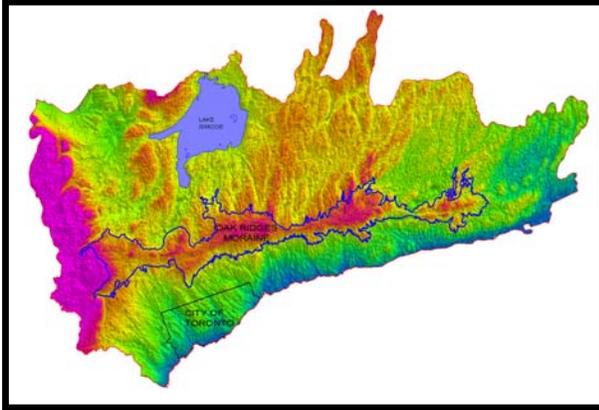


Figure 1. DEM of the Oak Ridges Moraine.

Shortly thereafter, the Provincial government released guidelines for managing land uses on the moraine (MOE, MNR, MMAH, 1991). Since that time several studies and reports have been commissioned and completed to investigate technical and land use issues related to the moraine (e.g. Oak Ridges Moraine Technical Working Committee, 1994; Hunter and Associates, 1996). This activity culminated in the release of the Oak Ridges Moraine Conservation Act and the accompanying Oak Ridges Moraine Conservation Plan, both of which were released by the province in late 2001. This legislation significantly curtails development on the Oak Ridges Moraine.

2 EXISTING JURISDICTIONAL SETTING

Groundwater protection/management in the Province of Ontario is currently achieved by a number of different agencies at all levels of government. A number of provincial Ministries currently touch on different aspects of groundwater management either through legislation or as part of their day to day functioning. These include: Ministry of Environment (MOE); Ministry of Natural Resources (MNR); Ministry of Agriculture and Food (OMAF); Ministry of Northern Development and Mines (MNDM – through the Ontario Geological Survey); Ministry of Health (MOH); and Ministry of Municipal Affairs and Housing (MMAH).

Following the Walkerton tragedy in 2000, there has been considerable re-thinking within the Provincial government to improve its approach to water management in general and groundwater management in particular. The process is still ongoing. As a result of this initiative, many legislative and procedural changes are currently taking place in terms of groundwater protection in Ontario. Some of the actions that are either in place or being actively pursued include:

- new legislation pertaining to nutrient management;
- new legislation under the Safe Drinking Water Act;

- \$15 million directed to various hydrogeological initiatives including mapping and wellhead protection delineation;
- revised legislation pertaining to water well construction;
- revised legislation for water taking permits;
- new legislation for Source Protection Planning on a Watershed Basis;
- new Legislation to ensure sustainable water and sewage systems;
- Oak Ridges Moraine Conservation Plan;

The MOE remains the lead agency in groundwater protection and management in terms of both quantity and quality, primarily through the Ontario Water Resources Act but also through the Environmental Protection Act. The MNR administers the Lakes and Rivers Improvement Act, and the Aggregate Resources Act and the Conservation Authorities Act, which established 36 Conservation Authorities across the province. Through these pieces of legislation, the MNR regulates activities related to water quantity (droughts and floods), dams, terrestrial and aquatic conditions, and aggregate extraction that can affect water resources. The MMAH administers the Planning Act, the Oak Ridges Moraine Conservation Act and the Regional Municipalities Act. It oversees items related to land development and, through land use planning, provides planning tools to protect and manage the natural environment including the groundwater system. The MNDM has a role in the geological mapping of the Province, and more recently has embarked on a program of aquifer mapping. The MOH plays a role in drinking water protection, through the Health Protection and Promotion Act, and OMAF, through its mandate to regulate management of animal waste, also has an important role with respect to the safety of drinking water.

On a local level, groundwater management activities are primarily carried out by Municipal Governments and Conservation Authorities. Regional municipalities are responsible for the development, maintenance and operation of water supply systems (both surface and groundwater). In this role they must have a sound understanding of water movement within the watersheds from which they are extracting water. Regional health units also provide support to private well owners. Through the Planning Act, Regional planning officials have the tools required to manage new land uses with respect to groundwater management, ensuring that inappropriate land uses are not placed in the sensitive groundwater areas.

