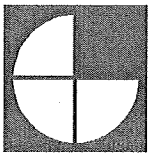

Gartner
Lee
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Final Report

Best Practices for Assessing Water Taking Proposals

Prepared For:

Ontario Ministry of the Environment

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Executive Summary

In 2001, the Ministry of the Environment recognized a need to review the existing Permit to Take Water (PTTW) process in Ontario. The need to do this was underlined by low water level conditions over parts of southern Ontario for several recent years, coupled with an increasing public awareness of the sensitivity of this resource. In 2002, the MOE set out on a two step process to improve their Permitting methods. The first step was to assess the Best Scientific Practices available to assess the impact of a water taking. The second step will be to verify existing methods and to fill in where methods are needed. At that point it is anticipated that the Ministry of the Environment will be able to revise their Permitting process on the basis of sound scientific and public participation principles. This report represents completion of the first step.

Existing regulations require those assessing proposed water takings to ensure that an ecosystem approach to environmental protection and resource management be considered. The MOE Statement of Environmental Values states that "this approach views the ecosystem as composed of air, land, water and living organisms, including humans, and the interactions among them." Therefore the scientific practices examined in this study included the various interactions of groundwater, surface water, aquatic habitat (fish, benthos), and terrestrial habitat (plants, animals). This was coupled with examination of public involvement issues. The work was conducted through a review of existing practices in Ontario, coupled with a review of other jurisdictions around the English speaking world (e.g., Canadian provinces, United Kingdom, South Africa, Australia, and the United States.). Beyond this review of present systems, a review was conducted of the technical literature to determine the applicability of methods, as well as to determine where methods are needed. The need to consider water taking as both a watershed, and site specific issue is a recurrent theme. This includes both direct effects, and cumulative effects. This report presents the findings in terms of: Existing Practice in Ontario, Best Practice that can currently be applied (taken from everywhere), and Recommendations on what needs to be done to fill in the gaps that exist in these practices.

It was found that the groundwater science is replete with methods to assess the effects of water taking on water resources. (Some additional work is required to develop methods that better quantify ground water contribution to headwater streams.) However, the science of assessing the effects of water taking on the ecosystem is in its infancy. We do however see that the available groundwater methods are easily adapted to characterization of the hydraulic functions in the ecosystem. The surface water work has revealed a full slate of methods for characterizing surface water flow, but there has been no focus on what that actually means in terms of the effects of water taking on the ecosystem. Several methods have been put forth as having some promise (and can be used in the interim) but will require verification against Ontario specific conditions. Use of hydrogeologic monitoring is an important part of establishing Adaptive Environmental Monitoring programs in support of protecting ecologic conditions.

The natural science components find a different state of practice. With respect to Aquatic Habitat, our research has revealed that numerous instream flow methods are available and can be separated into standard setting and incremental methods. However, currently no scientifically defensible method exists for defining threshold flows needed to protect fish or aquatic ecosystems, as they have not been tested and validated within Ontario. Until further research is conducted in Ontario, a conservative approach to water extraction should be applied and current methods should involve validation and correction through an operations process such as Adaptive Environmental Monitoring.

The terrestrial ecologic science is oriented to inventory and characterization of existing features. There is no literature that deals with the effects of intentional water taking on the terrestrial habitat. The most immediate gaps relate to the lack of quantitative knowledge connecting change in water volume, periodicity or frequency with a biological response. Present practice in Ontario is just developing and relates to establishing hydraulic conditions and examining changes induced by water taking, as well as to obtaining meaningful monitoring data. These methods have not been applied on an ecologic function or species specific basis. Some Conservation Authorities are moving towards watershed based approaches which include the interactions with the hydrogeologic functions as a basis for understanding cumulative effects.

The Ontario model for public involvement was notable in that it had some industry leading features, such as the electronic registry. On the other hand, the time at which public consultation begins is far too late in the process. Other jurisdictions are ahead in that they have a supporting network of water information available to both proponents and the public. This report recommends that earlier consultation be required, in a facilitative process that generates meaningful dialogue before issues become contentious. While this dialogue is the proponent's responsibility, the agencies need to provide basic information (e.g., existing water taking information, one-window review) from which all parties can work. Finally, a more participative mechanism is needed once Permits are issued, particularly an annual reporting process that includes dialogue with interested stakeholders.

In summary, the Ontario practice is similar in many areas to that in other jurisdictions. There are practices available from other jurisdictions that will strengthen our own practices. However, there are gaps that exist in the available range of scientific methods that no one to date has filled. In Section 5 of this report good and acceptable practices are presented as a first step to improving present practice. Section 6 of the report provides recommendations on what is needed to fill in the gaps. It is the collective authors' belief that the opportunity now exists to improve the scientific practice which will in turn provide confidence to the regulators and public in the approval of the taking of water in Ontario. This should have both environmental and societal benefits for all.

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1. Introduction

1.1 Background

The Ontario government issued the *Water Taking and Transfer Regulation* (O. Reg. 285/99) under the Ontario Water Resources Act in April 1999. Among other things, the Regulation detailed a series of issues that the Director must consider when issuing a Permit to Take Water, including:

1. *Protection of the natural functions of the ecosystem. (Section 2.(1))*

However this regulation was silent on what functions are to be protected, or the scope of the ecosystem to be investigated. Another change introduced with the new Regulation was an onus on the applicant for a Permit to Take Water to be required to consult with "*other persons who have an interest in the taking*", such as other government agencies and possibly the public, and report their responses in preparing the application (Section 2.(6)). Again, some direction is needed as to the scope of this.

Canada's *Fisheries Act* has become an issue in virtually every Permit to Take Water application that affects surface water, either directly through surface water withdrawal, or indirectly through the withdrawal of groundwater that supplies surface water baseflow. This is especially true for suppliers of spring water, where sensitive downstream fish habitat is often found.

Another challenge relating to the protection of the natural function of the ecosystem is the assessment of the cumulative effects of issuing permits to take water. Until recently, the Ministry of the Environment (MOE) has relied on the local knowledge and experience of its staff to assess the impact of multiple water takings within a watershed. With increased numbers of permits and challenges relating to staff turnover, information systems that allow an assessment of the cumulative impact of multiple water takings are increasingly needed. Further complications arise because the MOE often issues instruments like Certificates of Approval to Municipalities and industries that assume certain flow regimes to allow for adequate assimilation of wastes. Permitting further water takings from surface waters may impact on those assumptions.

Recently, the Ministry of the Environment has required that municipal water takers investigate their water taking to determine whether the taking is 'under the influence' of surface water. This has significant implications with respect to the water treatment requirements of the municipal supply (O. Reg. 459/00). Similar concerns exist for private water takings such as those of the bottled water industry, campgrounds, group homes or other small operations with communal wells. It is therefore important to provide a clear understanding of the criteria used in assessing groundwater supplies 'under the influence' of surface water.

Taken together, these recent developments are meant to provide environmental protection and procedural direction. However they have also resulted in considerable difficulty for regulators, proponents and the public alike, particularly related to the requirements for data and evaluation in support of new and renewed permits. For example, regulators are faced with a considerable difference in detail of supporting information, depending upon who (rural municipalities, golf courses, landscape nurseries, irrigation operations, drink packaging, and industry) is seeking a new or renewed Permit to Take Water. Whether the use is consumptive (drink packaging, irrigation) or non-consumptive (many industries) is a further complication in the level of detail required. The public are currently not directly included in the process until well into any application procedure (generally at the time of application and only through the EBR registry). They do not believe they have been properly consulted, and are thereby mistrustful of both regulators and proponents in many cases. Further, the permit information is very technical and not easily simplified for lay interpretation.

There are many other agencies beyond the MOE who may or may not become involved in the Permit process (among others, the Ontario Ministry of Natural Resources, local Conservation Authorities and the Department of Fisheries and Oceans Canada). These agencies (including the MOE) have differing approaches to the impact assessment methodology, not only between the agencies, but also from district to district within agencies as well. Local preferences and experience accounts for some of these differences, but more significant is the general lack of accepted practices for the evaluation of the taking that have been proven through field testing under operational conditions.

The purpose of this report is to develop a set of Best Practices to guide the review and assessment of water takings in Ontario, acceptable to all stakeholders (proponents, regulators and the public). This will improve the understanding of the issues, assess and develop tools for assessment based on sound science, and which may ultimately improve the process for communication and approvals. As outlined in the RFP document there are two initial phases. The first, which is addressed by this report, involves researching and detailing the best methods that can be used to evaluate a potential water taking. The second phase, testing and confirmation of the selected methods through pilot projects, is *not* part of this study. This report focuses on the first phase.

1.2 Ecosystems and Natural Functions

Ecosystem: *"Community of plants, animals and other living organisms, together with the non-living components of their environment, found in a particular habitat and interacting with each other; a dynamic complex of plant, animal, fungal, and microorganism communities and their associated non-living environment acting as an ecological unit"*

The traditional definition of ecosystem suggests a broad reaching assessment is required in order to address the requirements of Regulation 285/99. In order to assess ecosystem functions, the components

and their interactions need to be defined. Currently, there are no guidelines to as to how MOE staff should assess impacts to the ecosystem, what functions are to be protected, or even a working definition of ecosystem to guide the scope of the investigations required. In order to identify best practices for water taking proposals, it was necessary that we considered the scope of the ecosystem and by default, develop a working definition.

For the purposes of water management we have taken the hydrologic cycle as the minimum definition of the ecosystem that may be affected by water takings. The hydrologic cycle acknowledges the role that soil, landscape and water features, such as lakes and wetlands, play on the distribution of rainfall. Incidentally, it is also a fundamental concept in the determination of the availability of water for extraction.

There are two levels of ecosystem to be considered – the large scale and the local scale. The large scale takings are best assessed at the subwatershed and watershed level, as logical units for water management, as depicted on Figure 1. While it is acknowledged that ground Watersheds may be different than that of the surface watershed, unless the situation dictates otherwise, the watershed level should be adequate for most assessments. In most cases it is at the larger scale that cumulative effects from takings should managed and assessed[1].

From this scale, it is then possible to determine the appropriate scope of the local ecosystem to be examined, relying on progressively finer levels of detail in terms of the catchments affected within the subwatershed. It is at the smaller scale that the interrelationships between water features and life science features can be explicitly explored. We use the source-pathway-receptor model to assist in defining those features that will be linked to the taking. For our purposes we focus only on those features with explicit connections to water. Figure 1 illustrates the watershed features and highlights the catchment level issues in this hypothetical example. Specifically, assessments should consider all water features including springs, rivers, ponds, wetlands and lakes, in addition to surficial and deep aquifers. These water features have numerous life science attributes associated with them including:

a) vegetation associated with high water table or wetland features;
b) fish and other aquatic organisms;
c) wildlife that depend on water for all or part of their life cycle (e.g., fish eating birds, muskrat, beaver); and
d) humans who depend on the water for domestic and agricultural supplies and commercial or industrial requirements.

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1. *Where appropriate, there must also be some measure of cumulative effects assessment at the smaller scale within the specific reach or area of influence of any water taking. Certainly, the water taking will have to be identified to those in charge of management at the greater scale.*

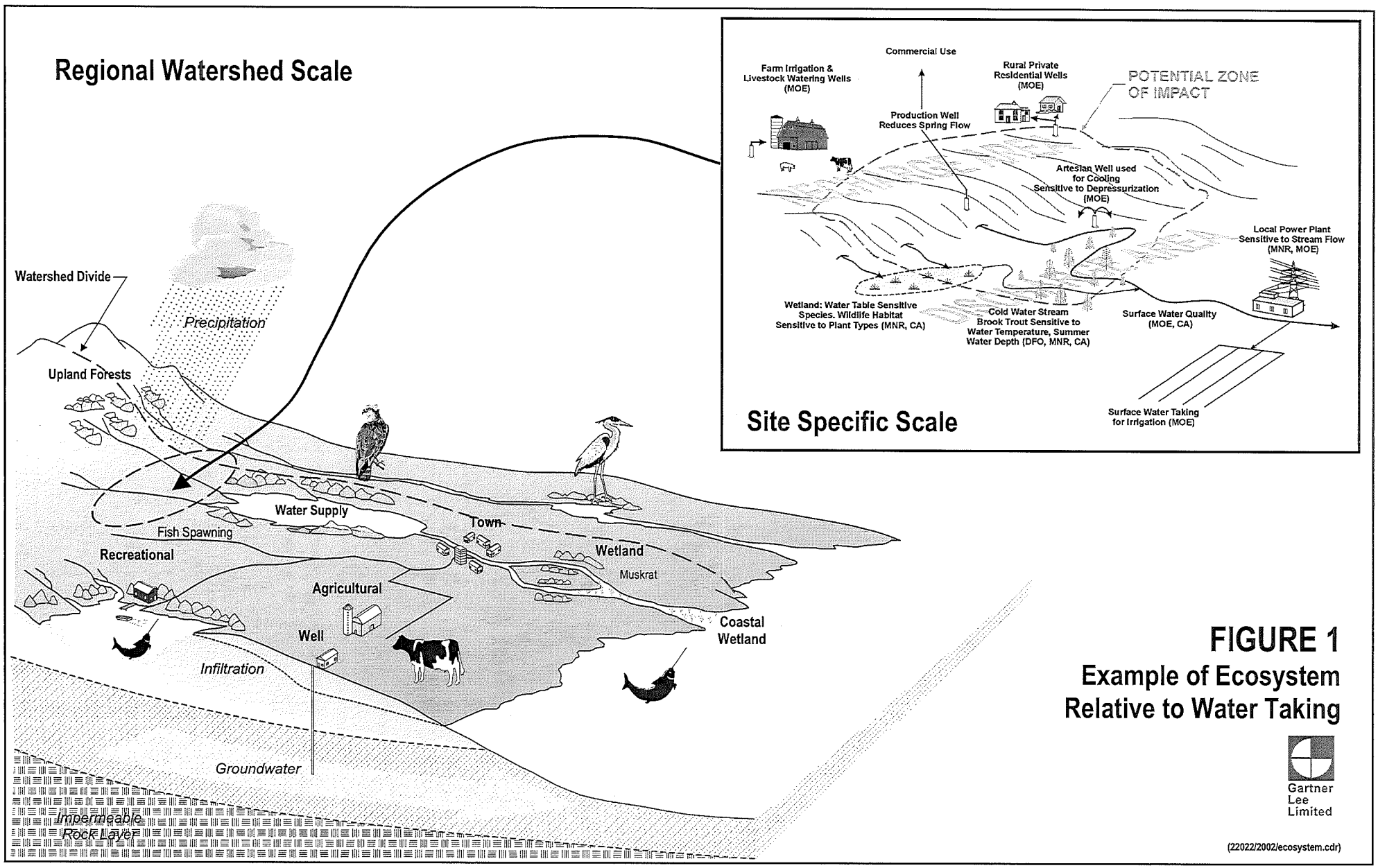


FIGURE 1
Example of Ecosystem Relative to Water Taking

Gartner Lee Limited

(22022/2002/ecosystem.cdr)

Further to the specific features, their function must also be considered. For example, baseflow may be a feature of a creek, but it also serves an important function for spawning cold water fish. In order to assist in determining best practices, we have included all of these features and functions. When individuals are determining the scope of their assessment, it is important to identify those features that may occur in the area and then use a source-pathway-receptor analysis to determine those with potential to be affected.

1.3 Objectives

The Prime objective of this work, as stated by the MOE and which our team endorses, is:

- *To provide an independent review of the best methods to assess water takings.*

"Best Methods" means best scientific methods that can also be applied practically, and are specific for a specific environmental setting. It is no coincidence that "Best Methods" can be applied equally well to the challenges of determining improvements in the public's participation[2] in the process.

Of equal importance is to ensure that these best methods, which cover many disciplines (groundwater, surface water, aquatic biology, terrestrial biology, social acceptance, etc), consider each other to be able to truly apply an ecosystem based approach to be entirely consistent with O. Reg. 285/99. *Supporting studies by definition must then be truly inter-disciplinary, and not just a piece-wise accumulation of data or methods that do not or cannot be physically related.*

The ultimate goal is to be able to issue a Permit to Take Water (PTTW) based on work that assumes as a guiding principal that "***everything is linked***" from an environmental perspective. It has been our experience that such work ensures the scientific defensibility of a proposal. This in turn gives the regulators the confidence to approve the undertaking and provides the public with the necessary assurance that they and the environment are being protected. This real and demonstrated consideration of the environment in turn lessens the likelihood of ongoing appeals and continued costs to proponents, communities, and regulators alike.

1.4 Methodology

Members of the PTTW team worked with Beverley Porter, GLL's Technical Information Co-ordinator, to develop appropriate strategies for searching the scientific literature. Separate keywords were identified

2. *If the public can be involved "appropriately" in the decision-making process, and included in the approach to getting a water taking permitted, the hope is that the current level of mistrust, public outcry and litigation can be reduced.*

for each discipline. Early in the process it was recognized by the team that "water taking", the preferred term in Canada, is referred to in the United States as "water withdrawal", while in England and other Commonwealth countries, the preferred term is "water abstraction".

We began with an internet search, using a number of search statements, including, but not limited to the following:

a) water and (abstraction or taking or withdrawal) and (policy or regulation or environmental impacts); and

b) water and (abstraction or taking or withdrawal) and fish, streamflow, groundwater/ surface water interaction, or wetlands.

Using this approach, we found information posted on the internet by authorities in Australia, South Africa, England, various American states and the Canadian provinces. The information retrieved primarily included policies, regulations and names of individual regulators. Based on this information, we developed our list of contacts, whom we later reached by telephone or email, to request further information on the development and application of local water taking policies.

We then conducted searches of commercial databases of refereed, scientific journals, again modifying the search terms to reflect the requirements of each discipline. Of the databases selected, the one that proved to be most relevant was Water Resources Abstracts. Other databases that were searched, with varying degrees of success, included Aquatic Sciences and Fisheries Abstracts, BIOSIS (Biology Abstracts), CAB (Commonwealth Agricultural Bureaux) Abstracts, Environmental Sciences & Pollution Abstracts, Georef and Zoological Record.

When potentially relevant bibliographic records were identified, either as a result of the formal literature search, or as a result of interviews with the various individuals whom we contacted, these items were then ordered. Most orders were placed with CISTI, the library of the National Research Council in Ottawa. Some difficulty was experienced, however, when we attempted to order journal articles or government documents that are not held in Canadian libraries and that are not commercially available. Some of these items have not yet arrived at GLL.

Once the initial data gathering exercise was complete, the study team met for several internal synthesis sessions. In these sessions each discipline would present their findings and the other disciplines would engage in a dialogue as to how they inter-related. By the end of the session, each discipline would have a grasp of each other's issues. This was an essential step in establishing methods and discounting others. It also was important in establishing whether a gap in the practice existed where none had been previously perceived, or whether gaps were coincident across the disciplines on any particular issue. At this point a steering committee meeting was convened and the basic results, in terms of available practices and gaps in the various sciences, were presented.

The final step was to host a greater synthesis session with both the steering committee and key members of other agencies and organizations (Appendix B). This was completed on June 12, 2002. Finally, a draft report was circulated to the steering committee for comment and this final report prepared.

2. Water Takings in Ontario

2.1 PTTW Statistics

Recently, the Ministry of the Environment collected the information from all Permits to Take Water into a database that permits a statistical overview of the permitting process in the province.

In order to understand the overview, some terminology will be defined. A **permit** is issued to a **client** for a **purpose.** One **permit** may allow the taking of water from one or more **sources.** The **permit** is classified according to whether the **sources** are **surface water, groundwater** or **both.** A **permit** usually specifies an **amount** of water that can be taken, and often the **rate** at which water can be taken (Litres per minute). The **purpose** of the water taking is classified by **general purpose** (for example, agriculture) and by **specific purpose** (for example, sod farms).

Although the database contains information on over 12,000 permits, many of these have expired. This analysis focuses on permits that were valid as of January 1, 2002.

2.1.1 Some Cautions Concerning the Completeness of the Data

Despite the work done in compiling the data, there are still some areas where the information is incomplete. The analysis has been done with the data as they were submitted to Gartner Lee in February 2002. Where modifications to the MOE data have been made, they are noted.

In total, there are 5,797 active **permits** in the database relating to water withdrawal from 8,204 **sources.** Seven permits were not associated with a source, and a further 148 permits did not have information on the volume of water permitted. Permits without water volume information were not included in any of the analyses where water volume estimates were made. It is apparent that the data are somewhat incomplete and that regional inconsistencies exist. Given the size of the database, however, the inconsistencies were not great enough to affect the analysis.

2.1.2 Estimating Water Volumes

Much of the following analysis involves the estimation of volumes of water associated with **permits**. As noted above, some **permits** did not have information relating to the water volume. Out of the 8,204 water **sources** related to active permits, 7,865 had water volume information associated with them. Only these were used for analyses involving water volumes.

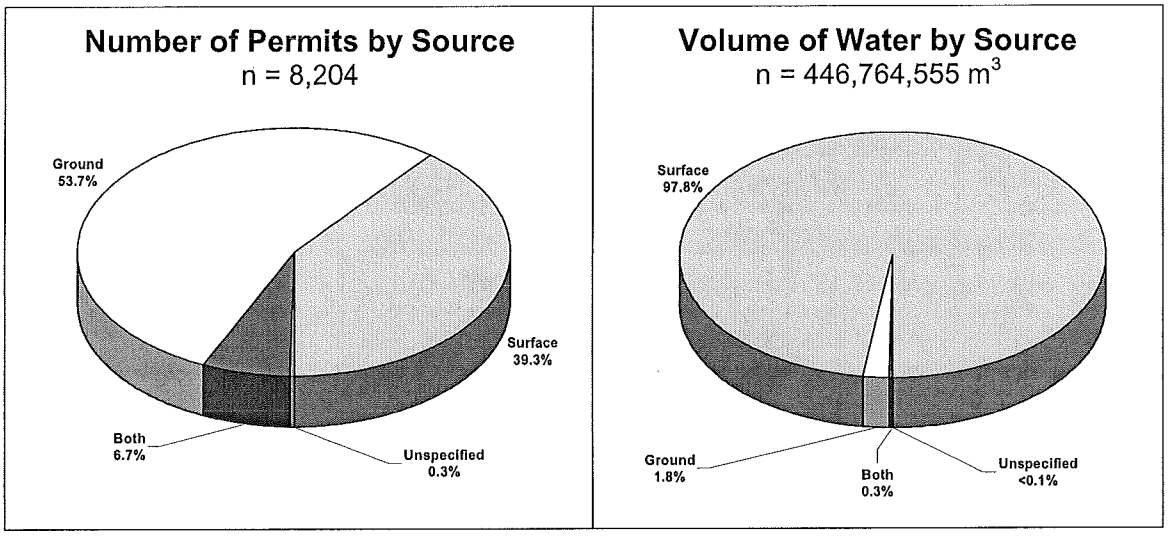
There are two aspects of water takings that are not explored here. The first relates to the seasonality of the takings. Many permits are issued for a limited number of days per year. In addition, many permits relating to irrigation are only being used during the summer months. There was insufficient data available to explore the seasonality of water takings, but it should be kept in mind that the volume estimates given here are a summation of the **maximum Litres per day** allowed by the permit.

The second aspect that is not explored is the consumptive nature of the permits. Some very large takings (cooling water or impoundment for power generation) do not represent consumption of the water. Other takings (for food and beverage production, for example) are consumptive. Still other takings (irrigation, for example) are partially consumptive. These aspects of the data are not explored here.

2.1.3 Numbers of Permits and Volumes of Water by Source

Of the permits with identifiable sources, 53.7% related to groundwater takings, while 39.3% related to surface water takings (the rest either took from both ground and surface water, or did not specify the type of source). The volumes of water, however, are markedly different. Surface water takings account for close to 98% of the total volume of water permitted (see Figure 2).

Figure 2. Numbers of Permits and Volume of Takings by Source



2.1.3.1 Surface Water Takings

Over two-thirds of the surface water is taken for industrial purposes (see Figure 3). The majority (over 80%) of the industrial takings are either for power production or for cooling water purposes (see Table 1).

Figure 3. Surface Water Takings (437,151,410 m^3/day) by Purpose

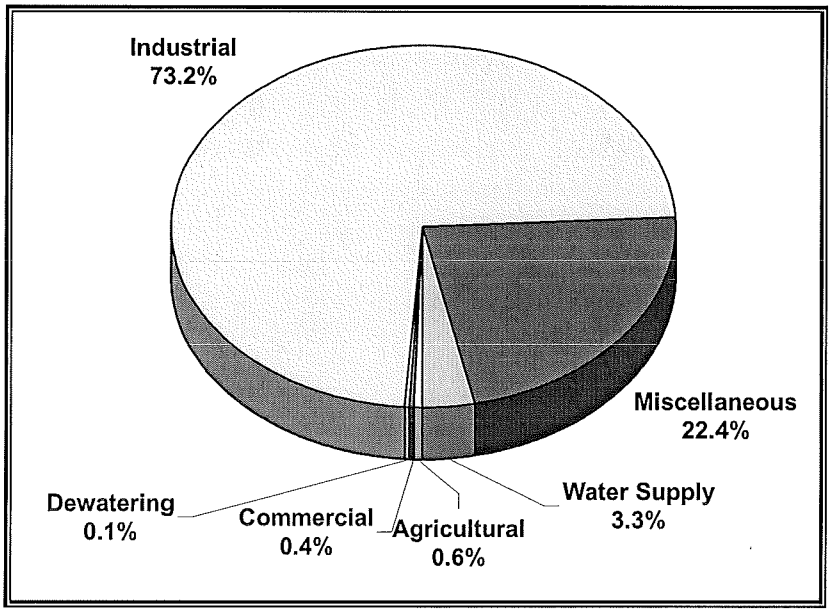


Table 1. Industrial Surface Water Takings by Specific Purpose

Specific Purpose	Percent by Volume
Aggregate Washing	0.05
Brewing and Soft Drinks	<0.01
Cooling Water	20.33
Food Processing	0.01
Manufacturing	1.76
Other – Industrial	10.52
Pipeline Testing	5.91
Power Production	61.41
Total Industrial (m^3)	**319,869,163**

The other large category of surface water takings is in the 'miscellaneous' category. Table 2 shows the breakdown of those takings by specific purpose.

Table 2. Miscellaneous Surface Water Takings by Specific Purpose

Specific Purpose	Percent by Volume
Dams and Reservoir	56.90
Heat Pumps	<0.01
Other – Miscellaneous	2.32
Wildlife Conservation	40.78
Total Miscellaneous (m^3)	**98,078,472**

This category is dominated by two purposes: dams and reservoirs and wildlife conservation. It should be noted that there was some inconsistency in the database about takings for wildlife conservation purposes. Some MOE regions assigned these takings to the 'Other – Miscellaneous' category. For consistency, all water takings for Ducks Unlimited and similar organizations were assigned to the 'Wildlife Conservation' category. These water takings are almost all exclusively for the impoundment of water and are therefore non-consumptive in nature.

Overall, four purposes accounted for over 81.7% of all surface water takings: power production, cooling water, dams and reservoirs, and wildlife conservation.

2.1.3.2 Groundwater Takings

Figure 4 shows the breakdown of all groundwater takings by general purpose.

Over 80% of groundwater is taken for one of three purposes: water supply, agriculture, and dewatering.

The largest general purpose for groundwater takings is for agriculture. Table 3 shows the specific purpose recorded for groundwater sources used for agriculture.

Most of the agricultural water takings are for unspecified purposes. The largest single specified purpose is for growing tobacco.

Municipalities dominate groundwater takings for the general purpose of water supply. Out of 2,462,671 m^3 daily withdrawal permitted, 95% of the volume is categorized as municipal water taking.

Figure 4. Groundwater Taking (7,944,354 m^3/day) by General Purpose

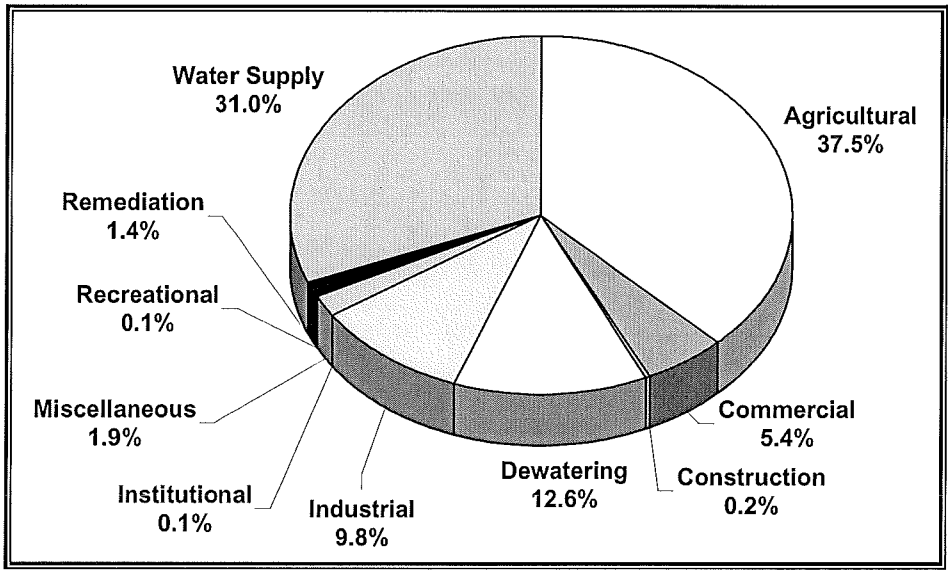


Table 3. Agricultural Groundwater Takings by Specific Purpose

Specific Purpose	Percent by Volume
Field and Pasture Crops	10.61
Fruit Orchards	0.58
Market Gardens / Flowers	1.94
Nursery	0.83
Other – Agricultural	54.64
Other – Miscellaneous	<0.01
Sod Farm	1.50
Tender Fruit	0.82
Tobacco	29.08
Total Agricultural (m^3)	**2,976,501**

Dewatering is the third largest general purpose of groundwater takings. Most construction dewatering permits are temporary, and typically have a short term impact, while Pits and Quarries require longer term dewatering permits. Pits and quarries are the single largest specific purpose for this use of groundwater (see Table 4).

Table 4. Dewatering Groundwater Takings by Specific Purpose

Specific Purpose	Percent by Volume
Construction	5.66
Other – Dewatering	27.92
Pits and Quarries	66.42
Total Dewatering (m^3)	**1,000,729**

2.1.4 Spatial Distribution of Water Takings in Ontario

"When the well is dry, we know the worth of water."
Benjamin Franklin, **Poor Richard's Almanac**

Conflicts over water takings usually arise when there is an insufficiency. Aggregating water takings on a provincial scale yields a useful insight as to the purposes for which permits are issued. However, in order to determine areas of the province where conflicts may arise, or special considerations should be applied to permits, a spatial analysis also provides useful insights.

As mentioned above, not all permits had water sources that could be located. Out of 8,204 sources associated with current permits, there were 7,684 that had UTM co-ordinates, and 7,382 that had both co-ordinates and a volume of water specified. In a few cases, a location on the Great Lakes was specified as the source, but geographic co-ordinates were not specified. In those cases, the water withdrawal was assigned to the appropriate Great Lake. With those few exceptions, the following analysis of the location of water takings is restricted to permits associated with sources with co-ordinates. There was a total of 8,785,410 m^3 that had a volume of water specified, but insufficient information to determine location.

Many of the largest permitted takings are from the Great Lakes. Eight out of the twelve largest single permits (in terms of volumes of water) are removed directly from the Great Lakes. Table 5 shows the water withdrawals from the Great Lakes and connecting rivers.

Table 5. Volumes of Water Taken from the Great Lakes and Connecting Channels

Lake/River	Volume (m^3/day)
Lake Huron	118,216,645
Lake Ontario	62,772,838
Lake Erie	16,396,222
St. Clair River	4,470,839
St. Lawrence River	787,346
Lake Superior	372,536
Detroit River	329,522
Lake St. Clair	18,184

Water withdrawals 'inland' vary widely throughout the province (see Figure 5). Many of the larger amounts withdrawn are associated with power generation. An examination of the distribution of groundwater withdrawals (Figure 6), shows that most of the volume of groundwater is withdrawn in Southwestern Ontario. Agricultural areas dominate groundwater withdrawal.

2.2 Existing Permit Technical Review Process

On March 29, 1961, an amendment to the Ontario Water Resources Commission Act was proclaimed, authorizing the regulation of water takings in Ontario. This legislation, with subsequent amendments, is now designated as Section 34 of the Ontario Water Resources Act. This is the main piece of legislation pertaining to the PTTW program. However, a number of other pieces of legislation or international agreements impact on the program. The Great Lakes Charter signed in 1985 is an agreement between the Great Lakes States and Provinces. It requires that prior notice and consultation, be given to it's other members, on certain water withdrawals and/or diversions from any water of the Great Lakes. The Environmental Bill of Rights passed in 1993, designated Permits to Take Water (PTTW) as Class 2 instruments requiring the posting of the Permit To Take Water applications on an electronic registry to allow for public comment on certain types of proposed takings. Regulation 285/99 provides further direction for the conservation, protection and wise use and management of Ontario's waters. Ontario Water Response (Province of Ontario, 2002), which is a multi-Ministry program, provides direction and guidance to water managers during low water and/or drought conditions.

The existing guidance document that is used by MOE Technical Reviewers is titled "Permit To Take Water Program Guidelines and Procedures Manual revised April 14, 1999". This version of the manual was prepared to update the statutory references in the 1984 edition. The 1984 version was an update of the 1974 manual that was written to assist the Regions when the program went to them after regionalization of the Ministry of the Environment. The Permit To Take Water Program was operated by the Water Quantity Management Branch of MOE after 1972, and by the Water and Well Management Branch of the Ontario Water Resources Commission prior to that date.

These manuals are/were a compilation of the established application and interpretation of guidelines, practices and legislation associated with the program. They were designed to assist Ministry staff in the administration of the permit program and in the investigation of water quantity complaints. It should be emphasized that the existing guidelines and procedures do not represent a rigid, unchanging set of decisions. Rather the process to date has been one of change and refinements to meet the changing circumstances, the expanding state of science and knowledge and increased water demands on Ontario's water.

Over the years, each Region has developed their own slightly different approaches and interpretations based on the knowledge and experience of the Regional staff involved in the program. The 1999 to 2001 annual average number of Permits to Take Water issued (new and renewals) by the various Regions were: Central Region 57, Northern Region 68, Eastern Region 97, Southwest Region 340 and West Central 418.

