YORK PEEL DURHAM TORONTO GROUNDWATER MANAGEMENT STRATEGY STUDY

Towards a Sustained Long Term Program

June 21, 2004

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1.0 BACKGROUND

1.1 PURPOSE OF PAPER

Given the significant success that the York, Peel, Durham, Toronto Groundwater Management Strategy has had over the past two years (see Appendix A), the agencies involved in the project are interested in investigating whether the YPDT Groundwater Management Strategy should be carried forward as a long-term sustained program.

This document is intended to provide an overall discussion on the YPDT Groundwater Management initiative, with the aim of providing the necessary "business case" and direction for establishing a long-term partnered groundwater program. Specifically the document:

- articulates the YPDT progress and achievements to date (Appendix A);
- presents a vision and the benefits of a continued partnership;
- outlines the technical objectives, scope of work, and the expected deliverables, with a view to maximizing the effectiveness of dollars spent on groundwater related issues;
- considers alternate governance structures (Appendix B) for a long-term program and recommends a preferred option;
- recommends a long-term YPDT structure, including geographical boundaries, staffing requirements; and budgetary considerations.

1.2 PERSPECTIVES ON GROUNDWATER MANAGEMENT

From a national and international point of view, a greater focus is being placed on fresh water resources. Unfortunately, our current level of understanding of the linkages between groundwater and surface water within Southern Ontario remains inadequate, partly due to the poor state of information collection and inconsistent protocols for information gathering, inadequate cross-jurisdictional coordination, and the lack of synthesis of the data collected.

The National Academy of Sciences in the United States (2000) has recently noted that:

> *"Large scale groundwater development throughout the nation has resulted in many ill effects, including lowering of water tables, salt water intrusion, subsidence, and lowered baseflow in streams with corresponding ecological damage. Groundwater, surface water and aquatic ecosystems are now seen to be closely interrelated and can no longer be managed and regulated independently."*

The YPDT study has conscientiously addressed the above shortcoming through its activities and will continue to integrate thinking from a number of different professional viewpoints as required. The current YPDT partnership model provides a functioning example of a multi-agency collaboration, with municipalities and conservation authorities interacting (along with the Provincial and the Federal Governments as appropriate), to collect and analyze data for water resource stewardship. The study is demonstrating how a partnership of many individual organizations has taken on a role of strengthening the overall approach to water management. The cooperative spirit exhibited by the partner agencies makes the YPDT study a successful initiative.

1.3 DEVELOPMENT OF PROPOSED YPDT PROGRAM

At the suggestion of the Planning and Public Works Commissioners, the longer-term governance of the YPDT groundwater initiative was discussed at a working meeting held on May 12, 2003 at Black Creek Pioneer Village. Planning and technical staff from all of the partner agencies were invited to participate. The ideas presented in this paper are a synthesis of the discussion held during that meeting and form the recommended approach forward. Since that time the document has benefited from the contributions of staff at the various partner agencies. The document is now intended for further evaluation by senior agency representatives in order to develop an appropriate program that can be presented to, and ratified by Councils and Boards of the partner agencies.

1.4 CURRENT YPDT PROJECT ACHIEVEMENTS

Through the partnership, a number of technical and policy initiatives have been undertaken over the past two years. These can be broadly classified under the following four areas: Data Management; Data Collection; Technical Analyses; and Policy/Planning Initiatives. Further discussion on the accomplishments of the partnership can be found in Appendix A, however the following key achievements are noted here:

- construction of a rigorous data model with 190,000 key locations containing millions of records of water related data (water levels, stream flows, precipitation, etc.);
- successful distribution and use of the database at partner agencies;
- use of over 70,000 geological picks and constraint points, to assemble a three dimensional sub-surface geological model using the framework and ideas generated by the Geological Survey of Canada;
- construction of a pass-worded web site where the entire ORM database, maps and graphs are accessible to partner agencies;
- construction of an 8 million cell, world class numerical groundwater model over the entirety of York Region and the City of Toronto and parts of Peel and Durham Regions (with a short term intent to expand the model to include all of Peel and Durham Regions).

1.5 LINK TO SOURCE WATER PROTECTION AND OTHER PROVINCIAL LEGISLATION

The scope of the YPDT initiatives that have been undertaken to date is proving to be in line with many requirements of new water-related legislation being introduced by the Province of Ontario, largely as a result of the Walkerton tragedy. The work to date will help to address many of the watershed planning requirements arising from the new legislation.

Examples of the new regulations where the YPDT technical work will provide a foundation for addressing some of the crucial issues include:

- The Oak Ridges Moraine Conservation Act and Plan;
- The Source Water Protection Legislation (pending);
- The Safe Drinking Water Act;
- Revisions to the Permit To Take Water system;
- Revisions to Regulation 903 (water well construction); and
- The Nutrient Management Act and Regulations;

All of these regulations, to be effectively implemented, require a solid understanding of groundwater systems; how water moves through the ORM watersheds and the role of groundwater in maintaining healthy watersheds. To date, a key goal of the collective work of the YPDT team has been to better understand those factors which will ultimately lead to a more effective implementation of the legislative aspects of these provincial initiatives.

The vision of the long term partnership continues to be to provide a multi-agency, collaborative approach to collecting, analyzing and disseminating water resource data as a basis for effective stewardship of our water resources. The partnership will provide sound and consistent technical, planning and management tools to all partners. Key aspects of the partnership program are seen to be: effective communication; continual data management and sharing; utilization of consistent, up-to-date technology; and science-based management policies.

1.6 BENEFITS OF CONTINUED PARTNERSHIP

Considering some of the accomplishments to date, the benefits of continuing the partnership are numerous and include:

- access to a panel of technical experts via partnership;
- common technical approaches and tools;
- coordinated policy planning related to water issues;
- policies based on state of the art technical understanding;
- reduction in duplication of efforts and refining interpretations near partner agency boundaries;

- economies of scale and one source information access/storage thus resulting in cost savings related to data management, modeling, data collection, etc.;
- value of partnership status in access to funding/assistance from provincial and federal governments for groundwater issues;
- strong, unified, consistent voice to communicate with provincial and federal agencies, as well as the public.

2.0 PROPOSED FUTURE DIRECTION

In moving forward, the partnership agencies require clear direction on the long term roles and scope of work to be undertaken. The following section addresses the considerations that must be taken into account as the partnership moves to a long term program.

2.1 PARTNERSHIP ACTIVITIES AND RESPONSIBILITIES

Strategic team planning will help establish tasks that are best carried out by a groundwater partnership on a regional scale as opposed to being carried out solely by each partner agency. The YPDT partnership should not take on tasks that are clearly the responsibility of each local agency (e.g. water supply development, operations, and monitoring, planning development review functions, etc.). **It should also be noted that the role of the YPDT is to produce consistent tools for member agencies and not to dictate how the tools are to be utilized.** It is to the discretion of each agency as to how best use the YPDT information to address specific jurisdictional issues and policies.