Conservation Authorities administer activities related to the management of streams and rivers within their jurisdiction and have been active in the development and implementation of watershed management strategies and resource management plans. Many Conservation Authorities are involved in groundwater and surface water protection as it relates to the surficial natural features and functions. In addition, many Conservation Authorities screen planning applications on behalf of the federal

Department of Fisheries and Oceans against possible harmful alteration, disruption or destruction (HADD) of fish habitat.

A key to effective implementation of all of the above regulations and practices is the need for a solid understanding of how much water is available and how water is moving through watersheds (i.e. understanding the hydrologic cycle). In Ontario, local government agencies (e.g. Regional municipalities and Conservation Authorities) that are responsible for managing water resources on a day to day basis are now moving into position to provide the understanding necessary for effective water management. Through the partnership of these two types of local agencies, effective natural boundaries can be evaluated to ensure that the issue of “water not respecting political boundaries” is effectively addressed. This is an issue that, formerly, local agencies would have turned over to the Province for support.

3 ESTABLISHMENT OF YPD PARTNERSHIP

In the late 1990's, the Toronto and Region Conservation Authority (TRCA) was instrumental in initiating discussions between the Regional Municipalities of York and Peel on groundwater management issues. Subsequently, the Regional Municipality of Durham also became involved through groundwater work being undertaken at Central Lake Ontario Conservation Authority. The City of Toronto, recognizing that land management issues on the moraine affect watersheds that traverse through the City, was also interested in supporting the partnership initiative. These discussions led to the initiation of the YPD Groundwater Management Strategy Study with a Phase 1 study commissioned in 2000 and completed in 2001, largely through the consulting firm of AMEC Earth and Environmental. The consulting report provided a background review of the existing landscape in terms of groundwater management issues and also provided an overview of the physical characteristics of the watersheds in the Toronto, York, Peel and Durham area.

At the same time, in a parallel process, the regions of York, Peel and Durham (as a partnership) and the Conservation Authorities Moraine Coalition (as a second partnership) were trying to address, from a land use planning and resource management side, the strong public concern over the Oak Ridges Moraine, specifically planning for the long-term management of the moraine lands. All of this was in advance of the introduction of the Province's ORM Conservation Plan.

The above initiatives were brought together when, as one component of their partnership project, the Conservation Authorities Moraine Coalition agreed to retain a project manager under their direction to lead the YPD groundwater study into a second phase. Therefore, the partnership now involves two distinct but overlapping geographies; one incorporating the geographical areas of York, Peel and Durham Regions and the City of Toronto;

and the other incorporating the area of the nine conservation authorities with jurisdiction on the Oak Ridges Moraine (which includes the entire Toronto, York, Peel and Durham areas). Figure 2 shows the boundaries of all partner agencies in the project. The overall initial intent of the partnership and groundwater strategy was to define the framework for a long-term, coordinated program that would ensure the protection of important hydrogeological features and functions across the entire moraine area.

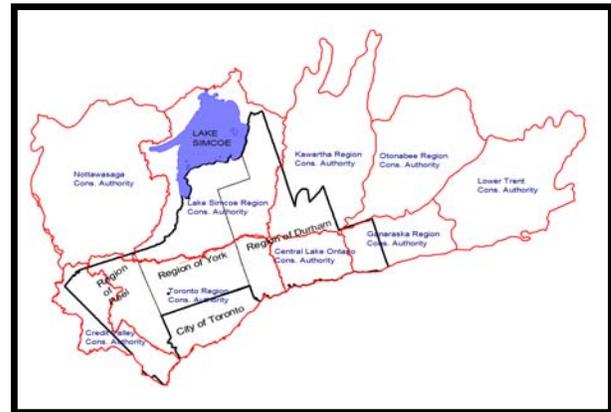


Figure 2. Partner Agencies Involved in the Study

A deliverable of the early YPD work was a proposed work plan for Phase 2 of the study which included five key strategic components:

1. Policy Framework Development – to set the approach to be used in developing and implementing policies associated with the management strategy.
2. Data Collection and Management – for use in technical analysis as well as in long-term monitoring plans.
3. Technical Analysis / Studies – to provide the technical basis for a strategy and associated policies.
4. Implementation Framework – that provides for the implementation components of a management strategy.
5. Monitoring and Evaluation - a long term commitment of evaluating and possibly adjusting the management strategy.