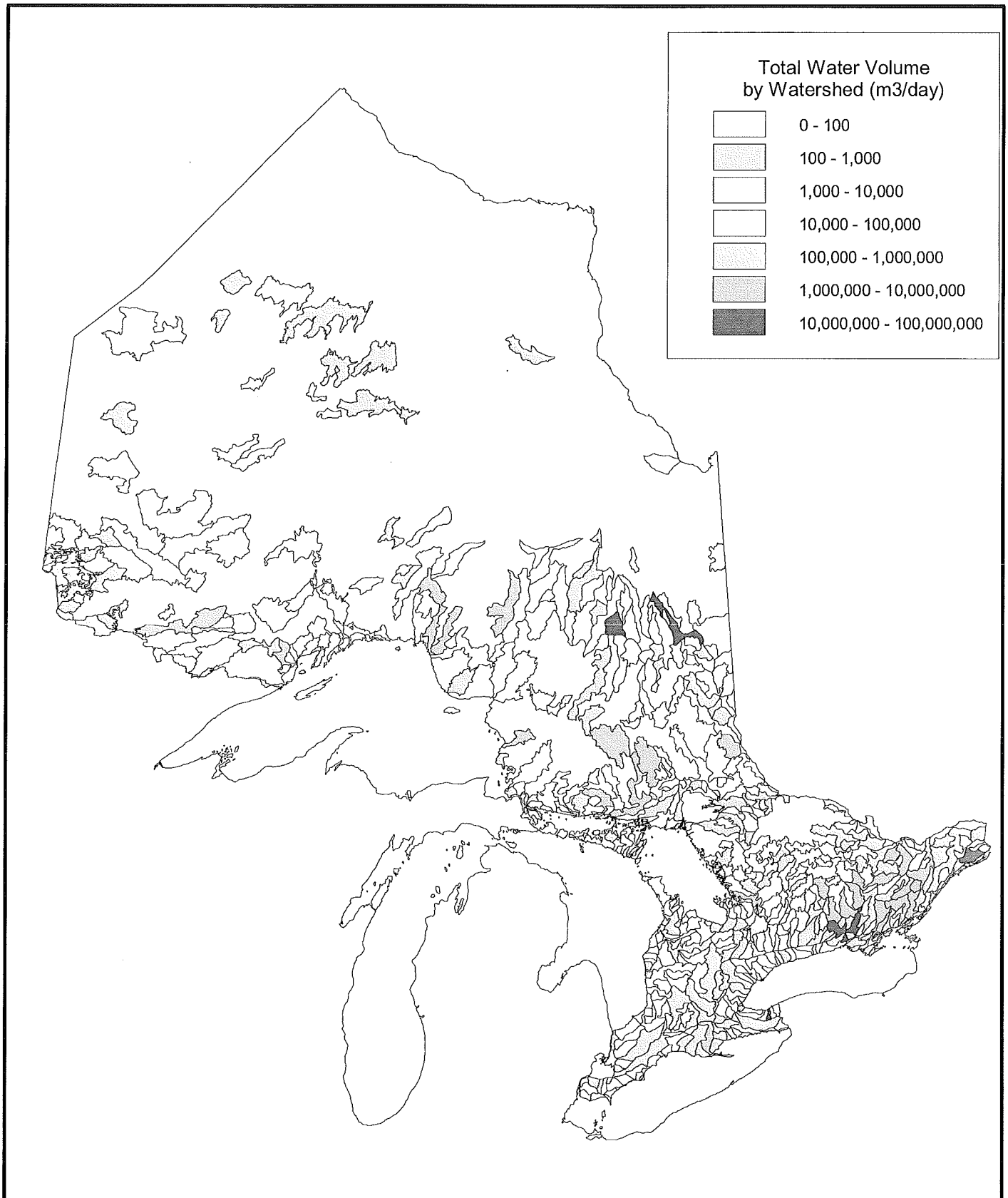


Figure 5: Total Water Taking Volume by Watershed

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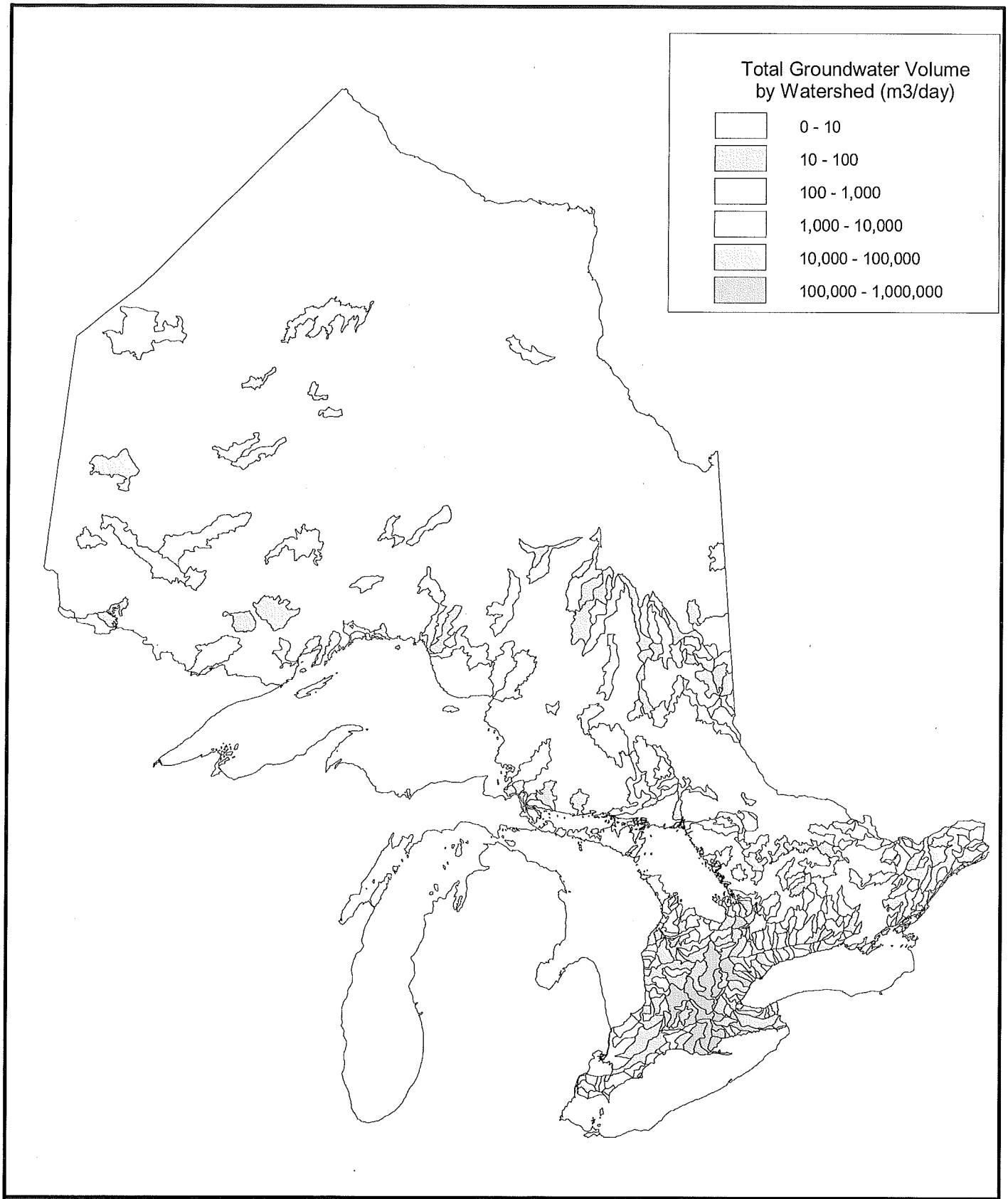

Figure 6: Total Groundwater Volume Permitted by Watershed

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The recent occurrence of a number of below average precipitation years and resultant low surface water levels in streams, rivers and lakes across parts of Ontario, has placed an increased emphasis on the PTTW program. Public concerns have been raised about the recharge and sustainability of the groundwater aquifers to provide high quality drinking water into the future. The increasing demands on what appeared to be a diminishing supply of water (caused by lack of precipitation) has resulted in an increase in competition amongst the existing and future potential users and uses of our water resources. Attempts have been made by the Ministry over the last couple of years to further standardize approaches across the Regions to control the taking of water by promoting its efficient development and beneficial use.

The following is a general summation of the existing approaches used to evaluate applications for Permits To Take Water. All applications are evaluated to determine that the proposals are consistent with the requirements of Regulation 285/99, in respecting the transfer of bulk water out of the Great Lakes Basin. Also, notification procedures to the other parties must be followed for any proposed takings that fall under the Great Lakes Charter. Posting of the required proposals on the electronic registry must be completed to meet the requirements of the Environmental Bill Of Rights allowing the public to provide input to the decision making process. Some water takings are exempt from the EBR posting, including:

a) short term (< 1 year) irrigation takings; or
b) short term takings related to aquifer tests, dewatering, or hydrostatic testing of pipelines.

The site specifics of the proposed taking will modify the general requirements and may require additional work beyond what is stated. Pre-consultation with the proponent or their consultant may occur prior to the submission of the formal PTTW application. This can take place as a telephone conversation, formal correspondence or a face to face meeting with one or more of the Ministry's technical reviewers. The specifics of the proposal and any additional supportive informational requirements by the proponent would be discussed.

Groundwater

Groundwater takings are evaluated on the bases of being sustainable[3] and having non-interference with existing groundwater takings and uses. (This has been referred to colloquially by some as the "first come, first served" principle.) Most PTTW applications for groundwater withdrawals require that a hydrogeological study to be undertaken. An exception are those applications for irrigation, largely in the Southwest Region, where the cost of such studies have been traditionally deemed to be too much for the farm businesses. A hydrogeological study typically involves the drilling of a number of bore holes,

3. *A sustainable water taking is defined as one that does not take more water than is naturally recharged. An example of a non-sustainable water taking is that of continuously drawing down an aquifer (sometimes called mining the aquifer) from year to year, and not reaching an equilibrium condition.*

installation of a number of piezometers (to measure groundwater elevation) and a pump test from 24 to 72 hours or longer depending on the site specific conditions. Based on this pump test (also called an aquifer test, or water withdrawal test), estimates can be made on the size of the long term area of influence and the potential impact on surrounding wells and surface water features. The proponent may also use the Ministry's water well records/logs as their main source of information to determine what other wells are in the area as well as use the data on those other individual wells.

The main purpose of the study is to document that the proposed taking rate and volumes do not impact on existing human groundwater uses and will be sustainable in the long term. For example, the Ministry does not allow mining of aquifers as this action is non-sustainable. If the area of influence of the proposed taking includes a surface water feature (stream, river, lake, pond etc.), the proposal would be passed on to a surface water technical reviewer. This reviewer would then determine if there were concerns with the proposed taking having an impact on the existing streamflow, ecological conditions, fisheries, waste assimilation capacity etc.

Potential concern about increased contaminant migration resulting from the groundwater withdrawal would also be included in the evaluation. In cases where the groundwater withdrawal is not consumed by its use, impact assessments maybe required to evaluate the acceptability of discharging this non-consumed water to a surface feature or returning it to the groundwater aquifer.

Currently, comments from the public are solicited through the Environmental Bill of Rights electronic registry. These comments would be considered for their technical validity. Concerns or additional information provided through the public review process would be taken into account by the technical reviewer prior to their recommendation to issue, reject or issue the Permit with conditions to the Section 34 Director.

Monitoring conditions of volumes withdrawn and measurements of surrounding groundwater elevations are typical conditions imposed on any permit issued. Additional monitoring conditions may be imposed, for the monitoring of groundwater and or surface water chemical quality. Some groundwater programs require monitoring of surface water elevations as an expression of the water table. In the past several years the need for progressive groundwater trigger levels requiring the reduction, then elimination of pumping, have been imposed to protect the natural functions of surface water.

Surface Water

Surface water takings are evaluated under the concept of sharing the water resource (including natural functions of the stream) amongst the various users. To provide for the sharing, there is a need to determine if the proposed taking and its use are totally consumptive or non-consumptive or some combination in between. If the taking is non-consumptive or only partially consumptive, the percentage of water returned and the return location must be kept in mind during the review. Also, whether the

period of taking is year round or seasonal will potentially impact on different uses. For large surface takings from groundwater recharge areas, the application may be turned over to a groundwater reviewer if there is a concern about the proposed water taking affecting the groundwater resources.

The review of a surface water taking is to confirm that the proposed taking will not seriously impact on the aquatic resources of the area and not interfere with downstream riparian rights of the landowners. The proposed taking rate and volumes may be compared to estimated low streamflows at that specific location. This may involve the pro-rating of existing gauged streamflow information from another location to the proposed location. A number of techniques are available to estimate streamflows and a range of flows maybe used varying from monthly average streamflow, 7Q10, frequency analysis, duration analysis etc. to evaluate the potential impact of the proposed taking on existing conditions.

The proposed taking rate would also be evaluated to confirm it does not stop streamflow downstream of on-stream ponds or reservoirs or in riffle pool sequences in flowing water bodies. This includes groundwater takings that may reduce or dry up seeps or springs in the immediate area. Some Regions have established the concept that no single taking can exceed 10% of the instantaneous streamflow present at the time and location of the taking without doing additional impact analyses. This additional work would have to predict that the proposed taking would not impact negatively on the existing or potential aquatic resources present. This approach recognizes the seasonal variability of streamflow and the concept of sharing the resource amongst the users. Taking rates must be decreased as streamflow volumes decrease, and certainly if there are multiple water-takers, the 10% value is reduced.

The need for any off-stream storage maybe evaluated to determine if it can provide sufficient buffering capacity to the requested withdrawal rates and volumes. Suggestions about the need for an off stream pond or increased off stream storage may be provided to allow the proposed taker to take at a reduced rate over a longer period of time from the watercourse but at a higher rate for a short period of time from storage.

The technical reviewers may contact other agencies or Ministries, such as local conservation authorities, Ministry of Natural Resources, Federal Fisheries officers etc., to obtain additional site specific information on aquatic resources present and any concerns respecting the proposed taking. This is in addition to his/her knowledge of the waterbody, respecting water uses such as waste assimilation capabilities, the location, size and type of any wastewater discharges or drinking water intakes, expected or known fisheries present annually or seasonally, areas of natural scientific interest, along with the general number and existing water uses by other permitted water takers.

Scientifically and technically concerns or additional information provided through the public review process (EBR posting) would be taken into account by the technical reviewer prior to their recommendation to issue or reject the Permit with conditions to the Section 34 Director.

Typical monitoring conditions include recording of dates, duration, rates and volumes of water withdrawn from the watercourse. Special monitoring conditions such as streamflow monitoring, taking water level readings from a staff gauge or measuring point, upstream/ downstream biological monitoring etc. may also be included.

2.3 Regulations and Other Guiding Documents

- **MOE Statement of Environmental Values**

  The mandate of the Ministry of Environment, as stated in their statement of Environmental values is: "*to protect the quality of the natural environment so as to safeguard the ecosystem and human health; co-ordinate the government's energy supply and demand-related activities; and foster the efficient use and conservation of resources.*"

  The first guiding principle in the statement of environmental values is the Ecosystem Approach, described in the following manner:

  > *"The Ministry will adopt an ecosystem approach to environmental protection and resource management. This approach views the ecosystem as composed of air, land, water, and living organisms, including humans, and the interactions among them.*
  >
  > *When making decisions, the Ministry will consider: the cumulative effects on the environment; the interdependence of air, land, water and living organisms; and the interrelations among the environment, the economy and society."*

  From a PTTW perspective this guiding principle sets the framework for providing a cross-disciplinary approach to assessing any proposed water taking.

- **Section 34 Ontario Water Resources Act**

  The Ontario Water Resources Act (OWRA) provides the legal basis governing the taking of water in Section 34 of the Act. Section 34 describes the need for a PTTW for any taking exceeding 50,000 L/day with the exception of domestic or farm purposes (irrigation of crops for sale is not exempted). Section 34 of the OWRA also protects other people's interests by giving the director the ability to prohibit a water taking where it adversely interferes with another person's interests in water.

- **Ontario Regulation 285/99**

  This regulation is the Water Taking and Transfer Regulation and is intended to provide for the conservation, protection, use and management of water in Ontario. As such it deals with the inter

basin bulk transfer of water, as well as providing guidance to the Section 34 Director on what should be considered when assessing an application for a Permit to Take Water. It was written in part to satisfy the needs of the Great Lakes Charter, and does not permit the inter-basin bulk transfer of water between the Great Lakes basin, the Nelson Basin and the Hudson Bay basin. The transfer of water in containers less than 20 L in volume is specifically exempt, as is water used to manufacture or produce a product.

Of particular interest to the water taking permitting process, O. Reg. 285/99 stipulates that the Director must consider the protection of the natural functions of the ecosystem. It does not however define the scope of the ecosystem, but relies on a reference to the Permits to Take Water, Guidelines and Procedures Manual, 1999. The Director may require the applicant to consult with other persons who have an interest in the taking (including other governmental authorities for other jurisdictions) and provide the Director with information on the interests of those consulted.

Further to this the Director may require the applicant to consult and report on these persons who have an interest in the taking (including other governmental authorities for other jurisdictions). Some MOE regions respond to this by having the applicant provide the Director with what is found out, and other regions circulate the file themselves. Difficulties often occur in the timeliness of the response from agencies to either the applicant or the MOE.

- **Ontario Regulation 459/00**

This regulation deals with municipal water treatment or distribution systems and includes a water works for which an approval would be required. It includes all water takings which supplies on a regular basis (i.e., for at least 88 days in every 90 day period), 50,000 L of water per day or more and to a water treatment or distribution systems that serves more than five private residences. This regulation therefore applies to permitted water takings that provide municipal water supplies.

This regulation stipulates the minimum level of water treatment required and the water sampling requirements. It also prescribes the requirements of proper notification or reporting of water quality results. There is also a requirement for the completion of the Engineers' Reports on the water treatment and distribution systems and the time frame for the completion of these reports.

- **Ontario Regulation 505/02**

This regulation applies to water treatment and distribution systems used to provide water for human consumption at a designated facility. This includes facilities such as schools and day nurseries as well as others. It does not apply to water treatment and distribution systems that are subject to Regulation 459. It will likely apply to water takings that are permitted by the MOE, which are not considered municipal systems, but still provide water for human consumption and includes the provision of water to washbasins, bathtubs, showers, kitchens or food preparation areas. This could also include facilities such as summer camps, retirement homes, restaurants etc.

The minimum level of water treatment is stipulated and sampling frequency and the parameters to be tested is provided in the regulation. The requirement for notification of adverse water quality and corrective action are also stipulated. The posting of water quality warnings as well as the maintenance of records is outlined in the regulation.

- **Ontario Clean Water Act**

  This act had just undergone first reading at the time of the finalization of this report, and therefore is not discussed here.

3. Framework

It is important to follow a framework when considering the range of scientific disciplines, the linkages between them, and their scale dependent needs. It is convenient to construct this framework at two scales. These are at the watershed scale and at the site-specific scale. This is because the issues that are addressed at these two scales are different. The following two sub-sections provide this framework.

3.1 Watershed Framework

As described in Section 1.3, a watershed or sub watershed (if big enough), are logical units for water management. Therefore this scale is an appropriate level from which to assess cumulative impacts. For the sake of convenience the term "watershed" includes both watershed and sub-watershed, with the understanding that the size of area to be considered depends upon the specific geology and resources present. A useful test to select an appropriate size is to ensure that it is large enough that any effects created by water taking within its boundaries do not cross or change those boundaries. Another consideration is that the watershed, while a convenient surface water unit, may not coincide in area with the underlying groundwater basin. On a similar basis, ecosystem function can cross watershed boundaries, as do municipal boundaries.

The watershed framework is best suited for assessing cumulative impacts of any proposed water taking on both the natural environment and existing water use condition. It is however an unrealistic scale for any individual proponent (excepting maybe higher tier municipalities) to examine cumulative impacts[4]. It is expected that an individual proponent would consult with the appropriate agencies to see how a proposed taking would fit in, and to scope out the extent of their site specific investigations, public consultation, and impact assessment.

4. *A proponent would of course assess cumulative impacts locally, as described in Section 3.2.*

3.2 Site Specific Framework (Linkages)

An individual proponent for a water taking is required to identify the potential impact of their water taking. Regulation does not prohibit an impact, but is intended to prevent any *adverse* impact. The detailed scientific work is usually done at the site specific scale. The term "site specific" means both on the site as well as the local environs. In other words, the site specific framework includes all areas that are directly affected extended out to a point where no effects can be demonstrated. Therefore the linkages between surface/groundwater and the natural environment, plus existing local water users have to be established. A cumulative impact assessment should also be done at this scale, although there are many cases where there are no other water takings or use of the resource that could accumulate impacts.

4. Present Practice Review

4.1 Groundwater

Groundwater takings will affect groundwater and may affect surface water, depending upon proximity and degree of abstraction. Surface water takings will affect surface water, but seldom affect groundwater. This section considers groundwater takings. Investigation of the effects of groundwater taking on the groundwater has been done for many decades and the science is well established. Investigation of the effects of groundwater taking on surface water has been historically done on a gross scale, but only recently on a detailed site specific scale. The principles of groundwater to surface water interaction have only recently been explored by the scientific community. The consulting community in Ontario is currently beginning to apply these principles, which are clearly summarized in Sophocleous, 2002. Discussion with other jurisdictions indicates that Ontario, although not the leader, is progressing well in their application of these principles.

4.1.1 Present Groundwater Practice

There are two levels of scale that need to be considered. The first is at a watershed and/or regional scale. This focuses on how the water taking fits into the greater picture. As will be discussed below, this is often the scale that has been historically ignored, and of course is as important as local considerations. Second, the site specific scale, which focuses on what is happening on a site and its immediate environs. For these reasons we have subdivided the following discussion along these lines.

4.1.1.1 Watershed Based Scale

For smaller water takings, where the amount taken is replenished locally, there is little need to consider the proposal on a watershed basis. As will be discussed below, site specific methods will determine whether there is potential for adverse off-site impact. For greater takings, where the contributing area exceeds the site boundaries a greater area needs to be considered. This is typically done by water balance methods on a sub-watershed basis. Water balance approaches are attractive as they rely on the conservation of mass, and at least in the surface water flows are measurable. In the groundwater, quantity measurement is based on water level measurements, and calculation of flow using the Darcy Principle. Therefore assessment of changes from water taking consider additive changes from all users, as well as changes in recharge caused by changes in available water (precipitation and recharge of parts thereof). Certainly the changes in meteorological conditions in recent years, such as lower precipitation and less frequent but more intense rainfall events, have caused a lowering of the water table in some (but not all) areas of the Province.

Current practice in Ontario is to carry out water balance calculations in two ways. The first is a through simplified calculation of "water in - water out" for a given area. The second is to apply groundwater modelling which does the same thing, but discretized over the incremental units, or elements of the model. The water balance depends upon a calculation of available water through analysis of meteoric records over a long term. Thornthwaite and Mather, 1957, is most commonly used in Ontario, and is based on an empirical formula derived from baseflow separation data. The formula is applied to the local meteorological records and determines a water surplus, which is the water that is available for runoff and infiltration after evapotranspirative losses have been subtracted. This is then partitioned between infiltration and runoff based on soils, topography and vegetative cover (MOEE, 1995, Chow, 1964). The method is best used as an evaluation of average annual conditions, but can be used for individual years to account for hot/dry or wet/cold conditions. It is calibrated against average annual baseflow measured from the outflow of the watershed.

These same methods are used to derive the input to numerical groundwater models. Currently, the most popular groundwater models are Modflow (McDonald and Harbaugh, 1988), and FEFLOW (WASY, 2001). Both have surface water interaction modules that allow the model to calculate the groundwater discharge to surface water. Some practitioners use surface water models, such as GAWSER (Schroeter & Associates, 1996) to calculate infiltration by subtraction, which is then fed to the regional groundwater models. As with all methods, the results need to be calibrated against stream discharge under baseflow conditions. This is an essential step that has not been economically possible in all cases, but those Conservation Authorities (GRCA, CVC) that are doing watershed modelling are currently doing this to verify their models.

If water budget calculations show the potential for interaction with other water supplies, and now also with the existing ecosystem, then attention is paid to these features. In Ontario, Regulation 285/99

requires this, however the level of sophistication that is applied is highly variable. Hydrogeologic assessment is focussed on the extent of the aquifer as well as the layout of the subwatershed. (The two don't always coincide, and therefore attention must be paid to both.) The assessment of the cumulative effect of a number of water takings is typically not considered by an individual proponent, although Reg. 285/99 requires that the Director consider this. It has been the position of some MOE regions to consider cumulative effect in-house, and other MOE regions ask the proponent to do so. Presently the current PTTW manual does not provide guidance on this aspect.

There are hydrogeologic tools available to help assess the cumulative effects of multiple takings in a water shed or aquifer system. Specifically, the same regional groundwater flow models used above[5] provide a means to examine existing conditions, and give the analyst the ability to numerically impose new takings to explore the potential impacts. These models are typically steady-state (equilibrium) representations of the flow systems and do not consider seasonal, annual or other transient conditions. The models themselves can do this, but the supporting data to populate and calibrate them are lacking. They are also of such a large scale that they do not accurately represent the immediate area surrounding any particular groundwater withdrawal. Because of the relatively wide difference in magnitude of groundwater flow rates and surface water flow rates, models do not deal well with ground/surface water interaction (Sophocleous, 2002). Typically, any individual proponent does not have the financial resources to make use of watershed sized models. Only Regional Municipalities, or those Conservation Authorities with appropriate funding, have the ability to use these larger groundwater flow models. Elsewhere, jurisdictions in temperate climates are moving slowly to introduce this as a planning tool, most notably in England (Hiscock *et al.*, 2002). Those in arid climates, where water supply is a critical issue, are more advanced in utilizing groundwater models.

The groundwater tools that are available on both a site specific, and a watershed basis, focus on the effects of water taking on water, that is, measurement of water depletion. There is little in the literature that makes the linkage of the effect of water taking on either the whole ecosystem, or on components of it. There has, however, been a recent move towards using the existing groundwater techniques to assess the groundwater contributions to ecological and linked surface/groundwater systems. For example, Curry and Noakes (1995a) used mini-piezometers and seepage meters to characterize groundwater discharge around spawning habitat. Their work did not consider the effect of water taking on these aquatic systems. We are aware that the University of Waterloo is currently doing new research in this area.

4.1.1.2 Site Specific Scale

The assessment of the effect of groundwater takings on the local groundwater system is well established in the literature, and in practice. Typically, investigations determine the geologic setting through both

5. *A number of consulting firms also use proprietary numerical models of either finite element or finite difference formulations as well.*

published information (geologic maps, water resource reports, water well records, etc.), and through site specific field investigation. Field work traditionally includes the installation of test wells and monitoring wells into the aquifer in question, and could include monitoring of other aquifers if present. Two types of investigation techniques are typically used: water well drilling, geotechnical drilling. The former is most wide spread in the water resources industry and is an economic way to find a groundwater supply. However it focuses on the drilling of the hole and does not yield reliable soil samples. The latter is the use of augered or cored holes that yield actual undisturbed soil samples. These samples are very helpful in determining the actual geology of a site, and hence its effect on groundwater flow. We have not provided any literature citations for these techniques as there are too many to list. Instead we refer the reader to several well proven textbooks and handbooks such as Freeze and Cherry, 1979; Driscoll, 1986; and Moss, 1990.

A well production test (or pump test) would be conducted to determine aquifer parameters such as transmissivity and storativity (and specific storage). The pump test would be taken to a long enough period (usually 72 hours) to examine for confined versus unconfined conditions. Measurement of water levels in the monitoring wells, and wells on neighbouring properties, are used to examine aquifer properties in different directions, as well as to measure well interference. Calculation of aquifer parameters can be done by many analytical methods (Walton, 1970; Driscoll, 1986; Moss, 1990). The more famous ones include Theis, 1935, for confined aquifers, and Boulton, 1963, for unconfined aquifers. The available analytical solutions examine a wide variety of conditions including partially penetrating wells, leaky aquitards (Hantush and Jacob, 1955), bounded aquifers (Ferris et al., 1962), etc. There are several commercial software packages that have automated many of these analytical solutions and most of the larger consulting firms in Ontario have their own automated software. One problem that is seen from time to time is that of inexperienced practitioners inappropriately using individual solutions within such software without having reviewed the governing assumptions. (The attractive graphical output to such programs often masks the applicability of a particular solution.) Fortunately there has recently been a trend to more thorough peer review in Ontario, and thus such cases are typically caught and corrected.

Through analysis of the results, long term predictions of aquifer performance and maximum theoretical drawdown of neighbouring wells are made. These predictions are based on the aquifer parameters determined from the aquifer tests, applied to the period of projected well use, typically extended to 5, 10 or 20 years. This exercise is theoretical in nature, as it assumes constant pumping volumes from year to year, a certain reliable long term recharge condition in the watershed, and no future uses interfering with the taking. However, it has been applied for decades, and usually changes in the assumptions require re-evaluation which happens generally well within these timeframes. Examination of the groundwater flow directions and hydrogeologic setting have not always been done, as the focus was traditionally on water supply and sustainability, not environmental impact assessment. These methods can be considered hydraulic methods as they do not directly address effects on the aquatic or terrestrial habitat. They are, however, tools that can be used to examine the natural habitat.

The principles of a traditional investigation also apply to environmental impact assessment, with appropriate modification to techniques. Measurement of drawdown at a neighbouring location, coupled with a distance drawdown prediction of long term effects, was sufficient to examine this issue from a water supply perspective. Examination of environmental effects requires longer pump tests, one week at a minimum, and sometimes up to 3 months, in order to induce reliably measurable effects in sensitive features such as wetlands and first order streams, where only a few decimetres of drawdown can be critical. The degree of instrumentation is necessarily different for several reasons. Construction of monitoring wells with traditional heavy equipment in low-lying wetlands and/or stream beds can be destructive to the very habitat requiring protection. Small diameter, hand driven, mini-piezometers solve this aspect, and have been used by a few (but not all) practitioners for over 20 years. These devices can also be placed in shallow settings to examine the near surface effects in a wetland, or in the base of a stream. They are limited in that they only provide assessment of changes in head, and are not practically tested for water quality or aquifer parameters. The use of seepage meters to measure groundwater discharge in the base of a gaining stream has been around since the early 1980s (Lee & Cherry, 1979). These devices provide useful information if correctly installed, but often field conditions such as cobbles and extremely variable substrates preclude this. Specific instrumentation, coupled with longer pump tests, has been used in Ontario and elsewhere to provide a stronger basis for long-term impact assessment that stands up to regulatory and public scrutiny. These techniques have not gained widespread use as of yet.

Another tool used by current practitioners in Ontario is that of a site-specific water budget. This is a calculation of the annual average recharge in comparison to the amount of water taken. For low capacity wells, the property itself can provide the necessary area to generate the recharge. For higher capacity wells, the contributing area invariably extends off-site, and the water balance is usually done on a subwatershed basis (most convenient) or on the aquifer extent (depends upon available information). In any event, it is desirable to calculate the amount of water moving in the aquifer, using basic groundwater equations such as Darcy's Principle, as an independent corroboration of the water balance. The purpose of the water budget is to demonstrate that the taking is sustainable and that the resource is not being mined. One must keep in mind, as Sophocleous 2002 points out, that the withdrawing of water at a rate just less than the recharge rate does not equal safe yield, as it intercepts water that otherwise would be sustaining downgradient ecological systems. Only in exceptional cases are the cumulative effects of a proponent's taking, plus neighbouring uses, considered at the site-specific scale. Where groundwater takings are expected to affect surface water, the water budget can be extended to consider surface water flow.

Computer modelling of groundwater flow systems is a tool that has become economical to use in recent years. This tool is rarely used for assessing site specific groundwater taking, due to its data needs and the corresponding cost. For example, a single site is usually a small part of a greater watershed. Groundwater modelling depends upon defining appropriate boundary conditions, that usually occur at the

limits of the watershed, and not on the site.[6] Most proponents just have access to their own property and rarely have the opportunity to drill or monitor on multiple neighbouring properties. As described earlier, modelling is most effective at the watershed scale.

4.1.2 Gaps in Groundwater Practice

4.1.2.1 Watershed Scale

Where a water taking is relatively small, this may be important on the site specific scale, but not at all to the watershed scale. If the groundwater taking is substantive in relation to the watershed and/or aquifer, then there is a need to assess the cumulative impact on that watershed and/or aquifer. The ability of individual proponents to assess the cumulative impact of their taking on the overall watershed, subwatershed, or aquifer is often limited by financial considerations. In those areas where there are no watershed plans, or no tools (e.g., models) being used by municipalities or conservation authorities, the assessment of cumulative impact is not always economically possible.

The use of models and watershed scale water budgets is valid at this larger scale. There is always some difficulty in accurately knitting in a specific water taking to a large scale model, due primarily to relative scale. Presently these models represent only planning tools, and are not to be used to the exclusion of site specific study.

4.1.2.2 Site Specific Scale

As discussed above, well proven techniques (drilling, aquifer tests, monitoring, analytical techniques) for assessing the effect of a groundwater taking on ground and surface water exist and are used routinely in Ontario by some practitioners. This is particularly true where the effects of groundwater taking on groundwater are being assessed. These same tools can be adapted to assessing the effects of groundwater taking on surface water. As Section 4.2 will discuss, the order of scale of the water taking in comparison to the surface water flow is important. If the surface water regime is small, for example a headwater tributary, then the size of the groundwater taking is of paramount importance. (In contrast, in the case of a major river, then it would be difficult to even measure the effect of a groundwater taking on that river.)

One gap therefore that requires addressing is the establishing of a sound methodology for assessing the effect of groundwater takings on small first order streams. Present non-intrusive technology such as in-stream piezometers and seepage meters provide ways to look at relative changes induced by water taking.

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6. *Or, unfortunate from the proponent's point of view, lies across a boundary between watersheds.*

They do not provide quantitative measurement of groundwater discharge, and therefore limit the ability of the analyst to determine actual contribution to the ecosystem which relies on the groundwater. This is explored further in Section 4.3 of this report.

Most methods rely on one time tests with the extrapolation of data to the long term. It is extremely costly to carry out long term tests that would examine the seasonality of the surface/groundwater system. Similarly it is even more onerous to assess annual effects such as normal, hot/dry, or cold/wet years. These questions are now common from an increasingly more well-educated public, and the valid extrapolation of a test in one season to these varying conditions is difficult to do. This same issue is carried forward to assessment of a water taking under those conditions on the functions of the natural ecosystem. In short, diverting a known amount of water from a wetland or spawning stream in the summer of a dry year is different than taking the same amount in the spring of a wet year.

The consideration of temporal effects is also true in the short term scale of a daily cycle. Diurnal fluctuations of water levels in wetlands and flow in small creeks, in response to daily evapotranspirative cycles, is often not considered. Collection of hand measured data will often mask this issue and can introduce interpretative error of up to 20% for streamflow and several centimetres for groundwater or creek levels. This "fuzzing" of the data can lead to analyst error when assessing sensitive ecological conditions like upward groundwater flux, or the correct amount of inundation for sensitive wetlands like fens. The need to use continuous datalogging equipment to understand these cycles is necessary, but not widely practiced in Ontario.

4.1.3 Groundwater Opportunities

4.1.3.1 Watershed Scale

The opportunities at the watershed scale lie with the watershed approach to environmental assessment. (From a hydrogeologic perspective, the term watershed includes all linked aquifers, whether they lie within the surficial watershed boundaries or not.) The assessment of cumulative effect must necessarily be done at this scale. Presently the Municipalities in concert with the Province of Ontario have begun to carry out the studies necessary to have a framework from which cumulative impact assessment can be made. Aquifer Characterization and Wellhead Protection studies are currently underway for the majority of southern Ontario. Even though these studies focus on municipal water supply and wellhead protection, the opportunity lies with completing this work in order to develop the management tools that will support a defensible approach to cumulative impact assessments.

It can be expected that these regional studies will identify specific data needs to provide more accurate and reliable results. Where a proponent carries out a study for a water taking, the information could be collected in such a manner as to be conveyed to the regional database. Certainly a provincial database on

actual water use (as opposed to the present listing of maximum permitted amounts) could be developed provincially or regionally. Some areas are further ahead than others, in terms of only a few Conservation Authorities completing or undertaking sub-watershed studies. However most have not done this in any detail, and therefore a full set of more comprehensive sub-watershed studies (possibly beginning with those more populated regions) should be undertaken.

4.1.3.2 Site Specific Scale

The principles of ground/surface water interaction have become established in the scientific literature. There exists a set of investigative tools that deserve greater use in assessing the localized effects of water taking on first and second order streams, wetlands and other ecologic features that depend upon ground and surface water. These include mini-piezometers, seepage meters, staff gauges, weirs, flowmeters, and supporting data logging methods. These tools, when placed strategically as directed by the natural scientists (aquatic biologist, terrestrial biologists, hydrogeologists), can be extremely effective in determining hydrologic baseline conditions as part of habitat assessments. More importantly, the natural scientist's investigations can be conducted co-operatively during carefully designed pump tests and changes in hydraulics documented in conjunction with ecologic observations.

Notwithstanding this direction to take better advantage of existing tools, there are limitations to those tools. Current in-stream techniques are often qualitative in nature, and to be used more effectively should be quantitative. For example actual groundwater discharge into a creek can only be identified through temperature, observational, or groundwater head measurements. However the actual rate of discharge cannot be accurately measured. The research community should be challenged to develop more accurate methodologies.