In reviewing the accomplishments and activities completed to date, there are several categories of activity that emerge as being most effectively addressed through a long term partnership program.

2.1.1 Data Management

In 2001, the Tri-Region Strategy on the ORM identified issues relating to data management as critical to the on-going effectiveness of the partnership. At that time, the Strategy recommended that warehoused groundwater data be managed by one of the Conservation Authorities or a university, in a model similar to that used by the Transportation for Tomorrow survey. Since that time, the YPDT team, managed by an exclusive YPDT project manager, has proven its ability to manage large quantities of data and to provide a sound mechanism for the updating and distribution of this data to the partner agencies.

With respect to data management, it is important to note that subsequent to the approval in principal of a long term YPDT program, there remains much work to do in order to work out some of the more sensitive details revolving around data. Certainly protocols will have to be established to address data accessibility and ownership, to name two of the most pressing issues. The initial concept that has been put forward is that each agency adding data to the database will have the capability of setting the “accessibility index” for that data. In other words the agency would determine the level of accessibility of the data across a spectrum from fully accessible to fully restricted.

It is recommended that the data model be continuously maintained through the YPDT study. Specific responsibilities of the YPDT project manager and retained staff could include:

- Oversee the development, construction and maintenance of a secure web site where ready access to the database (in map, graph and table format) is available to authorized YPDT partners and updated on an ongoing basis;
- Establish protocols and provide for public access to selected information via the web site;
- Coordinate with partner agencies for the incorporation of new data;
- Incorporate updated stream flow and climate data from federal agencies;
- Incorporate updated data from the Province (e.g. water well records and permits)
- Provide partner agencies with an updated database on a regular schedule (6 months is proposed as a target);
- Work with private sector companies to develop an exchange program whereby new data is incorporated into the database in exchange for access to the YPDT products (maps, drawings, graphics, data, reports, etc.);
- Develop QA/QC protocols to ensure that the data gathered by member agencies and entered into the YPDT database is adequate and reliable;
- In cooperation with partner and other agencies (Province), develop standards for data collection so that newly collected data is reliable and of the highest quality;
- Work towards providing public access to selected information (mapping graphics, data compilation tables, technical reports) through a web site;
- Develop and maintain a metadata process to track data origin and data quality;
- Implement innovative approaches/technologies to data collection and interpretation as these are developed;
- Work with Provincial agencies to ensure that the partner data model is in line with, and recognized as, a provincial standard.

Figure 1 presents a summary of key data model management/maintenance tasks envisioned under the partnership role versus those best fitted to the partner agency role. **It is proposed that through a Memorandum of Understanding or alternative legally-based agreements, all partner agencies hold joint ownership of the data model and the database.** Such agreements would be worked out once the long term YPDT study is approved by agency Councils and Boards.

2.1.2 Data Collection

Data collection will, to a large extent, be carried out by the various partner agencies, as dictated by the specific needs of each agency. From a regional ORM perspective there remains an important ongoing partnership role in establishing protocols, and to continue to collect and synthesize key hydrogeological and geological data to further advance a regional groundwater management and protection framework. Specific responsibilities related to data collection should include:

- Establishment of protocols (standards and guidance) for data collection;

- Identification of priority areas for data collection (for partnership as well as individual agencies);
- Coordination of efforts in data collection, especially near agency borders;
- Coordination of funding, and technical requirements for key drilling activities, geophysical testing, pump-testing, streamflow measurements, infiltration/recharge testing, etc.; and
- Coordination of the incorporation of newly collected data into the database.

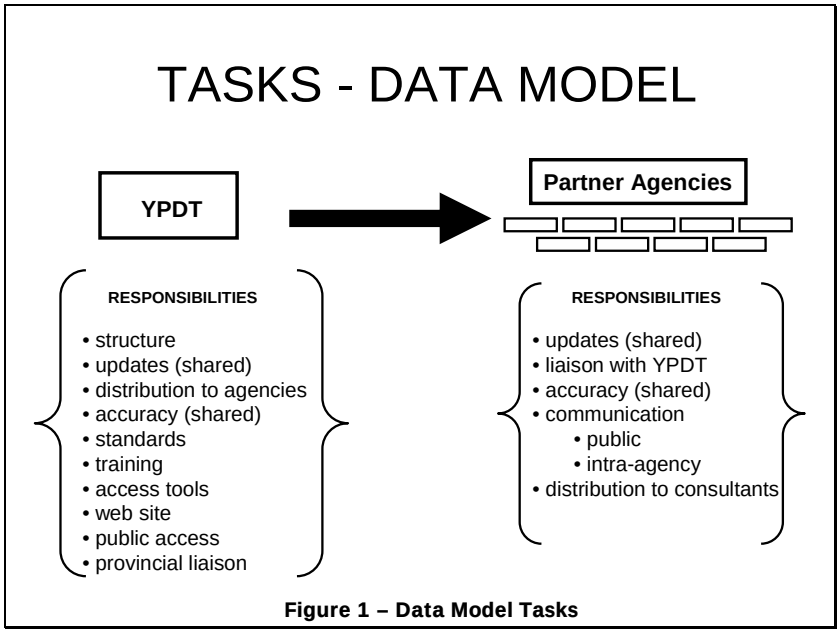


Figure 1 – Data Model Tasks

2.1.3 Technical Analyses

All partner agencies will continue to need a sound and defensible numerical groundwater model to be available and applied to understand and manage conditions in view of new situations that arise that could affect the groundwater flow system. Examples include: new permits to take water; new well development; subdivision and other development applications. The model can also be applied to revisit wellhead capture zones; undertake water budget analyses; etc. Partner agency studies or investigations at the Regional or smaller scale can be "cookie-cut" from the regional numerical groundwater flow model. **The partnership could play a key role in ensuring the maintenance and upkeep of the models, providing all partners with access to updated hydrogeological information as well as access to an updated numerical flow model.** Specific responsibilities for the partnership with respect to groundwater flow model management should include the following:

- Maintain the model as a baseline analysis and management tool for all partners; this will require that the model be continually refined and updated using newly available data;

- Ensure that key new discoveries or advances in understanding that are achieved through localized consultant studies are translated back into the overall understanding of the flow systems at a regional level and vice versa;
- As new information becomes available, maintain updated hydrostratigraphic surfaces by incorporating new information into the model;
- Maintain updated parameter assignments (hydraulic conductivity, porosity, recharge rates, etc.) for the various hydrostratigraphic units;
- Distribute (perhaps on a cost recovery basis) selected "cutouts" or components of the model to consultants to ensure the forward progression of all new technical analysis in a timely fashion;
- Provide direction to agency staff and consultants carrying out site specific work as to the appropriate application of the model (e.g. establishing reasonable boundary conditions, etc.);
- Maintain links between the coalition database and models and provincial databases to ensure widespread support for partner efforts; and
- From time to time, seek outside independent review of the model to ensure its long-term application, integrity and defensibility in support of agency mandates.