In late 2001, shortly after the initiation of the Phase 2 study, the Provincial Government announced funding for a series of groundwater studies across the Province, and the YPD Partnership was successful in securing funding. Through the partnership, the funding was allocated to several key technical projects all of which have progressed successfully.

The partner agencies are now interested in moving the YPD Groundwater Management Strategy Study from a specific project to a longer term groundwater management program.

4 ACCOMPLISHMENTS AND FUTURE POTENTIAL OF PARTNERSHIP

Through the partnership, a number of technical and policy studies have been undertaken over the past two years. These initiatives can be classified under the following four areas: Data Management; Data Collection; Technical Analyses; and Policy/Planning Initiatives. The following provides a brief summary of studies completed over the past two years.

4.1 Data Management

Data management is one of the most critical areas where the partnership has had tremendous success. The partnership, with the assistance of Earthfx Inc., a local consulting firm, has built a robust data model that accommodates numerous types of information required for hydrological and hydrogeological analysis of watersheds originating on the Oak Ridges Moraine.

Currently, the database incorporates:

- water well records from the MOE's Water Well Record database (approximately 135,000 records);
- geotechnical boreholes largely in the City of Toronto (13,000 records);
- key wells added to the database by various partnership staff members (several hundred records);
- water level data from regional monitoring wells (1.8 million records);
- pumping data from regional municipal supply wells (290,000 records);
- stream flow data from Environment Canada's Hydat Database (2 million records);
- climate data from Environment Canada's climate database (3 million records); and
- geological layer "picks" from the modeling exercise (40,000 records).

The database is dynamic and increasing in size at a substantial rate continuing to grow as it is used and populated by staff at partner agencies.

The data is available to each partnership agency through two means:

1. On a semi-regular basis each agency receives an update of the database of their area plus a 5 km buffer. In addition, staff from all partner agencies have been trained in the organization and the use of the database including how to access and enter new data to the database; and
2. The data is also available privately to agency staff through a pass-worded web site, where there is ready access to view and work with the data (via maps, graphs, and cross-sections).

Another significant component of the data management program carried out under the partnership has been the digital scanning and photographing of key hydrogeological reports and documents. The partnership has now scanned over 1,000 documents that are available through the YPD website. Currently the reports are being geo-referenced so that they can be searched and queried by location.

The need by all agencies for ready access to up-to-date, high quality data has been established. It is envisioned that the YPD partnership could be responsible for maintenance of the database in the future and updating it with new information on a regular basis. To more effectively incorporate data, it is envisioned that the partnership will initiate a working relationship with private sector companies to develop an exchange program whereby new data is provided for incorporation into the database in exchange for database access. QA/QC procedures will be reviewed with a view to developing standards for data collection and to ensuring the accuracy of data that is in the database. It is also planned that the database will be made accessible to the public.

4.2 Data Collection

Several data collection initiatives have been undertaken through the YPD partnership including: i) baseflow/low streamflow (groundwater discharge) measurements in support of groundwater model calibration; ii) geophysical well logging; iii) correction of well record coordinates; and iv) drilling of key high quality boreholes. These activities were largely carried out in support of the regional groundwater modeling exercise (see companion paper). All new data collected to date has been incorporated into the database.

Ongoing collaborative data collection is seen as continuing component of the YPD partnership. Certainly any data collection programs will have to be strategic in nature and contribute to the understanding of the regional groundwater flow system. Through the partnership, collective data collection programs will achieve a measure of consistency that will add to the overall quality of work undertaken by any of the partner agencies. There is also likely a role for the partnership both in coordination of data collection activities being undertaken by individual agencies (to ensure no duplication of efforts) as well as in the coordination of funding for some key activities.