In all cases, the budget and resources are not available for a proponent to carry out pump testing of all possible scenarios. For some water takings, there is no background data beyond a few months collected by the proponent prior to carrying out his test. Presently the MOE is using a conservative/cautionary approach when dealing with applications in sensitive headwater areas (where often no background data exist) by issuing 1 or 2 year permits with monitoring conditions. This allows them to adjust the water taking amount based on the information collected in the interim. The opportunity that needs to be explored is the possibility of conducting operational testing. That is, an interim permit could be issued based on the pump test and baseline studies being completed. The water taking would then go into an "in-service" mode, subject to specific monitoring, for an extended period depending upon the nature of the taking. (e.g., seasonal takings would extend over one or two full annual cycles). The nature of the monitoring would be more extensive than a long term Permit might presently anticipate, and would be geared towards defining the effect of taking. It would focus on both hydrologic and biologic monitoring. This type of monitoring is called Adaptive Environmental Monitoring, and is described in more detail in Section 4.3. The term "adaptive" refers to specific conservative triggers that could be set up to adjust

monitoring frequency or even the rate of water taking in order to protect the local ecosystem during this period. Once an operational test is complete, an application for a longer term permit based on the results and a more focussed monitoring program could be made. From a groundwater perspective, the tools exist today to collect the necessary hydraulic data. The linkage between hydraulic performance to ecologic function needs to be made to provide the proper assurances that the ecosystem will be protected from adverse environmental impact.

Adaptive Environmental Management is currently being developed along the lines described above, in a number of sensitive head water cases in southern Ontario. Expanding its use to other types of water taking, such as municipal systems, or large industrial takings, where it would be difficult to reduce or stop the taking needs to be explored. In those cases staged development of the water resource may have to be considered, as well developing practical contingency measures.

4.2 Surface Water

4.2.1 Surface Water Quantity

Surface water takings account for about half of the water taking permits in Ontario and more than 95% of the volume of water taken. Unusually dry weather from the autumn of 1997 to late 1999, and again in 2001 resulted in decreased stream flow in many watercourses. Unfortunately, these same drought conditions have coincided with peak takings, particularly for water takings for irrigation purposes. This has added to the concern that existing surface water takings may be having a negative impact on the aquatic ecosystem. Many users of surface water have applied for renewals of their permits over the past several years expecting to be granted a renewal as a matter of course. As the MOE implement assessment of ecosystem function, these users are being asked to undertake studies to determine the state of the aquatic ecosystem in the watercourse from which water is being taken. This information is then augmented by an analysis of stream flow data in an effort to determine whether the taking may have an adverse impact on the watercourse, and to specify a safe threshold (below which no taking would be permitted) to protect the ecosystem.

Takings classified as surface water takings may draw water from one or more sources, which may include lakes, ponds, large rivers, small rivers, springs or wetlands. Factors contributing to the impact of a specific taking include not only the quantity of water being taken, but the source of water as well. This section will focus on methods to assess takings from watercourses. Generally this includes evaluating flow data for a watercourse to determine how much water may be taken, as well as a flow threshold below which no taking would be permitted. It should be noted that takings from ponds, springs and wetlands might result in a decrease in flow in a downstream watercourse, requiring an impact assessment for both the primary source (pond, spring or wetland) as well as the downstream watercourse. Water takings from large lakes are unlikely to result in significant environmental impacts, as long as the intake is located far

enough off-shore to prevent any impact to near-shore fish spawning habitat. Takings from ponds and wetlands may result in water level fluctuations, which may have an impact on the aquatic or terrestrial habitat (see Sections 4.3 and 4.4).

4.2.1.1 Summary of Literature and Methods Used in Other Jurisdictions

4.2.1.1.1 Watershed Based Methods

Our research did not reveal any jurisdictions that are using a watershed based approach for assessing the impact of water takings on the ecosystem.

4.2.1.1.2 Site Specific Methods

The current permitting process in Ontario is described in detail in Section 2.2. The review of a permit application for a surface water taking is conducted to confirm that the proposed taking will not seriously impact on the aquatic resources of the area and not interfere with the downstream riparian rights of the landowners. Determining whether a taking may result in an impact on the aquatic environment has historically included an assessment of flow data for the watercourse in the vicinity of the taking. These data indicate the range of flows in the stream during the period of record, from which various flow statistics may be computed.

Permits to take water from a stream generally include a maximum rate of taking and a total permitted volume per day. The Central Region of the MOE also stipulates a stream flow threshold. Once the flow in the watercourse drops to the threshold the taking must cease until the stream flow rate once again exceeds the threshold. The evaluation of historical stream flow data and the calculation of flow statistics provide the context in which to evaluate a proposed maximum rate of taking and stream flow threshold.

There is currently no standard approach to setting the stream flow threshold, either in the Province of Ontario or elsewhere. Various jurisdictions approach the problem in different ways, due to differences in the size of rivers in the jurisdiction, the number of users and the scarcity of water. Large rivers that are the source of water are frequently viewed as unlimited sources that will not be measurably affected by water takings. The Provinces of Alberta and Saskatchewan have apportionment agreements for the North and South Saskatchewan Rivers, which only allow each Province to allocate their portion of the stream flow. However, each Province may allocate their entire portion to users. Most jurisdictions recognize that, for smaller streams a portion of the stream flow must be allocated for the preservation of the aquatic ecosystem. The approach to protecting the aquatic ecosystem in most jurisdictions includes setting a threshold flow.

On smaller streams many jurisdictions, including Manitoba and Alberta, use the Tennant Method, or the Montana-Tennant Method to set thresholds. These Methods are based on the mean annual flow (MAF) in the watercourse. The Tennant Method specifies that flow greater than 30% MAF provides good habitat conditions. The Montana-Tennant Method specifies that flows greater than 20% MAF from October to March and greater than 40% MAF from April to September represent good habitat conditions. Ontario also includes the Tennant Method in its list of methods that may be acceptable for setting a flow threshold. These methods were developed for rivers in Montana and do not take into account different stream types and flow regimes. Neither are different species and life stages of fish considered by these methods.

The majority of methods that are either described in the literature or that are used in other jurisdictions may be classified as hydrologic methods. These methods evaluate flow data in an effort to determine a threshold flow rate below which no taking would be permitted for a specific location in a watercourse. These methods recognize that the flow rate in a stream varies over time and that the aquatic ecosystem within the watercourse has evolved to expect these variations. Nevertheless, natural fluctuations in flow, particularly abnormally low flows, may result in an impact to the aquatic ecosystem. These methods yield a threshold flow that would presumably protect the aquatic ecosystem from an impact due to water takings. Examples of such methods include: the $7Q_{10}$, the $7Q_{20}$, the median monthly flow, the summer median flow, the Tennant method (30% MAF), the Montana-Tennant Method, the Aquatic Baseflow method (August median flow) and the 60% duration flow.

If the methods described above are applied to a set of flow data each will result in a significantly different threshold. For example the $7Q_{20}$ flow represents the lowest seven-day average flow that would be expected in a 20 year period. The flow in a watercourse is unlikely to get that low except under extreme drought conditions. Using this flow as a threshold would result in the prohibition of water taking for several days a year on average, which may or may not protect aquatic habitat. On the other hand, the 60% duration flow is, by definition, the flow that would be reached or exceeded only 60% of the time. Using this threshold to limit water takings would result in the taking being prohibited for 40% of the time. This may be good for ecosystem protection because it is overly conservative, but it is overly restrictive on the water user and therefore introduces conflict. These methods do not consider the ecosystem and need to be tested against actual effects in the aquatic ecosystem.

This difference in the threshold flows recommended by each of these methods underlines the difficulty with these methods. Each is based on flow statistics and makes an assumption regarding the point at which natural flow fluctuations start to have an impact on the aquatic ecosystem. Little documentation has been discovered that would validate any of these thresholds as being meaningful in protecting aquatic habitat. None of the methods consider the hydraulic geometry (cross-sectional shape, longitudinal gradient), the quality of the aquatic habitat or the species of fish present. Nor is an assessment made of the sensitivity of a given reach to changes to the flow regime.

The wetted perimeter method is different from the hydrologic methods described above. It evaluates the relationship between flow and the wetted perimeter at a particular stream cross-section to determine a threshold flow. Essentially, this method yields a threshold that represents the lowest flow at which the entire width of the streambed would be covered with water. This method is virtually identical to the Toe-Width Method developed by the Washington Department of Fisheries, Washington Department of Game and the U.S. Geological Service in the 1970s. The literature indicates that this flow represents the minimum suitable rearing habitat for fish. Unlike the hydrologic methods described above, the Wetted Perimeter method does not require historical flow data. It does relate the depth of flow in the stream at a given cross-section to the requirements of the aquatic ecosystem. It does not, however indicate that the predicted threshold is appropriate for different life stages of fish (i.e., spawning), nor does it differentiate between the needs of different species of fish.

Both the wetted perimeter method and the hydrologic methods described above yield a threshold flow in a stream below which no water taking would be permitted. The threshold flow also implies that all flow in the watercourse in excess of the threshold would be available for taking. As noted above, the aquatic ecosystem in a watercourse has evolved and become accustomed to flow variations over a specific range. If significant quantities of water are taken from a stream at times when the stream flow rate is greater than some designated threshold, the range of flows to which the ecosystem has become accustomed may be reduced. It is unclear what impact this may have on an aquatic ecosystem in the long term.

The Environmental Agency for England and Wales has developed SWALP (Surface Water Abstraction Licensing Procedure) which includes a methodology for setting thresholds based on the sensitivity of a river to changes in its flow regime. This methodology is described in *Managing Surface Water Abstraction (I.C. Barker and A. Kirkmond, 1998)*[7] which notes that "The protection of flow variability is recognized as fundamental to the management of abstraction in the context of a flow regime for ecological needs". The three basic principles of the methodology to safeguard flows for ecological needs are:

1. The protection of low flows is fundamental as is ensuring that the naturally occurring low flows are not artificially reduced.
2. The occurrence, frequency, magnitude and duration of high flows are important factors in shaping the river channel and in creating and maintaining certain habitat features.
3. The maintenance of flow variability between these two extremes is considered important.

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If these three principles are accepted, it may be concluded that any change to the flow regime may result in an impact to the aquatic ecosystem. It is therefore important to determine a method that will assess both the sensitivity of a watercourse to changes in its flow regime, and the point at which changes to the flow regime result in a significant impact. The SWALP program implements a methodology that uses and Environmental Weighting (EW) procedure to classify the reach of a watercourse from which a taking is to occur. The EW considers equally the physical characteristics, the ecology and the fisheries of a stream in order to rate its overall sensitivity. It should be noted that the EW is not a measure of environmental quality, but rather a reflection of a stream's sensitivity to changes to the flow regime. A threshold is then specified based on the EW. Streams that are considered environmentally sensitive are given a threshold equivalent to the Q_{95} flow (the flow that is reached or exceeded 95% of the time) while streams that are considered to be insensitive to alterations to the flow regime are given a threshold flow of Q_{99}.

Although the SWALP considers the sensitivity of a reach to changes in flow regime when setting the threshold, the reference does not include evidence that the Q_{95} or Q_{99} is a meaningful threshold for aquatic ecosystem. Furthermore, the thresholds specified by these methods are hydrologically based. Although the EW does take into account the physical characteristics of the watercourse and the fish species that are present, this information only indirectly affects the establishment of a flow threshold.

4.2.1.2 Gaps in Surface Water Quantity Methods

4.2.1.2.1 Watershed Based Methods

The lack of watershed based methods is a significant gap in the current practice, both in Ontario and elsewhere. An individual taking may not result in a measurable impact, however the cumulative impact of all takings on a watercourse may result in significant impacts.

Furthermore, there is no explicit linkage between water takings and effluent discharge into the same watercourse. In Ontario, Permits to Take Water are granted under Section 34 of the Ontario Water Resources Act, and sewage discharges are granted a Certificate of Approval (C of A) under Section 53 of the Act. Any effort to assess the cumulative impact of water takings on the aquatic ecosystem of a watercourse must also evaluate the combined impact of takings and sewage discharge.

It should be noted that the effluent quality that is specified in a C of A for the discharge of sewage into a watercourse is generally based on contaminant concentrations that would be expected in the watercourse when the flow is at the $7Q_{20}$ level. This assumes that the contaminant concentrations in the watercourse will be at acceptable levels when the flow is greater than the $7Q_{20}$ flow. Therefore, if a threshold flow is set for water takings, it should be greater than or equal to the $7Q_{20}$ in order to prevent the takings from reducing the water available for dilution to an unacceptable level. If water takings are permitted without

setting a threshold below which no taking is permitted, there is the potential for takings to reduce the water available for dilution to an unacceptable level. Permitting several users on the same watercourse to take a proportion of the flow (10%, for example) regardless of the flow conditions creates the possibility of damage to the ecosystem due to the combination of water takings and sewage discharges. This aspect of cumulative effects analysis is occasionally overlooked, and depending upon the experience of the MOE technical reviewer, may not be caught. Section 4.2.2 deals with this in more detail.

4.2.1.2.2 Site Specific Methods

There is no shortage of methods to determine a threshold flow in a watercourse below which all taking must cease. The majority of these methods may be termed hydrologic methods, which are based on flow statistics computed using historical flow data. An assumption is made that somewhere within the range of flows experienced by a reach of river is a flow at which the aquatic ecosystem is affected to an extent that is unacceptable. This threshold is usually set toward the lower end of the range as described above.

The magnitudes of the thresholds specified by the various methods are quite different. The reason for these variations is that the development of these methods seldom includes any significant assessment of the aquatic ecosystem. Little effort has been made to determine a flow rate for a reach at which the aquatic ecosystem is unacceptably affected, and then evaluate this flow in the context of the range of flows experienced by the reach.

The first step toward developing a standardized approach to setting threshold flows is to define what is meant by an unacceptable impact to the aquatic ecosystem. The definition should take into account different species of fish as well as different life stages, and should consider chronic effects from the decreased variability of flow as well as acute affects from individual low flow events.

4.2.1.3 Opportunities for Surface Water Quantity

4.2.1.3.1 Watershed Based Methods

Many watersheds in southern Ontario already have hydrologic models in place that could be used to help evaluate the impact of water takings. Continuous models would be preferable, since they would allow the user to assess the impact of several takings on the flow regime of a watercourse. Any such model should also include sewage discharges in the watershed. It should be noted that hydrologic models can predict the impact of takings on the flow regime of a watercourse, but not the impact of water takings on the aquatic ecosystem. As noted above, it is necessary to determine the flow that is necessary to maintain a healthy ecosystem in order to make use of hydrologic models as a tool to predict the impact of takings on fish.

Models that include the tracking of water quality and temperature would also provide valuable information. The end result of any watershed based analysis would be to determine the amount of flow at different points in the watershed that is necessary to sustain a healthy ecosystem. Flow in excess of this amount could then be allocated to prospective users.

4.2.1.3.2 Site Specific Methods

Ontario in general and southern Ontario in particular is home to numerous gauged watersheds on varying sizes. It is relatively straightforward to evaluate streamflow data in order to calculate flow thresholds based on the methods described above. In order to set an appropriate threshold flow to protect the aquatic environment, the hydrologic analysis should be accompanied by a comprehensive study of fish and invertebrate responses to altered flow regimes.

4.2.2 Surface Water Quality

4.2.2.1 Summary of Literature and Methods Used in Other Jurisdictions

4.2.2.1.1 Watershed Based Methods

Wasteload Allocation

The US EPA and a number of states have adopted an approach called 'wasteload allocation'. The wasteload allocation is back calculated from a total maximum daily load (TMDL).

TMDL

According to the US EPA 'The TMDL is a tool used to achieve applicable water quality standards. The TMDL process quantifies the loading capacity of a waterbody for a given stressor and ultimately provides a quantitative scheme for allocating loadings (or external inputs) among pollutant sources. In doing so, the TMDL quantifies the relationships among sources, stressors, recommended controls, and water quality conditions. For example, a TMDL might mathematically show how a specified percent reduction of a pollutant is necessary to reach the pollutant concentration reflected in a water quality standard.'

The TMDL process involves the identification of receiving waters that are impaired by not reaching one or more water quality objective. Management of the parameter of concern is conducted on a watershed basis, and an allocation of an amount of the pollutant is divided between point and non-point sources.

Water Quality Models

The Enhanced Stream Water Quality model (QUAL2E) is a widely-used model that simulates water quality (temperature, dissolved oxygen, nitrogen, phosphorus, chlorophyll *a*, BOD, coliform bacteria, and up to three conservative minerals) as a function of discharge in stream channels. It is a two-dimensional model developed in the 1970s and is incorporated in the U.S. EPA's 'Better Assessment Science Integrating Point and Non-point Sources' (BASINS) tool.

HEC-5Q (U.S. Army Corps of Engineers) and the Water Quality Simulation Model (WASP) developed by the U.S. EPA, and MIKE 11 (DHI Software) are other examples of widely applied water quality models dependent on flow.

4.2.2.1.2 Site Specific Methods

British Columbia

British Columbia is in the process of reviewing its policy framework under which water takings are licensed. The major policy review and development initiative was described in A *Freshwater Strategy for British Columbia*, released in November 1999. This document provided an overview of the direction of water management in B.C. The *Freshwater Strategy* sets three long-term goals:

1. Healthy Aquatic Ecosystems;
2. Assured Human Health and Safety; and
3. Sustainable Social, Economic and Recreational Benefits of Water

With regard to policies that impact on water quality, the policy directions are described in more detail later in the report. Particularly relevant are the statements 'The ministry is taking actions to eliminate the stresses on aquatic ecosystems. This includes meeting the needs of fish and other aquatic life when making water allocation decisions...'.The recognition that some water allocation may be required to maintain water quality '...the upstream uses of water can affect the downstream uses. For example, significantly reducing the flow of water at one location or introducing toxins into the water limits the uses further downstream...'

Alberta

There appears to be no overall water allocation policy in Alberta, but there is a regulation on the allocation of water in the South Saskatchewan River Basin (Alberta Regulation 307/91 under the Water Resources Act). The focus of the regulation is the supply of water for irrigation, but other allocation needs are recognized. 'Water may be allocated for:

a) domestic purposes;
b) municipal purposes;
c) agricultural purposes, other than irrigation;
d) industrial purposes;
e) water power purposes;
f) other like purposes; and
g) purposes specified in Section 11(1)(b) and (d) of the Water Resources Act. AR 307/91 §6.' The regulation does not indicate what priority these should be given relative to irrigation rights.

Manitoba

Applying Manitoba's Water Policies Section 3: Use and Allocation:

Policy 3.1 *Economic well being and sustainability shall be the goal in the allocation and utilization of Manitoba's water resources for consumptive and instream uses' (p 30)*

...'The provincial government recognizes that surface water also has important instream uses such as **maintenance of natural ecosystems, recreation, waste assimilation and hydro-electric development.'**

The policy intent is to ensure that water needed for ecosystems functions is not allocated for uses that would threaten environmental sustainability.

Policy 3.2 *'Water management priorities shall be determined through a basin planning process that takes into account the protection of potable water supplies, environmental integrity, existing commitments, and economic requirements'* policy calls for management on a watershed-wide basis.

Policy 3.4 '*Surface water shall be managed to ensure sustainability of supplies.'* further states ...'Flow requirements needed to support the aquatic ecosystem and other instream uses are often overlooked or compromised'. The policy also calls for the government to monitor flow volume and water quality in surface water sources and maintain a comprehensive surface water database.

Ontario

Water taking is regulated under Ontario Regulation 285/99. § 2.3 states 'A Director who is considering an application under § 34 of the Act for a permit to take water may consider the following matters...Existing and planned municipal water supply and sewage disposal uses of the water.'

Newfoundland and Labrador

Under the Policy for Allocation of Water Use, the precedence for water uses are set out in the following order:

a) domestic;
b) municipal;
c) commercial and industrial;
d) water power;
e) recreation; and
f) other purposes.

The policy (§ 4.2.2) states 'The application will be assessed by the officials of this Department in relation to the availability of water, existing uses, potential water use conflicts, potential pollution or impairment of water quality, and downstream impacts among other considerations.'

United States Policies

In the 'National Water Quality Inventory: 1998 Report to Congress', flow modification was identified (after agricultural impacts) as the second most common cause of impairment of rivers. The uses of rivers are broken down into six categories:

a) aquatic life support;
b) fish consumption;
c) primary contact recreation (swimming);
d) secondary contact recreation (boating, etc.);
e) drinking water supply; and
f) agriculture.

Rivers were assessed in terms of their degree of impairment with respect to these uses. From this program a number of useful concepts have emerged, and are described below.

The most common reasons for impairment were siltation, pathogens, nutrients, oxygen-depleting substances, metals, pesticides, habitat alterations and thermal modifications.

4.2.2.2 Gaps in Surface Water Quality Methods

Although certain jurisdictions make mention of changes to water quality as a result of water takings in their regulations, none appear to directly link the water taking to the water quality impact. In Ontario

water takings must not adversely affect the ecosystem, however no effort has been made to define what adversely affecting the ecosystem is. Specific effluent criteria are written into C of A's for sewage discharges based on flow, however the impact of water takings on flow is not considered when evaluating a sewage discharge application, or on the issuance of a water taking permit.

Water temperature is also an important consideration. If the cumulative effect of several takings is that water temperature increases in a cold water fishery, the impact to the ecosystem could be significant during periods of hot, dry weather.

4.2.2.3 Surface Water Quality Opportunities

There is considerable information available on the impact of various pollutants on fish, and models that link alteration in flow regimes to water quality. In watercourses that have questionable water quality, an evaluation should be undertaken to determine whether water takings during low flow periods might exacerbate an existing water quality problem. This would be helpful in the setting of flow thresholds. Further, there are models and software available (for example, BASINS and MIKE) that integrate water quality and flow regimes on a watershed basis. There is an opportunity for Ontario to investigate the application of these tools.

4.3 Aquatic Habitat

The development and management of water resources by humans has altered the natural flow of rivers around the world, and the impacts of such flow alteration on aquatic organisms have been well documented. For example, modifying the timing, frequency or duration of floods can eliminate spawning or migratory cues for fish or reduce access to spawning or nursery areas. Changing the groundwater contribution to streams can reduce, or may alter, temperature or groundwater discharges on which trout are dependent for spawning. There are a number of ways in which the changes to water can affect the fish community.

Since the early 1970s, there have been numerous methodologies proposed for determining appropriate instream flows for the protection of aquatic organisms. Many of these methods were developed in the United States, but have been adopted and modified for use in different countries. Most methods being used by agencies in other countries resort to conservative threshold flows, because the scientific community cannot predict fish population sizes under various flow regulation scenarios (Orth 1987). Castleberry *et al.* (1996) concluded that "currently no scientifically defensible method exists for defining the instream flows needed to protect particular species of fish or aquatic ecosystems". The pressure to take short cuts in assessments will continue, as the expense of increasing our knowledge base may not be feasible for agencies to consider (Orth 1987). More detailed comprehensive studies of stream fish and invertebrate responses to altered flow regimes will be needed before simpler and less costly methods evolve.

It is becoming increasingly obvious that evaluation tools are required to predict the effects of change on fish habitat, not only for the protection of the fish, but for use in the approvals of projects. The Federal *Fisheries Act*, directs that there be no harmful alteration, disruption or destruction of fish habitat. This act plays a pivotal role in permitting of water takings that have the potential to affect streams in Ontario and will continue to do so.

4.3.1 Fish and Streamflow

Influence of Flow Regime

Native fish species possess life history traits that enable individuals to survive and reproduce within a certain range of environmental variation (Richter *et al.* 1997). However, if variations within the environment are too frequent and severe, fish will be unable to establish self-sustaining populations. If the abundance of an aquatic species in a particular stream is limited by the naturally occurring low flows in that stream, then further reduction in flow would have a detrimental effect on that species. But, if the species is not limited by low flows then further reduction in flow will have little effect (Jowett and Duncan, 1990, cited in Jowett 2002). Given that the life expectancy of most stream fish is between 3 and 15 years, fish will have survived a variety of low and high flow conditions. So, where is the line drawn between changing flows or water levels that are naturally occurring and those that contribute to a harmful alteration of the community and habitats? The status quo, in terms of stream biology, is likely to be retained if the minimum flow is not allowed to fall below the average natural low flow, or the mean annual minimum flow. As alluded to above in Section 4.3, one still has to be aware that the magnitude, duration, timing and frequency of changes in hydrological conditions may also be of biological significance, and require consideration.

Habitat Requirements

Most aquatic species are found in a wide range of rivers and streams, from large to very small. If anything, their abundance is inversely proportional to stream size (Jowett 2002). Studies of native fish species, such as brook trout, have demonstrated that the fish are more abundant where the average stream characteristics are close to the preferred habitat for the fish species. Consequently, native fish densities are often higher in smaller streams than in larger streams or rivers because their preferred habitat is shallow water. It is the quality of the habitat that is provided by the flow that is important to stream organisms, not the magnitude of the flow *per se*. In many streams, flows less than the naturally occurring low flow, are able to provide good quality habitat and sustain stream ecosystems (Jowett 2002). However, depending on the species requirements and the morphology of the stream, the magnitude of this flow will vary. Water velocity is considered one of the most important characteristics of a stream, and without this characteristic, a stream has the potential to become a lake or a pond.

The flow at which conditions start to become limiting varies with stream morphology. Generally, minimum flow increases with stream size, because stream width increases with stream size. However, the relationship is not linear. Consequently, small streams require a higher proportion of the natural stream flow to maintain minimum habitat than do large streams (Jowett 2002).

4.3.2 Summary of Literature and Methods Used in Other Jurisdictions

4.3.2.1 Watershed Based Aquatic Habitat Methods

Our research did not reveal any jurisdictions that are using a watershed based approach for assessing the impact of water takings on the ecosystem.

4.3.2.2 Site Specific Aquatic Habitat Methods

In 1976, the American Fisheries Society held a landmark conference that discussed some of the techniques being used to quantify the habitat flow needs. Since then, the debate has continued and the discussion of flow assessment methods has been extensive without any real resolution (Castleberry *et al.* 1996; Van Winkle *et al.* 1997).

Instream flow methodologies can be divided into two categories depending on the objectives of the decision process: standard-setting or incremental (Table 6 in Appendix A). Standard setting methods are appropriate for low-intensity decisions, where inexpensive, straightforward, rule-of-thumb solutions are required. These methods set a limit below which water cannot be diverted (Stalnaker *et al.* 1995). Standard setting methods can be further divided into two categories:

1. historic flow methods; and
2. hydraulic methods.

Table 6. Historical Flow Methods

Table 6 is located in Appendix A

In contrast, incremental methods are appropriate for high complexity projects, which have many decision variables. They are typically more expensive, more scientifically accepted and are designed for bargaining (Stalnaker *et al.* 1995). They are more commonly referred to as "Habitat Methods".

All three categories (historic, hydraulic and habitat) aim to maintain the stream environment, but they focus on different aspects of the stream, such as flows, wetted perimeter, or physical habitat. Differences between methods do not mean that one is right and the other wrong. Some methods are more suited to some conditions than others. For example, the level of controversy or significance of the fishery may dictate which method to use.

Generally, these methods are being used in other countries in one form or another. For example, the approach to minimum flow assessment currently favoured in Australia and South Africa is to maintain a natural flow regime, low flows, seasonal variation, and flood frequency in order to protect aquatic species. However, in Tasmania they use instream habitat methods. The New Zealand system is managed regionally with each region applying different rules. Water use is governed by the Resource Management Act, which deals with the effects of water diversion or extraction. The criterion favours a flow assessment method that has some biological justification, such as the **River Hydraulics and Habitat Simulation** (RHYHABSIM: Jowett 1999).

In Britain, the "**Minimum Acceptable Flow**" (MAF) concept is used, which has no precise legal definition. The law lays down what factors need to be considered in setting the flow, and what the statement should contain, but it leaves the application of these factors very flexible in order that the Agency can respond to the particular circumstances of the river in question (Petts *et al.* 1999). In the United States, where they have a good understanding of their stream systems, the most commonly used method of assessing flow requirements is the **Instream Flow Incremental Methodology** (IFIM) (Stalnaker *et al.* 1995). This method is considered the most defensible method at present and is particularly useful in "trade-off" situations.

In Canada, the majority of instream flow discussions have been based in British Columbia, where hydroelectric power generation and fisheries are important economic and social resources to the province. In 1993, the provincial government directed B.C. Hydro to undertake an overview assessment of the environmental impacts of operating hydroelectric facilities owned by B.C. Hydro. A review by B.C. Hydro concluded that there are significant gaps in scientific understanding; consequently basic data to undertake such a review does not currently exist (Higgins 2001). Since that review, B.C. Hydro has developed 23 Water Use Plans (WUP) (see http://www.elp.gov.bc.ca/wat/wup/wup.html), which currently use an "**Adaptive Management Approach**" (Higgins pers. comm. 2002).

4.3.2.2.1 Historical Flow Methods

Of the many techniques available for standard setting related to fisheries, the easiest to use requires data on the hydrologic records of a stream. The use of stream gage records assumes that measured flows support aquatic resources at acceptable levels (Wesche and Rechard 1980 in Stalnaker *et al.* 1995). This assumption only applies where streams are essentially undeveloped or where the pattern of development has been stable for a long period (Stalnaker *et al.* 1995).

In situations where it is possible to use historical records, several questions arise, for example: Is it best to recommend a flow based on natural or altered conditions? What percentage of the historical stream flow should be recommended? Table 6, in Appendix A, lists many of the historical flow methods available to the water resource manager, but the Tennant method (1976), also known as the "Montana" method is perhaps the most widely known of these methods. The Tennant method is recommended by the Ontario Ministry of the Environment (MOE), when applying for a Permit-To-Take-Water (PTTW) (MOE 1999). It is also the second most popular method (behind PHABSIM, see section 4.3.2.2.3) in the United States and is recognized by 16 states (Reiser *et al.* 1989).

The Tennant method assumes that some percentage of the mean flow is needed to maintain a healthy stream environment. Tennant used 10 years of personal observations in Montana and the mid-west to categorize streams into varying quality trout habitat based on recorded flow. He also recommended that periodic high flows be provided to remove silt, sediment, and other bed material. The percentages proposed by Tennant are based on the mean annual discharge of a stream in its pristine state and therefore, some states recognize that they cannot apply Tennant's recommendations to their own streams without adjustments. In these cases, changes are made for the species of interest and the types of streams in a particular state (Stalnaker 1995). Users of the Tennant method also recognize that it is based on substantial amount of field data. Thus it has become widely recognized and accepted in places where the relationship between fish production and stream discharge is reasonably well known (Newcombe and Ptolemy 1985). In Ontario this relationship has not been established, and there are no empirical correlation's suitable to calibrate the Tennant Method for use here. However, conceptually the Tennant Method is sound and when it is properly calibrated it would be very useful.

4.3.2.2.2 Hydraulic Methods

Hydraulic methods relate parameters of the hydraulic geometry of stream channels to discharge (Table 6). Hydraulic geometry is based on surveyed cross-sections, from which parameters such as width, depth, velocity and wetted perimeter are determined. Because of the field and analytical work involved in this, they are more difficult to apply than historic flow methods.

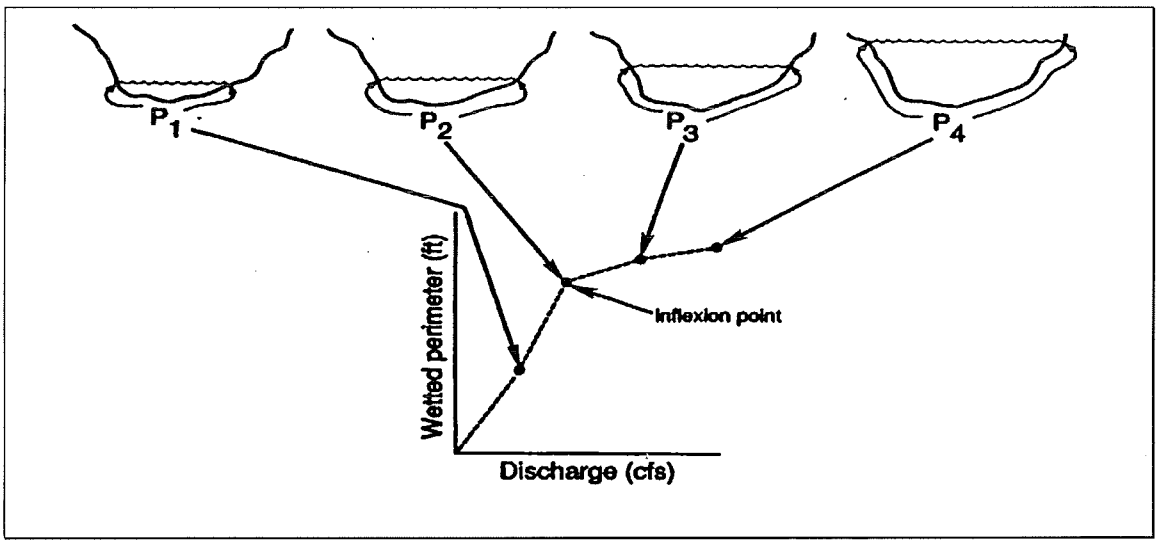
Wetted Perimeter Method

The most common Hydraulic Method is the "Wetted Perimeter Method" (Nelson 1980). This method is the third most popular method in the United States (behind PHABSIM, Section 4.3.2.2.3 and the Tennant Method), being used or recognized in 6 states (Reiser *et al.* 1989). It is also one of the recommended methods when applying for a Permit-To-Take-Water (PTTW) in Ontario (Ontario Ministry of the Environment, 1999).

The Wetted Perimeter Method uses a hydraulic approach, where a desired low-flow value is chosen from a habitat index that incorporates stream channel characteristics. The technique selects the narrowest wetted bottom of the stream cross-section that is estimated to protect the minimum habitat needs.

During field data collection, a biologist selects an area assumed as critical for the stream's functioning based on habitat usage (typically a riffle) and as an index of habitat for the rest of the stream. When a riffle is used in the analysis, the assumption is that minimum flow satisfies the needs for food production, fish passage, and spawning. The procedure is to choose the break or "point of maximum curvature" in the stream's wetted perimeter versus discharge relation as a surrogate for minimally acceptable habitat (Hamilton 1985).

Figure 7. Use of the Wetted Perimeter Method to Estimate Instream Flows (Stalnaker 1995)



The point of maximum curvature represents the flow above, which the rate of wetted perimeter gain begins to slow. Once this level of flow is estimated, other habitat areas such as, pools and runs, are also assumed to be satisfactorily protected and the following conditions tend to prevail:

a) all substrates are covered with water, thus providing maximum area for food production;

b) there will be running water at the shore where undercut banks, exposed roots, etc., will provide cover and rearing habitat;

c) the water width will be sufficient to catch all or most of the terrestrial insect fallout and leaf detritus;

d) streamside grasses and shrubs at or in the water margins will provide cover and habitat; and

e) the effect of solar radiation on water temperature will be reduced because of shade from banks and overhead canopy.

The Wetted Perimeter Method requires transects (cross-sections) to be established at critical areas in the stream and flow measurements taken at different times, in order to produce a wetted perimeter versus discharge curve. It is a method that can be used in areas where previously no information has been collected and is useful at the site specific level of assessment. It represents a good interim method until a more robust method that includes aquatic habitat considerations is developed.

4.3.2.2.3 Aquatic Habitat Methods

The methods previously discussed result in a single stream flow value, which has given rise to the term 'minimum flow'. Such standard-setting recommendations are hard to use in negotiation because too little information is available to allow an informed compromise (Stalnaker *et al.* 1995). Answering the hard questions, which are asked during negotiation requires moving away from tools leading only to minimum flows and towards incremental methods. Techniques need to show the relationship between the amount of habitat and stream flow (Table 6).