Figures 2 and 3 summarize some of the key tasks that could best be accomplished through the partnership and those that could be effectively carried out by the partner

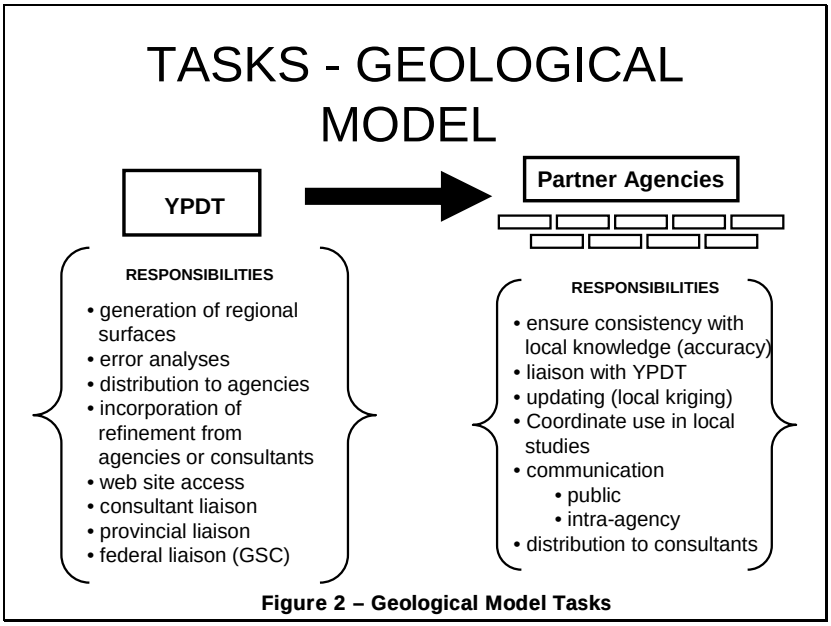


Figure 2 – Geological Model Tasks

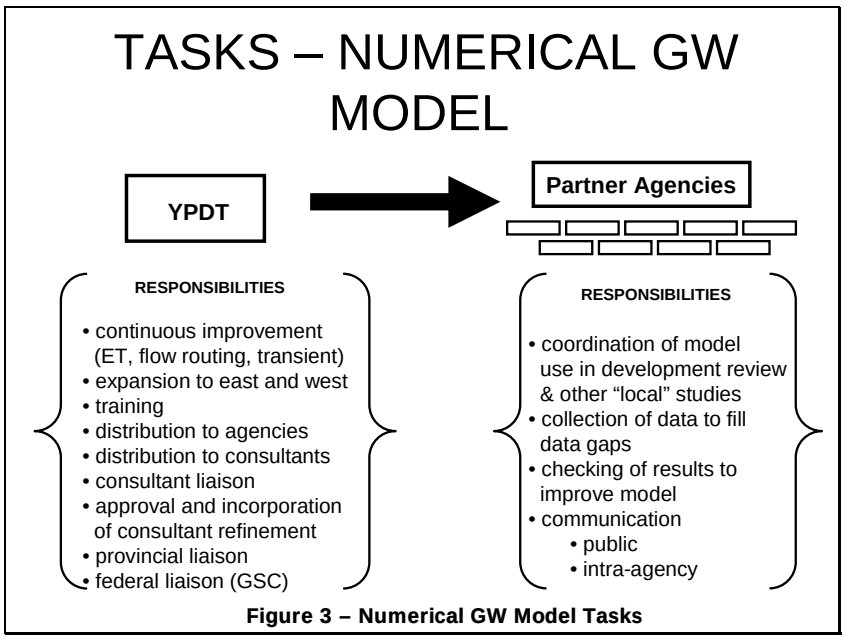


Figure 3 – Numerical GW Model Tasks

agencies, both with respect to the geological model (Figure 2) and with respect to the numerical groundwater model (Figure 3). It is proposed that through a Memorandum of Understanding or an alternate legally-based agreement, all partner agencies hold joint ownership of the YPDT generated numerical groundwater model.

2.1.4 Planning/Policy Initiatives

Given the similar physiography shared by municipalities and conservation authorities across the ORM, it makes sense that official plan policies, as well as accompanying guidance documents, that are implemented to minimize impacts to groundwater, should be consistent. The Tri-Region Strategy, prepared and endorsed in August 2001, put forward the principle of harmonization of an official plan policy framework amongst the three regions. 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 written in ways that are responsible, progressive, and that can be appropriately implemented at either a local or regional municipal level. The role of the long-term partnership in planning and policy would be:

- establishment of a consistent and effective groundwater policy framework that can work on a variety of planning levels (e.g. Regional OP, Local OP, Secondary Plan, etc.);
- coordination of Terms of Reference documents that can be used by planners to direct proponents in appropriately characterizing their properties given the hydrogeological sensitivity of their sites;
- supporting the transfer of the project's technical understanding into implementation through a variety of planning tools; and
- ensuring that there is an overall compatibility across the area where provincial direction is absent, or in ensuring that provincial direction is interpreted consistently.

It is important that municipal decision makers have access to the results and implications of the various technical initiatives. Land use change decisions have the potential to significantly affect the groundwater and surface water systems. Given the proposed partnership model, municipalities will have the ability to propose policies based on local and up-to-date technical information.

2.1.5 Securing Federal/Provincial Funding

Given the considerable strength that a partnership of 13 municipal agencies carries, along with the coordinated, high quality work that is being undertaken, the partnership can be a key player in coordinating and soliciting specific Provincial or Federal funding for ground and surface water initiatives and in rationalizing the costs. The partnership will continue to facilitate and foster long-term provincial and federal involvement in and support of the partnership work.

The YPDT partnership has already secured funding from two different Provincial Ministries for a total of nearly $2 million (for the period of 2002 – 2005) to be directed to some of the key components of the YPDT work. This funding has allowed the partnership to initiate strategic data collection (e.g. geophysics, streamflows) and technical studies (e.g. groundwater modeling). The Ministries involved will have access to the database and mapping generated through the programs they support and they will also be key partners in the reports arising from the studies, allowing them to showcase their efforts. YPDT staff will continue to work closely with both the Provincial and Federal Governments for common benefits to all partners and will continue to seek future financial support from these government levels.

2.1.6 Education

There is a role for the partnership in producing key educational pieces to promote the understanding and appreciation for water resources and their function across the broader ORM landscape. The YPDT partnership can contribute to aspects of education beyond the work that partner agencies currently provide (e.g. well maintenance, water conservation, etc.). The partnership is well suited to play a reinforcement role in education, given that the public still has a long way to go in terms of understanding basic issues related to water management. Other education related functions that could be undertaken by the partnership are those of coordinating regional groundwater symposia, as well as producing and presenting technical papers.