4.3 Technical Analysis

Another area in which the partnership is providing a contribution is in the undertaking of numerical groundwater modeling projects. Two projects are underway at differing scales. One of these projects is more detailed in scope, and was designed to compliment an adjacent study being carried out by York Region on the Yonge Street Aquifer on the north flank of the moraine. It is focused on understanding the groundwater flow system in the watersheds (Rouge, Don, Humber) that abut the

York Region study area, and flow south off of the moraine to Lake Ontario. The two studies are being run as a joint project recognizing that by modeling the area from Lake Ontario to Lake Simcoe as one system, uncertainty introduced through boundary conditions will be minimized. The second modeling exercise extends the length of the Oak Ridges Moraine and incorporates most of the watersheds within the boundaries of the Conservation Authorities Moraine Coalition (Figure 1). Both of these undertakings involve “state of the art” technology and are some of the largest numerical groundwater modeling projects being carried out not only in Ontario, but in North America.

Currently, it is the intent that the partnership will continue to maintain an up-to-date numerical groundwater model for the ORM area. There will be a continued need by all partner agencies for a numerical groundwater model to be available for ongoing analysis of the groundwater flow system. Partner agency studies or investigations at the regional or smaller scale can be “cookie-cut” from the full area numerical groundwater flow model. It is proposed that the partnership act to maintain the model into the future, thus providing all partners with access to updated hydrostratigraphic layers as well as access to the updated numerical flow model.

4.4 Planning / Policy Initiatives:

A planning component of the program has also been undertaken by a core team including the planners from the partner agencies. To date, all official plan policies related to groundwater have been compiled and reviewed. An initial direction has been set, in that the need for several policy/guidance papers including guidance related to wellhead protection, aquifer vulnerability, groundwater mapping, water budget analysis has been established. An initial paper on wellhead protection planning has been prepared and circulated for review.

Given the common physiography shared by municipalities and conservation authorities across the Oak Ridges Moraine, continuing to collaborate on policy directions is also part of the long term plan for the coalition. This will ensure consistency in the way that land use applications will be addressed for different parts of the moraine and will allow for different organizations to readily learn from experiences in other jurisdictions. Through the partnership arrangement, an opportunity exists for policy planners to interact with technical experts from the various partner agencies in order to ensure that policies are achievable from a technical point of view and written in ways that are consistent with the science of the day.

5 FUTURE DIRECTIONS

In considering the future direction for the YPD partnership, several issues must be considered. Local government agencies are directly connected to the public and are accountable to the ratepayers on a day to day basis. Careful consideration must therefore be given as to those

responsibilities that are best carried out by a partnership versus those that are more appropriately carried out at a local agency level. Geographical boundaries, costs, and association with Provincial directions must all be considered.

Considering all of the above, the four areas presented above are considered areas where a partnership of agencies can assist in leading an initiative to for improved water management on the Oak Ridges Moraine. Costs and geographical boundaries remain to be considered. As noted above, there have been a number of recent provincial initiatives with respect to groundwater management and drinking water protection largely as a result of the Walkerton tragedy. Source water protection, a program still being developed by the Provincial government will continue to evolve and might influence, to some degree, the work undertaken through the partnership. Source water protection, combined with some of the other provincial initiatives, may change the responsibilities of municipalities and conservation authorities with respect to groundwater management and drinking water protection. Through the established partnership, a more substantial link can be established with the Province to ensure that the requirements of agencies working on the ORM can be effectively addressed.

6 CONCLUSIONS

The Oak Ridges Moraine is one of southern Ontario's most significant physiographic features, and spans across portions of three regional municipalities, numerous counties and local municipal governments, and nine conservation authorities. The current partnership model of local government agencies was created out of a need to effectively, efficiently and consistently manage the significant groundwater resources on and off the moraine both for the purposes of ensuring a continued high quality drinking water source and also to ensure the maintenance of stream flows and the many key ecological functions provided through the groundwater system. A multi-agency scale system was required that could make available water related information, knowledge and understanding at a regional scale, while at the same time addressing issues that are dealt with at a local level. Of significance, is the fact that tools and products being developed through the partnership can be utilized at various scales, from a scale that is appropriate to local municipal decision making, yet at the same time, also at a scale that encourages an understanding of the regional groundwater flow system.

The current partnership model provides a concrete example of how local municipal agencies can work together interacting with both the Provincial and the Federal Government, to seek expert knowledge, assistance and funding and build a solid water management program across a large geographical area. Through the cooperative spirit exhibited by staff at all of

the partner agencies, the study has had, and will continue to have significant successes.

7. REFERENCES

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