Habitat methods determine flows that create conditions which are considered to maintain "good" aquatic communities. They are an extension of hydraulic methods, but they are based on hydraulic conditions that meet specific biological requirements rather that the hydraulic parameters themselves. Because habitat methods are based on quantitative biological principles, habitat methods are considered in the U.S. to be more reliable and defensible than assessments made by other methods (Annera and Conder 1984). Habitat methods were first used for the assessment of flow suitability for spawning salmon, but have been applied to most instream uses, biological and recreational, since then (Stalnaker *et al.* 1995).

Physical Habitat Simulation Component - Instream Flow Incremental Methodology

The most widely known method is the **physical habitat simulation component** (PHABSIM: Milhous *et al.* 1984) of the instream flow incremental methodology. It is the most common method in the United States, being used or recognized in 38 states and the preferred method in 28 of them (Reiser *et al.* 1989).

In a PHABSIM study, recommended flow regimes are based on calculating the surface area of usable habitat for target species. Weighted usable area (WUA) is an index computed by multiplying the surface area of a portion of a stream by a weighting factor that describes the suitability of the stream for the organism of interest (Cavendish and Duncan 1986). The target species can be selected on the basis of their economic importance, their status as endangered species, or by their association with important management species (Cavendish and Duncan 1986).

One of criticisms of this method is the calculation of the WUA, which relies on suitability curves. The curves are the biological basis of habitat methods and because they are not site specific, they may be misleading and cause unreasonable results (Higgins pers comm. 2002). In addition, the fundamental assumption of a positive linear relationship between "potential available habitat" (WUA) and biomass of fish has neither been documented nor validated, particularly in warmwater streams (Mathur *et al.* 1985). Validation of the PHABSIM models has been one of the biggest problems encountered by B.C. Hydro and ALCAN Canada, while they were developing methods for determining instream flow studies (Higgins pers. comm. and Rubley pers. comm. 2002). Other researchers, such as Railsback (1999) suggest that the model only requires simple modifications, which would reduce major uncertainties, improve accuracy and cost-effectiveness. However, he continues to say that "these improvements address only physical habitat simulation; in too many studies one of the biggest sources of uncertainty is the assumption that PHABSIM by itself can predict how changes in flow affect fish populations".

However, habitat methods are particularly suitable for "trade-off" situations, where incremental changes in habitat can be compared with the benefits of resource use. Habitat/flow relationships can be used to evaluate alternative flow management strategies and are part of the information base used in the process of choosing appropriate flow rules for river management (Cavendish and Duncan 1986).

4.3.3 Gaps in Aquatic Habitat Methods

Virtually all models and methods for setting instream flow requirements in common use today have been criticized for their overly simplistic and reductionist treatment of complex ecosystem processes and interactions (Richter *et al.* 1997).

In Ontario, many of the methods being used today in other jurisdictions have not been tested or validated in this province, which can result in unnecessary loss in the productive capacity of fish habitat. This potential loss of productive capacity is where the major gap in our current knowledge exists. Frustration among biologists exists because fish population responses to flow alterations cannot be predicted. This frustration will continue until intensive, long-term research efforts can advance the state of the art with methods to reliably assess instream flow needs based on biological responses.

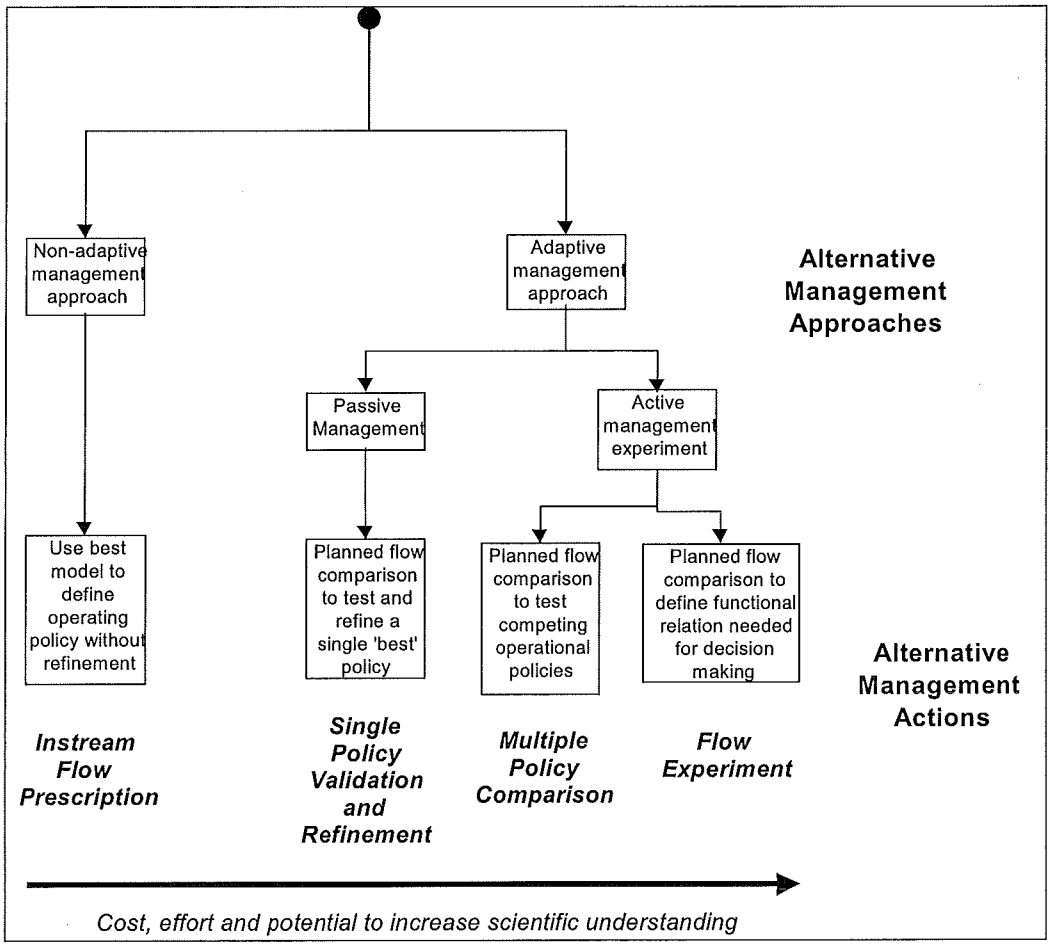
4.3.4 Opportunities for Aquatic Habitat Methods

As documented throughout this report, there are numerous models to choose from when attempting to establish an instream flow for a water extraction project. The problem is that models can produce different results, which may or may not be biologically defensible.

Currently the most biologically defensible methods are the habitat methods, which are expensive and time-consuming, and still have questionable validity. However, these methods are not always required and in many circumstances standard-setting methods can be used. Knowing the scope of the project is necessary prior to determining which instream flow method to use.

However, in order to determine which method works best, they must all be tested and validated within Ontario and if necessary modified for a specific purpose. This testing and validation should be undertaken in both scientific and operational studies. Adaptive Environmental Management (AEM) approaches have been advocated in British Columbia (Higgins 2001) to measure physical and biological responses to flow modifications and modify the operations to take into account the uncertainty inherent in the evaluation methods used (Figure 8). It is clear that demands for permits will continue over the period of testing and validation of methods to the variety of water taking situations and environmental settings that are found in Ontario. Recognizing uncertainty as a dynamic variable in the management environment is the first step to ensuring that action can be incorporated to allow for variation from predicted. Evaluation methods should be accompanied by an analytical framework to account for the uncertainty on decision making and to reduce scientific uncertainty over time. Currently, the MOE use a cautionary/conservative approach which will not cause irreversible damage. The development of methods should take advantage of this to verify them in an operational manner. Many agencies are currently concerned about making the wrong decision and seek increasingly more information in support of their decision. Therefore an approach that uses validation through operational testing will alleviate this, and assist those agencies in making the decision in a timely fashion . A mechanism for reporting and sharing this information as it becomes available is essential to ensuring that the results from individual projects can be analyzed to determine the most appropriate methods to be applied in various situations.

Figure 8. **Translation of Non-Adaptive and Adaptive Management Approaches for Instream Flow Assessment and Making Management Decisions into Four General Types of Possible Management Actions (from Higgins 2001)**



4.4 Terrestrial Habitat

The importance of evaluating impact of water takings on the environment were first triggered by such anthropocentric effects as wells running dry and losses of prized trout streams. An increasing understanding of the linkages among ecosystem functions and recognition under the Planning Act of the importance of maintaining wetlands and other terrestrial habitats, has led to direction in the water taking legislation to protect natural ecosystem function. Given that wetlands depend on changes in water levels to maintain them, the objective with respect to wetlands is to avoid changing this variable ecosystem regime.

The objective of this investigation was to review existing practice in Ontario and beyond, as to current methods used to evaluate impacts to wetlands by water takings. Relatively small changes in water volume and patterns can create substantial changes in wetland structure and function. Evaluating whether these changes are acceptable or not is much more difficult.

Potential effects of water taking on terrestrial ecosystems include:

a) water table suppression which leads to a net drying of vegetation communities and shift from flooding tolerant to flooding intolerant species and associated wildlife;
b) decrease in area of permanently flooded wetlands;
c) decease in area of seasonally flooded wetlands;
d) decrease in length of flooding of seasonally flooded wetlands;
e) change in dominant influence of groundwater to surface water;
f) shift from discharge to recharge function, in part or in whole;
g) effect on ephemeral pools as a result in changes to flooding and/or water table levels (the Americans have had a big emphasis on the losses in this type of habitat and have addressed this issue extensively, though not in relation to water taking);
h) effect on fisheries: spawning habitat, nursery habitat, foraging;
i) effect on small mammals; and
j) effect on crustaceans (burrowing crayfish in particular).

This list is far from complete, but serves to illustrate the complexity of the problem faced by the evaluators.

4.4.1 Summary of Terrestrial Habitat Literature

A total of 44 papers and/or abstracts were reviewed. Of those, not one reported on a *methodology* that could be used to evaluate the linkage between wetlands and water takings. Papers included case studies documenting landscape scale examples of wetland degradation due to groundwater mining, a method to measure changes in water table and parching, and a model for looking at abstraction impacts to seeps. Other texts discuss policies with respect to preservation of wetlands, but no methods to evaluate impact.

It appears that few jurisdictions require an assessment of impact to wetlands and terrestrial habitats as the result of water taking, and therefore there are few existing practices. No useful information was available from Alberta or the European Union on existing practices. In Scotland and Northern Ireland, permits are currently not required for groundwater abstraction.

Half of the papers offered concepts that may be useful in the development and refinement of a best practices methodology in the future. These included:

a) useful background information from Europe;
b) case studies of urban impacts on groundwater in fens;
c) heat and water balance disruption by invasive plants in peatlands;
d) regional and local hydrogeology of calcareous fens;
e) evaluating the effects of wetland regulation through hydrogeomorphic classification and landscape profiles;
f) plant community development and peat stratigraphy in forested fens in response to groundwater flow systems; and
g) characterization of wetland hydrology using hydrogeomorphic classification.

4.4.2 What Was Found

The assessment of impact to ecosystem function in wetlands as a result of water taking requires that the sciences surrounding surface water and groundwater must both be invoked. Ideally, hydrology and hydrogeology should be approached as part of the same science, however finding a satisfactory model that resolves the very different rates of flow above and below ground has escaped the practitioners. As wetlands typically relate strongly to the interface between these two parts of the hydrological system, a lack of integration between the disciplines makes assessment laborious and expensive. In addition, the science of wetland ecology is rapidly evolving, and until recent decades, management objectives in Ontario were geared more towards the draining of wetland features than preserving them.

There appear to be no standard practices regarding the assessment of impacts to wetlands created by water abstraction. One approach is the examination of direct local impacts to resources (e.g., pump tests), which is only useful in groundwater systems. The other is the modelling of water resources by watershed, to determine if the resource use is sustainable. The latter integrates hydrogeology and hydrology, however understanding of the hydrogeological setting of any particular watershed varies from poor to good. Often modelling is undertaken only in response to ecological or economic disaster and/or extreme development pressure. No examples of the cumulative effect of water taking on wetlands were found.

In our review, examples of studies that have linked water taking with wetland loss were in areas of low precipitation (e.g., 400 to 700 mm/yr.) (Munoz-Reinoso 2001). However, there are examples in Ontario where cumulative abstraction has reduced the water table (e.g., Richmond Hill, Orangeville). There is further qualitative evidence in the form of dehydrating wetlands, and wetland trees with expanded boles (hypertrophy) indicative of much more extensive flooding, that surface water management has generally reduced water tables in many areas of Ontario, leaving former wetland areas high and dry.

Almost no literature related loss of wetland function specifically to wildlife habitat. Snodgrass (1996, 2000) draws a general relationship between wetland drawdown and the effect on fish assemblages, but it is a qualitative approach, not quantitative, therefore not of use in evaluating permits.

The impact to wetlands of water taking depends fundamentally on whether the wetland is dominantly fed by a groundwater source, or by surface water and precipitation. All are on a continuum whose supply relies in part on both sources. Impact will depend on whether the water taking is consumptive or non-consumptive. And finally, the impact to the hydroperiodicity (the length of time the wetland is flooded), the frequency of flooding (how many times is the wetland flooded during the year, and at what times of the year), and the depth of flooding.

For groundwater dominated systems, permits historically were issued until an effect was noted. The current direction requires that the permit only be issued if there is no interference with surface water features, and no effect on contaminant migration patterns (Table 7). This is significant with respect to wetlands, because a wetland that is normally a discharge site can become a recharge site if a water taking affects the aquifer on which the wetland depends. This shift would significantly change the function of the wetland, as well as the characteristic plants and animals. Methods to assess this impact have focused on calculation of water budgets, measurement of vertical gradients and the observations of the effects of pump tests. Consideration has to be given to seasonality of vertical gradients, and the type of wet or dry year underway at the time of the test.

Table 7. Comparison of Groundwater *vs.* Surface Water Objectives and Methods

	Groundwater Systems	Surface Water Systems
Historical Philosophy	♦ "First come, first served"	♦ Shared resource
Direction of Current PTTW	♦ Consideration of existing takings and surface water features[8], and more recently potential future use. ♦ No effect on contaminant migration patterns permitted	♦ No impact on aquatic resources[9] and riparian rights ♦ No single taking >10% of instantaneous stream flow in some jurisdictions
Methods to Assess Impact of Water Taking	♦ Pump tests to examine water table in wetland.	♦ Water balance. Maintain hydroperiodicity, frequency and depth of flooding.
Methods of Wetlands Classification/Evaluation		
Hydrogeomorphic Method (HGM) - U.S. Army Corps of Engineers	♦ Not developed based on hydrology specifically, but due to emphasis on position in the landscape, it predicts hydrology well. (Shaffer *et al.* 1999)	
Ecological Land Classification for Southern Ontario (ELC) (Lee *et al.* 1998)	♦ A classification system that incorporates soil texture and soil moisture regime in the definition of plant communities, and therefore groundwater and surface water roles can be deduced from the vegetation (i.e., cold groundwater tends to produce wetlands with organic soils - more than 40 cm organic because the cold inhibits decomposition.)	
Ontario Wetland Evaluation System (OWES) (OMNR 1994)	♦ A system aimed at ranking wetlands as provincially significant or locally significant. Ranking does not reflect sensitivity to water taking. Hydrology component, but not expressed in ultimate significance.	

8. *Surface water features are conceptually limited in the literature to "lakes, ponds and streams", but are interpreted here as including wetlands*
9. *Not clear that "aquatic resources" includes wetlands, but for this study it is assumed that it does.*

For surface water systems, our agricultural heritage has ensured that the resource was shared; that riparian rights would be ensured under common law. Current philosophy now directs that an impact to aquatic resources will not be acceptable; a broader concept that includes impacts to wetlands. Current practice, when it is used, includes calculation of water balance, and careful attention to hydroperiodicity, frequency and depth of flooding. The difficulty is in identifying the thresholds beyond which change in these three factors will trigger a change in wetland ecosystem function.

In other words, the current methods, if they are employed, are adaptations of classic hydrologic calculations and measurement of groundwater levels in wetlands. No biological methods were identified, although there have been Habitat Suitability Indices developed for specific species.

Three approaches to wetland classification or evaluation listed in Table 7. All three can be useful in helping to identify whether a wetland potentially affected by water taking is groundwater or surface water driven. However, none of these methods can be used as a measure of sensitivity of the wetland to water taking. Presently, it is common practice to evaluate impact to a wetland only if it is provincially significant (PSW). This is a reflection of the protection that PSWs receive under the Planning Act. However, if the intent is to protect ecosystem function, then all wetlands should be considered when evaluating the permits to take water.

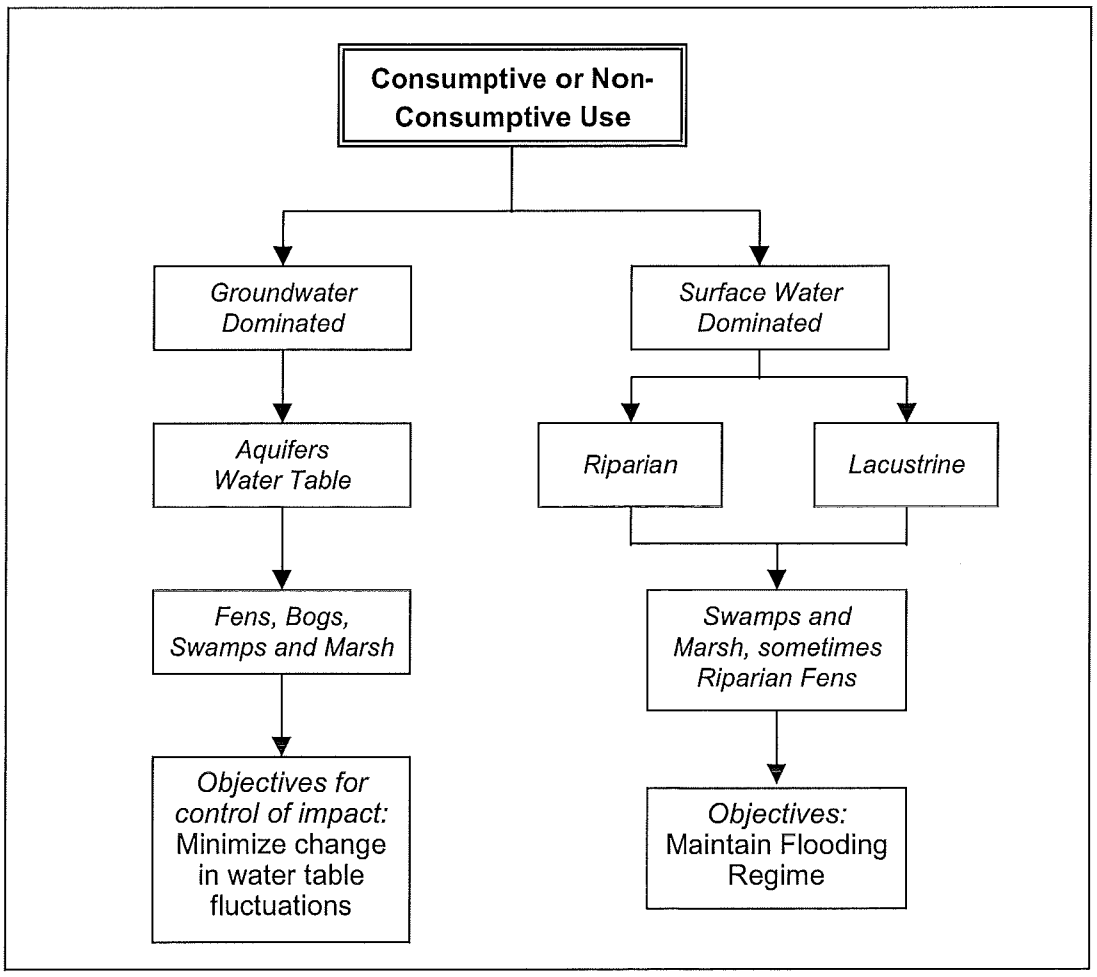
An approach to analyzing potential impacts to wetlands is sketched in Figure 9. Consumptive use has a greater potential to create an effect, because the water has been removed from the watershed and cannot be returned to the water cycle. Non-consumptive uses may return the water, however the pathway by which this is accomplished must be examined.

The concept of scale is very important. Sites tend to be evaluated at a very local scale (individual farms or golf courses), but the effects tend to be watershed and ultimately Great Lakes Basin wide due to their cumulative nature. The MOE have evaluated Permits in past on a local basis, but in recent years have been paying more attention to assessing cumulative impacts.

4.4.3 Terrestrial Habitat Gaps

The most immediate gaps relate to the lack of quantitative knowledge connecting change in water volume, periodicity or frequency with a biological response in the wetlands. The linkage between water taking and effects on fisheries (to which the Federal *Fisheries Act* may apply) or other wildlife reproduction/rearing/feeding functions in wetlands has not been quantified. The ambiguity in the new Policy with respect to what is meant by "protection", and "ecosystem function" compounds this problem.

Figure 9. Ecological Hierarchy of Water Taking Context



A methodology is not available that evaluates impacts to wetlands from water takings as a result of cumulative effects. On a watershed basis, hydrogeologic links among headwaters and wetlands is poorly understood.

It is very difficult to separate the effects to wetlands from land use changes, climate changes and water taking. Complicating factors that require investigation include direct *vs.* indirect effects on wetlands (cumulative effects), subsidence of the water table below the surface but which still controls wetland vegetation, hydrogeomorphic position of wetlands in the landscape (e.g., riparian conditions *vs.* an isolated position), limited understanding in changes in evapotranspiration rates among vegetation types and organic soils (peat) that artificially perch moisture and delay biological response to water table drawdown.

Thresholds are virtually unknown that will trigger changes in ecosystem function in wetlands. The most significant threshold will relate to the percentage of the growing season during which anaerobic *vs.* aerobic conditions prevail. The literature provides little information regarding the point at which any impact begins, and when that impact passes a benchmark determined to be "significant".

Other topics that may aid in evaluating effects on wetlands:

a) plants that are indicators of groundwater or surface water control of the wetland (Ontario Wetland Evaluation System has a list of the former) (thresholds are important here as our work has indicated that plants have different thresholds for groundwater input as the wetland flips from groundwater to surface water control seasonally);

b) plants as indicators of disturbance in wetland; and

c) insects as indicators of groundwater upwelling (Red damsel for instance).

4.4.4 Terrestrial Habitat Opportunities

Wetland response to relatively small changes in water tables as a result of water taking is poorly understood, and there is a great need for monitoring that integrates the skills of the hydrogeologist, hydrologist and wetland biologist. Recent work has demonstrated that wetlands may shift from predominantly groundwater fed to surface water control at some point in the growing season. The timing of this shift can determine critical wetland functions, yet it has not yet been studied in any detail. Therefore, there is an opportunity to contribute to this understanding through monitoring of individual wetlands before water taking begins, and its response following implementation.

In the long term, monitoring should be required to evaluate the results of the water taking on the local wetlands. Knowledge of the appropriate thresholds for wetland function is poorly documented and requires confirmation with empirical data. However, the cumulative effect on wetlands throughout the watershed, which includes isolated as well as connected wetlands, is unlikely to be evaluated unless a watershed approached is undertaken, which includes a good understanding of the hydrogeologic functions, and their relationships to wetlands. This is the approach undertaken by Grand River Conservation Authority (Blair-Bechtell Subwatershed), and is most appropriately undertaken by Conservation Authorities, and/or local and regional governments.

4.5 Public Involvement

4.5.1 Introduction

4.5.1.1 Stakeholder Involvement in PTTW

Determining the appropriate degree of public involvement in government decision-making processes is a function of the prevailing government desires, the proponents and the expectations of the public stakeholders. The underlying rationale for public involvement extend from a minimum position that governments can benefit from public input (in particular, receiving any information they have that may not be readily available to government) to the notion that interested parties have a right to be involved[read as heard] in government decision making that may affect their "interests". The countervailing opinion is that these schemes allow interested parties access to these decision making processes often results in unnecessarily delays in decisions and increases the costs of the process. In our review, we searched for a reasonable spectrum of approaches to public involvement.

Our search was based on a mixed-scanning approach [through published reports, articles and Internet Web sites] to identifying jurisdictions with:

a) various types of public involvement schemes in their permitting processes;

b) innovations in their permitting processes, that may or may not include innovations in their public involvement features; and

c) leading-edge approaches to public involvement in environmental decision-making generally.

We discovered very quickly that scanning for environmental permits generally was more productive than the narrower focus on just "permits to take water" or "water abstractions", etc.

4.5.1.2 Definitions

Given the diverse disciplines drawn upon by public consultation practitioners, we have included this short glossary as part of the text to reduce some of the potential misinterpretations and confusion.

4.5.1.2.1 Stakeholder Involvement

In 1998, the Stakeholder Involvement Workgroup of the EPA's Common Sense Initiative Council ["Report of the Common Sense Initiative Council's (CSIC) Stakeholder Involvement Work Group", the Environmental Protection Agency, June 3, 1998 , pp.1-3] offered the following definitions of terms:

a) **Public Participation and Public Involvement**
These two terms are interchangeable. They are used as generic terms for all types of activities designed to include the public in decision-making process, prior to the decision being made. The level of inclusion can range from an exchange of information and opinions at one end of the scale, to agreement-seeking processes at the other.

b) **Stakeholder Involvement**
This term can be used interchangeably with "public participation" or "public Involvement," since the term "stakeholder" is usually defined as "any individuals or groups who see themselves as potentially impacted by a decision." The term "stakeholder involvement" is a generic term, like "public participation" and "public involvement," in that it can describe activities ranging from an exchange of information to agreement-seeking processes.

Given the interchangeable nature of these terms, we have adopted the expression "stakeholder involvement" to cover any and all types and degrees of involvement of individuals or organizations with an interest in a particular undertaking.

4.5.1.2.2 Consultation

The Ministry's "Guideline on Consultation in the Environmental Assessment Process (Ministry of the Environment, December 15, , 2000) defined "consultation" as:

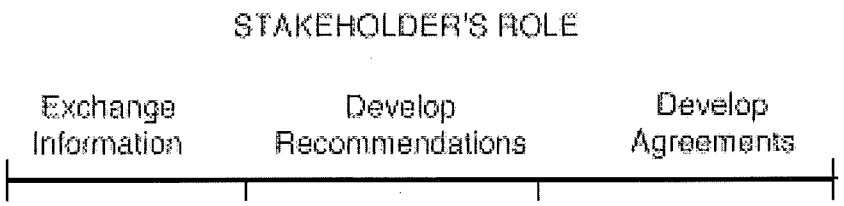
> *"the activities carried out by a proponent to provide a two-way communication process to involve interested stakeholders in the planning, implementation and monitoring of an undertaking.... In 1997, amendments to the EAA formally recognized the benefits of early consultation by legally requiring proponents to consult with the public, reinforcing the importance of consultation in responsible environmental decision-making. Public consultation protects the public interest and ensures that issues are identified early and resolved where possible." [p. 6]*

4.5.1.2.3 Stakeholder Roles

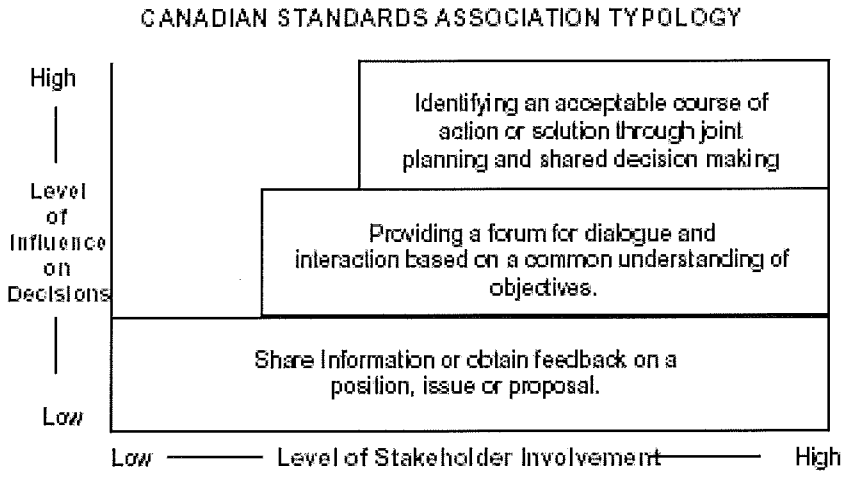
The CSIC's Stakeholder Work Group also examined the ways of categorizing different types of participation...and [found that] there is general agreement among the experts that there are three levels of involvement.

1. "**Information Exchanges [Exchange Information]** - At least one party provides information or advice to the other, and often times there will be an exchange of views and concerns. The participants are not expected to reach any agreement. Public meetings and public hearings are the most notable examples of information exchange processes, and can be one time or ongoing events.
2. **Recommendations [Develop Recommendations]** - The participants reach a general agreement on recommendations to the agency, but no one is "bound" by the decision and the agency is not expected to implement all aspects of the advice. The agency will give the advice serious consideration and then flesh it out before making a decision. The outside parties are not bound to refrain from criticism or legal actions. Examples of processes that fit in this category are advisory committees and policy dialogues.
3. **Agreements [Develop Agreements]** - Affected parties or stakeholders, including the agency, negotiate to reach a specific agreement, and each is expected to abide by it and implement its terms. Examples are negotiated rulemaking, negotiated or consensus permits, and the settlement of enforcement or other legal action cases.. [The following] diagram is intended to suggest that rather than being discrete categories, the three terms represent points along a continuum, with the level of stakeholder influence upon the decision increasing towards the right end of the scale." [Op cit, pp. 4-5]

Figure 10. Stakeholder's Role



In a similar vein, the Canadian Standards Association [*A Guide to Public Involvement*, Canadian Standards Association, Etobicoke, Ontario, Canada, 1996.] developed the following typology to illustrate a similar range of stakeholder involvement.



The point is that the choices of the tools and techniques should be driven by the underlying purpose of stakeholder involvement and these are two similar and useful ways of categorizing the underlying purposes.

4.5.1.3 Six Criteria for Determining Best Practices

In our search for a set of criteria one could use in screening the various practices in Ontario and other jurisdictions, we began with the Ministry's Guideline on Consultation in the Environmental Assessment Process, [Op cit.] which identified five goals of public consultation:

1. "to make the public aware of a proposal;
2. to ensure that the public is provided with opportunities to participate in the decision-making process and to influence decisions that will affect them;
3. to identify the widest range of potential issues about a proposal as early as possible and, in some cases, get them resolved;
4. to ensure that government agencies and ministries are notified and consulted early in the process; and
5. to ensure a broad range of perspectives are considered in any decision."

Using these five goals and drawing on our training workshops on effective policy development processes, we developed the following six (6) criteria to guide our search and analysis of best practices:

1. **Informed Decision-Making ...** did the practice result in accurate and timely information being tabled?
2. **Accountability ...** did the practice result in decisions being made by the appropriate authorities and made available for public review?
3. **Procedural Fairness, Transparency and Openness ...** was the practice fair, open and transparent to the vast majority of the stakeholders?
4. **Efficiency and Economy ...** was the practice efficient and affordable from the proponent, stakeholder and government's perspective?
5. **Proportionate ...** was the practice proportionate, in its requirements, to the severity of the situation / concerns / risks?
6. **Problem-Solving** ... was the practice designed and useful in inducing/incenting the proponent and the stakeholders to resolve their differences of opinion rather than depend on the default decision of the regulator.

These six criteria are not intended to be definitive. They are intended, however, to "set the bar" at a level that meets the Individual Environmental Assessment's standards and meet the stakeholder involvement expectations of the majority of stakeholders in Ontario.

4.5.2 Existing Practices

4.5.2.1 Justice O'Connor and the Management of Water

One of the challenges of this review and search for best practices in assessing water taking applications / proposals is that the management of water is in flux. One of the major effects of Justice O'Connor's investigations and the Part Two Report [Report of the Walkerton Inquiry: A Strategy for Safe Drinking Water, the Honourable Dennis R. O'Connor, May 2002] has been a wide-scale re-examination of all aspects of the water business. With the growing interest and support for watershed-based planning and management of water, all aspects of water management are receiving increased attention. Applications to take water are receiving increased attention in a holistic and systems approach to water. This double-edged sword of increased priority on water issues as well as increased public expectations has renewed the pressures from the public and stakeholder organizations to be involved in water-related decision making. Hence, we have assumed that future permits to take water (PTTW) must accommodate increased public scrutiny and increased demands for more stakeholder involvement.

4.5.2.2 The Gibbon's Report

The "Managing the Environment" Report [A Review of Best Practices, Volume 1, Executive Resource Group, January 2001, p.12] made a number of recommendations regarding the need to change the Province's paradigm regarding environmental decision-making and strategic approaches to managing the environment:

1. ***From*** one ministry having sole responsibility for environmental protection ***towards*** A high-level, government-wide vision and goals with implementation shared across different departments.
2. ***From*** a primary emphasis on ensuring compliance with minimum standards for large stationary facilities ***towards*** A new and broader emphasis on strategies to promote continuous improvement in environmental outcomes and accountability across all sources of pollution.
3. ***From*** traditional program delivery according to municipal or ministry/department area or region boundaries ***towards*** A place-based approach with boundaries that make environmental planning sense and facilitate a total cross-media, cumulative approach (such as watershed management).
4. ***From*** a primary reliance on traditional investigation, enforcement, and abatement tools ***towards*** A more comprehensive, flexible set of regulatory and non-regulatory compliance tools and incentives.
5. ***From*** a reliance on government to do it all ***towards*** An approach based on shared responsibility with the regulated community, NGOs, the public, and the scientific / technical community.

As the Ministry of the Environment continues its implementation of this report and recommendations, our interpretation of the implications for stakeholder involvement is that the ministry will be interested in practices that move further right across Figure 10 to increase the role of stakeholders.

4.5.2.3 Existing Practices Regarding Permits-To-Take-Water

In terms of stakeholder involvement , the Guidelines [Permit To Take Water Program Guidelines and Procedures Manual revised April 14, 1999, Ministry of the Environment] sets forth a process that one would classify (according to the previously cited taxonomy of Stakeholder Roles) as primarily an "exchange of Information". As Figure 11 illustrates, the permit application and review process can be desegregated into six stages or milestones:

1. Proponent Preparation of Application;
2. Submission of Application;
3. Agency Review of Application;
4. Posting Notice, Comment Period, etc.;
5. Agency Decision; and
6. Appeal to the Tribunal.

Figure 11. Schematic Diagram of the Public Involvement in PTTW

MOE public consultation features	
Degree and Type of Stakeholder Involvement	Stages/ Milestones
• Proponent determines stakeholder involvement at this stage unless directed by Ministry or other regulatory authority	**1. Proponent Preparation of Application**
	2. Submission of Application
• Ministry may require public consultation for specific reasons	**3. Agency review of Application**
• Posting on EBR for 30 days -comments reviewed	**4. Posting Notice, Comment Period**
• The permitting authority makes a final determination on the permit application	**5. Agency decision**
• Only if granted leave to appeal	**6. Appeal to the Tribunal**

At the 1st stage (1. Proponent Preparation of Application), the Guidelines and Procedures Manual leave the proponent to his or her own in determining their methodology and approaches to stakeholder involvement. The Ministry, however, may recommend that the proponent "consult", but again the manner, scope and outcomes are unspecified [as the reader will note from later examples, the U.S. examples have mandatory requirements for early/advance notification and comment provisions]:

- **Public Consultation Advised & May Be Required**
  "In areas where the proposed water taking is, or may potentially be, the focus of public concern, then it is recommended that the applicant consult with those persons who have an interest in the water resources in order to identify and address those concerns prior to applying for a Permit to Take Water (PTTW). Approval of a Permit application can be delayed if the Director receives comments from the public, the municipality or from other agencies either directly or through the Environmental Bill of Rights registry. Depending on the nature of the comments received, under Regulation 285 the Director may require the applicant to conduct consultations on any issues related to the water taking that require additional attention prior to the deciding whether to issue a Permit." [Source: *Guide for Applying for Approval of Permit To Take Water, Section 34, Ontario Water Resources Act, R.S.O. 1990 Interim Guide, Regional Operations, June 2000*].
- **Where Other Approvals are Required**
  May have to consult "...For proposed water taking by damming or diversion works, approval under the Lakes and Rivers Improvement Act is also required from the Ministry of Natural Resources... and a copy of the approval from the Ministry of Natural Resources.. For water takings from surface water bodies, approval may also be required from the Department of Fisheries and Oceans Canada, the local Conservation Authority and/or the Ministry of Natural Resources regarding fish spawning areas and habitat concerns ... copies of letters of approval, or letters confirming that the appropriate agencies have no concerns with the proposed water taking, be included with the application form." [Source: PTTW Application Guidelines].