In addition to the more standard education initiatives that provide a critical societal need, the YPDT study can perhaps effectively fulfill a role of targeting education to the senior levels of management or even the political level (Councilors, Ministers, MP's, etc.) at both the provincial and/or agency level. There remains a very significant need to continually ensure that key decision makers are aware of the implications of land use decisions on the overall water resources of the ORM watersheds. Such education initiatives can include targeted seminars or strategic education pieces.

2.2 GEOGRAPHICAL BOUNDARIES

It is proposed that the geographical boundaries to be considered under the groundwater partnership generally be fixed to encompass those agencies having jurisdiction on the Oak Ridges Moraine. The Regional Municipality of Halton, being the only GTA municipality not within the partnership (and not having any of the Oak Ridges Moraine area within its jurisdiction) has been offered the opportunity to join. The final name for the long term program might be tied to whether Halton Region is interested in joining the partnership.

Considering the geographical area incorporated through the partnership, and leaving room for similar partnership models to be developed elsewhere in the Great Lakes basin, proposed names for the longer-term initiative include:

- Central Ontario Watershed Management District;
- Oak Ridges Moraine Groundwater Project;
- YPDT Groundwater Strategy/Partnership.

Attached, as Appendix B, is a list of current and potential partners to be considered in the establishment of a long term program.

2.3 BUSINESS MODEL, STRUCTURE AND GOVERNANCE

In order to effectively service the partner agencies and ultimately the public, there has to be in place an effective structure and reporting mechanism under which the partnership operates. A number of operating structures or business models were discussed amongst the YPDT partners including: Federal; Provincial; University; Municipal; Conservation Authority; Private Sector; joint private sector/public sector. Appendix C provides a more detailed discussion on governance and business model considerations and how a final decision was made on the recommended model for a long term groundwater strategy.

The current model with dedicated public sector staff assigned to oversee the project and coordinate communication amongst the various partner agencies is a solid model that has worked well for the past two years. It is recommended that the YPDT continue with a similar structure in the future. The current structure provides flexibility to the partnership in that consulting contracts can be established with different private sector companies to provide targeted products or services required by the partnership. In fact, with a partnership model in place, any component of the strategy can be undertaken in partnership with any of the above agencies.

Figure 4 provides a chart showing the organizational structure and the main responsibilities needed to successfully continue the YPDT Partnership. The ultimate decision making responsibilities for the project would lie with the Municipal Councils and the Conservation Authority Boards of the various partnered agencies. (It is proposed that formal official approval of budget items and consulting contracts continue to be made through the Toronto and Region Conservation Authority Board since Councilors

from all four municipalities are represented on the TRCA Board). In addition, Municipal Councilors and CA Board Members (who were not members of the TRCA Board) would

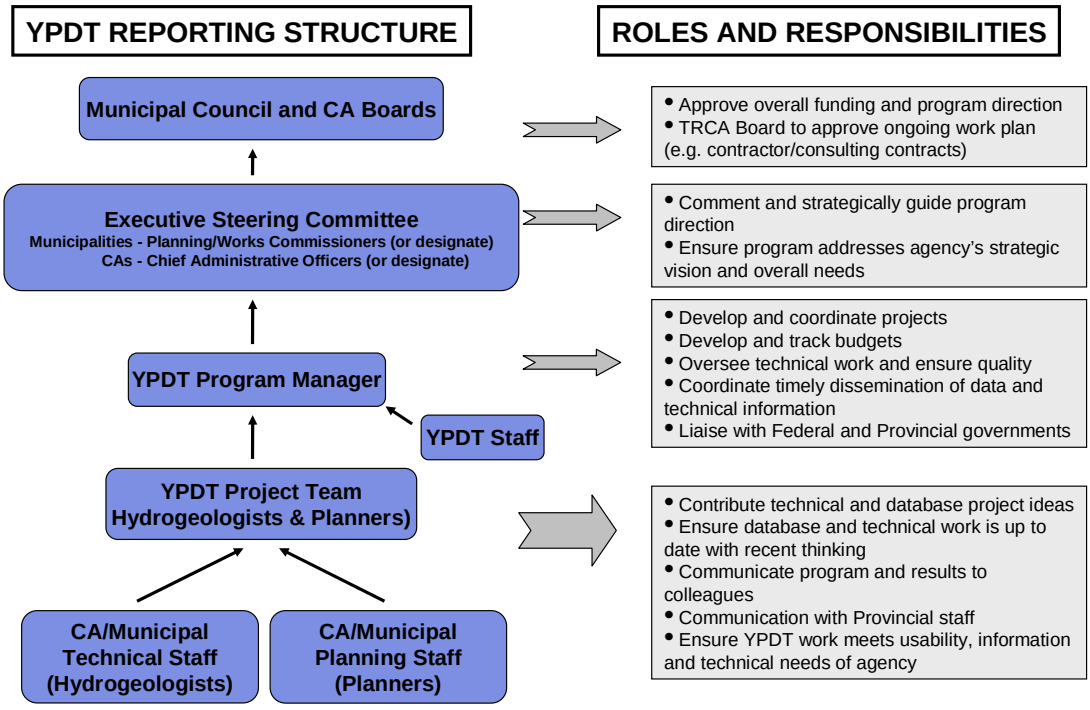


Figure 4 – Proposed YPDT Reporting Structure + Roles & Responsibilities

be updated by the Commissioners and Chief Administrative Officers from the partner agencies. As is currently the case, it is proposed that the YPDT program manager officially report on a minimum bi-annual basis to an Executive Steering Committee consisting of Commissioners and CAO's of the partner agencies (or their designates). Matters pertaining to administrative, legal, and budget issues as well as data sensitivities and major communication initiatives would be brought to the Executive Steering Committee for direction. Dedicated YPDT staff would be the responsibility of the program manager. The program would continue to have planning and technical staff from the partner agencies contributing through various meetings and working groups. Decision making on all partnership initiatives will continue to be made in an open manner by the partner agency staff at team meetings, which are typically held on a six to eight week basis.

2.5 SPECIFIC EXAMPLES – THE USE OF YPDT TECHNICAL STUDIES TO FACILITATE DECISION MAKING

Example 1 – Watershed Studies

The YPDT work will:

- help to eliminate inconsistencies at watershed boundaries;

- provide a watershed perspective that recognizes the inter-linkages with neighbouring watersheds;
- provide ready access to up-to-date geological/hydrogeological information based on a "groundwatershed" approach (recognizing that groundwater systems can cross - and therefore link - significant watershed boundaries).

Example 2 – Development Review
The YPDT database, mapping, and modeling products can be utilized by municipal and CA staff for:

- day-to-day development review, specifically with reference to maintaining recharge and discharge conditions, and to the maintenance of hydrogeologically sensitive areas:
- addressing public enquiries and concerns regarding changes to watershed conditions resulting from development proposals;
- addressing well interference, development impacts and other related issues that require readily available information and a fast, effective scientifically based review.

Example 3 – Water taking permits and water budget analyses
The YPDT groundwater flow model provides a tool for:

- for evaluating the potential effects of water takings on: i) the groundwater system (neighbouring wells); ii) stream flows; or iii) other natural areas (e.g. wetlands);
- undertaking water budget analyses on a (sub)watershed basis to satisfy requirements of the ORM Conservation Plan.

3.0 SUMMARY

Projected population and economic growth in and around the Greater Toronto Area will continue to produce demands for new sources of clean water and will also produce additional stresses on the area's natural groundwater resources. The current YPDT partnership was established to begin to address these issues and to provide direction for long term groundwater resource management. The project has proven to be successful in introducing consistent groundwater management direction and programs across a significant portion of southern Ontario. The initial successes of the YPDT partnership provide momentum for continuing with the long-term goal of comprehensive, consistent water management in the ORM area. The success to date can be attributed to:

- a recognition from high-level management within the partner agencies, that a united effort could result in more effective water resource management for partnered agencies;
- a commitment to move to comprehensive water resources understanding through investment in staff, technology and public communication;
- recognition and respect for jurisdictional mandates and responsibilities that currently lie with each municipal or CA partner;

- the recognition of the interconnectivity of water resources and related ecosystem components, and the development of technical and policy strategies to incorporate this thinking into future decisions;
- the development of relevant tools and products for partner agencies that can be readily utilized to address agency-specific groundwater issues at scales appropriate for both regional and local scale evaluations;
- a multi-agency team approach focused on serving the public's interests and wishes;
- strong, cost-effective technical support and innovation from private sector companies;
- effective sharing of limited resources and expertise, thus building and strengthening local knowledge for the collective benefit of all partners;
- the strong technical and moral support directed to the project from contributing staff members;
- continued strong support from Councils/Boards at all of the partner agencies.

In order to build on the early success it is recommended that groundwater strategy continue as a formal long-term program and that a YPDT partnership business model be adopted as the model for moving the program forward. The partnership program will require commitment from the partner agencies both politically and financially. The following recommendations and steps are provided to direct the future program:

- Formalize a final working name for the future partnership;
- Make use of the current structure as a model for the long term partnership;
- Upon receipt of support and direction from the 3 or 4 Regions (depending on whether Halton joins) and the City of Toronto (Planning and Public Works Commissioners) and Conservation Authorities (CAOs), prepare a staff report to be circulated to Regional Councils and Conservation Authority boards seeking approval for the long term partnership;
- Upon approval of partnership in principal by Councils and Boards, prepare a memorandum of understanding (addressing tasks, ownership, and reporting structure) that can be adopted and signed by Regional Councils and Conservation Authority Boards;
- Retain a permanent staff of three individuals with the right mix of skills (technical, database, planning, communication) to support the long term groundwater management program;
- Formalize a reporting mechanism through the Regional Planning and Public Works Commissioners as well as CAO's from the Conservation Authorities Moraine Coalition.

APPENDIX A

Background & Accomplishments to Date

A1. BACKGROUND

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. Similarly, in 1999 the Central Lake Ontario Conservation Authority (CLOCA) Groundwater System Information Report was published and discussions were initiated with Durham Region to "create a consistent approach to groundwater research across municipal and watershed boundaries…and that partnerships with Conservation Authorities, municipalities and provincial agencies be established." The ensuing discussions led to a partnership between the three regions, the City of Toronto and six conservation authorities to undertake a Groundwater Management Strategy Study. Phase 1 of this study was commissioned in 2000 and completed in May 2001, largely by AMEC Earth and Environmental. The Phase 1 report reviewed the existing landscape in terms of groundwater management issues and also provided an overview of the physical characteristics of the watersheds in York Peel and Durham Regions and in the City of Toronto.

In a parallel process, the Regions of York, Peel and Durham in partnership with the City of Toronto (as a partnership) and the Conservation Authorities Moraine Coalition (as a second partnership) were addressing the strong public concern over the protection of the Oak Ridges Moraine (ORM), specifically planning for the long-term management of the moraine lands. Also under consideration was the growing public interest in water resources protection in general. This was in advance of the introduction of the Province's ORM Conservation Plan.

The two partnership initiatives were brought together when, as one component of their partnership project, the Conservation Authorities Moraine Coalition (CAMC) agreed to retain a project manager under their direction to move the York-Peel-Durham (YPDT) Groundwater Management Study into Phase 2. As a result of this consolidation, current ongoing groundwater studies incorporate two geographical areas:

- the geographical areas of York Peel and Durham Regions (YPDT) as well as the City of Toronto (T); and
- the area of the nine conservation authorities with jurisdiction on the Oak Ridges Moraine (ORM).

In late 2001, shortly after the initiation of the YPDT Phase 2 study, the Provincial Government announced funding for a series of groundwater studies across the Province. The YPDT partnership (Phase 2) was successful in securing funding for a series of groundwater initiatives across the YPDT area. In total, the YPDT partnership (either collectively or individually) obtained all of the funding allocated to the Central Region of

the Ministry of the Environment. Through the informal partnership established between the 13 partner agencies, these studies have produced significant results.

A2 ACCOMPLISHMENTS

A2.1 Database Management

Data management is one of the most critical areas where the partnership has made tremendous strides forward. With the assistance of a consulting firm (Earthfx Incorporated) retained by the YPDT team, the partnership has built a robust data model to accommodate all types of information required for hydrological and hydrogeological analysis of watersheds originating on the Oak Ridges Moraine.

The initial database was developed and populated by Earthfx in 2001 using available information provided by the Province and all partners. Since then, the database has been updated with new data, which the partners are continuing to provide on a regular basis.

Currently, the YPDT database incorporates:

- all of the water well records from the Ministry of the Environment's (MOE) Water Well Record database (135,000 records updated to about mid 2001);
- all of the boreholes in the City of Toronto's geotechnical borehole database (13,000 records);
- selected key wells that have been added to the database by various partnership staff members (several hundred records), the source of which are agency technical reports;
- 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);
- spot stream flow measurements from Conservation Authorities;
- climate data from Environment Canada's climate database (3 million records);
- over 1,300 scanned consultant reports including figures and maps;
- geological layer "picks" from the modeling exercise (50,000 records).

The data is available to the partnership agency staff through two means:

1. each agency receives regular updates of the database. The update includes a CD with all of the data falling within each agency's borders (plus a 5 km buffer) has been provided to each agency. In addition, staff from all partner agencies have been introduced to the organization and the use of the database including how to access and enter new data to the database.
2. the data is also available to agency staff through a secure (pass-worded access only) web site. Available on the web site is ready access to all of the data (via maps, graphs, and cross-sections) across the area covered by the Conservation Authorities Moraine Coalition.