Given the multiple jurisdictions in Ontario regarding water issues, the proponent is expected to "consult with" the regulatory reviewers and externally co-ordinate with them in preparation of the proposal/application. [This review also describes how some other jurisdictions have undertaken streamlining and one window approaches to improve the efficiency of their permitting processes for the benefit of both the proponent and the stakeholders.]

The 2nd Stage (2. Submission of Application) is driven by the proponent with the Ministry review aimed at ensuring completeness of all the required documentation. The third stage (3. Agency review of Application) entails the internal review of the application by the Ministry. The submission is also forwarded to other regulatory authorities who would have an interest and their comments are requested. Over the years each Region, has developed their own slightly different approaches and interpretations based on the knowledge and experience of the Regional staff involved in the program, Regional needs and work loads in other program areas. The assessment of the review methodologies is covered in the other sections of this report.

"Information developed or received by the Ministry related to Certificate and Permit applications shall be available to the public for comment, except when there are legal constraints, such as imposed under the Freedom of Information and Protection of Privacy Act. There will be selective public consultation on applications for Certificates of Approval and Permits. Criteria will be established to identify the special circumstances when a public consultation program is required. Public consultation shall, at a minimum, include notification and provide an opportunity for the public to submit written comments. Additional consultation activities may be performed as needed." [1994 Guidelines on Public Consultation (#281901)]

The Ministry is especially cautious with the following types of applications and usually directs the proponent to ensure stakeholder involvement, in particular, where there has been some evidence of stakeholder concerns:

a) consumptive uses (e.g., bottlers of water);
b) high quantity abstractions (e.g., tobacco farmers in a region);
c) proximity to headwaters (e.g., fish farms); and
d) where contaminants may be added (e.g., golf courses).

The 4th Stage (4. Posting Notice, Comment Period, etc.) is where the Ontario model for stakeholder involvements kick into gear. Unless the type of permit is excepted (and there are some stakeholders who are concerned about some of the exceptions, e.g., agriculture, short term but high volume extractions, in particular), all the permits must be posted on the Electronic Registry of the Environmental Bill of Rights (EBR)

> *"Permits to Take Water are Class I Prescribed Instruments under EBR. All applications for Permits To Take Water will be Class I instruments except:*
>
> *a) Applications for a short term (< 1 year) increase in volume of water takings for irrigation of agricultural crops...*

b) *Applications for water takings for a period of less than one year. These short term takings are normally for pumping an aquifer to conduct yield tests, dewatering for construction, for hydrostatic testing of pipelines.." [Source: PTTW Application Guidelines]*

The electronic registry and the requirement to "post" proposals that have potential impacts on the environment, was one of the leading edge applications of the Internet for the purposes of stakeholder involvement.

> *"The EBR provides the public with more opportunities to participate in environmental decision-making and will give the public enhanced access to the courts. The EBR establishes a procedure for notifying the public when environmentally significant decisions are proposed by prescribed government Ministries. The EBR does not duplicate existing public participation processes for environmentally significant decisions, but establishes the minimum level of public notice and consultation. The EBR will not duplicate public participation processes. For example, the Environmental Assessment Act (EA Act) already has a public participation process in place which meets or exceeds the requirements of the EBR." Proposals for Acts, Regulations, Instruments*

> *"Public notice will be provided on the Registry of proposed Acts, regulations, instruments which are of environmental significance. During the minimum 30-day notification period, the public may provide written comments on these proposals to the appropriate Ministry, which must consider and respond to these comments (other participation rights may also be provided by Ministries). When a decision is made regarding the proposal, it is placed on the Registry." [1994 Guidelines on Public Consultation (#281901)]*

Given some stakeholder concerns that sometimes the exceptions to the public participation requirements are cited to avoid posting, we have identified these exceptions below:

a) **Emergency...**
The delay in allowing for public participation would result in danger to the health and safety..

b) **Equivalent Public Participation...**
The environmentally significant aspects of the proposal have already been considered in a process of public participation..

c) **EAA or Tribunal Decision...**
The proposal is a step towards the implementation of an undertaking approved by a decision made by a tribunal under an Act affording an opportunity for public participation or a decision made under the Environmental Assessment Act..

d) Environmentally Insignificant...

The application is for an amendment or a revocation of an existing permit where there will be an insignificant effect on the environment.."

Although one could quibble with the adequacy of the 30-day period for comment, the EBR is still a leading edge electronic means of facilitating and supporting stakeholder involvement.

The 5th stage (5. Agency decision) occurs when the ministry publishes its decision (and conditions on any approval), its supporting rationale and responses to major comments and concerns received. All of which is open, transparent and publicly accountable.

a) Certificates of Approval and Permits

"Once the Ministry makes the final decision, all stakeholders shall be notified of the decision and how the public's input was considered." [1994 Guidelines on Public Consultation (#281901)]

The 6th and final stage (6. Appeal to the Tribunal) is a commonly accepted appeal to an independent body capable of being objective and guaranteeing the applicant and stakeholders an appropriate measure of "due process". Briefly, the appeal process contains the following:

b) Public Appeals

"Any resident can seek leave to appeal a decision to issue a Class I or II instrument within 15 days of its being placed on the Registry." [1994 Guidelines on Public Consultation (#281901)]

c) To Seek Leave to Appeal:

"(a) a person must demonstrate that he or she has an interest in the decision (for example, that the person had commented while it was posted on the Registry or that he or she lives close to the site, etc.); and,

(b) a person must demonstrate the decision is unreasonable, and that significant environmental damage would occur if the decision was not changed. If the leave to appeal is granted, the instrument is 'stayed' (suspended) until the hearing of the board, unless the board orders otherwise." [1994 Guidelines on Public Consultation (#281901)]

4.5.2.4 Ontario's Low Water Response Mechanism

One of the most recent additions to the Government's palette of water management tools has been the establishment of an "historical partnership between the province and local jurisdiction. Much of Ontario, organized on a municipality and conservation authority basis, has the institutions and will to effectively deal with low water conditions at the two scales." [Ontario Low Water Response report, Revised, June, 2002]

"This plan provides that:

a) In the organized areas of the province where Conservation Authorities exist, the local Conservation Authority will establish a water response team (WRT) if Level I conditions are confirmed. Other areas may want to establish these teams as a precautionary measure.

b) In organized areas with no Conservation Authorities, the district office of the Ministry of Natural Resources establishes a WRT if Level I conditions are confirmed.

c) In unorganized areas, the Ministry of Natural Resources maintains responsibility for water management issues, and deals directly with local communities, First Nations and dam owners/operators and other stakeholders.

d) The Ontario Water Directors' Committee (OWDC) shall set up a standing Low Water Committee to interact with any watershed in a confirmed Level II (or greater) condition. The OWDC has designated the position of the Water Resources Section Manager (MNR) to serve as the "Low Water Committee Co-ordinator". The principal members of the Low Water Committee will be the appropriate Field Directors and Water Directors (or their delegated representatives) of the Ministries of Environment, Agriculture and Food, Municipal Affairs and Housing and Natural Resources. The OWDC through the Low Water Committee will be responsible for co-ordinating provincial response efforts.." [pp. 10-11]

From a stakeholder involvement perspective, the plan recognizes the importance of involving key stakeholders in the condition verification process:

> *"The local Conservation Authority and/or MNR district office will confirm a watershed condition. Once the leading agency (CA or MNR) has confirmed that the watershed(s) has entered a Level I condition the leading agency will make appropriate contacts and host the first WRT meeting. Prior to the first water response team meeting, the leading agency should collect appropriate information that characterizes the watershed. The local WRT should lead discussions with its local groups well in advance of a drought. These discussions would help establish priorities and set up mitigating strategies.*
>
> *Level I - Voluntary Conservation*
>
> *The Level I condition will be managed through existing programs of the Conservation Authorities, municipalities and other key provincial agencies with leadership and direction provided by the WRT. The WRT, using a variety of communications tools, will emphasize the need for voluntary water conservation with a target reduction of water use of 10 per cent. District or regional level provincial ministry staff will be part of the WRT.*
>
> *Level II - Conservation and Restrictions on Non-Essential Use*
>
> *The watershed's WRT will confirm that a watershed has entered a Level II condition. In this condition the WRT will continue in a leadership role, communicating a strong conservation message and implementing restrictions through the municipalities on non-essential use. At this time, the OWDC Low Water Committee Co-ordinator will advise the OWDC Co-chairs and under their guidance, will activate the Low Water Committee to enhance and reinforce cross-ministry program support. The OWDC Low Water Committee Co-ordinator will also notify the Provincial Emergency Response Co-ordinator (MNR) and request commencement of regular briefings with Emergency Measures Ontario regarding any Level II condition.*
>
> *Level III - Conservation, Restriction, Regulation*
>
> *The OWDC Low Water Committee is responsible for making declarations of a Level III condition based on the recommendations of the local WRT and advice of the provincial field representatives. A Level III declaration represents the most severe level condition and corresponding response designed to mitigate the impending impacts of an escalated drought condition. These may include water use restrictions affecting a range of small and large water users. Consequently, prior to any declaration decision the OWDC Low Water Committee is obligated to ensure that:*

1. *The WRT has clearly implemented and documented the conservation and reduction efforts taken through the Level I and II strategies and can demonstrate that the majority of the water users have participated in these efforts (including by-law restrictions by municipalities on non essential uses).*
2. *Any significant social, environmental and economic impacts arising from current low water conditions have been documented and adequately described.*
3. *Recommendations have been provided on priorities for water use restrictions and other reduction activities within the watershed.*

The local WRT and the OWDC Low Water Committee will jointly discuss the range and type of implementation measures to be taken. The OWDC Low Water Committee Co-ordinator will be the liaison with the local WRT Chair(s) as necessary, and with the OWDC Co-chairs prior to the declaration of a Level III condition. [pp. 11-12]

Perhaps the most telling feature of the nature of the stakeholder involvement is the report's description the Water Response Team membership and roles:

"WRTs will include provincial, municipal and Conservation Authority staff as well as representatives for local interests and users. Team membership will vary, but representation from the following sectors should be considered:

- *Agriculture*
- *rural private industry*
- *business*
- *recreation*
- *resource management interests*
- *First Nations*
- *municipal government*
- *provincial government*

The participation of other local groups and users is also necessary for success of the WRT. Examples include First Nation communities, dominant local industries (e.g., pulp and paper, aggregates, hydroelectric power generators), recreation users (Trent Severn Waterway, downhill ski facilities) or special interest bodies (such as Ontario Federation of Anglers and Hunters, Ducks Unlimited).

There is no distinction in decision-making power or responsibility among members of the WRT with the exception of provincial representatives, (the focus of provincial representatives is on advice rather than participating in the decision making process). Each representative should have equal opportunity for input, sharing information and accountability. It is therefore imperative that the membership of the WRT accurately reflect the balance among the sectors within the watershed." [pp. 14-16]

4.5.2.5 Preliminary Conclusions About the Existing Practice

According to the criteria we established as screening tools for identifying candidate best practices, we offer the following assessment regarding the existing practice regarding:

a) **Informed Decision-Making...**
The Ministry makes every effort to have the proponent provide the necessary data and information needed to make an informed decision as well as plumbing its own internal databases and the knowledge of its own internal experts. However, the Ministry is seeking to improve the methodologies to assess water takings, witness this study of best practices. At the same time, the overall shift to more comprehensive, watershed-based planning and assessment of water quantity and quality underscores the need to add to the current body of science regarding water.

b) From a stakeholder involvement perspective, they continue to want science / evidence-based decision making and they want to be assured that the analysis supporting PTTW applications is sound, replicable and available for their review.

c) **Accountability...**
The current decision-making process is publicly accountable through the postings of both the application and the Ministry decisions on the EBR and the independent appeal process through the Tribunal.

d) **Procedural Fairness, Transparency and Openness...**
The EBR remains the primary platform for meeting this criteria and does this well with the following caveats:

- the 30 day period is viewed by some stakeholders as too short some of the time to conduct the reviews of the underlying science;
- is dependent on all interested parties having access to the Internet; and
- some of the "exceptions" may be problematic for some of the stakeholders some of the time.

e) **Efficiency and Economy...**
Although we have no estimates of the development and processing costs of typical applications, it is probably fair to say that the current costs are less than they will be as a result of the increased requirements for better science and increased stakeholder involvement as a result of growing stakeholder concerns over water taking proposals.

f) **Proportionate...**

Although some might argue against the amount of discretion the Ministry has to require varying types and degrees of consultation (in addition to the EBR requirements), the Regions do vary the intensity of stakeholder involvement according to the potential risks and degree of stakeholder concerns. They seek to make the requirements proportionate.

g) **Problem-Solving...**

The Ministry tries to walk that fine line between requiring the proponent to solve the stakeholder concerns and letting the proponent determine how they will go about meaningfully engaging the stakeholders in a problem-solving process. Unfortunately, this flexibility has often resulted in less than satisfactory efforts by the proponents and the stakeholder concerns have remain on the table, unsolved. Historically, the problem-solving aspects of stakeholder involvement in Ontario have received the least attention. But that changed with the 2000 Guideline on Consultation for EAs [which we argue are transferable in spirit to PTTW] which are much more suggestive while still allowing the proponent flexibility:

> *"... 4.2.7 Resolution of Issues and Conflicts 7 – Proponents are urged to make every effort to address, and resolve where possible, any issues, concerns and conflicts that occur during the EA process in order to avoid costly delays. Leaving issues unaddressed creates a perception that the proponent does not treat concerns seriously, and will ultimately, damage the credibility of the proponent, the EA process and the proposed undertaking. Some basic steps to consider in responding to/addressing issues raised include:*
>
> - *meeting one-on-one with those individuals or parties with specific concerns;*
> - *initiating smaller working sessions for interested parties to attend to provide an opportunity for everyone to hear all sides;*
> - *formatting meeting agendas to specifically address unresolved issues; and*
> - *establishing a citizen-led committee to provide a forum specifically for issue resolution. If the proposed undertaking might benefit from involving a third party to provide some balance of power and neutrality to discussions, conflict resolution techniques, such as those that follow, are available to the proponents at any point in the EA process.*

- *Not all matters can be resolved with certainty. If the project is approved, a proponent will usually be required to address remaining uncertainties through conditions of approval and/or commitments that may include terms such as monitoring, feedback, and contingency plans and reports, and a liaison committee that meets periodically during construction and implementation.."*

4.5.3 Survey of Other Jurisdictions

In terms of different approaches and features used in stakeholder involvement in applications for environmental permits, the Federal and State regulatory authorities in the U.S., provided the most useful fodder for this review. Research Paper #12 included offshore case studies of New South Wales, the European Union, England, the Netherlands and Sweden. In each of these jurisdictions, the stakeholder involvement features followed a similar pattern:

a) interested parties are notified of the application for a new or varied license, usually advertised in the local press;

b) a copy of the application is placed on a public register of some type and public comment is enabled, usually for a 30 day period;

c) if the application triggers an environmental assessment of some type, the consultation requirements add additional notice and comment provisions;

d) the regulatory agency is required to take public concerns into consideration; and

e) appeal of any regulatory decision was usually through application to some court.

This pattern of public involvement seems to reflect the "exchange of information" end of the taxonomy identified earlier and does little to address the underlying growth in public concerns about water related decisions.

- **European Environmental Framework Directive**
  From our perspective, the more valuable reference jurisdiction was Pollution Probe's description of the European Union's "European Environmental Framework Directive October 23, 2000" which set forth the requirement to specify the intended stakeholder involvement program and the stipulation of significantly increased notice and comment periods.

"..Member States will now be held accountable for publishing the following documents for each watershed district (article 14 EEFD, 2 October 2000):

1. *A time schedule and action plan regarding watershed management three years in advance of the beginning of a project (including a description of the intended measures for stakeholder consultation).*
2. *An interim overview of important water management issues in the watershed district at least two years prior to the beginning of the project.*
3. *Copies of the concept watershed management plan at least one year prior to the beginning of the project. For each of the publication requirements above, the public has a time frame of six months to raise concerns regarding the watershed management plans. Public concerns may be submitted in written format (Article 14 EEFD, October 2000). For The Netherlands, this new EU legislation means that time-periods during which public concerns may be raised will be much longer (The Netherlands allows for public involvement 4 weeks after a permit concept is published and again 6 weeks after the final permit is published)." [Wastewater Discharge Permitting and Public Involvement, Pollution Probe, supporting study to Managing the Environment Report, December 2000, pp. 40-41]*

- **Code of Practice on Written Consultation – UK**

  If not for its common sense approach to stakeholder involvement, then its plain language would qualify this effort by the Cabinet Office as an example of a good practice.

  "1. Consultation should be built into the planning process for a policy or service from the start, so that it has the best prospect of improving the proposals concerned, and so that sufficient time is left for it at each stage.
  2. *It should be clear who is being consulted, about what questions, in what time scale and for what purpose.*
  3. *A consultation document should be as simple and concise as possible. It should always summarize in no more than two pages the questions on which views are sought. It should make it as easy as possible for readers to respond, or make contact.*

4. *Documents should be made widely available, using electronic means as far as possible (though not to the exclusion of others), and effectively drawn to the attention of all interested groups.*

5. *Sufficient time should be allowed for considered responses from all groups with an interest. Twelve weeks is preferable, and eight weeks should be regarded as a general minimum.*

6. *Responses should be carefully and open-mindedly analyzed, and the results made widely available, with an account of the views expressed, and reasons for decisions finally taken.*

7. *Departments should monitor and evaluate consultations" [www.cabinet-office.gov.uk/ servicefirst/2000/consult/code/ConsultationCode.html].*

With regard to #5…, sufficient time, the code of practice went on to say:

- *"Inadequate time for responses is the single greatest cause of annoyance to people consulted by government. Proper planning in accordance with this code should avoid consultation periods being limited in order to meet later deadlines.*
- *Consultees' circumstances should be taken into account in fixing a period. Issues consulted on may themselves be complex, requiring a period of weeks to draft responses. Organizations may have many staff or members that need to be consulted, sometimes through a structure of committees with members from all over the country, which will rarely be able to meet simply to fall in with a consultation timetable.*
- *An eight week period may be particularly inadequate if a substantial holiday period falls within it.*
- *Where a question of real urgency arises, the consultation period may exceptionally have to be under eight weeks. The document should in that case state the reasons for the restriction, and what special measures have been taken to ensure that consultation is nevertheless as effective as possible.*
- *In order to ensure fairness, a provisional view should be taken before the consultation about dealing with requests for deadlines to be extended."*

4.5.3.1 The EPA is the American Baseline for Stakeholder Involvement

Because of their size, scope and history, the U.S. EPA is the major reference points in the search for best practices. The EPA in its role as prime regulatory authority, has established the template for the U.S. approach to stakeholder involvement in environmental decision-making, permitting in particular...

> *"Rather than issuing most permits itself, EPA generally has established programs to authorize state, tribal, and local permitting authorities to perform most permitting activities. Once EPA has delegated its authority for a permitting program to a state or tribe, they can then implement their own version of the permit program as long as it meets the minimum requirements stated in the governing statutes and regulations."*
>
> *"The Policy establishes the objectives of public participation in EPA programs, outlines essential elements that must be incorporated in any public participation effort, discusses a number of public participation mechanisms with ground rules for their effective use, and assigns responsibility for planning, managing, funding, and carrying out public participation activities to EPA managers." [Reference Guide for Public Involvement in Environmental Permits, EPA Handbook, August 2000, p. 2-1]*

The EPA permitting programs occur under the Clean Air Act (CAA), such as the New Source Review (NSR) and Title V, for air emissions, the National Pollutant Discharge Elimination System (NPDES) for discharges of pollutants into surface water, and the Resource Conservation and Recovery Act (RCRA) for waste management.

4.5.3.2 The EPA Permitting Process has Four Milestones

[Reference Guide for Public Involvement in Environmental Permits, op. cit., pp. 2-1 to 3-28

Although each Act has its own specific flowchart for the steps and stages, generally the EPA Guidelines are structured around four milestones plus one or two appeal levels depending on the State, Tribal or regulatory authority. The following descriptions are extracts for these Guidelines:

"**Milestone #1:** The permitting authority receives and reviews the permit application (pre-application activities are included in this milestone):

1. **Public Notice** – Public notices are required at various points in the public involvement process for certain activities, conducted by the regulating agency and by facilities being regulated. Most notices contain essentially the same information:

- name and address of the facility and the facility owner/operator;
- a brief description of the processes conducted at the facility;
- name, address, and toll free telephone number of an individual at the permitting authority;
- an overview of the public involvement process, including the comment procedures, and the date, time, and place of any hearing;
- the opening and closing dates for comment periods;
- description and contact information for all sources of state or EPA technical or legal assistance available to the public;
- the location of the administrative record and the times when it is open for public inspection;
- any supporting information that will be considered when making a permit decision; and
- relevant web site addresses for the facility, regulating authority and EPA.

2. **Mailing Lists** – In general, requirements for mailing lists under different permitting programs are very similar. Variation occurs in whether the list must contain only those who express an interest in being on the mailing list, or include all parties who may be affected by an agency activity. Mailing lists are therefore an important means of communication, and are the principle method by which many of the parties involved in public participation activities obtain their information. Mailing lists are used to reach both broad and targeted audiences. The better the mailing list, the better the public outreach and delivery of information.

3. **Fact Sheets/Statement of Basis** – Fact sheets and statements of basis are produced throughout the permitting process and inform the public about the regulatory process as well as technical issues surrounding a draft permit. They are helpful in establishing a general community understanding about a project.

Milestone #2: A draft permit or notice of intent to deny the permit is issued by the permitting authority.

Milestone #3: A public comment period of at least 30 days is *provided* to allow the public to comment on the draft permit:

1. **Public Comment Periods** – Public comment periods are required after the issuance of a draft permit application. They allow citizens to comment on agency and facility proposals and have their comments incorporated into the formal public record .. A public comment period is a designated time period in which citizens can formally review and comment on the agency's or facility's proposed course of action or decision. Public comment periods are typically 30 to 45 days long. Public comment periods cannot begin until notice of the permitting activity is given. If written comments are submitted during the public comment period, the permitting agency is required to discuss them in the response to comments.

2. **Contact Persons** – A contact person assures that a permitting agency is actively listening to citizens' concerns and provides the community with consistent information from a reliable source .. Agencies should designate a staff member who will be responsible for responding to questions and inquiries from the public and the media. A contact person should be able to respond to any questions or concerns interested persons may have about the permitting process. The same person should remain the contact throughout the permitting process .. The agency contact should also maintain a log book of all citizen requests and comments received during the process. This ensures that all requests are handled in a timely and efficient manner.

3. **Public Meetings** – A public meeting provides a forum where interested persons can ask questions and discuss issues outside of the formality of a public hearing. Public meetings are flexible tools that are open to everyone. Regulatory requirements for public meetings vary across different permitting programs .. Public meetings allow all interested parties to ask questions and raise issues in an informal setting. A public meeting can provide a useful means of two-way communication at any significant stage during the permitting process. The purpose of the meeting is to share information and discuss issues, not to make decisions. Due to their openness and flexibility, public meetings are preferable to hearings as a forum for discussing issues. Importantly, comments made during a public meeting do not become part of the official administrative record as they do during a hearing.

4. **Public Hearings** – Public hearings are required by regulations and provide a formal opportunity for the public to present comments and oral testimony on a proposed agency action. Public hearings generally should not serve as the only forum for citizen input, since they usually occur at the end of the permitting

process. During the public comment period, anyone may make a request for a public hearing. Public notice of the hearing must be given at least 30 days in advance. Public hearings are held:

- when requested by a member of the public during a public comment period;
- during the public comment period following the issuance of a draft permit, major permit modification, or at the selection of a proposed corrective measure; and
- when the level of community concern warrants a formal record of communication.

Milestone #4: The permitting authority *makes a final* determination on the permit *application.*

1. **Notice of Decision and Response to Comments** – Requirements for notices of decision during the public participation process are generally very similar. This type of public notice serves as a record of an agency's final decision regarding permit issuance, denial, or modification. Response to comment documents should identify and describe public involvement activities and summarize the public's significant comments. In addition, the document should provide specific responses to the comments, in terms of modifications to the permit, or explain why comments were not incorporated into the permit.

Appeal: Most permitting programs include procedures for administrative appeal by any person who files comments on the draft permit or participates in any public hearing.

Judicial Appeal: Once the administrative appeal process is exhausted, judicial appeals are generally available.

Figure 12. Schematic Diagram of the Public Involvement in EPA's Environmental Permits

EPA public consultation features	
Stages / Milestones	Degree and Type of public consultation
Milestone #1	
• **Proponent Preparation of Application**	• Proponent prepares case / application
1. Permitting authority receives and reviews permit application	• The permitting authority receives and reviews the permit application (pre-application activities are included in this milestone); 1. Public notice; 2. Mailing lists; 3. Fact sheets/statement of basis;
Milestone #2	
2. Draft permit or notice to deny the permit	• A draft permit or notice of intent to deny the permit is issued by the permitting authority;
Milestone #3	
3. Public comment period	• A public comment period of at least 30 days is provided to allow the public to comment on the draft permit; and 1. Public comment periods; 2. Contact persons; 3. Public meetings and 4. Public hearings as mandated
Milestone #4	
4. Agency decision	• The permitting authority makes a final determination on the permit application....5. Notice of Decision and response to comments
5. Administrative appeal where applicable	• Most permitting programs include procedures for administrative appeal by any person who files comments on the draft permit or participates in any public hearing.
6. Judicial appeal	• Once the administrative appeal process is exhausted, judicial appeals are generally available

In reviewing the EPA template against our criteria for determining best practices, the EPA stakeholder involvement features rated a respectable assessment: As part of this capsule assessment, we have included excerpts from EPA's 2001 Dialogue - ways to improve public involvement in the permitting process [Democracy On-Line .. An Evaluation of the National Dialogue on Public Involvement in EPA Decisions, Thomas C. Beierle, Resources for the Future, 1616 P Street, Northwest · Washington, D.C. 20036 ... Internet: www.rff.org] The National Dialogue on Public Involvement in EPA Decisions (the Dialogue) brought together 1,166 people in July 2001 for a two-week on-line discussion of public participation at the Environmental Protection Agency (EPA). EPA designed the Dialogue to complement the formal notice-and-comment process for its draft Public Involvement Policy (PIP) and to solicit ideas for implementing the PIP.

a) **Informed Decision-Making...**

The EPA template is more regulatory in its requirements for the data analysis and the dissemination of such information to interested parties than the MOEE, but that does not mean the EPA template will result in more Informed decision making. The EPA template does however, address the concerns of those stakeholders who worry about regulatory decision-making where the agency/ authority has the "discretion" to determine what data analysis and conclusions will be allowed.

b) **Accountability...**

The EPA delegated decision-making process is probably more publicly accountable because of its mandatory use of a wider range of public accountability devices (i.e., formal regulatory requirements on State , Tribal and local permitting authorities regarding notification requirements, mailing list requirements, information depositories, public hearing and notice of decisions).

c) **Procedural Fairness, Transparency and Openness...**

Where the EBR remains the primary platform for meeting this criteria in Ontario and the EPA has its notice and comment provisions, the EPA template includes the due process of a formal public hearing. However, the EPA stakeholders made extensive suggestions for improvements during Dialogue 2001:

- "Under Content, it was suggested that materials be prepared in clear, concise language to inform the public of triggering events which initiate a proposed action, and provide details on supporting research analysis and methodology."
- "Methods to Improve Communication Between EPA and the Public: Many commenters were dissatisfied with the Dialogue and Hearing section. They felt we placed too much emphasis on describing hearing requirements, and did not give enough attention to other methods of ensuring communication between EPA and the public. We responded to these concerns by amplifying the Dialogue section to include these suggestions and listing other methods of soliciting and using public input. These methods include review groups, workshops, conferences, personal correspondence and conversations, meetings, and citizen panels."
- "Those who commented on the Content of Notice section stressed the importance of early and clear discussion of the issues and alternatives the public is asked to comment upon. Under Conduct of Hearing, many commenters asked for more informality and opportunity for questions and answers in the hearing. People also commented that hearings are often located too far from the affected area. We have revised the Policy to incorporate these idea"
- "45-Day Notice Prior to Hearings: Although some commenters felt that a 45-day notice prior to the date of a hearing was a needless delay of time and would slow down the process, others felt that 45 days was much too short a time to expect individuals or groups to prepare adequately for a hearing, and some said that a 60 or 90-day notice would be more appropriate for proper preparation."

d) **Efficiency and Economy...**
Again, although we have no comments on the efficiency of the EPA template, the EPA and its sister agency OHSA have been the subject of chiding about the regulatory and paper burdens they often impose on delegated authorities, proponents and employers...

e) **Proportionate...**
The EPA Guidelines are by and large a minimum standards template for stakeholder involvement (approximately half of the Guidelines document is dedicated to the minimum standards and the balance is dedicated to optional or enriched features that may be employed depending upon the wishes of the convening authority. The mandatory requirements are a one-size-fits-all and not what one would call proportionate.

f) **Problem-Solving**...
The EPA template is, like Ontario, based on the "exchange of information" model, not a process designed to encourage/require problem solving. In fact, Dialogue 2001 reported the following comments by stakeholders regarding the use of Advisory Groups (a typical tool used in problem solving):

- "Use of Advisory Group Recommendations – A number of people experienced with advisory groups reported their frustration with instances when the group felt their recommendations were being suppressed by the agencies they advised. Since a major purpose of this Policy is to improve openness on the part of governmental entities, we have added a short section to the Policy which makes it clear that advisory group recommendations should be publicly available.

4.5.3.3 Illustrations of Best Practices

As a result of the converging trends in "re-inventing government", "citizen engagement" and "recasting environmental policy", we have classified our findings under the following headings drawn from Figure 10:

a) Exchange Information between Proponent, Interested Parties and the Regulator;
b) Develop Recommendations to Regulator; and
c) Develop Agreements between Proponent, Interested Parties and the Regulator.

Before getting into the examples from other jurisdictions, we found that the ministry's own Consultation Guideline for Individual Environmental Assessment should not be overlooked as a good practice of stakeholder involvement.

- **Individual Environmental Assessment – Ontario Ministry of the Environment and Energy**
  Although permits to take water are not subject to the requirements of the environmental assessment process, the public consultation requirements of the Individual Environmental Assessment should be considered as an example of a good practice in this category of "develop agreements". The MOEE Guidelines on Consultation [Op cit, pp. 5-14] require consultation opportunities / apertures at the following stages:

  - A ToR Submission, "..proponents are required to submit both a consultation summary that describes. the consultation undertaken during the development of the ToR and...
  - The Environmental Assessment Stage .. "When preparing the EA document, the proponent must consult with government reviewers and interested parties on issues such as..."
  - Consultation After Submission ... "A concurrent public and agency review of the documentation allows EAAB to identify and resolve issues early in the review and decision-making process.."
  - Consultation after the Publication of the Government Review ... "The Notice of Completion of Review provides a minimum five (5) week public review period. Anyone, including government agencies, can provide further comments in writing at this time..."
  - Consultation if an EA is Referred to a Hearing .. "The likelihood of the Minister referring a whole EA to the Environmental Review Tribunal is greatly diminished if the proponent and interested parties have participated in consultation. The Environmental Review Tribunal emphasizes the need for parties to reach agreement on as many issues as possible prior to a formal hearing."
  - Completion of EA Process – Project Implementation ... "The level of consultation and/or involvement of affected parties after the EA process is completed varies. Generally, the more contentious the project, the greater the involvement of affected parties during the implementation phase of the undertaking."

Given these multiple opportunities for "interested parties" to place their objections on the public record (thereby requiring the proponent to respond to an almost never-ending and cascading series of counter-arguments), there is a built-in incentive to design the consultation approach so that: as many as possible of the objections/concerns of the "interested parties" are dealt with and by mutual agreement, taken off the table.

4.5.3.3.1 Exchange Information

As noted earlier, this category refers to the following: "*At least one party provides information or advice to the other, and often times there will be an exchange of views and concerns. The participants are not expected to reach any agreement. Public meetings and public hearings are the most notable examples of information exchange processes, and can be one time or ongoing events.*"

Generally, this category represents the primary reason for and role of stakeholder involvement in government environmental permitting processes. It is founded on the symbiotic principles that:

a) regulators can benefit from hearing what stakeholders have to say about a given issue, especially if the stakeholders have "hard" data and information; and

b) the stakeholders have a right of due process to be informed of what the regulator is considering.

In our review of best practices, we found a cluster dealing with improving the ways and means of "notifying" stakeholders of pending decisions regarding various permits:

- **Neighbour Notification & Drinking Water Program: Indiana**

  This example deserves consideration because (a) it places the oneness for notification on the permit applicant (as opposed to on the regulatory agency) and because it applies to permits that would affect as few as 10 Potentially Impacted Parties (PIPs).

  Indiana Code, Title 13, Article 15, Chapter 8 requires permit applicants to notify adjoining and owners or occupants when applying for an environmental permit on land that is undeveloped, or on land for which a valid existing permit has not been issued .. The notice must 1) be in writing, 2) include the date on which the application for the permit was submitted to the department, and 3) include a brief description of the subject of the application."

In general, the Drinking Water Program utilizes the following approach for public notice requirements.

- [Applicant must] provide a list of Potentially Impacted Parties (PIPs) who may be affected...
- If there are ten (10) or more PIPs, a notice may be published in a local newspaper of general circulation. The notice must describe the proposed project and allow a thirty (30) day public comment period. Afterward, IDEM (Indiana Department of Environmental Management) will address concerns related to permitting the proposed project it received during the comment period.
- On the other hand, if there are fewer than ten (10) PIPs, those individuals may instead be notified by IDEM when it issues a decision regarding the permit. That Notice of Decision includes information on where to view the pending permit and how to appeal IDEM's decision. The PIPs then have eighteen (18) days to consider the pending permit and to file an appeal, if they so chose, with the Office of Environmental Adjudication. Notice will always be issued using one of these two means. [IDEM Permit Guide: Indiana Department of Environmental Management, 100 N Senate Ave., P.O. Box 6015, Indianapolis, IN]

- **Community Outreach Provisions from EPA's Dialogue 2001**

There is a growing interest in the U.S. in ensuring that the broadest possible spectrum of interested parties are notified and engaged by the stakeholder involvement features of the EPA and its delegated authorities.

"..participants [in Dialogue 2001] asked for amplification of the Outreach section. Commenters sent many valuable suggestions, many of which the final Policy incorporates .. including the following:

1. *public access to information is critical to successful public participation programs;*
2. *information must be translated from "technical" language into language understandable to the lay public;*
3. *outreach activities should be emphasized as ongoing activities so the public can be kept up to date on matters of concern; and*
4. *the uninterested but impacted publics' views need to be solicited in some manner."*

> *"Community outreach can involve a variety of actions including posting information on an agency web site to holding a public hearing. This includes understanding how the audience prefers to learn, making information easy to understand, and providing information in plain English or the predominant languages of the community. Certain groups are easier to communicate with than others. However, chances are that some groups most likely to be impacted by a decision will be hardest to reach." [Stakeholder Involvement & Public Participation at the U.S. EPA - Lessons Learned, Barriers, & Innovative Approaches, EPA-100-R-00-040, January 2001]*

The increased use of "outreach" is significant because in Ontario (a) the approach has been to rely on the EBR; and (b) where public meetings are to be used, the usual approach is to advertise in the local media and let the interested parties self-select.