One innovative component of the data management program carried out under the partnership has been the digital scanning and photographing of key hydrogeological reports and documents. Through this activity the partnership has now scanned close to 2,000 documents that are available for viewing on the secure YPDT website. Currently the reports are being geo-referenced so that they can be searched and queried by location directly from the data management system. While this functionality is being developed, all reports are filed electronically according to municipality and community and can be accessed from CD or the project website.

The YPDT partners continue to work with consultants and others to ensure that new information, and other key data not already in place, is added into the database. The YPDT partners are already benefiting from the database in that, for key projects, the YPDT study is cooperatively providing to consultants retained by partner agencies, selected components of the database (or hydrogeological model) that are utilized in related groundwater projects carried out by partner agencies.

A2.2 DATA COLLECTION

Several field data collection initiatives have been undertaken through the YPDT partnership including:

i) baseflow/low streamflow (groundwater discharge) measurements;
ii) geophysical well logging;
iii) well record coordinate corrections; and
iv) drilling of key high quality boreholes.

These key activities were largely carried out in support of the regional geological and groundwater flow modeling exercises that are discussed below. All of the data collected to date have been incorporated into the database. Note that borehole/piezometer information collected by the partner CA's for the MOE/CA groundwater monitoring program have also been added to the database when provided.

A2.3 TECHNICAL ANALYSES

Another significant achievement of the YPDT partnership is the development of numerical groundwater models and application of these models to conduct specific analyses. Two projects are underway at different scales. Both of these undertakings involve "state of the art" technology involving some of the strongest numerical modelers in the province.

The first model extends the length of the Oak Ridges Moraine and incorporates the watersheds within the boundaries of the Conservation Authorities Moraine Coalition. When completed, it is anticipated that this model will establish a regional framework to assist with understanding the groundwater flow system across the area. Investigations of a more local nature (e.g. watershed studies, wellhead protection studies, development investigations, etc.) will benefit from the regional model in that boundary conditions can

quickly be established and the geological framework can be quickly assessed and subsequently refined as the local project advances.

The second model is designed to complement the Yonge Street Aquifer study being carried out by York Region and is focused on understanding the groundwater flow system for the watersheds (Rouge, Don, Humber, Duffins) that lie to the south of the Yonge Street aquifer. By modeling the area from Lake Ontario to Lake Simcoe as one system, any uncertainty introduced through boundary conditions is minimized. The level of detail in this model is currently much greater than that of the regional model, however this model will eventually become a subset of the regional model. This model will be used to assist in land use decisions by allowing decision makers to assess how changes in such things as recharge rates or groundwater use will affect the groundwater system and discharge to the stream network. On a local scale, the model can also be used by partner agencies for providing input on system management, monitoring, and permitting.

A critical step in both modeling initiatives is the construction of the geological framework, a key input into the numerical groundwater models. Considerable effort has been expended in building on the Geological Survey of Canada's geological model. The current YPDT digital geological model will serve as a baseline framework on which to build in the future.

A2.4 POLICY PLANNING INITIATIVES

The planning component of the program has been undertaken by a core team including 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 has been established. A draft paper on wellhead protection planning has been prepared and circulated for review. Additional papers on groundwater vulnerability, groundwater mapping, well abandonment, and water budget analyses are planned to address local and provincial watershed management requirements. The goal of these papers is to provide direction to the planning community so that the technical understanding gained from the above studies is appropriately incorporated and implemented through municipal planning tools.

APPENDIX B

FUNDING CONSIDERATIONS

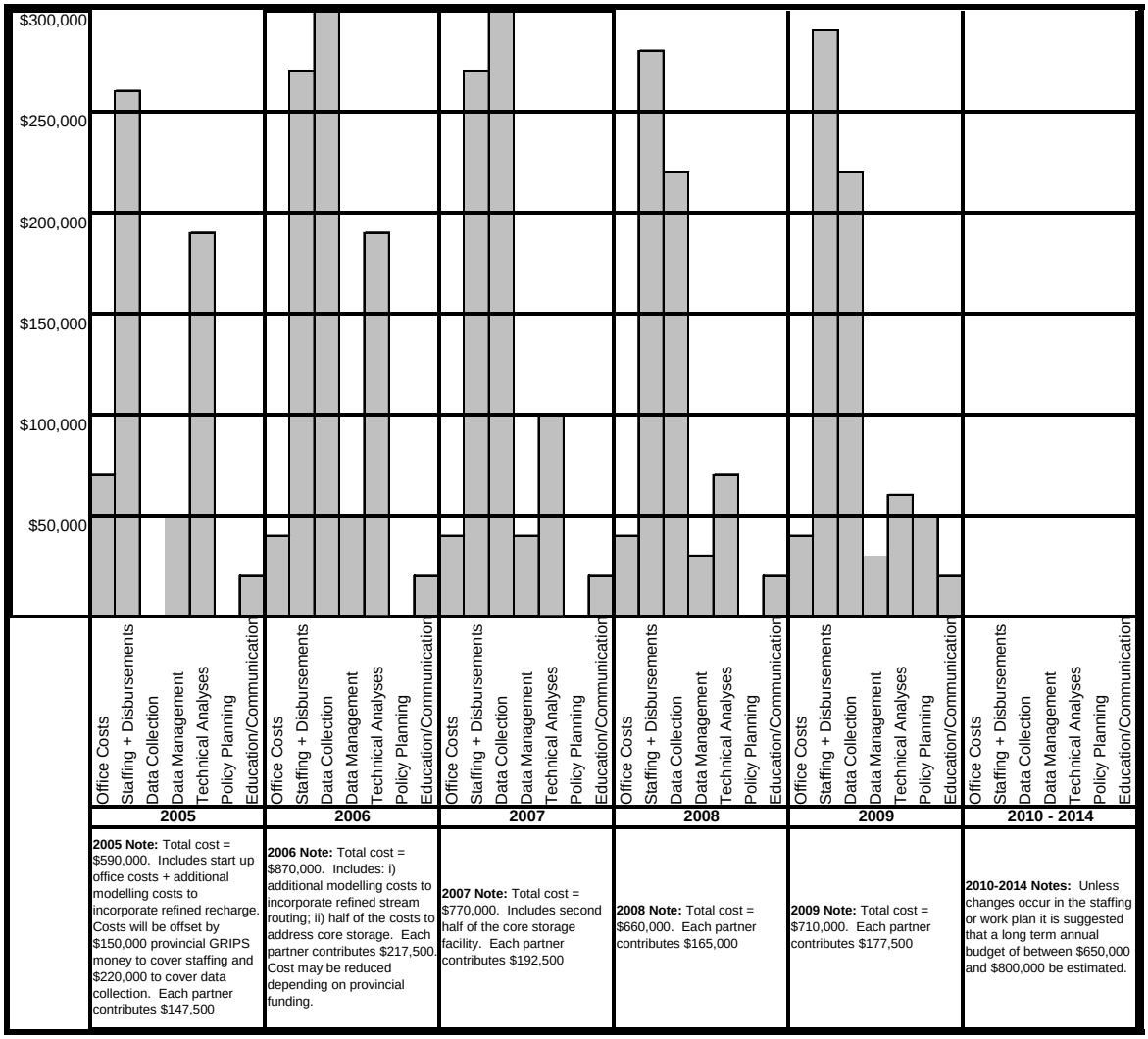
B1 COSTS

To date the YPDT Project has received funding from various sources. On top of base funding of $100,000 annually provided by each of the four senior funding partners (Regions of York, Peel, and Durham as well as the City of Toronto), the YPDT project also secured funding through the MOE ($531,000) for 2002, 2003, and from the MNDM ($1.4 million) for 2004, 2005 (this latter funding extends over the area from Halton Region to the Trent River). The partnership appears to be in a unique position to receive special funding allocations from the Province or from the Federal Government however, permanent funding will be required to maintain the long-term groundwater project needs.

In an effort to gauge the costs that might be incurred by the four funding partners over the next few years, a table has been produced that breaks down the anticipated costs of the program into the various tasks that have been discussed in the document. The following discussion provides some background thinking as to how the costs were derived.

B1.1 Office Costs

Should the YPDT Groundwater study evolve into a longer term program, initial costs would have to be established to set up the appropriate office space. It is assumed that YPDT staff would continue to be staff members of one of the partner agencies and that accounting services (P.O's, contracts, etc.) would also be operated through one of the partner agencies as is presently the case. This avoids having to establish separate accounting procedures and related staffing needs. Should a separate office be established, it would likely be prudent to plan for accommodating three individuals. To establish three offices an initial cost estimate would be on the order of $50,000. This would be a one time start up cost, based on office set up requirements (furniture, moving, computers and software, telephone, fax, etc.). Once established, operation of an office on an annual basis is estimated to amount to $3,000/month considering rent and ongoing maintenance.



B1.2 Short Term Costs

As part of the initial phases of the Long Term YPDT program, there would also be some short term costs required on a one time basis related to some of the work considerations discussed above. Two specific items are considered here: a core storage facility; and additional modeling infrastructure.

The current numerical model is at a very technical level and is emerging as a world class model. The current model developers have proposed to add two features that further supplement the capabilities of the existing model: i) an unsaturated zone model that would provide better recharge rate estimates for the groundwater model; and ii) a flow routing routine that would allow for an even more rigorous accounting of water within the model. An estimated budget of $200,000 has been reserved for these two add on components and it is proposed that they would be built through 2005 and 2006.

The final item under this category would be for establishing a core storage facility. The drilling of the key boreholes under the long term project will lead to the production of a

significant length of cored sediment for each borehole. This material provides an immense wealth that future scientists and water managers can build on. The core is extremely expensive to obtain and it makes sense that the core be retained and available locally for consultants and others to view and study. Currently all core obtained to date has been sent to the Geological Survey of Canada warehouse for storage in Ottawa. An estimated budget of $200,000 has been reserved to establish a facility for core storage to be established on a property that is owned by one of the partner agencies. The cost related to this item has been spread over 2006 and 2007.

B1.3 Long Term Costs

Long term costs have been estimated for the project. It is envisioned that in the years 2005 through to the end of 2007 that the YPDT project would remain in a stage of building reflecting capital costs. Beyond 2007, it is envisioned that the project would switch to a more operational phase and costs would likely come down to reflect this. As an example the longer term cost for 2010 and beyond are projected at $660,000 annually. These have been assigned to one of seven categories. Office and staffing costs have been estimated based on three staff members operating out of a rented office facility. These costs amount to approximately $300,000 annually.

Other costs are tied to the five areas of work proposed above and would largely relate either to consulting costs associated with contracting YPDT work to private consulting firms or to the collection of strategic geological and hydrogeological data. Over the five year projection reflected in the above figure, external consulting costs have been adjusted downwards in successive years to reflect less reliance on external consultants.

Under data management there would continue to be work done to build new information into the database as well as to maintain the structure and function of the database on the web site as well as at each partner agency. A cost estimate of $50,000/year has been identified in this area. As the database becomes more fully developed it is envisioned that external consulting costs associated with data management will be reduced.

Under data collection it is envisioned that the YPDT staff would be building on work that is ongoing, either through one of the partner agencies, or through the consulting community. Monies have been identified for work related to drilling and geophysical work. It is envisioned that this money would be spent to enhance ongoing projects so that the data collected meets the YPDT standards for high quality data (e.g. PQ coring; well installations that are appropriate for geophysical logging, etc.). $220,000/year has been estimated in this area. For 2005, no money has been set aside for data collection activities since provincial funding through Ministry of Northern Development and Mines will continue to be applied to strategic data collection.

Under technical analyses it is envisioned that there will be specialized modeling tasks required on an ongoing basis to answer specific questions. In addition, the model will have to be updated on a regular basis to keep it current. Monies have been reserved to address these two areas of modeling. There also might be some costs involved in working with the consulting community to ensure that their information is collected and

stored in a way that brings it to the standards of the YPDT program and makes it easily transferable into the YPDT modeling environment. $90,000/year has been estimated for this area of work in the next three years. In the longer term it is envisioned that the external modeling costs would be reduced as the model becomes more accepted and perhaps enhanced and refined through specific projects. This reduction is reflected in the above figure.

With respect to policy development, it is envisioned that money would be allocated to specialized planning consultants with expertise in specific water related areas. Such individuals might be periodically required by the YPDT team to assist with specialized policy development. For the purposes of budgeting, $50,000 has been reserved in 2009 to carry out an updated policy study.

Finally $20,000/year has been estimated to assist with education and communication related activities. This money would be allocated to publications, seminars, and symposia that might be held to communicate the efforts that are ongoing through the YPDT team.

B1.4 Other Considerations

Situations might arise where, either due to work load, technical or other considerations, that it makes sense for a partner agency to link up with the YPDT team to undertake specific work that is more closely aligned with the interests of the particular partner agency rather than being aligned with the interests of the overall partnership. Within the framework developed for the YPDT program, consideration should be given to working with individual partner agencies, on an as requested basis, to address such situations. Each request would have to be evaluated on its merits, considering work load, relevance, budget, and the overall interests of the partnership.

B1.5 Funding Sources

The overall operational budget for the long term program has been projected at between $660,000 and $870,000 annually depending upon which projects were undertaken. If the main funding sources remain at the partner agency level, and Halton Region does not enter into the partnership, then this translates into an annual budget of between $160,000 and 217,500 for each of the three regions and the City of Toronto.