- **Public "Primer" on Watershed-based Planning - Portland, Oregon**

This example illustrates how the Metro level of government for Portland commissioned a user-friendly "primer" for use in its public consultation processes on watershed-based planning.

"The purpose of this technical report is to provide a sound scientific foundation for public policy related to the management of fish and wildlife habitat in the region. Metro's Regional Urban Growth Goals and Objectives state that the region should "Manage watersheds to protect and ensure to the maximum extent practicable the integrity of streams, wetlands and floodplains, and their multiple biological, physical, and social values," as well as that "A region-wide system of linked significant wildlife habitats should be developed. This system should be preserved, restored where appropriate, and managed to maintain the region's biodiversity." Based on the direction outlined in this policy, Metro is taking a watershed approach in the characterization of the best available science relating to fish and wildlife habitat.

A key goal of this technical report is to provide accessible information to help elected officials, planners, and the general public understand the needs of fish and wildlife, the effects of urbanization on these species, and the biological processes that support them." [Metro's Technical Report for Goal 5, January 2002]

- **Degree of Consultation Based on Levels of Risk – Oregon … Dept. of Environmental Quality**

Oregon's "proportional" approach to consultation is driven by an a priori assessment of the degree of risk assigned to the permit application.

"In 2000, the DEQ adopted new guidelines for the public participation process in solid waste and water quality permitting. These guidelines will be adopted for use in air permitting in 2001. The new guidelines assign permit applications to one of four categories with each category requiring different levels of public involvement. Category assignments are based on the following:

- anticipated level of public concern;
- potential Environmental Concern; and
- legal requirements for the particular permit.

"Each category has its own public participation guidelines for the permitting process.

Category 1: Low environmental and public health significance

- no notice prior to developing draft permit;
- no notice sent of draft permit;
- no written comment period; and
- no hearing.

Category 2: Low to moderate environmental and public health significance

- no notice prior to developing draft permit;
- notice of draft permit sent;
- 30 day written comment period; and
- no hearing.

Category 3: Potential for moderate to high environmental and public health significance

- no notice prior to developing draft permit;
- notice of draft permit sent;
- 35 day written comment period;
- hearing at request of 10 people or automatically scheduled;
- 30 day notice of hearing; and
- written comments accepted for 5 days following hearing.

Category 4: Potential for high environmental and public health significance

- *notice sent prior to developing draft permit;*
- *30 day notice of informational meeting (question/answer session);*
- *notice of draft permit sent;*

- *40 day written comment period;*
- *automatic hearing with question/answer session immediately prior to hearing;*
- *30 day notice of hearing; and*
- *written comments accepted for 10 days following hearing." [Permits Handbook, pp. 5-6, Chapter 1. "DEQ Online" the official web site of the Oregon Department of Environmental Quality, Portland, Oregon]*

- **Green Permits Program – Oregon – Dept. of Environmental Quality (DEQ)**

This example was included as a good practice because of its requirements for the publication of annual performance reports and ongoing communication with interested stakeholders. Publication of report cards coupled with ongoing mechanisms for stakeholder involvement are proving to be effective tools for ensuring ongoing environmental improvements.

"DEQ's Green Permits Program is a voluntary program that encourages and rewards facilities that go the extra mile to reduce environmental impacts. Green Permit modifies how a facility needs to comply with environmental regulations if it meets certain qualifications. A deposit of $5000 is required with the Green Permit application to cover agency costs to develop and administer the permit. Actual costs will vary depending on the number of staff hours needed to issue the permit.

a) Requirements for a Green Environmental Management Systems (GEMS) permit include:

- *Environmental Management System (EMS): This approach ensures a reliable process to facilitate continual improvement of the facility's environmental program.*
- *Superior Environmental Performance: The EMS addresses a broad range of environmental impacts, including those not currently regulated, and promotes high performance.*
- *Public Reporting and Stakeholder Involvement : Publication of annual performance reports and ongoing communication with interested stakeholders ensures ongoing environmental improvements." [Permits Handbook, pp. 86-87, Chapter 10 .. "DEQ Online" the official web site of the Oregon Department of Environmental Quality]*

- **Surf Your Watershed – EPA Web Site**

As more and more jurisdictions use the Internet to convey information to their constituencies, this example is especially useful in how it nests various databases on watershed issues, organizations and examples in the U. S. in a very accessible format with extensive links to other relevant sites.

"Surf Your Watershed contains the following Search Information databases. Information can be added to any of the Watershed Atlas databases using the Add Information button found at the top of Surf Your Watershed pages. Adopt Your Watershed- Is a database of Watershed groups throughout the nation. You can search for a group in your area either by State, Zipcode, Group Name, Keywords or even Stream Name. Currently over 3,000 groups are indexed. Sites and groups are voluntarily submitted. Sites are reviewed. (Adopt Your Watershed Home) Wetlands Restoration Projects- View ongoing Wetlands Projects, add information about your own project or update previous information about your project. Organized by State and watershed. (Wetlands and River Corridor Restoration Home, Database by State) Speak Out Discussion Database- offers you the opportunity to add to online dialogue about environmental issues. This moderated bulletin board allows you to compose a comment or view other comments by: Category, Topic, Author or Date. (Speak Out!)

American Heritage Rivers Services- A multi-agency initiative to help communities find support for their rivers. The database offers a "yellow pages" directory of services to help communities revitalize their rivers environmentally, economically and culturally. Currently indexes over a 1000 records. Voluntarily submitted. Sites are reviewed. (American Heritage Rivers Services Home)

SURF-Environmental Websites Database- A directory of websites dedicated to environmental issues and information. Search this SURF database using Keywords, Geography, Organization or even by the information medium you desire. You can locate your place and find relevant information. Currently more than 5000 web sites are indexed. Voluntarily submitted. Sites are reviewed." [www.epa.gov/surf/]

- **Envirofacts Warehouse – EPA Web Site**

One of the complaints of some stakeholders is their lack of access to government held databases and information. These stakeholders make the case that their review of particular proposal or initiatives sometimes requires access to databases that contain baseline information on natural features and functions of particular ecosystems. The EPA's Envirofacts Warehouse is an example of increasing access to this kind of data.

"The Environmental Protection Agency (EPA) created the Envirofacts Warehouse to provide the public with direct access to the wealth of information contained in its databases. The Envirofacts Warehouse allows you to retrieve environmental information from EPA databases on Air, Chemicals, Facility Information, Grants/Funding, Hazardous Waste, Superfund, Toxic Releases, and Water Permits, Drinking Water, Drinking Water Contaminant Occurrence, and Drinking Water Microbial and Disinfection By-product Information (Information Collection Rule [ICR]). You may retrieve information from several databases at once, or from one database at a time. Online queries allow you to retrieve data from these sources and create reports, or you may generate maps of environmental information by selecting from several Mapping Applications." [www.epa.gov/enviro/index_java.html]

- **Pennsylvania Notifies Permit Applicants Via E-Mail**

"Pennsylvania has become the first state to use e-mail to notify residents when new permit applications are received for review. The new program, called eNOTICE, is available through the Pennsylvania Department of Environmental Protection (DEP). Pennsylvania citizens can now receive e-mail notification of all environmental permits, including those involving air- and water-pollution control facilities, landfills, incinerators, transfer stations, drinking water treatment plants, water sources, surface and deep coal-mining operations, quarries, X-rays, and other sources of radiation. In order to register for the program, visitors sign up for a password on the DEP website. Then they can track the permits by registering to be notified when any permit applications come from their township, borough, city, or county. People can also register to be notified about specific individual permits that are already in the DEP database and receive e-mail alerts as they move through review." [DEP website at www.dep.state.pa.us and choose DEP eNOTICE]

- **EPA's Revised Policy on Consultation (3. Dialogue)**

Another example of best practices where stakeholder involvement is undertaken to promote and "exchange of information", the EPA's response to Dialogue 2001 provides a succinct description of how this can be improved and enhanced. Interestingly, their list of "other techniques" begins to creep into the subsequent categories of stakeholder involvement seeking "recommendations" and "agreement".

"There must be dialogue between officials responsible for the forthcoming action or decision and the interested and affected members of the public. This involves exchange of views and open exploration of issues, alternatives, and consequences. Public consultation must be preceded by timely distribution of information and must occur sufficiently in advance of decision-making to make sure that the public's options are not foreclosed, and to permit response to public views prior to agency action. Opportunities

for dialogue shall be provided at times and places which, to the maximum extent feasible, facilitate attendance or participation by the public. Whenever possible, public meetings should be held during non-work hours, such as evenings or weekends, and at locations accessible to public transportation. Dialogue may take a variety of forms, depending upon the issues to be addressed and the public whose involvement is sought. Public hearings are the most familiar forum for dialogue and often are legally required, but their use should not serve as the only forum for citizen input. When used, hearings should be at the end of a process that has given the public earlier opportunity for becoming informed and involved. Often other techniques may serve a broader purpose:

- *review groups or ad hoc committees may confer on the development of a policy or written materials;*
- *workshops may be used to discuss the consequences of various alternatives, or to negotiate differences among diverse parties;*
- *conferences provide an important way to develop consensus for changing a program or the momentum to undertake new directions;*
- *task forces can give concentrated and experienced attention to an issue;*
- *personal conversations and personal correspondence gives the individualized attention that some issues require;*
- *meetings offer a good opportunity for diverse individuals and groups to express their questions or preferences;*
- *a series of meetings may be the best way to address a long and complex agenda of topics;*
- *toll-free lines can aid dialogue, especially when many questions can be anticipated or time is short; and*
- *a hearing panel compiled of persons from representative public groups may be used in non-adjudicatory hearings to listen to presentations and review the hearing summary.*

This list is not exhaustive, but it indicates the importance for program managers in being flexible and choosing the right techniques for the right occasions." [An Evaluation of the National Dialogue on Public Involvement in EPA Decisions, Thomas C. Beierle, Resources for the Future, 1616 P Street, Northwest Washington, D.C., Appendix D, pp. D-16 -D –17]

Although the Ministry process does not use hearings as a mandatory feature of the comment periods, the participants in the Dialogue 2001 process had some very interesting criticisms of the statuary hearings:

- **Suggestions for Improvement of Hearing Format**

  "All sectors of the public responding felt that hearing procedures needed to move away from rigid rituals and be more attuned to listening and responding to the public's views. We agree that public hearings can be more successful if they are conducted in a non-intimidating manner, and if the public has been informed of the issues and has access to pertinent information prior to the hearing. Those who commented on the Content of Notice section stressed the importance of early and clear discussion of the issues and alternatives the public is asked to comment upon. Under Conduct of Hearing, many commenters asked for more informality and opportunity for questions and answers in the hearing. People also commented that hearings are often located too far from the affected area. We have revised the Policy to incorporate these ideas."

4.5.3.3.2 Develop Recommendations to Regulator

As noted in Section 2.2, this category refers to the following: *"The participants reach a general agreement on recommendations to the agency, but no one is "bound" by the decision and the agency is not expected to implement all aspects of the advice. The agency will give the advice serious consideration and then flesh it out before making a decision. The outside parties are not bound to refrain from criticism or legal actions. Examples of processes that fit in this category are advisory committees and policy dialogues."*

- **Regional Water Planning – Texas Water Development Board**

  Give its similarities to the role of Conservation Authorities and the newly established Low Water Response mechanism in Ontario (includes Ministry of Natural Resources, the Ministry of the Environment, Ministry of Agriculture and Food, Ministry of Municipal Affairs and housing, Ministry of Enterprise, Opportunity and Innovation, Association of Municipalities of Ontario, Conservation Ontario), Texas presented an example of good planning practices that are place-based and "bottom-up" (i.e., specific to watersheds).

  "In June 1997, Governor George W. Bush signed into law Senate Bill 1 (SB 1), comprehensive water legislation enacted by the 75th Texas Legislature. This *legislation was an outgrowth of increased awareness of the vulnerability of Texas to drought and to the limits of existing water supplies to meet increasing demands as population grows. The state's population is expected to increase from its current level of about 19 million to more than 39 million people by the year 2050. With passage of SB 1, the Legislature put in place a "bottom up" water planning process designed to ensure that the water needs of all Texans are met as Texas enters the 21st century. SB 1 allows individuals representing 11 interest groups to serve as members of Regional Water Planning Groups (RWPG) to*

prepare regional water plans for their respective areas. These plans will map out how to conserve water supplies, meet future water supply needs and respond to future droughts in the planning areas..

In February 1998 after extensive review and public comment, the TWDB adopted state and regional water planning rules, delineated 16 regional planning areas and selected 270 individuals from 11 SB1-required interest groups to serve as initial members of the RWPG. Each RWPG is responsible for preparing and adopting a regional water plan for their area. RWPG have hired consultants to assist with developing the engineering, socio-economic, hydrological, environmental, legal and institutional components of the regional water plans. RWPG must provide for public input in the planning process, hold public meetings and furnish a draft report of the plan for public review and comment." [www.newenvironmentalism.org/program.cfm? typeprogram=Permit%20Reform .. Reason Public Policy Institute, 3415 S. Sepulveda Blvd., Suite 400 Los Angeles, CA

- **Standardizing the Underlying Science – Texas**

As a follow-up, the TWDB has published in November 2001 "Guidelines for Regional Water Plan Development" as a further guidance document to Chairs-Regional Water Planning Groups, Designated Political Subdivisions and Designated Consultants. Given the need for a common methodology, this is also an example of the extent to which one may have to go to ensure consistent approaches to such planning. This degree of specificity also provides a transparent platform for the stakeholders to review and either support or challenge. [Draft of Guidelines for Regional Water Plan Development, November 27, 2001]

- **Watershed-Based Approach – Upper Little Tennessee River Watershed – North Carolina**

Watershed-based planning has become the accepted paradigm for the evaluation of many environmental permits. Although we have included the Upper Little Tennessee River, we could have just as easily included the North Carolina Wetlands Restoration Program, Washington's Nisquilly River Watershed at the southern end of Puget Sound or the Tomorrow-Waupaca River Priority Watershed Project. The fundamental feature that makes these projects examples of a good practice is that they all involved stakeholders in the grassroots development of plans and associated recommendations to the regulatory authorities.

"North Carolina, in the early 1990s, initiated a comprehensive, formal process for developing water-quality management plans that use river basins as the basic management unit. This process emphasizes local decision-making, inter-agency and inter-governmental co-ordination, collaboration between various interests in the watershed, and science-based planning and decision-making.

The idea behind the approach is that by involving locally affected individuals and decentralizing the decision-making process, watershed management plans will be uniquely suited to their areas and thus more successful than other, more "top-down" programs. Although the individual watershed management plans are largely state-funded, they are often initiated by local non-profit groups that maintain significant roles in the watershed's management.

One of North Carolina's most comprehensive watershed management plans is in the Upper Little Tennessee River Watershed. The Upper Little Tennessee River is highly valued for its scenic qualities, recreational opportunities, and biodiversity, but it is threatened by pollution from excess sediment and stormwater runoff. Efforts to protect the river began in 1993, when a group of local citizens and agency representatives came together to explore river protection and restoration efforts, and eventually formed the Little Tennessee Watershed Association (LTWA)." [www.newenvironmentalism.org/medium.cfm?medium=Water]

- **The Blackfoot Challenge – Montana**

This is an example of the incremental development of a consensus among unlikely interests with modest beginnings (a common pattern among advisory groups that succeed) and not that dissimilar from the Don River Watershed group in Toronto. Reviewers have called it "A project to identify and promote innovative approaches to addressing serious environmental challenges and creating a society of self-motivated environmental stewards."

"The Blackfoot River in Montana achieved the pinnacle of environmental notoriety in 1976 with Norman MacLean's novella, A River Runs Through It. The Blackfoot Challenge was formally chartered in 1993 and began its life as a non-profit organization in 1994. A purely voluntary organization lacking even formal membership rules, the Challenge serves as an information clearinghouse, providing monthly steering committee meetings, fax/electronic mail linkage, and quarterly newsletters sent to some 400 local residents. The modest goals that underline the informal nature of the organization are:

- *provide a forum for the timely distribution of technical and topical information from public and private sources;*
- *foster communication between public and private interests to avoid duplication of efforts and capitalize on opportunities;*
- *recognize and work with the diverse interests in the Blackfoot Valley to avoid confrontation;*
- *examine the cumulative effects of land-management decisions and promote actions that will lessen their adverse impacts in the Blackfoot Valley; and*
- *provide a forum of public and private resources to resolve issues.*

The Blackfoot Challenge has succeeded as a means of bringing the federal government and state and local stakeholders together. Receiving some funding from the Partners for Wildlife program of the FWS, the program has been called "one of the finest private-land programs around. It's opened up all these avenues [for co-ordination] with private-lands people who, before, if you even mentioned government, they'd turn around, get in their trucks, and leave." [Reason Public Policy Institute, 3415 S. Sepulveda Blvd., Suite 400 Los Angeles, CA]

4.5.3.3.3 Develop Agreements – Proponent, Interested Parties and Regulator

This category refers to the following: *" Affected parties or stakeholders, including the agency, negotiate to reach a specific agreement, and each is expected to abide by it and implement its terms. Examples are negotiated rulemaking, negotiated or consensus permits, and the settlement of enforcement or other legal action cases."*

This is the top end of the taxonomy of stakeholder involvement, and although it is the most desirable from a regulators point of view, it is often the most difficult to achieve. Edward DeBono, in his book "Conflicts: A Better Way to Solve Them" [Penguin Books, 1986] proposed that all conflicts could be distilled own to one or more of 4 basic reasons why people disagree:

a) because they see things differently;
b) because they want different things;
c) because their thinking style encourages them to; and
d) because they are supposed to.

In many respects, the examples of best practices for stakeholder involvement included here seek to address one or more of these basic reasons why people disagree. Some sponsors of stakeholder involvement initiatives believe that "if we could only educate them in the reality, they would see the light " (a.k.a come around to our way of thinking). In our experience, agreements are hard-won and usually only possible if timing, attitudes, personalities, politics and the right solution are aligned.

- **Good Neighbour Agreements**

  Although broader than just environmental permits, the concept of Good Neighbour Agreements is a good practice in this category because they "seek agreements between the parties" to solve some problem or issue.

  "An example of a NGO approach to involving the public in environmental *issues is the use of Good Neighbour Agreements. The goal of these agreements is to foster sustainable development in a community by reconciling economic development with the welfare of the community, including health*

and the environment. In addition to promoting sustainability, these agreements seek to increase corporate accountability. An array of industry sectors, including oil refineries, foundries and chemical plants, have entered into Good Neighbour Agreements in the United States.

Though many agreements have been initiated as a result of industrial accidents, some have been negotiated before a crisis arises or in response to chronic issues such as pollution or job concerns. The philosophy common to all Good Neighbour Agreements is the community organization's and industry's mutual acknowledgment of the necessity to build relationships responsive to community and industry needs. Some agreements are nonenforceable, but many can be legally enforced." [Linda Breggin and Heidi Hallman, *Building Capacity to Participate in Environmental Protection Agency Activities: A Needs Assessment and Analysis*, Environmental Law Institute, 1999, pp. 32-33]

- **UK's First 'Good Neighbour Charter'**

Friends of the Earth today (Tuesday 2 May) welcomed the signing of the UK's first 'Good Neighbour Charter'. The agreement which will be signed today in ... Edinburgh commits incinerator company, Dundee Energy Recycling Ltd. (DERL) to high standards (above and beyond those currently required by-law) towards their neighbouring community of Douglas. The issues already covered by the DERL Good Neighbour Charter include:

- setting up a liaison group of local people, elected representatives and company directors, with external advisors where appropriate;
- community access to company information in a form which is easily understood by lay people;
- a right to inspect the facility;
- public review of company preparations for accident;
- reduction of pollution to higher standards than legal minimum; and
- good jobs available to local people where possible [www.foe-scotland.org.uk/press/pr20000501.html]

- **Project XL - EPA**

Here is another good practice in which the EPA is leading the way . We have included this example because it is based on another set of experiments in stakeholder involvement approaches designed to seek agreements between proponents/industry and the local community of stakeholders.

"The U.S. Environmental Protection Agency (EPA) created Project XL to give companies, communities, state and local agencies, federal facilities, and even industrial sectors, the opportunity to propose cleaner, cheaper, and smarter ways of protecting the environment .. EPA will, after careful evaluation, replace or modify regulatory requirements, policies or procedures if the proposed XL project will produce superior environmental benefits and promote accountability to the public...

To ensure these new approaches truly meet local needs and protect the environment, people from the community, environmental groups and workers are included in evaluating each Project XL proposal. EPA calls this "stakeholder involvement." The goal of Project XL stakeholder involvement is a collaborative working relationship between sponsors and stakeholders who believe they or their community could be affected by an XL project..

Generally speaking, the scope and complexity of the stakeholder process should match the scope and complexity of the project itself. If the sponsor is asking for significant changes from existing environmental requirements and national policy or if the project could have widespread impacts on the community or particular segments of it, then the stakeholder involvement process may need to be equally significant. If the changes or impacts are modest, then it may be appropriate to scale back the involvement process." ["*Project XL Stakeholder Involvement: A Guide for Project Sponsors and Stakeholders*", United States Environmental Protection Agency, Office of the Reinvention [1802], EPA 100-F-99-001, March 1999, p. 14-15]

- **Constructive Engagement – EPA**

  Although it sounds like more jargon, the concept and the experiments to date have shown sufficient progress to merit inclusion as a good practice. It is another term for getting parties to "sit down and reason together".

  "EPA's Common Sense Initiative (CSI) involved selected industries, environmental and public interest groups, state regulators, and others to improve the environmental results and reduce the [adverse] economic impacts of EPA programs. The subcommittee developed the concept of a facility-based alternative system of environmental protection, with the objectives of increasing facilities' environmental performance; regulatory flexibility; and constructive engagement of, and accountability to, communities and workers".. Constructive engagement means representatives of the facility's management and employees, the relevant Federal, State, and local regulatory agencies, and the community striving to develop and continuously improve a co-operative partnership. Through this partnership, these parties jointly work to assure that each of them has the capacity to participate, and does participate, in establishing facility environmental management system goals and objectives, in monitoring the effectiveness of the system, and in evaluating facility performance. The capacity to effectively participate includes each party having timely access to relevant information, sufficient technical understanding and expertise, and the resources to effectively participate. [*Constructive Engagement Resource Guide: Practical Advice for Dialogue Among Facilities, Workers, Communities and Regulators*, EPA Order Number: EPA745B99008, National Service Centre or Environmental Publications, P.O. Box 42419, Cincinnati, OH]

5. Best Practices

5.1 Permitting Process

To obtain a Permit to Take Water (PTTW) there are several steps that should be followed from a procedural perspective that will help scope the technical approach. The proponent will need to know at an early stage if the undertaking is feasible, and similarly, the local water management authority will need to know if the taking is sustainable from a cumulative impact perspective. To properly scope the undertaking the proponent should carry out a desktop study of existing information at the regional or watershed scale. It is this step that the cumulative impact of a proposed water taking will be screened against the water management authority's overall assessment of available water resources. In particular screening items should include:

1. Peak taking rate in comparison to minimum existing resource.
2. Average taking rate in comparison to average existing resource.
3. Other takings in immediate area.
4. Downstream/downgradient takings of similar or smaller magnitude that might be deprived of a portion of their water.
5. Other natural uses (not water taking), particularly ecologic features and functions.

The next step is to do site specific scale work to provide an estimation of actual anticipated impacts. The scope of this work would be determined from the initial watershed scale work. It would have to demonstrate the linkages between groundwater, surface water, aquatic habitat and terrestrial habitat through baseline monitoring. This work would be at least on a four season basis with an assessment as to how the results would compare to annual fluctuations. If the proposed water taking was only seasonal in nature, then those seasons of taking would only have to be assessed, unless of course substantial water was taken from groundwater storage, and then the recovery seasons would also have to be assessed. The detailed work would confirm how the site fits into the watershed scale picture. It would include confirmation of the additional impact to the undertaking on the overall cumulative impact derived earlier at the watershed scale. Stakeholder consultation would begin during this process. The site specific scale work would be expected to develop the proposed water taking limits, and environmental thresholds, as well as an appropriate monitoring program (following the Adaptive Environmental Monitoring concept).

The application to the MOE for the PTTW would be based on the above two steps. It is anticipated that an Interim PTTW, at reasonable extraction rates to ensure a cautious/conservative approach with no chance of irreversible environmental damage, would be issued for two years with detailed conditions related to monitoring and contingency action planning. Consideration has been given to allowing only low extraction rates in this period, however this would not be fruitful if no impact was created and the actual stresses on the system could not be evaluated. Stakeholder participation would continue during this period as well. Once operational information is collected during this interim two year period, detailed reporting would be necessary to support a longer term permit at water taking rates that have been demonstrated to be sustainable. At this point, monitoring could be scoped to levels necessary to ensure unacceptable conditions don't inadvertently develop, still adhering to the Adaptive Environmental Monitoring System. Reporting requirements would be based on the level of risk to the environment, those with higher risk requiring an annual compliance reporting frequency. In any event, renewal of a longer term PTTW would still require supporting technical documentation based on the previous permitted period.

Any requested amendments to a PTTW in terms of increased taking would have to be supported by detailed monitoring beforehand and the schedule would revert to the two year interim period. Already existing permits, acquired before the improved permitting process, could only be renewed on the basis of addressing the full ecological spectrum as for new permits. Those Permit holders would be notified of this well in advance to allow the initiation of appropriate monitoring.

There will be types of water taking applications where an interim PTTW approach may not be feasible. For example municipal water supplies, where the operational period would mean that the water supply had already been committed to those using it and could not be practically withdrawn. In this case more thorough initial testing in terms of scope and length of time would be necessary and coupled with the development of a detailed contingency plan.

The following sections provide a description of the best practices necessary at both the watershed scale and the site specific scale. Where gaps exist, Section 6 is intended to provide recommendations on filling these.

5.2 Watershed Scale

By way of summary, the watershed framework is best suited for assessing cumulative impacts of any proposed water taking on both the natural environment and existing water use condition. Some guidance can be taken from the existing federal approach to cumulative impact assessment. Appendix C provides a brief assessment of the federal approach under the Canadian Environmental Assessment Act and is summarized here. In the case of water taking projects, cumulative effects are those incremental and

residual effects caused by the proposed project when added to, or combined with, the effects that in the same time frame are caused by other projects or activities off-site. Time related issues are important because water is a renewable resource and restoration is in most cases as simple as reducing or stopping the water taking. Through an initial screening step, the federal process allows the cumulative impact assessment to be scoped down to those effects that overlap in time or space. For example, two coincident water takings that are close enough together to affect each other, or the downstream/downgradient area in a cumulative fashion. If they are not close enough, or occur at different times of the year, then the assessment is not necessary. The actual cumulative assessment is often qualitative and not quantitative as different undertakings have different levels of information available. The relative contribution of each water taking is the paramount consideration in the context of the overall potential cumulative effect. Of equal importance, the federal assessment only considers the net effect, after any necessary mitigation has been selected, and then determines if the net effect is significant.

The watershed scale is however an un-realistic scale for any individual proponent (except maybe higher tier municipalities) to examine cumulative impacts. It is expected that an individual proponent would consult with the appropriate agencies to see how a proposed taking would fit in, and to scope out the extent of their site specific investigations, public consultation, and impact assessment on this basis.

An individual proponent should be expected to assess the broad feasibility of any proposed water taking prior to initiating site specific investigations. This feasibility assessment should include an overview of the regional physical setting in terms of the environmental disciplines necessary to ensure compliance with Regulation 285/99 and the MOE Statement of Environmental Values. That is, what components of the environment (as per Section 1.3) could be affected. Consideration must be given to providing the rationale why some of these components won't be affected, as part of the scoping process. Most importantly this work should not be done in isolation, but rather in consultation with the agencies, and the linkages between disciplines explored by professionals in those fields.

The regional geology should be established in terms of published geological maps identifying the overburden and bedrock settings. Use of the MOE water well database to assess stratigraphy with depth must also be done. Reliance can be made on existing regional geological studies where they exist. The assessment should be made by a professional geoscientist and include an integrated description of both surficial and vertical geology at a scale that establishes all possible influences on the site. The regional hydrogeologic conditions will be based on the geologic framework. Use of existing groundwater resource reports, or aquifer characterization studies should be undertaken where they exist. Hydraulic information from surface water features and water wells should be used to assemble a conceptual hydrogeologic model from which the scope of site specific issues can be derived. This work would be used to determine whether the groundwater basin coincides with the watershed or sub-watershed.

A water balance for the watershed should be created, based on long term meteorological records. It is expected that many jurisdictions will be creating this as part of current studies in the province, so that as time progresses this can become available to a proponent in that fashion. The water balance methods need to include precipitation, evapotranspiration, runoff, infiltration, and for the long term case can consider groundwater storage as a net zero term. At the regional scale they may be calibrated against watershed outflow, if the data exists. Part of the water balance should include the net consumptive water usage within the basin, to address the issue of cumulative impact. The scope of this may beyond the means of many proponents, and therefore the agencies responsible for watershed management will have to be relied upon to maintain current water use data. At the watershed level, elements of the watershed need to be identified that rely on maintenance of the existing water balance, versus those that can sustain water taking without *adverse* effects.

From a surface water perspective, the watershed level assessment should take advantage of existing information, such as topographic mapping and agency gauging stations to quantify the size of the watershed, streamflow and the stream order. Historical records are to be used where available to establish the range of flow conditions observed over time. This information will be useful in confirming the water balance calculations. Correlation with documented water fed ecological features such as wetlands or existing water impoundments will be necessary. As with groundwater takings, an inventory of existing surface water taking records should be made to help assess cumulative effect. Again, this is expected to be conducted by the agency responsible for watershed management, and be made available to any proponent. If not readily available an effort should be made to estimate water usage based on known land use. Specific locations of pertinent water use in relation to the proponent's site would be determined at this point.

The aquatic habitats of the watershed should be assessed on the basis of stream-types, a knowledge of regional conditions, existing records, and published information on typical and rare species. How these aquatic habitats are potentially affected by existing development and watercourse features (e.g., dams, online ponds, road crossings, etc.) should be assessed. How the observed aquatic species and habitat are linked should be assessed in order to judge what effects a water taking might have. Major terrestrial habitat features such as wetlands, woodlots or other undisturbed areas will have to be identified from existing provincial records and conservation authority inventories. How these features represent linkages and how they function at the watershed scale should be determined. Particular attention should be given as to how individual regional features depend upon water, particularly in relation to the subject site.

5.3 Site Specific Scale

As described in Section 3.2, the site specific framework includes all areas that are directly affected, extended out to a point where no effects can be demonstrated. Therefore the linkages between surface/groundwater and the natural environment, plus existing local water users have to be established. While the following sections provide a description based on disciplines, it must be kept in mind that the site assessment and impact analysis must be linked in a cross-disciplinary manner.

5.3.1 Groundwater

In preparing the site specific groundwater investigations from the watershed framework there will be some aspects that may require no further assessment[10], but there will be several essential elements. For a groundwater taking, the present practice as described in Section 4.1.1.2 should be followed as a minimum. This includes the geologic investigation, test well construction and pump testing for aquifer yield, as well as site specific water budgets and hydrogeological studies for larger takings. Where the possibility of interference with ecological features has been identified, a longer term pump test and more specialized instrumentation are required.

Instrumentation for headwater streams should include in-stream piezometers to measure vertical hydraulic gradients under baseline and pumping conditions. They should be placed in consultation with qualified fisheries personnel to ensure meaningful information is collected. These should be rigid steel construction if over-wintering is necessary to avoid ice damage. Temporary piezometers can be made from flexible Polyetheylene, particularly for water quality sampling purposes. These in-stream piezometers should be installed at a supportable depth, typically 1 m or deeper, to prevent equilibration with surface water head. If a flow net analysis is deemed necessary, these can be installed in pairs at 1 and 2.5 m depths, complimented by installations behind the stream bank. For bigger streams conventional piezometers at greater depths can be used in conjunction with in-stream piezometers.

If quantification of upwelling rates are necessary, the use of seepage meters (Lee & Cherry, 1979) may be used, although these devices are often difficult to install in cobbley streams and require several per site to get statistically valid results. The calculation of baseflow from subtraction methods along a reach are not encouraged because the accumulated error of measurement is often greater than the actual baseflow contribution. This method can be useful, however, as an independent check where baseflow is considerable.

10. For example, a water taking from a deep confined aquifer may have no potential for affecting a local surface water body.

Instrumentation of wetlands can be done using the mini-piezometer technique as well. To determine vertical gradients, adjacent pairs of these devices are required, as there is often no ponded water on which to base the calculation. Placement of these devices should be done in consultation between the hydrogeologist and the wetland evaluator to ensure they are collecting meaningful information. Some plants are indicative of groundwater discharge (Rough Sedge *Carex scabrata,* Golden Saxifrage *Chrysoplenium americanum*) which can verify the results of the instrumentation. Other species, such as Tufted Sedge *(Carex stricta*) are indicators of significant surface water flooding, that may or may not be augmented by baseflow conditions. Because wetlands, like headwater streams, exhibit strong diurnal fluctuations in water levels and flow, the timing of measurements is critical. For this reason continuous recorders may be used to understand the particular diurnal cycle for a system.

A pump test to assess effects on natural features is typically much longer than a conventional 24 or 72 hour aquifer test. Tests can be one week to three months in duration depending upon the nature of the effects that require assessment. The test needs to be long enough to develop equilibrium conditions to demonstrate no impact, or long enough to demonstrate impact on the critical features. Since analysis of the test data to determine aquifer parameters is not as critical, the test does not have to be run as a constant flow test. In fact it is better to be run as a step test with two or more discrete conditions. For example, pumping at the average proposed extraction rate, followed by a shut down of equal length, followed by pumping at the peak taking rate for the same length of time. These types of tests introduce long pulses of different hydraulic heads, manifestations of which can then be looked for in the monitoring data.

A local ecosystem will have significant seasonal differences. For example, Brook trout spawn in the autumn, and the eggs over-winter, hatching in the early spring. Water taking that affects such a stream therefore has to be carefully controlled over this period. Wetland plant species tolerate specific ratios of anaerobic *vs.* aerobic soil conditions that are determined by water sources and flooding regimes. Many wetland plants depend on water pressure for rigidity (erect stems), and lack cuticle that prevents desiccation. Changes in water levels may alter this ratio with damaging effects on the plants that could prevent flowering and/or seed set. Therefore timing of the pump tests is critical for two reasons. First, the test should not cause irreparable harm (like drying up a stream containing fish eggs). Second, the results obtained in one season will have to be extrapolated to other seasons which may be critical for other reasons.

Monitoring is key to understanding what baseline conditions exist, how the pumping affects the natural system, and then ultimately to police the actual water taking once operational. It is like an insurance policy for the proponent, the regulator and the environment. Documentation of actual effects can confirm the original assessment, thus providing all involved that the environment has been protected. If unanticipated results occur, then the water taking can be modified if necessary to protect the environment. A PTTW does not provide for direct ownership of water, but rather allows a proponent to use a certain

amount of water for a fixed time period. The PTTW can be modified from time to time in response to changing conditions. Monitoring provides the policing of the agreement. Therefore the monitoring program must reflect those conditions that require confirmation. The proponent is expected to provide an appropriate monitoring program as part of any water taking. Section 6.3 elaborates further on this. Whether the original testing was conducted in a dry year or a wet year will influence the results. Therefore analysis of meteorological records is essential to put the results into proper perspective.

5.3.2 Aquatic Habitat and Surface Water

Aquatic habitat and surface water practices are so closely connected in the PTTW process, that they are combined in this section to avoid any overlap.

In most cases, instream flow assessments currently being applied in Ontario to set threshold flows for aquatic habitat are not adequate to ensure that a Harmful Alteration, Disruption, Destruction (HADD) of fish habitat is not occurring. In fact, there is widespread understanding in the scientific community that these assessments are uncertain, and that this uncertainty has the potential to result in significant ecological and economic losses (Higgins 2001). Therefore, until further research is conducted within Ontario to develop and test instream flow methods that incorporates fish and fish habitat functions, a conservative approach should be taken in respect to water extractions and an "adaptive management approach" should be applied.

Nevertheless, there is an obvious practical necessity for instream flow assessments while methods are being developed. When attempting to determine a threshold flow for low-controversy projects with few decision variables and where standard setting values are sufficient (golf courses, nurseries, water bottlers, etc.) the Tennant Method (Historical Flow Method) and/or Wetted Perimeter Method (Hydrologic Method) could be used. If the project is controversial and has many decision variables (hydro-electric and thermonuclear facilities) a more biologically defensible method is required. In such cases, the Physical Habitat Simulation Model (PHABSIM: Habitat Method) could be used. As discussed in Sections 4.2 and 4.3 the approach taken to assessment also depends upon scale. For example, historical flow methods are appropriate at the watershed level, whereas aquatic habitat or hydrologic methods may more clearly assess small sub-watershed or reach scale undertakings. In any event, threshold flow recommendations should be accompanied by baseline data collection (1 to 3 years) and long-term monitoring programs, which is essentially the "adaptive management approach". By adopting an Adaptive Environmental Management (AEM) program the proponent can be conservative, while still using the opportunity to truly test the ecosystem at operational levels. AEM will give the ability to back off the water taking before irrecoverable damage occurs. These programs need to test the recommended flows and determine whether they are impacting the natural environment. They need to answer important questions about fish populations and physical habitat and should be scientifically accepted. A monitoring program that determines whether fish are still present is not acceptable, as it may be too late to do anything.

Baseline data collection and monitoring programs should contain information on the following topics:

a) pumping test (if required);

b) stream flow (data loggers installed with monthly monitoring programs to establish rating curves);

c) water and air temperature (data loggers installed);

d) fish habitat (standards should be developed and implemented by a fisheries biologist, ensuring data are reproducible for future years);

e) fish populations (fish species should be properly identified and voucher specimens should be sent to the Royal Ontario Museum (R.O.M.) for positive identification; biomass assessments should also be implemented when long-term monitoring is required); and

f) benthic invertebrates (a "Rapid Bioassessment" protocol for invertebrate sampling should be carried out yearly to better describe habitat quality).

5.3.3 Terrestrial Habitat

A uniform approach to evaluating the impact to wetlands as a result of water taking in the short term, and on a site specific basis should include an assessment of the wetland that may be affected by a biologist with expertise in wetland science. A good field biologist with a wetland specialty is a valuable asset on the evaluation team because the discipline currently is dominated by qualitative approaches that must be evaluated on a case by case basis on field evidence.

The basic data required for evaluation of impact as a result of water taking include:

a) dominant source of water maintaining the wetland (i.e., recharge vs. discharge site);

b) degree of linkage between wetland and water taking;

c) vegetation community classification including soils description (organic vs. inorganic, texture, moisture regime);

d) plant and wildlife species inventory (includes fish);

e) water and air temperatures; and

f) landscape context (ecodistrict, position in the watershed).

An assessment of the potential impact will include the consumptive vs. non-consumptive nature of the water taking, and the effect that this will have on the overall water budget.

Methods for Data Collection

Determination of water source can be determined through the installation of piezometers to confirm discharge *vs.* recharge conditions on a seasonal basis. A water budget should be calculated to determine the relative importance of surface water to groundwater to wetland function. Further evidence confirm the monitoring and calculations, may be observed during site investigations in the form of organic soils which are greater than or equal to 40 cm in depth, degree of decomposition, and the presence of plant indicators of discharge. Water temperatures and ambient air temperatures should be recorded.

The wetland inventory should include vegetation mapping using Ecological Land Classification for Southern Ontario (Lee *et al.* 1998). A complete Wetland Evaluation using the Ontario Wetland Evaluation System (OMNR 1994) is unnecessary because the MOE policy directs that the impact on all surface features be assessed, not just those identified as provincially significant. The methodology for establishing wetland boundaries (based on the occurrence of 50% upland vegetation) is the same for ELC and OWES. This will result in congruent wetland boundaries regardless of the source of mapping.

The potential for the wetland to function as wildlife habitat, including fisheries should be assessed based on the habitat provided by the vegetation and availability of water. Casual wildlife encounters should be recorded.

The potential for linkage between the wetland and the water taking should be evaluated based on the results of pump tests, identifiable hydrologic connections and the position of the wetland in the watershed. An assessment regarding the attenuation function of the wetland (high to low, depending on flow-through characteristics) should be undertaken. This may require detailed topographic mapping of the wetland basin to determine outflow inverts.

Goals for minimum wetland water needs should be determined based on the source of water, its periodicity, and volume that is required to maintain the requirements of the vegetation and fauna associated with the wetland.

5.3.4 Stakeholder Involvement

The purpose of this search was to find best practices that hold the promise of improving stakeholder involvement in the Ministry's permitting decisions to take water. The following figure highlights our proposals:

Figure 13. Proposed Modifications to MOEE's Public Involvement in PTTW

MOE public consultation features		Proposed Modifications
Degree and Type of Stakeholder Involvement	Stages/ Milestones	Proposed Modifications
• Proponent determines stakeholder involvement at this stage unless directed by Ministry or other regulatory authority	**1. Proponent Preparation of Application**	1A -Where application is contentious and/or potentially high risk, require proponents to submit a Stakeholder Involvement Plan for approval including a mandatory Stakeholder Advisory Committee for the planning, start-up and operation of the water taking (see Oregon's Risk-based approach)
	2. Submission of Application	2A - MOEE make submission immediately available to all interested parties for review and study (see Pennsylvania's automatic notification of stakeholders)
		2B - MOEE create and maintain an electronically accessible "water matters" databases and user-friendly "primers" on developing and evaluating permits for use by proponents and stakeholders (see EPA's EnviroFacts Warehouse, Portland's Primer on Watershed Planning, etc.)
• Ministry may require public consultation for specific reasons	**3. Agency review of Application**	3A - MOEE to establish an MOU mandated one-window approach by all the regulatory authorities involved in approving PTTWs (see Ontario's Low Water Response model)
• Posting on EBR for 30 days -comments reviewed	**4. Posting Notice, Comment Period**	
• The permitting authority makes a final determination on the permit application	**5. Agency decision**	5A -Require the proponent to publish an annual report card and maintain ongoing communication with interested stakeholders (see Oregon's Green Permits)
• Only if granted leave to appeal	**6. Appeal to the Tribunal**	

5.3.4.1 1A – Stakeholder Involvement Plan

- ***Where application is contentious and/or potentially high risk, require proponents to submit a Stakeholder Involvement Plan for approval including a mandatory Stakeholder Advisory Committee for the planning, start-up and operation of the water taking.***

The current Ministry guidelines for PTTW make reference to stakeholder involvement in the following manner:

"13. In areas where the proposed water taking is, or may potentially *be, the focus of public concern, then it is recommended that the applicant consult with those persons who have an interest in the water resources in order to identify and address those concerns prior to applying for a Permit to Take Water (PTTW). Approval of a Permit application can be delayed if the Director receives comments from the public, the municipality or from other agencies either directly or through the Environmental Bill of Rights registry. Depending on the nature of the comments received, under Regulation 285 the Director may require the applicant to conduct consultations on any issues related to the water taking that require additional attention prior to the deciding whether to issue a Permit."* [*Guide for Applying for Approval of Permit To Take Water*, op cit, p.3]

Since the Ministry is especially cautious about higher risk proposals and/or where there has been some evidence of stakeholder concerns (e.g., consumptive uses – e.g., bottlers of water; high quantity abstractions – e.g., tobacco farmers in a region; proximity to headwaters – e.g., fish farms; where contaminants will be added – e.g., golf courses) and usually directs the proponent to ensure stakeholder involvement, this proposed modification does three things:

a) makes the decision to require stakeholder involvement at the front end of the process (i.e., if the permit involves one of the four types of water takings described above), stakeholder involvement is required during the preparation of the application, when there is time to do it properly and when it can be meaningful;

b) requires the proponent to submit a stakeholder involvement plan for approval before engaging the stakeholders in any process. This is an attempt to ensure that the consultation process is based on constructive engagement .. A guidance document for proponents would assist in describing minimum requirements, including a stakeholders advisory group (the ministry already has an excellent starting point in its Consultation Guideline for Individual Environmental Assessments); and

c) puts the oneness for stakeholder involvement on the proponent from day one as opposed to having the ministry require it during its review of the application.

Purpose

The U. K. Code of Practice for Written Consultation eloquently described the purpose of meaningful consultation in a way that merits inclusion here:

a) "The main purpose is to improve decision-making, by ensuring that decisions are soundly based on evidence, that they take account of the views and experience of those affected by them, that innovative and creative options are considered and that new arrangements are workable.

b) Effective consultation ought also to ensure that so far as possible everyone concerned feels they have had their say or at least that their interests have been taken into account.

c) Consultation with a wide cross-section of the public [is critical], without which the openness and accountability of government could be impaired, and the dangers of privileged access magnified" [op. cit., p. 4]

Key Factors for Success

Features of the Stakeholder Involvement Plan:

a) Notification .. identify all stakeholders and notify them of the intent to apply for a permit and the detailed schedule of the involvement plan.

b) Meaningful opportunities for all stakeholders to review and comment on plans to take water which allow a minimum of 30 days from receipt to deadlines for submission of comments.

c) Establishment of a Stakeholder Advisory Group (SAG) comprised of a cross-section of all stakeholders that is designed and facilitated by an independent, neutral third party.

d) SAG to submit a comprehensive report on its findings and conclusions which becomes an integral part of the application.

References

- League of Women Voters: Strategies for Effective Public Involvement Drinking Water Source Assessment and Protection [www.lwv.org/elibrary/pub/water/dw_3.html]
- Constructive Engagement - 23 Lessons .. The EPA's Manual on Constructive Engagement (available as a .pdf file at www.epa.gov/stakeholders/siteguide.htm), pp. 80-84
- Intermodal Surface Transportation Efficiency Act – Planners Workbook .. Public Involvement, by Kristina Younger, Intermodal Surface Transportation Efficiency Act, US Dept. of Transportation, ISTEA Planners Workbook
- *FAA Guide to the Best Practices for Environmental Impact Statement Management* - July 2001, Best Practices Guide - Report to Congress on Streamlining the Environmental Process, Community and Environmental Needs Division, Office of Airport Planning and Programming, Federal Aviation Administration, Washington DC

5.3.4.2 2A – Automatic Notification of Stakeholders

- ***MOEE to make submission immediately available to all interested parties for review and study.***

Although the MOEE Guidelines are silent on stakeholder notification, the normal practices of the Regions is to ensure that stakeholders they are aware of, are notified of the application.

Purpose

This proposed modification is designed to:

a) provide an automatic notification of stakeholders of applications received for PTTW; and

b) simplify this normally onerous task.

Key Factors for Success

Features of an "e-notification" approach:

a) establish a page on the Ministry's Internet web site devoted to PTTW; and

b) advertise the presence of the site and request that people sign-up to receive notification of applications they may be interested in receiving ... Pennsylvania notes the following on their site: *"Get free alert messages by e-mail as soon as new permit applications are submitted to DEP in your township, borough, city or county and then track those permits through the permit review process. To start, register your e-mail and create your own password-protected tracking list that only you have access to. Complete the registration form. If you are interested in receiving eNOTICES about new Draft Technical Documents, Click here!".*

References

- For more information, visit the Pennsylvania DEP website at www.dep.state.pa.us and choose DEP eNOTICE. or [www.dep.state.pa.us/efacts/]
- Delaware Environmental Release Notification System:

  "In response to Senate Bill 33, which became law in July 2001, the Department of Natural Resources and Environmental Control (DNREC) developed this system to allow Delawareans to learn promptly of releases or discharges of contaminants or pollutants in their neighbourhoods or throughout the state. When you register you choose to be notified in one of three ways-by phone, by e-mail or by fax. You also can choose to be notified about releases from specific facilities or about all releases that occur in one or more zip codes throughout the state .. Registrants will be notified within 12 hours of DNREC receiving a report when there is a release or discharge in the geographic area(s) selected.."[www.dnrec.state.de.us/dnrec2000/notification/pub/]

5.3.4.3 2B – "Water Matters" Dbases and "Primers" for Developing and Evaluating Permits

- ***MOEE to create and maintain an electronically accessible "water matters" databases and user-friendly "primers" on developing and evaluating permits for use by proponents and stakeholders.***

Given the trends towards watershed based planning and evaluations of proposed water projects, databases on water matters takes on an increasingly important role, especially when coupled with science-based decision making. At the same time, if stakeholders are expected to make "informed" input and participate in processes that have a scientific /technical side, then efforts will need to be undertaken to "enable" this quality of participation. It is important to acknowledge the progress the Ministry has made with its Water Resources Information Project in moving towards a comprehensive provincial water resources database.

Electronically Accessible Dbases

Purpose

To increase the availability and access to data on water matters that are integral to the planning and evaluation of PTTW in Ontario

Key Factors for Success

Features of electronically accessible Dbases to support stakeholder involvement in reviewing PTTW:

a) Given the adoption of watershed-based planning generally by the Ontario government, the concept of integrated/linked Dbases regarding water matters is critical across a variety of ministries and agencies. Therefore, this proposed modification is just about making, whatever is decided about water-related Dbases, accessible to stakeholders.

b) Ground rules for the protection of proprietary data need to be developed.

c) The EPA's "Surf your Watershed" initiative mates the dbases to the geographical references to enable stakeholders to focus on individual watersheds.

References

- EPA Surf Your Watershed [www.epa.gov/surf/]
- EPA's EnviroFacts Warehouse [www.epa.gov/enviro/index_java.html]

- Environmental Permitting Clearinghouse website [www.epa.gov/permits/]
- CERES: California Environmental Resources Evaluation System [www.ceres.ca.gov/]:
- *"CERES is an information system developed by the Watershed Information California Resources Agency to facilitate access to a variety of electronic data describing California's rich and diverse environments. The goal of CERES is to improve environmental analysis and planning by integrating natural and cultural resource information from multiple contributors Environmental Information and by making it available and useful to a wide variety of users."*
- Environment Australia's Online Databases [www.ea.gov.au/sdd/erin/databases.html#top]

User-Friendly Primers on the Underlying Science, Methodologies, etc.

- ***The term "primers" is used to describe documents/web pages that distil the science of water related issues into understandable form that stakeholders can access and use to understand applications for permits to take water.***

Purpose

To enable stakeholders to participate meaningfully in the planning and evaluation of PTTW.

Key Factors for Success

Features:

a) Assemble, peer review, get permissions and post "good primers" on an MOEE web page for use in Ontario. The volume of potential "primers" on the Internet is growing by the day and can be expected to continue as the Internet accelerates the thirst for such knowledge. There is little need to reinvent the wheel with so many others filling the knowledge gap. However, there may be the need for some Ontario-specific tools that interpret/apply the knowledge based on Ontario standards and methodologies.

References

- Peter Dana's award winning "primer" on GPS - Global Positioning System Overview [www.Colorado.EDU/geography/gcraft/notes/gps/gps.html#DODSystem]
- A Watershed Perspective [www.tbcc.cc.or.us/~tcwrc/tutorials/WATPER.HTM]:
  "This document, entitled A Watershed Perspective, is provides citizens and watershed councils with basic information on watershed characteristics, processes, and assessment. Information is based on

a literature review of federal, state, and local watershed publications. Words highlighted in the text are linked to a glossary; click once on the word to list definitions. After reading this document, proceed with the three watershed assessment modules contained on this CD-ROM. After reviewing A Watershed Perspective and completing the assessment modules, citizens can begin to identify and address concerns in Tillamook Bay Watershed management." ..The Tillamook Bay Watershed is located approximately 77 km (48 mi.) south of the Columbia River and 96 km (60 mi.) west of the City of Portland.

- Environmental Organization Web Directory! [www.webdirectory.com/]:

  "Amazing Environmental Organization Web Directory! is the result of a group of hard working people dedicated to helping others keep in touch and informed on the World Wide Web. With thousands of sites, it is the largest exclusively environmental organization directory on the Web and includes sites from over 100 countries. Our goal is simple - to make it easy for people from around the world to find your web page. We currently have 23 terrific staff members - all dedicated to provide a free service to the environmental community."

- ENE Primers [www.cee.vt.edu/enviro/software/primers.htm]:

  "The Environmental Primers are an ongoing project by students in the Environmental Engineering *and Sciences Program at Virginia Tech. Each term, students in one or more classes are required to write a web page on a topic of their choice dealing with some aspect of the class. These pages are collected and incorporated into the Primer. This is a long term project. Further topics will be added each semester. The overall goal is a student-authored document that can serve as a resource to other students and the general public."*

- What is Risk? -- Principles, Policy, Papers, and Primers [www.em.doe.gov/irm/question.html]

- ATSDR - ToxFAQs (TM): Hazardous Substance Fact Sheets [www.atsdr.cdc.gov/toxfaq.html]:

  "The ATSDR ToxFAQsTM is a series of summaries about hazardous substances developed by the Agency for Toxic Substances and Disease Registry *Division of M N O Toxicology. Information for this series is excerpted from the ATSDR Toxicological Profiles and Public Health Statements. Each fact sheet serves as a quick and easy to understand guide. Answers are provided to the most frequently asked questions (FAQs) about exposure to hazardous substances found around hazardous waste sites and the effects of exposure on human health."*

- Climate Change - What is Climate Change - Primers, Pamphlets, Presentations [www.climatechange.gc.ca/english/issues/what_is/primers_pamphlets.shtml]

- Public "Primer" on Watershed-based Planning - Portland, Oregon [www.metro-region.org/habitat/goal_5_tech_report.pdf]:

  "This chapter provides a summary of recent scientific literature and studies relevant to the protection of fish and wildlife habitat. The purpose of this technical report is to provide a sound scientific foundation for public policy related to the management of fish *and wildlife habitat in the region .. A key goal of this technical report is to provide accessible information to help elected officials, planners, and the general public understand the needs of fish and wildlife, the effects of urbanization on these species, and the biological processes that support them."*

- Computational Science Resources: Environment [www.krellinst.org/AiS/textbook/resources/unit2/environment.html]:

  "The resources on this page relate to the environment and ecology. Included are links to environmental organizations, government agencies, sources of data and links to links. Since the environment is related to many other disciplines, you should also look at the resources on the biology, chemistry, geology, and physics pages. More resources will be on the general science page."

- FAQs (frequently asked questions) About Groundwater [www.epa.gov/seahome/groundwater/src/intro.htm]

  "This computer program presents the following: • The basic concepts of the hydrologic cycle, hydrogeology and supply and demand as they pertain to groundwater. • The contaminants that can affect water quality along with the risks these contaminants pose. • Activities that an individual or community can do to help protect and conserve groundwater. • Programs that are now in place at the federal, state, and local levels to help protect groundwater.

  The information in this program can be broken into two major categories: groundwater quantity and groundwater quality issues. Quantity issues includes such things as: "where does groundwater come from?", "how does groundwater travel?", "what is groundwater used for?", and "how can we preserve groundwater supplies?"

  Water quality issues considered are: "where do water contaminants come from?", "what treatment devices should be used for specific contaminants?", and "how can we modify our actions to preserve and improve groundwater quality?"

5.3.4.4 3A – One Window Approach

- ***MOEE to establish an MOU mandated one-window approach by all the regulatory authorities involved in approving PTTWs. One of the serendipitous findings of the search was the identification of a number of jurisdictions involved in permit reform. One of the major themes for permit reform was streamlining/one window/integrated application processes and tracking systems. In addition to the benefits of increased efficiency of the permitting processes, a one-window approach would benefit stakeholder involvement by simplifying and increasing the transparency of the review process.***

Purpose

To make the PTTW process simpler, more understandable and more transparent.

Key Factors for Success

Features:

- MOEE lead the development and implementation of a Memorandum of Understanding to create a "one window" approach to PTTW between all regulatory authorities (Federal, Provincial and local) who may be involved in reviewing and/or approving Permits To Take Water.
- Model the one window approach along the lines of the Ontario Low Water Response report:

  "Ontario Low Water Response (formerly Ontario Water Response-2000) is intended to ensure provincial preparedness, to assist in co-ordination and to support local response in the event of a drought. This plan is based on existing legislation and regulations and builds on existing relationships between the province and local government bodies .. This plan recognizes the partnership between provincial and local authorities and that natural resource and environmental management must be approached at both the provincial and local levels ... The roles and responsibilities of the province and its agencies are described ...." [Ontario Low Water Response, Ontario Ministry of Natural Resources, Ontario Ministry of the Environment, Ontario Ministry of Agriculture, Food and Rural Affairs, Ontario Ministry of Municipal Affairs and Housing, Ontario Ministry of Economic Development and Trade, Association of Municipalities of Ontario, Conservation Ontario, May 2001]

References

- Ontario Low Water Response model [www.mnr.gov.on.ca/MNR/water2000/OLWR_opt.pdf]
- SUPER Permit Reforms - Oklahoma Dept. of Environmental Quality

  "Environmental regulation in Oklahoma was a nightmare for industry at the beginning of the 1990s. Spread across a multitude of entities, the permit process was cumbersome *.. To remedy this "hodgepodge, the Oklahoma DEQ undertook a series of reforms aimed at streamlining the permit process and allowing for more stakeholder input at every stage. ..the Super program is not really a specific thing that a company can apply for. Rather it is a series of initiatives that DEQ has undertaken to make the process of environmental permitting simpler and more understandable .. These included creation of a uniform permit process, customer involvement, better use of technology, permit tracking, permitting tiers, simplification, and better oversight processes"* [The New Environmentalism, Reason Public Policy Institute, Los Angeles, CA]

- OPC Permit Reform - Mississippi Dept. of Environmental Quality

  "In 1997, the Office of Pollution Control (OPC) within the Mississippi Department of Environmental Quality (MDEQ) began reengineering the process of permitting in the state. OPC's ultimate goal was to change the system from a traditional, single-media permitting process to a new "one-stop" approach. ..The reengineered permitting plan includes a variety of innovations to improve the efficiency and quality of environmental protection.

First, the new plan called for the creation of an Environmental Permits Division to undertake all permitting functions regardless of media. The media divisions now act as advisors, aiding the Environmental Permits Division by making recommendations regarding permit applications for their respective departments.

Second, the new system calls for a single point of contact – a Permit Manager – to be responsible for all the permits required for a given facility. The Permit Manager will either act alone or lead a team of permit writers depending upon the complexity of the permits required for a given facility." [The New Environmentalism, Reason Public Policy Institute, Los Angeles, CA]

5.3.4.5 5A – Proponent to Publish an Annual Report Card

- ***MOEE to require the proponent to publish an annual report card and maintain ongoing communication with interested stakeholders***

Purpose

To create a longer term public accountability mechanism for potentially high risk and/or contentious PTTW.

Key Factors for Success

Features:

- *"Demonstrating success is one of the more challenging, yet necessary, aspects of the implementation process. This is true for several reasons. From a technical perspective, the linkage between management actions and environmental benefits that result from those actions is not always clear .. Even in cases where improvement in environmental indicators can be measured and linked to actions that have been implemented, these indicators may not always be meaningful to the public in terms of "success." For example, it may be difficult for the general public to see how increases in dissolved oxygen levels in the water column, or decreases in sediment contaminants, equate to improvement in the quality of resources they care about, such as recreational uses, shellfish areas, or habitat. With these challenges in mind, three basic factors should be carefully considered when addressing the need to demonstrate success.*

  First, a clear and realistic definition of successful implementation should be developed and communicated to all stakeholders. ... this definition is typically driven by the goals and objectives developed during the planning process. Considered in total, the achievement of these goals and

objectives equates to the yardstick that the stakeholders will use to determine if progress is being made during the implementation process.

Second, appropriate and measurable indicators should be selected that track with this definition..

Third, results should be communicated through avenues and in terms that are meaningful to all stakeholders." [Case Studies: Organizational Structures Relevant To Implementation of Comprehensive Conservation Management Plans, EPA , Office of Wetlands, Oceans, and *Watersheds*, 1995]

- *"As the UCLA Institute of the Environment's Southern California Environmental Report Card noted in its 1999 Report Card, "The complex problems we face are institutional as well as technical. Their solution requires more than a single discipline. Our approach is to integrate research among many disciplines. The Institute represents more than 50 professionals with knowledge spanning environmental fields from 20 different disciplines ... As discussed in more detail by our Editors, we hope each Report Card is an accurate, unbiased and understandable account of environmental issues."* [www.ioe.ucla.edu/publications/report99/ director.html]

References

- Green Permits Program - Oregon - Dept of Environmental Quality (DEQ)

  "Public Reporting and Stakeholder Involvement : Publication of annual performance reports and ongoing communication with interested stakeholders ensures ongoing environmental improvements." [Permits Handbook, pp. 86-87, Chapter 10.. "DEQ Online" the official web site of the Oregon Department of Environmental Quality]

- THE FUJIFILM ENVIRONMENTAL REPORT / 2000 EDITION

  "At our company, efforts toward environmental measures are based on the following three points:

  1. *care for the natural environment (harmony between humans and nature);*
  2. *the assurance of safety with regard to chemical substances; and*
  3. *source reduction (not wasting resources, which are limited)..*

  Our company's fundamental approach is to work toward the realization of Responsible Care, an international effort, through management systems that conform to ISO 14001, which is, similarly, a worldwide standard. We began these efforts before an ISO 14001 certification system was inaugurated in Japan, and, when this system was first implemented (fiscal year 1996), all four of our factories in Japan acquired certification..

In the context of RC, communication with all stakeholders is an important issue. Environmental Reports constitute one example of efforts directed toward that issue. We began publishing annual environmental reports in 1996 and are continuing this important effort with this edition for the year 2000." [http://www.fujifilm.co.jp/kankyoreport/index.html]

- IDEM Monthly Status Report on Environmental Permits

  "The Indiana Department of Environmental Management Status Report on Environmental Permits, part of the Commissioner's monthly Report to the Environmental Quality Service Council (EQSC), is produced by IDEM to track monthly permit related decisions and permit fees collected. The Commissioner's report also includes Rulemaking Activities, Permitting Program Areas' Monthly Permit Report Cards, as well as Outreach, Education and Assistance Activities." [www.in.gov/idem/permitreport/]

- Nuclear Report Cards and Publications -Ontario Power Generation [www.opg.com/ops N_pub.asp]

  "OPG releases report cards which benchmark the performance of our nuclear operations against nuclear industry standards and measure program effectiveness on a number of key indicators, emphasizing public and employee safety and environmental and production performance. OPG is currently developing a new report card, to be issued on a quarterly basis starting at the end of July 2002."

- Southern California Environmental Report Card [www.ioe.ucla.edu/publications/report99/director.html]

  "Our objective in this and future Report Cards is to focus attention on environmental issues that affect the quality of our lives. We hope to issue a "call to action" when there are problems, as well as recognize decision-makers and the public when credit is due. In this edition of the Report Card, we have a mixed record of successes and failures. We also suggest actions that can be taken to further improve the environment."

We conclude this chapter on stakeholder involvement with the following quote from the National Academy of Public Administration Panel on Civic Trust and Citizen Responsibility [June 1999]:

"Government programs are improved and civic trust is substantially elevated when government agencies reach out to engage citizens directly in agenda setting, program development and policy implementation. Agencies that do this soon learn that citizens have much to add, that they are important repositories of experience and ideas. Citizens benefit as well from the opportunities to see problems from broader perspectives and from the enhanced civic skills that come from working with trained government professionals and other citizens in problem-solving activities."

6. Recommendations

The review of existing and best scientific practices in assessing the impact of water taking on the ecosystem, including the public involvement practices has identified many action items. Table 8 in Appendix D provides a succinct list of prioritized recommendations for improvements to current practices and for future research or pilot testing. It is intended to provide the basis for future work to be undertaken in Phase 2 of this project. An attempt has been made to prioritize these items, and list whose responsibility they may be. The following sections discuss these in the context of present practice and the gaps in present practice.

Table 8. Phase 2 Recommendations

Table 8 is located in Appendix D

6.1 Responsibilities

In the short term there are several tasks that need to be addressed. The present state of knowledge for water usage is not consistent across the Province. Several Conservation Authorities (e.g., GRCA, CVC) have been developing watershed management plans and have completed the inventory of most of their watersheds. The state of knowledge in the other major watersheds is not nearly as well developed. If proponents of water taking are going to be able to affordably determine the cumulative effect of their proposals, then this work will have to be undertaken Province-wide. The responsibility for this lies with the conservation authorities, with support from the Province as it is permitting is a Provincial responsibility.

Through the consultation process on this project it has become apparent that there has been no comprehensive accounting for current water usage. Through the PTTW database, one can determine the total permitted usage, which provides an upper bound. Since there is no consistent reporting of actual volumes used (both consumptively and non-consumptively by water takers) the water volume that is actually taken is unknown in all MOE regions. A program should be initiated by the Province to require all Permit holders to report actual usage on a monthly basis to a central database. This would create an immediate tool for assessing cumulative impact and for assessing all applications for water taking.

There is a wide range of practice amongst different stakeholders in terms of the required amount of technical information needed to support applications for PTTW. The agricultural community only require PTTW for irrigation operations, and the level of detail is very low. Consumptive water users are required to provide substantially more detail. Similarly there have been cases where those in high profile water taking activities are required to provide such detail, even though a formal policy needs to be developed by the Province clearly outlining the level of detail required for the different sectors. An education initiative for both the sectors and the technical practitioners needs to accompany this to ensure a level playing field. It will be the responsibility of the practitioners to adhere the good and acceptable practices provided in this report, and to keep informed as these are modified from time to time. Consideration should be given to assembling a list of qualified professionals to allow the dissemination of future information, as well as to solicit for support in future revisions.

6.2 Improved Practices

The purpose of this section is to identify where future work is needed to develop Ontario specific methods. Opportunities are broken down by discipline, however the interdisciplinary nature of the ecosystem mandates that development of these tools is done in concert.

6.2.1 Groundwater

As described in Sections 4.1 and 5.3.1, existing groundwater practices are proven and available, and are used by many (but not all) practitioners[11]. While none of these methods directly address ecosystem effects, they can be used to indirectly measure habitat parameters. As part of the development of methods to measure ecosystem conditions, groundwater tools need to be incorporated. From a monitoring perspective, these include measurement of groundwater levels, groundwater flow directions, groundwater quality, and streamflow. These measurements need to be made on a seasonal basis and related, by way of meteorological records (precipitation and temperature measured on-site or from regional stations), to the range in long term conditions as long as the aquatic or habitat response is not irreversible.

The use of long-duration pump tests to assess the impact of a water taking on not only ground/surface water, but on the aquatic and/or terrestrial habitat needs to be formalized. These tests are not tests for operational yield, but to induce a realistic change that these other features can effectively be monitored for. (For example, a constant flow test, while necessary for assessing aquifer characteristics, is not as effective as a stepped pump/recovery test carried out over many weeks to assess habitat response.)

11. Practitioners are those in the educational, consulting and government research fields.

6.2.2 Surface Water

There is no shortage of methods to determine a threshold flow in a watercourse below which all taking must cease. The majority of these methods may be termed hydrologic methods, which are based on flow statistics computed using historical flow data. An assumption is made that somewhere within the range of flows experienced by a reach of river is a flow at which the aquatic ecosystem is affected to an extent that is unacceptable. This threshold is usually set toward the lower end of the range as described above.

The magnitudes of the thresholds specified by the various methods are quite different. The reason for these variations is that the development of these methods seldom includes any significant assessment of the aquatic ecosystem. Little effort has been made to determine a flow rate for a reach at which the aquatic ecosystem is unacceptably affected, and then evaluate this flow in the context of the range of flows experienced by the reach. Where no data exist a baseline of measured flows should be collected under baseflow conditions and comparison made to other similar cases where conditions were understood.

The first step toward developing a standardized approach to setting threshold flows is to define what is meant by an unacceptable impact to the aquatic ecosystem. The definition should take into account different species of fish as well as different life stages, and should consider chronic effects from the decreased variability of flow as well as acute affects from individual low flow events. After defining what is meant by an "unacceptable impact" it will be necessary to determine this point in different watercourses for which flow data are available. Flow statistics would then be computed from the flow data and compared to the unacceptable impact level in an effort to develop some relationship for streams in Ontario.

The wetted perimeter method should also be tested to determine how the predicted threshold compares to the unacceptable impact level.

6.2.3 Aquatic Habitat

As indicated in Section 4.3 and in Table 6, there are three general categories of methods being used to determine threshold flows for aquatic environments: Historical flow methods, Hydraulic methods and Habitat methods. Several methods within each of these categories has the potential to be used in Ontario, but currently many of the methods being used in other jurisdictions have not been tested or validated in this province. Of the methods discussed, we would recommend testing and validating the Tennant Method, Wetted Perimeter Method and the Physical Habitat Simulation Method (PHABSIM) in different systems and under different water taking scenarios within Ontario. The testing should be rigorous, long-term (>5 years) and involve water extractions that stress fish populations. The research should involve validation and correction through an operations process.

A short-term stress on the population is required because researchers do not know the short-term response to high stress. In order to determine the amount of water that can be extracted without causing a HADD, a reaction in the population needs to be triggered (Power pers. comm. 2002). The work must be done under the strictest of controls, supervised by an experienced fisheries biologist, when the DFO are participating, they should be consulted on the proposed method. With this approach, long-term effects can be projected from the short-term responses and methods can be continuously modified.

6.2.4 Terrestrial Habitat

Section 4.4 detailed the effects that can be expected to occur in wetlands as a result of water taking. The fact that these effects occur is documented, as the literature search revealed. However, the thresholds at which change begins to occur, and the rate at which change occurs relative to changes in depth to water table, flooding frequency and duration, and depth of flooding are not well understood.

Wetland science in the United States is focused on delineation of wetlands, and creating wetlands elsewhere in compensation for those removed through development practices. There is little attention paid to the low level effects of water takings. Therefore, recommendations to improve this science point to the necessity of monitoring wetlands using an integrated approach that incorporates hydrogeological, hydrologic and biological monitoring methods. This also requires incorporation of climatic data to which wetlands may respond dramatically. We require an opportunity to test the effects of wetlands on altering flooding regimes and water tables under relatively controlled conditions in order to evaluate the results on wetland functions and attributes.

Further research is also required into the evapotranspiration rates of wetland plants in Ontario. The current surrogates are unlikely to accurately reflect conditions in wetland communities, which in turn, introduce error of unknown proportions into the calculation of water budgets.

Others have examined the hydrogeology of swamps and peat fens located in central Ontario, with interesting results. However, the function of peat on perching the water table, and the effect on water head in relation to the plants obscures any deduction that may be made regarding thresholds for water taking under these circumstances.

Therefore, our best opportunity for improving our methodology with respect to wetlands is through improved wetland monitoring (which is rarely undertaken currently), and an assessment of wetland response over time.

6.2.5 Stakeholder Involvement

Section 5.3.4 outlines the proposed good practices with respect to Stakeholder Involvement. It is recommended that this be tested on a pilot basis for several different sectors. A draft stakeholder involvement document could be produced and made available to any proponent wishing to voluntarily use the approach recommended here. This should probably focus on the more controversial types of water taking applications, both consumptive and non-consumptive.

6.3 Concept of Environmental Weighting

Section 4.2.1.1.2 of this report outlined the approach used in England under their SWALP program, whereby surface water is environmentally weighted on the basis of sensitive ecologic function. More sensitive streams for example have higher threshold flows than less sensitive streams. This concept was grasped by some members of the study steering committee as having potential merit for application in Ontario. A conceptual *decision tree*[12] was developed by the study team on a trial basis during the course of this study. It has not presented as the assessment methods needed determine decision points are not yet available (and should be developed as part of the results of Phase II of this project). The following discussion elaborates on this, and although it focuses on watercourses, there may be some merit in applying it to groundwater resources.