YPDT staff would look to obtaining special funding grants from more senior levels of government to offset these costs however, for the purposes of budget planning each agency should allocate $150,000 to $200,000 as the base level for long term average funding.

APPENDIX C

Governance and Business Model Considerations

1.0 Governance

Much of the following discussion is based upon a paper entitled "Good governance in restructuring water supply: a handbook" prepared by Dr. Karen Bakker for the Federation of Canadian Municipalities, and the Program on Water Issues (U of T). The paper discusses various business models and governance considerations (e.g. government utility, municipal board, cooperative, private utility, etc.) for municipal water systems operations. Although the long term groundwater management strategy study being considered in this document cannot be directly linked to a full municipal water distribution operation, several governance principles can be adopted from Dr. Bakker's paper into the strategy being considered for groundwater management.

Bakker defines **governance** as "the process by which stakeholders articulate their interests, their input is absorbed, decisions are taken and implemented, and decision-makers are held accountable". Further it can be described as the process of achieving desired results in the right manner. A **governance model** is further defined as a "description of the principles of good governance, and of the allocation of responsibilities and relationships between stakeholders for tasks and practices required for good governance".

In considering the long term groundwater management strategy, the stakeholders are the partner agencies involved in the study. The above-cited paper summarizes the characteristics of good governance models as:

1. The model articulates a set of governance principles or expresses a vision
2. The governance principles are coherent and are ranked in order of priority
3. The model builds on the governance principles to create objectives and policies
4. The model is responsive: learning and reviewing options will inform restructuring
5. The model enables the production and dissemination of high quality information
6. The model includes an open transparent decision making process
7. The model facilitates the participation of stakeholders

The above characteristics of a good governance model can be considered within the context of the overall paper discussing the continuation of the groundwater management partnership. The vision or purpose of the partnership is expressed in Section 3.0 of the document. Although not specifically laid out, the principles of accountability, responsiveness, transparency, efficiency and participation are common threads in the document. Objectives of the long term partnership are presented in the document, although strict policies have not been considered and are unlikely to be needed provided the partnership carries on in the open transparent manner that it has done to date. Responsiveness will be a key component of the partnership in that the needs of the partner agencies can change and the partnership will have to adjust to ensure that it is

serving the needs of the partner agencies. Production and dissemination of high quality data is a key characteristic of the current model. Open and transparent decision making as well as the participation of stakeholders are two characteristics that have been carried through the current partnership model and certainly there is no reason to change from the existing strategy. In summary all of the key characteristics of a sound governance model have been demonstrated through the partnership strategy and they will continue in the future.

2.0 Business Model

In discussions to date, the term "governance" has been used loosely to correspond with the mechanics or business model of how the long term study will operate. Specifically, the question that has been considered is "Who is best suited to move the groundwater management strategy forward in the long term? This question is more a question of business model than it is of governance. Good governance could likely be achieved under any business model adopted. In considering the business model that is best suited to the long term program, several options have been put forward for consideration: i) Federal; ii) Provincial; iii) Municipal/CA; iv) University; v) Private sector; and vi) Partnership. Each of these identified business models would likely be capable of tackling the management or governance of the long term project, however the partners are interested in the ability of the selected model to deliver the required services in the short time frame that municipalities and conservation authorities work under. In order to arrive at the most appropriate business model for the long term study, each of the above options was considered under five categories: dedication of appropriate resources; conflict of interest; ability for timely delivery; cost; and technical abilities. Table B1 compares the business models against these five categories and shows the current partnership model to be the most favourable option for proceeding. Further discussion on the considerations put forth for each business model are presented below.

Federal – the federal government has little direct mandate for water resource management (except fisheries) at the municipal public sector level but could be encouraged to play a scientific and funding support role (perhaps infra-structure or Great Lakes environmental stewardship funding). The Geological Survey of Canada remains a key partner in the YPDT initiative, and are best suited to continue playing a research support role.

Provincial – the province has urgent priorities relating to establishing a regulatory and enforcement regime for environmental compliance and would either be in a conflict of interest position or would not be able to respond to the groundwater management needs of municipal level agencies in a timely fashion. Key Provincial Ministries and staff would of course continue to be involved in the ongoing YPDT work that is being carried out.

Municipal/C.A. – one possibility for the management of the data and the groundwater program would be to have it reside at one of the partner agencies, with staff assigned the task of managing the program on behalf of all of the partner agencies. Concerns come up

over whether the staff at the lead agency would put their full energies into the regional multi-jurisdictional program. In addition, perception of preferential treatment provided to the host agency is another concern.

Universities – a collaborative effort on the part of several university professors could be used to manage the project for the partner agencies. Again there is concern over whether the service to the partner agencies would be a priority given the many demands on university staff in today's universities or whether this would fit their research mandate. Given the high rate of turnover in the staff (students) who would likely be assigned to the project, the variability in the quality of these staff, and the high likelihood that turn around times in terms of delivery to the partner agencies could suffer because students need to complete their degrees, it is unlikely that this model would be successful.

Private Sector – although the private sector is capable of effectively running the program on behalf on the partner agencies it would likely come at a higher cost. First, a private company would tend to look at ways of maximizing profits from the project rather than the public interest. It may be necessary to keep them focused on meeting the needs of the partner agencies. Secondly, in terms of keeping the database up to date, private sector companies might not have the dedication that is required to keep the database up to date. Thirdly, a private sector lead may limit access to other private sector databases. Having flexible geographical boundaries might also create problems for private sector companies since agreements would have to be re-written etc.

Current Partnership Model – the current model with dedicated public sector staff assigned to oversee the project and coordinate communication amongst the various partner agencies is a solid model that has worked well for the past two years. In terms of linking up with the private sector, the current model provides flexibility to the partnership in that consulting contracts can be established with different private sector companies to provide targeted products or services that are required by the partnership. In fact, with a partnership model in place, any component of the strategy can be undertaken in partnership with any of the above agencies. Decision making on all partnership initiatives will continue to be made in an open manner by the partner agency staff at team meetings which are typically held on a six to eight week basis.

APPENDIX D

Agencies currently (and potentially) linked to the ongoing groundwater initiatives

1.0 York Peel Durham Groundwater Management Strategy Study Partners

City of Toronto
Regional Municipality of York
Regional Municipality of Peel
Regional Municipality of Durham
Toronto and Region Conservation Authority
Central Lake Ontario Conservation Authority
Ganaraska Region Conservation Authority
Kawartha Region Conservation Authority
Lake Simcoe Region Conservation Authority
Credit Valley Conservation Authority

2.0 Conservation Authority Moraine Coalition Partners

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

3.0 Potential Additional Partner Agencies

Regional Municipality of Halton
Halton Region Conservation Authority