Section 4.3.1 identified that in smaller streams the quality of the habitat is more important than the quantity of flow. This example demonstrates that there are likely opportunities to classify sensitivities to water takings based on the size and habitat function. There is potential that a decision model, like the decision tree, could be developed that uses information on the sensitivity of a source along with information on a proposed water taking. This decision model could determine the degree of protection warranted by tailoring instream flow thresholds to the watercourse size or position in the watershed. It could also determine the level of technical evaluation required for a particular undertaking. For example, small streams require a higher proportion of the natural stream flow to maintain minimum habitat than do large streams, so the percent taken may trigger more complex investigation. The decision model might also determine the extent of stakeholder consultation.

A member of the steering committee pointed out: "It may be that there are a suite of best practices, as opposed to a single best practice, that ought to be used. Instead of using a one-size-fits-all approach, a scheme for classifying sources and takings could be used to ensure the best practice is employed for evaluating any given water taking proposal." The forgoing report certainly makes this case. This opportunity, to use environmental weighting to develop a decision model, should be pursued.

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12. A decision tree is a flow chart that examines fundamental questions about an undertaking and directs the user to different courses of action, depending upon the answer to the questions.

6.4 Adaptive Environmental Monitoring System (A.E.M.S.)

An Adaptive Environmental Management System (AEMS) is a system that is designed to react to changing conditions in the environment. When applied to a water taking, the nature of both the taking and the monitoring are adapted to vary as conditions change. For example, when drought conditions affect a watershed, water taking can voluntarily be reduced in response to monitoring triggers. The same principle can be applied to the dry time of the year. The triggers can be pre-determined in terms of water levels, streamflow, or other practical and easily measured parameters. There are typically three levels of triggers[13]. The first is the *Early Warning Level*, where increased monitoring frequency and/or additional locations are begun. The second level is the *Action Level*, where a progressive reduction in the level of taking is implemented to maintain acceptable streamflow or water levels. The final level is the *Threshold Level* beyond which all water taking is stopped.

The AEMS approach is flexible and responsive to actual field conditions. Triggers can be in the form of water levels, streamflow, presence of fish, etc., and can be seasonally adjusted depending upon the nature of the taking. Monitoring can be manual if the operations permit it, and or remote through data logger and telemetry technology for more remote sites. Attention must be paid to extraneous forces, for example wildlife such as beavers can affect results, so that false compliance issues do not arise.

Adopting an AEMS approach to monitoring is recommended. As can be easily anticipated, triggers and levels of water taking are site specific and cannot be selected using a "standards" approach. As described in Section 5.1, the AEMS will be particularly important in the interim two year period of a granted PTTW. The principles should however be adhered to even in the longer term period, although an established taking may not require as much monitoring and the AEMS could be scoped to key areas. As of this writing several PTTW in one sector (water bottling) are incorporating this approach. It should be pilot tested in other sectors as well, particularly related to surface water takings.

13. By way of clarification, these three levels do not correspond to those of the Low Water Response protocol.

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Mr. Douglas Jones	• Surface Water Flow	Gartner Lee Limited
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Appendices

Appendix A

Table 6. Historical Flow Methods

Appendix A. Table 6 – Historical Flow Methods

Method	Sources	Function	Appropriate Scale	Assumptions/Limitations	Level of Effort/Data Requirements	Location(s) Applied[1]
Standard Setting Methods (Historical Flow Methods)						
New England Aquatic Baseflow (ABF)	Larson 1981, Kulik 1990	- This method recommends the August median flow as a minimum instantaneous flow requirement unless additional, seasonal releases are needed to protect fish spawning and incubation. During the spring and fall/winter periods, the respective recommendations are the April/May median flow and the February median flow	- Reach	- low flow conditions during August represent a natural limiting period due to reduced living space, high water temperatures and low dissolved oxygen. Because stream organisms have evolved to survive these periodic flow conditions without major, long-term population changes, a base flow equal to the August median flow should perpetuate them (Annear et. al. 2002). - Biology is addressed using hydrology as a surrogate for habitat. - Does not require a site visit - Streamflow records reflect an unstressed fishery/watershed. - Relates primarily to the low flow period in the northeastern study streams where it was developed and may not be applicable in other regions.	- Office technique that requires little effort. - It uses long-term gage records or default values. - The watershed area at the project must be determined and is usually measured from existing maps.	New Hampshire, Massachusetts, New Jersey, Vermont, West Virginia,
60% duration flow summer months	Ministry of Environment and Energy.	- Flow (Q) ≥ (60% duration flow) 60% of the time in summer	- Reach	-	- Office technique that requires little effort. - It uses long-term gage records or default values. - The watershed area at the project must be determined and is usually measured from existing maps.	S. Ontario
Median monthly flow	Bovee 1982	- Median flow for each month	- Reach	- acts as a surrogate for the natural annual pattern of stream flow because it provides a flow that typifies historical flows for each month.	- Office technique that requires little effort. - It uses long-term gage records or default values. - The watershed area at the project must be determined and is usually measured from existing maps.	U.S.A. – no specified state identified
$7Q_{10}$	Velz 1984, Annear et al. 2002.	- The $7Q_{10}$ is not an instream flow method. It is a flow statistic used for identifying the volume of water needed to meet point discharge water quality thresholds. - The hydrologic statistic has often been misused as a minimum flow for keeping fish alive - Lowest 7-day avg. flow in a 10-yr period - This statistic is a flow statistic used to simulate drought conditions in water quality modeling to evaluate waste load allocation	- Reach	- Assumption is that sewage treatment can be designed to discharge during low flow conditions such that the integrity of the receiving water body is protected. - This method does not protect aquatic life (Camp, Dresser and McKee 1986 in Annear et al. 2002) and its use as a standard to do so is inappropriate. - The $7Q_{10}$ for some streams is zero – aquatic life needs more water.	- Long term stream flow data	S. Ontario (Canada), Georgia, Massachusetts, New Jersey, Pennsylvania, Virgina
10% method		- 10% of mean annual discharge (MAD)	-	-	-	S. Ontario
Tennant (Montana) Method	Tennant 1976; Annear et al. 2002	- Tennant recommended different percentages of the mean annual flow during different periods of the year (October – March and April – September) to support varying	- River segment	- Assumes that the various percentages of average annual flow are appropriate for maintaining habitat quality, that the time periods for providing different	- Low level of effort - Long-term stream flow data	**CANADA** – Alberta, British Columbia, Manitoba, New

1. *Canada and U.S.A locations are derived from: Resier, D.W., Wesche, T.A. and Estes C. 1989. Status of Instream Flow Legislation and Practices in North America. Fisheries, 14 (2): 22-29.*

Method	Sources	Function	Appropriate Scale	Assumptions/Limitations	Level of Effort/Data Requirements	Location(s) Applied[1]
		qualities of fish habitat, such as: ➢ flushing – 200% ➢ Optimum – 60-100% ➢ Outstanding – 40-60% ➢ Excellent – 30-50% ➢ Good – 20-40% ➢ Fair – 10-30% ➢ Poor – 10% ➢ Severe degradation - <10%		levels of flow are appropriate and that if calibrated to the local hydrologic and biologic conditions, the method is transferable from the streams Tennant used to develop the method to those under current study - Fish habitat will be protected under different recommended flow regimes - Tennant never intended users to select one flow from his table (e.g., 30% average annual flow) to be used as the only flow needed. - Should be associated with analyses of biological habitat needs at various times of year to be most useful in a specific region. - Prescriptions are only as good as the hydrologic records on which they are based.	- Watershed area	Brunswick, Nova Scotia, Newfoundland, Quebec – Labrador, Ontario **U.S.A.** - mid-west, Great Plains, and intermountain west: Montana, Wyoming, Nebraska, Alabama, Alaska, Indiana, Missouri, North Dakota, Pennsylvania, Utah, Washington, West Virgina
Modified Tennant Method	Stalnaker et. al. 1995	- This approach calls for the repetition of all Tennant's steps. However the analyst would begin by observing habitats known to be important in the species life history and by studying the stream during flows approximating various percentages of the mean annual flow.	- Reach	- The new table would reflect the empirical observations of the analyst, instead of Tennant, and would be tailored specifically to the species and stream of interest.	- cross-sectional width - depth - velocity and stream flow data	U.S.A. – no specified state identified.
Standard Setting Methods (Hydraulic Methods)						
Wetted Perimeter Method (WPM)	Nelson 1980	- Uses a graphical representation of the wetted perimeter versus discharge as a surrogate for physical habitat. It selects the breakpoint on this graph as the prescribed instream flow.	- Reach	- Assumes that the flow represented by the breakpoint will protect the food producing riffle habitats at a level sufficient to maintain the existing fish population at some acceptable level of sustained production. - There will be running water at the shore where undercut banks, exposed roots, etc., will provide cover and rearing habitat; - The water width will be sufficient to catch all or most of the terrestrial insect fallout and leaf detritus; - Streamside grasses and shrubs at or in the water margins will provide cover and habitat - The effect of solar radiation on water temperature will be reduced because of shade from banks and overhead canopy. - Should not be applied to pool cross sections or to alluvial streams that are usually low gradient, meandering, and have pool-crossing bar features. - Not useful in streams without riffle/run/pool sequences. - Should be restricted to bedrock-controlled high gradient streams with well-defined rectangular-shaped riffles and no significant floodplains. - If used in other streams, it should be considered as	- Several visits to the site at numerous discharges (10 or more) are necessary if empirical relations are to be used - With hydraulic models, less than one day is needed - Physical cross-section data - Flow measurements	**CANADA** – British Columbia, Ontario **U.S.A.** – Idaho, Michigan, Montana, North Carolina, Mississippi, Virgina

Method	Sources	Function	Appropriate Scale	Assumptions/Limitations	Level of Effort/Data Requirements	Location(s) Applied[1]
				only one component of a recommendation that uses additional analyses. - Only addresses low flows (usually summer/fall) and does not address intra-or inter annual variability.		
Thompson Method	Thompson 1972 (Oregon State Game Commission, Environmental Management Section)	- Establishes minimum flows for salmon and trout to accommodate passage, spawning, incubation and rearing by using physical stream habitat measurements and linking it back to flows in the creek.	- Reach	- only verified in Oregon on salmon and trout	- life history requirements for fish species - stream flow data during different seasons	Oregon – U.S.A.
Single Transect Hydraulic-Based Habitat Methods	Developed by the U.S. Forest Service (Anonymous 1974; Rose and Johnson 1976 in Annear et al. 2002)	- These methods represent a transect approach for quantifying minimum or base flow values for times of year when streamflow is at its lowest. - The purpose of the methods is to identify flows sufficient to provide a minimum or basic survival level of fish hydraulic habitat. - A stage-discharge relation is computed using Manning's equation and the prescribed instream flow is the discharge that provides the percent of wetted perimeter, average depth, and average velocity as specified by the particular method.	- Reach	- Assumes that if adequate wetted perimeter, average depth, and average velocity are maintained over the shallowest portion of stream riffles (the hydraulic control), then the hydraulic habitat will be sufficient to sustain the fishes and macroinvertebrates in all other parts of the stream reach as well. Also assumes that water quality, sediment transport, and channel geometry are acceptable and will not change or that flows to maintain those functions and processes are provided based on other methods. - Limitations are that the method does not consider and ecological components other than biology/habitat and then it only yields a single flow - The selection of study riffles and placement of transects requires a skilled practioner.	- Requires medium level of effort. - Site specific data at one or more transects across the stream and computer generated hydraulic characteristics are needed.	U.S.A. – no specified state identified
Washington Toe-of-Bank Width Method (Toe-Width Method)	Collings et al. 1972; Collings 1974 and Swift 1976 in Annear et al. 2002.	- A model used primarily in western Washington on alluvial channel streams to determine flows that maximize preferred depths and velocities over suitable spawning gravel. - The method employs several equations with channel cross-section parameters for different species and life stages. - The purpose of the method is to determine flows that provide adequate spawning and rearing habitat for anadromous salmonids	- Reach	- Assumes that spawning or rearing habitat are limiting factors for production of anadromous salmonids in Washington, and flows that maximize these habitats can be predicted using regression models - Limitation is that recommendations resulting from application of the method are within the order of magnitude of naturally occurring flows for the activity (spawning or rearing) in most streams of the size for which the method was developed. - In smaller streams, the model generates flow recommendations that exceed typical flows, and in larger streams (>5,000 cfs mean annual flow) the method generates recommendations that are much lower then the lowest flows on record.	- Requires a minimum level of field work. - Widths between toes of bank and average toe-of-bank widths - Stream flows - appropriate equations	Washington (U.S.A.)

Method	Sources	Function	Appropriate Scale	Assumptions/Limitations	Level of Effort/Data Requirements	Location(s) Applied[1]
Incremental Methods (Habitat Methods)						
Physical Habitat Simulation Model (PHABSIM)	Developed by the U.S. Fish and Wildlife Service, Cooperative Instream Flow Service Group (CIFSG) (Bovee and Milhous 1978, and Milhous 1979); Annear et al. 2002	- A computer model that is used for quantifying the suitable versus unsuitable hydraulic habitat attributes of selected species and life stages as a function of discharge. - It is a major component of IFIM[2], which is a process not a model. PHABSIM incorporates hydrology, stream morphology, and microhabitat preferences to generate relationships between river flow and habitat availability. - The purpose of PHABSIM is to develop the relation between hydraulic habitat features and discharge for individual species and life stages of fish or macroinvertebrates in specific river reaches.	- Results are based on microhabitat and are applied to mesohabitats and river reaches.	- Most expensive - Technical - Ecological interactions (e.g., competition and predation) are not accounted for - Large data requirements - Extensive computer use - Most time consuming method to execute - Not appropriate if the fish population is not limited by stream flow. - Not appropriate for multi-channel rivers, streams with uniform flows (springs), heavy weed growth, shifting channels, ice cover, or at streamflows much greater or less than the calibration streamflow. - Limited by the availability of appropriate habitat preference data. - The data should be specific for the river and fish species under consideration - Can't be used in turbid rivers (can't see the positions occupied by the fish), or in non-wadable streams (because most habitat preference data has been collected from wadable streams) - Results are user dependent - Many of the underlying assumptions are rarely tested - Results are almost never verified or monitored	- physical cross-sectional data - habitat features - long-term flow data - species suitability criteria	**CANADA** – Alberta, British Columbia, Manitoba, New Brunswick, Nova Scotia, Newfoundland, Labrador, Ontario **U.S.A.** – Colorado, Alabama, Alaska, Arizona, Arkansas, California, Georgia, Idaho, Illinois, Indiana, Kansas, Maine, Mississippi, Missouri, New Mexico, New York, Ohio, Oklahoma, Oregon, South Dakota, Tennessee, Texas, Utah, Virgina, Washington, West Virgina, Wisconsin, Wyoming,
PHABSIM/MAD equation	Hatfield and Bruce 2000	- used as a planning tool - PHABSIM and Mean Annual Discharge (MAD) are used to develop equations for determining optimum flows for 4 fish life histories	- Results are based on microhabitat and are applied to mesohabitats and river reaches.	- developed for western North America - developed for salmonids - has similar issues as above for PHABSIM	- watershed area - gradient	Western North America (Alaska, British Columbia, Washington, Idaho, Oregon, Nevada, and California)
River Hydraulics and Habitat Simulation	Jowett 1999	- Developed to provide hydrologists, engineers and resource managers with an integrated solution to some of the more common hydrometric and hydraulic computations, such as: calculation of flow, stage/discharge rating curves, hydraulic parameters, water surface profile analysis and incremental flow analysis of stream depth, width, velocity, and instream habitat	- Results are based on microhabitat and are applied to mesohabitats and river reaches.	- based on the U.S.A. PHABSIM model	- physical cross-sectional data - habitat features - long-term stream flow data - species suitability criteria	New Zealand
Habitat Quality Index (HQI)	Binns 1982	- Attempts to correlate physical stream attributes with fish population sizes. - It is developed by regressing several habitat variables against the standing crop of fish	- Reach	- stream specific - recommendations are related to critical low flows - only applicable to trout	- physical stream data - fish habitat data - Biomass data	Wyoming
Two-Dimensional Hydraulic Models	Ghanem et al. 1994; Leclerc et al. 1995 in Annear et al. 2002.	- Two-dimensional hydraulic models are computer models that are useful for simulating velocity patterns throughout a stream reach. They can be linked with hydraulic habitat models (e.g., physical Habitat Simulation [PHABSIM]) to simulate habitat characteristics at unmeasured discharges.	- Reach	- Assumes that theoretical equations of physical processes along with a description of stream bathymetry (using x, y, and z coordinates) provide sufficient input to simulate velocity distributions throughout a stream reach.	- stream bathymetry data - long-term stream flow data - if used with PHABSIM, then more data is required	U.S.A – no specific state identified

2. *IFIM is a process, not a model. It evaluates the effects of incremental changes in stream flow on channel structure, water quality, temperature, and availability of suitable microhabitat in order to recommend a flow regime that will maintain existing habitat conditions. IFIM contains the following models: institutional analysis (LIAM), physical habitat simulation (IFG-4, WSP, HEC-2, HEC-6, HABTAT, HABTAV, HABEE), temperature (SRTEMP, SRSHADE, SNTEMP, SNSHADE), water quality (QUAL-2E), total habitat (HABNET), hydrology (WATSTORE), time series library (HABTS, HABNET, LPTDUR, ANNTS, LNK12H), effective habitat (EFFHAB, ANEQTS).*

Method	Sources	Function	Appropriate Scale	Assumptions/Limitations	Level of Effort/Data Requirements	Location(s) Applied[1]
Biological Response to Flow Correlation Method	(Neave 1949, Mckernan et al. 1950; Smoker 1953, 1955; Swift 1976; Binns and Eiserman 1979; Mathews and Olson 1980; Frenette and Julien 1984; Anderson and Nehring 1985; Conder and Annear 1987; Bovee 1988; Fausch et. 1988; Hvidsten 1993; and Nehring and Anderson 1993) in Annear et al. 2002)	- The Biological Response to Flow Correlation method establishes a relation between biological data or habitat quality and hydrology or other components or combinations of components (e.g. hydraulic habitat, geomorphology, water quality) - The purpose of the method is to identify correlation's between biological response or habitat condition and flow-related variables. -	- Reach, subwatershed, watershed, region	- Assumption is that some independent variable, such as flow, or a combination of variables, exerts a significant enough affect on the biological response or habitat condition that the effect can be described by development of a statistical model. Once developed, the relations can be used to predict the biological response in streams and stream types for which the relation was developed. - Limitation is that some models may require existing data on flow and an associated response for use to be practical. Regression or other statistical tests used to develop the model or relation do not directly identify flows that should be provided or protected, but indicate the effect of flow or some habitat index on biological response - Results are often used in conjunction with river management objectives for population or habitat management to quantify flow need.	- The level of effort for this technique is initially moderate to very high. - Gather data on biological response of interest (population size, year-class strength, average growth, condition) or habitat condition or quality; tabulate corresponding flow statistic of interest (e.g., peak flow, low flow, average flow, average flow over a period); and run regressions of biological response against flow statistic of interest. - Once a significant correlation has been established, these regressions can be used for management decisions on that stream to assess the adequacy of existing flow patterns or the potential benefit of modified flows or flow regimes.	U.S.A – no specific state identified
Feeding Station Method	Fausch 1984; Beecher 1987; Washington Department of Fish and Wildlife and Department of Ecology 1996) in Annear et al. 2002.	- The Feeding Station method describes a feeding habitat index based on areas of slow water adjacent to faster water that meet or exceed depth thresholds. - The method attempts to identify the discharge that maximizes the number of feeding stations for trout, using hydraulic simulation. - It serves as an alternative to conventional weighted usable area (WUA) and relies on concepts of Bachman (1984) to provide a comparison to WUA, which in the early 1980s made intuitive sense but was unvalidated.	- Microhabitat	- Assumes that trout select feeding stations (microhabitat) based on hydraulic habitat (i.e., consisting of slow water immediately adjacent to faster water). Presence of the described feeding areas enhances salmonid production. - Limitation is that the method is very scale dependent: distance between verticals (cell width and transect placement) must match the actual search range of the species of interest. Otherwise you can underestimate actual feeding stations. - This method has resulted in inadequate flow recommendations and should not be used without additional research.	- The model requires a high level of effort in the field and in the office. In addition to hydraulic modelling requirements, the model requires manual review of each cell within a hydraulic simulation and its relation to adjacent cells at every flow of interest.	U.S.A. – no specific state identified
Plunge Pool Method	Washington Department of Fish and Wildlife and Department of Ecology 1996 in Annear et al. 2002	- The Plunge Pool method is an empirical method designed to provide a mixture of fast flowing, turbulent plume and slow, deep water in steep bedrock channels or channels formed by very large boulders (greater than 1 m diameter) - The intent of the method is to establish minimum flow standards and operational flow regimes in high gradient, bedrock or boulder-controlled trout streams.	- Mesohabitat, reach	- Assumes that although pool area changes little with flow, maintenance of a high velocity plume at the head of a plunge pool transports greater amounts of food and is important for fish production. - Limitations are that the method is only applicable to high gradient, cascading bedrock or boulder streams inhabitated by trout. - It does not address other biological aspects, such as spawning, incubation, or migration flows	- Level of effort is moderate to high - Field effort is high but interpretation is simple. - Pool transects are required. - Determine flow that provides greatest area of deep, calm water.	U.S.A – no specific state identified

Riverine Community Habitat Assessment & Restoration Concept (RCHARC) Method	(Nestler et al. 1993, 1996 in Annear et al. 2002)	- This is a transect-based model that examines the spatial and temporal distribution of depth and velocity, as a proxy for habitat conditions, to compare different water management alternatives.	- Reach or segment	- **Assumptions:**
				  - River channels are stable
				  - Transects accurately characterize habitat conditions
					- Requires minimal fieldwork.
					- Transect data must be obtained
						Originally developed by the U.S. Army Waterways Experimental Station

Method	Sources	Function	Appropriate Scale	Assumptions/Limitations	Level of Effort/Data Requirements	Location(s) Applied[1]
		- The models purpose is to assess depth and velocity distributions among alternative management scenarios.		- Depth and velocity distributions measured in the reference river represent ideal conditions - Depth and velocity distributions adequately represent habitat conditions - The depth and velocity distributions for mean monthly flows adequately represent the intra-annual variability - Target rivers are similar to the reference river - **Limitations:** - It does not consider the needs of some organisms for special low flows - Does not address the needs of specific species and life stages and their special seasonal flow needs if outside the monthly mean. - Habitat conditions may not be adequately represented if transects are not located primarily with habitat in mind, are insufficient in number, or measured with a minimum number of verticals - The use of mean monthly flows may not adequately consider specific flow requirements (magnitude and temporal aspects) of certain life stages of aquatic organisms. -	- Hydrologic data are necessary - Analysis can be done by computer with commonly available software.	and used on the Missouri River to assess flow management alternatives
Habitat Suitability Index	F&W Dept. of Interior ('80's)	- Applies to trout and other species	- Mesohabitat	- species specific method - Not specifically linked to changes in flow	- s/a	U.S.A. – no specified state identified

Appendix B

June 12, 2002 Synthesis Session

Oliver, Ocean & Company

Gartner Lee

Appendix B

June 12, 2002 Synthesis Session

Best Practices Workshop Invitation List

Participant	Affiliation
Bruce Hawkins	MOE Water Supervisor
Paul Odom	MOE Water Supervisor
Robert Ryan	MOE Water Supervisor
Clyde Hammond	MOE Water Supervisor
Dave Hollinger	MOE Water Supervisor
Claude Lafrance	MOE Tech Support Manager
Bonnie Fox	Conservation Ontario
Hazel Breton	Credit Valley Conservation Authority
Lorrie Minshall	Grand River Conservation
Jim Oliver	Long Point Conservation Authority
Paula Thompson	Ministry of Natural Resources
Don Greer	Ministry of Natural Resources
Nicola Crawhall	Association of Municipalities of Ontario
Don McCausland	Association of Municipalities of Ontario
Trevor Pawson	Ministry of the Environment
David Neufeld	Ministry of the Environment
Mark Gordon	Ministry of the Environment
Pat Lachmaniuck	Ministry of the Environment
Ed Debruyn or Karen Ralph	Dept. of Fisheries and Oceans
Wendy Leger	Environment Canada
Jim Myslik	Ministry of Agriculture, Food and Rural Affairs
David McRobert	Sr. Policy Advisor, In-House Council, Environmental Commissioner's Office
Robb Ogilivie	Ogilvie and Ogilvie limited
Doug Huber	Huber Environmental
Steve Usher	Gartner Lee Limited
Deborah Martin-Downs	Gartner Lee Limited
Bernie Neary	Gartner Lee Limited
Doug Jones	Gartner Lee Limited
Dale Leadbeater	Gartner Lee Limited
Rick Palmer	Gartner Lee Limited

Proposed Agenda

PTTW Best Scientific Practices – Synthesis Workshop

June 12, 2002 at MOE offices
40 St. Clair Ave. W, 10th Floor - Room 1040 / (905) 314-7991

10:00 a.m.	Welcome
10:05 – 10:30	Introductory Baseline Information ➢ Key PTTW Statistics ➢ Definition of Ecosystem ➢ Basic Permitting Process
10:30 - 11:30	Plenary Sessions on Ground Water, Surface Water ➢ Will describe Present Practice, Current Problems, Available ➢ Methodologies, and will include preliminary questions
11:30 - 11:45	Break
11:45 - 12:30	Plenary Sessions on Aquatic Habitat, Terrestrial Ecology ➢ Will follow the same approach as above.
12:30 - 1:15	Lunch
1:15 - 1:45	Plenary Sessions on Public Involvement ➢ Will follow the same approach as above.
1:45 - 2:30	Discussion of Gaps and Opportunities ➢ Watershed Basis ➢ Site Specific Basis
2:30 - 2:45	Break
2:45 - 4:00	Discussion of Screening Tools
4:00 - 4:30	Table of Contents
4:30 - 4:45	Summarize and discuss Next Steps
4:45	Adjourn

Appendix C

Canadian Federal Cumulative Effects Assessment

Gartner Lee

Appendix C

Canadian Federal Cumulative Effects Assessement

Section 16(1) of the *Canadian Environmental Assessment Act* (CEAA) requires a consideration of cumulative environmental effects in relation to any project that triggers *the Act*.

The Cumulative Effects Assessment Practitioner's Guide (The Cumulative Effects Assessment Working Group and AXYS Environmental Consulting Ltd.) and the Canadian Environmental Assessment Agency's Operational Policy Statement (Canadian Environmental Assessment Agency, 1999) provide guidance in conducting an assessment of cumulative effects to meet the requirements of the Act. According to the Practitioner's Guide, a cumulative effects assessment (CEA) is *"an assessment of those incremental effects of an action on the environment when the effects are combined with those from other past, existing and future actions" (pg. A1).*

Cumulative Effects Assessments (CEAs) are intended to:

- Assess effects over a larger (regional) area.
- Assess effects during a longer period of time into the past and future.
- Consider effects on Valued Ecosystem Components[1] (VECs) due to the interactions with other actions and activities.
- Include other past, existing and future (reasonably foreseeable) action.
- Evaluate significance in consideration of other than just local, direct effects.

In the case of water taking projects, cumulative effects are those incremental and residual effects caused by the proposed project when added to, or combined with, the effects that are caused by other projects or activities off-site.

As noted in the Practitioners Guide, the identification of residual effects of the proposed project "paves the way" for cumulative effects to be assessed. A cumulative effects assessment for a *"single project under regulatory review should fundamentally do the following:*

1. *Determine if the project will have an effect on a [Valued Ecosystem Component] VEC.*

1. *A Valued Ecosystem Component (VEC) is a term that refers to any part of the environment (for example, a wetland), that is considered important by the proponent, public, scientists or government involved in the assessment process. Importance may be determined on the basis of cultural values or scientific concern. (Page A4, Hegmann, et. al., 1999)*

2. *If such an effect can be demonstrated, determine if the incremental effect acts cumulatively with effects of other actions, either past, existing or future.*

3. *Determine if the effect of the project, in combination with the other effects, may cause a significant change now or in the future in the characteristics of the VEC after the application of mitigation for that project." (pg. 10).*

As noted above, the first fundamental objective of the cumulative effects assessment is to determine if the project will have any adverse effect on a VEC, significant or otherwise. The CEA should therefore build on the environmental analysis for the project.

Where the project is likely to cause a residual adverse effect, significant or otherwise, the CEA should identify potential regional issues associated with the effects of the project and at a minimum, consider the additive cumulative effects. Where there are no likely measurable or demonstrable residual adverse effects on a VEC (i.e., no adverse effect following mitigation) a CEA does not need to be carried out.

Other projects and activities should be identified to determine if the residual adverse effects of the project have the potential to act cumulatively with the effects of other projects and activities, either past, existing or future.

The CEA should consider past and existing projects or activities that are currently affecting the same VEC in terms of quality, quantity, value or use; and other future 'certain' and 'reasonably foreseeable' projects that are likely to have an effect on a VEC.

As recommended in the Practitioners Guide, projects and activities are considered to be 'certain' to occur because they:

1. have been approved for development;
2. have been announced by the proponent and/or to a regulatory agencies; or
3. are currently under review for approval.

As recommended in the Practitioners Guide, projects and activities are considered to be 'reasonably foreseeable' to occur because they:

1. are identified in an approved development plan; or,
2. are not directly associated with the project under review, but may proceed if the water taking project is approved.

A review of available secondary source information is typically undertaken to identify certain or reasonably foreseeable projects and activities that may need to be considered in the CEA. Public consultation may also serve to identify those regional issues of concern and other projects and activities that may need to be considered in the CEA.

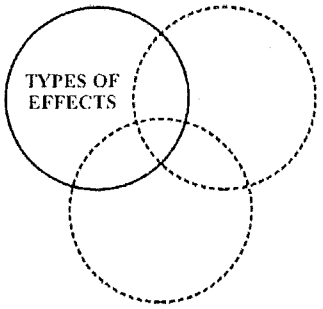
The CEA should list each of the projects and activities that may need to be considered and provide a summary rationale for why they may need to be included. To be consistent with the Practitioners Guide, these other projects or activities should be grouped into three major categories:

- past and existing physical works and activities;
- certain physical works and activities; and
- reasonably foreseeable physical works and activities.

Once a long list of other projects and activities has been identified, each project or activity should be characterized in terms of its location, timing and potential effects relevant to the CEA. An initial screening exercise is typically undertaken to confirm whether or not each project or activity is applicable to the CEA. Several tests are used for the screening exercise.

1.1.1 Type of Effects

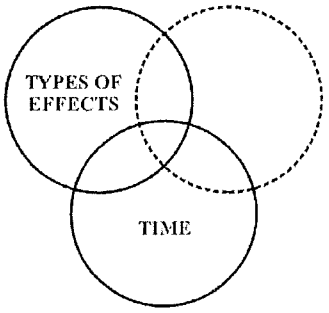
- Are the type(s) of effects completely different from any of those that would be associated with the water taking project?



1.1.2 Temporal Overlap

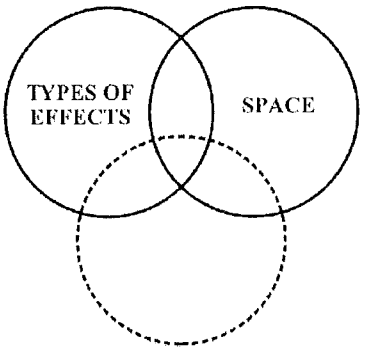
- Do the effects of the other projects or activities occur at the same time as those of the water taking project

- Will the effects of the other projects or activities cease prior to the commencement of the water taking project?



1.1.3 Spatial Overlap

- Are the effects of the other projects or activities measurable within the same geographic area as those of water taking project ?



The objective of the screening is to identify only those other projects and activities that will have a measurable effect on the same VEC, within the same geographic area and over the same time frame.

As such, some projects and activities initially identified may be removed entirely from the detailed cumulative effects assessment or their inclusion is "scoped down" to only those relevant components of the CEA (e.g., effect of surface water flow, effect on fish). The screening step is typically summarized in a series of matrices for easy reference, supported by a rationale.

The core of the assessment is the analysis of the cumulative effects. Wherever possible, the descriptions of the cumulative effects should consider information generated through the other component studies for the project, but need to be carefully applied since the same level of information will not necessarily be available for the other projects and activities (e.g., there may be no specific water quality information available for a particular industry in the area affecting the same water body as the water taking project). For this reason, the CEA analyses tend to be qualitative or semi-quantitative and based around descriptions of the effects and their likely significance rather than quantification of the effects. Where possible, the description of cumulative effects discuss the relative contribution of the water taking project in the context of the overall cumulative effect.

If the analysis concludes that a cumulative effect on a VEC is likely and measurable, reasonable mitigation opportunities to avoid, reduce the severity or eliminate adverse cumulative effect need to be identified. These will not only include such aspects as proven technologies or best management practices, but also whether a mitigation measure is within the proponent's ability to implement. Any mitigation that is judged to be reasonable, practical and can be implemented is then factored into the assessment of significance. For any cumulative effects identified, CEA's typically make a determination as to whether the cumulative effect is likely to be significant or not. Where a cumulative effect has been identified the need for a follow-up program is typically considered.

References:

Canadian Environmental Assessment Agency, 1999:

Addressing Cumulative Environmental Effects under the Canadian Environmental Assessment Act. CEEA OPS-EPO/3. March, 1999. 5 pp.

Hegmann,G., G. Cocklin, R. Creasey, S. Dupuis, A. Kennedy, L. Kingsley, W. Ross, H. Spaling and D. Stalker. 1999:

Cumulative Effects Assessment Practitioners Guide, prepared by AXYS Environmental Consulting Lte. And the CEA Working group for the Canadian Environmental Assessment Agency. Hull, Quebec, 65 pp.

Appendix D

Table 8. Phase 2 Recommendations

Appendix D. Table of Phase 2 Recommendations

Priority	Recommendation
1	• Definition of unacceptable impact to aquatic ecosystem based on scientific criteria
2	• Define relationship between streamflow/water depths and healthy ecosystems
2	• Investigate potential links between water quality models and flow regimes
2	• Initiate long term research regarding in-stream flow and water depth needs, based on biological responses to daily, seasonal, and annual fluctuations, as well as changes imposed by water taking
1	• Calibrate Tennant Method for Ontario using the relationship between fish production and stream discharge
1	• Develop quantitative methods for determining groundwater inflow to headwater streams
2	• Develop a province wide database on existing water use
1	• Extend detailed watershed analysis from CVC and GRCA to all other Conservation Authorities to provide basis for watershed management
2	• Develop Cumulative impact protocol for watersheds for use by proponents in evaluating their potential contribution
1	• Develop Protocol for sharing of scientific information between the private and public sectors.
1	• Establish a rigorous basis for establishing hydrogeologic features that support wetland function.
2	• Establish range of water level fluctuations that the different wetland types can be maintained.
1	• Establish investigative methodology to be used to determine threshold conditions in wetland
1	• Initiate rigorous monitoring of wetlands for water and ecologic features to determine the timing and nature of critical wetland functions
1	• Formally require that cumulative effects analysis for wetlands consider on a watershed basis and not on a site by site basis
1	• Prepare a Stakeholder Involvement Policy to be followed by all PTTW applicants and stakeholders, as per Section 5.3.4 of report.
1	• Establish a One-Window approach by all regulatory authorities involved in approving or commenting on PTTW applications with finite timelines and identification of responsibilities.
2	• Develop a Decision Model, potentially using Environmental Weighting as outlined in Section 6.3 of the report, by establishing key decision points in evaluating and guiding the level of detail for PTTW applicants.
1	• Develop the concept of Adaptive Environmental Management (AEM) and promote its use on all new and renewed PTTW.

(1 = highest priority, 2 = secondary priority)

AMO *Association of Municipalities of Ontario, and/or member municipalities*
CO *Conservation Ontario, or member Conservation Authorities*
DFO *Department of Fisheries and Oceans contribute guidance, funding*
MOE *MOE funding and direction*
MNR *Ministry of Natural Resources*
Research *Research Community in Universities, Government Agencies*