

The specific tasks involved in developing the estimates of water use included:

- The collection and compilation of information from various sources including private, local, provincial and federal agencies;
- A QA/QC review of the data to remove spurious, duplicate, incorrect or out-of-date information;
- Data management and display using ArcView⁹ and MS Access⁹;
- Classification of information by uses, such as public and self-supply (including domestic, irrigation, livestock, industrial and others);
- The development of recommendations for future monitoring and management of groundwater use.

4.7.3 Methodology for the Water Use Assessment

Because no single database of water use exists, a number of complementary approaches were used in developing water use estimates. In many cases, these approaches involved a combination of several data sources, with considerable processing and filtering of each data set prior to use. Many of these approaches were developed and tested in other Provincial Groundwater Studies, including those for York Region and North and South Simcoe County. This section of the report provides details on each of the data sets, and the manipulation of each data set prior to use.

Permit To Take Water Database

The MOE PTTW database contains details regarding existing PTTWs in the general study area, including permitted withdrawals and the location of each water source (see Figure 28). Permits are classed as either surface or groundwater permits, with a third classification for systems that use a combination of surface and groundwater sources. Within each of these categories, the PTTW's are classified according to the permitted water use. Figure 29 identifies the use distribution for the groundwater permits within the study region.

Prior to use, the PTTW database was queried to identify and exclude inactive permits such as older temporary permits issued for activities such as construction dewatering or well testing, or permits that have been superseded by newer permits, revoked, or voluntarily surrendered. A second set of queries attempted to identify incorrect PTTW UTM co-ordinates. These included permits for which the:

- Upper Tier and/or City/Township field corresponded with the study area, but the UTM co-ordinates fell outside the area, or
- UTM co-ordinates fell within the study area, but the Upper Tier or City/Township field did not correspond to the study area.

In addition, the Upper Tier and City/Township codes in the PTTW database correspond to the municipal structure that existed prior to the large-scale amalgamations of the late 1990s. In order to report groundwater use with respect to the current municipal structure, a new field was added to the PTTW database, and populated with the name of the corresponding current municipal region.

Because the PTTW database gives only permitted rather than actual water usage, a telephone survey of representative large (>200,000 L/day) groundwater users was conducted, based on the survey guidelines prepared by the MOE.

The design and lack of completeness of the PTTW database precludes using it to provide an accurate and detailed estimate of permitted water use in the study area. The primary limitations of this method are:

- The permitted capacity has not been recorded in the database for approximately 6% (18/310) of the water sources, although the problem is mainly with surface water permits. This tends to bias the results towards underestimating the total permitted water use.
- Of necessity, it was assumed that the total permitted water use for each PTTW is the sum of the maximum litres per day (MaxLitresPerDay field) for each source associated with that permit, multiplied by the number of permitted days per year (DaysTakingPerYear field) for each source, or by 365 days where the permitted days per year is not indicated.

While this is an assumption we must make for this study, it is recognized that it is not always correct, as some PTTWs have a total daily permitted maximum water use that is less than the combined permitted total from all related sources. Additionally, there is some double-counting of permitted water use, as in the case where a stream feeds an off-stream irrigation pond and both the transfer from the stream to the pond, and from the pond to irrigation use are treated as separate permitted uses. Both of these situations tend to bias the results towards substantially overestimating the total permitted water use. Neither of these situations is easily accounted for given the current structure of the PTTW database.

There exist additional concerns in attempting to determine actual water use from the PTTW database, which have been identified in the Phase II Groundwater Protection Study for the County of Oxford (Golder Associates Ltd., 2002). In general, the total permitted extractions for agricultural, municipal and industrial uses tend to be much larger than the actual takings. For example:

- the actual taking from municipal wells in Oxford County was found to be only about 19% of the total permitted amounts;
- the actual pumping for quarry dewatering at a large quarry in Oxford County was only about 16% of the total permitted amounts; and
- the estimates of actual takings for crop irrigation in Oxford County were only about 7% of the total permitted amounts.

Even with the limitations and inherent inaccuracies detailed above, the utilization of this data provides a useful insight into the water allocation process and generates a maximum value stress to the ground and surface water system. However, this assessment also highlights several of the inadequacies of the system, which need to be resolved in the near future.

Engineers Reports for Municipal Systems

All municipal groundwater systems are required to have an Engineer's Report prepared under O. Reg. 459. These reports contain much of the data required for the current groundwater study by the MOE ToR, including surveyed locations of all active wells. There are only two known municipal groundwater systems in Chatham-Kent, in Ridgetown and Highgate, and none in Essex. The available Engineers Reports for these municipal systems were reviewed.

The principal limitation is the lack of information available for non-municipal communal water systems, which are not required to have an Engineer's Report prepared. The Chatham-Kent Health Unit database lists 47 known small communal systems (<5 connections) and 11 larger communal systems (>5 connections). Other communal systems likely exist in Chatham-Kent that are not included in the Health Unit database. A comprehensive search for, and survey of, communal water systems was beyond the scope of this study. The Windsor-Essex Health Unit was unable to provide any information on small communal systems in their jurisdiction.

MOE Water Well Database

The MOE water well database contains information on the location and construction details of thousands of water wells across the study area. In most cases the primary water use purpose is identified, but there are no details as to annual groundwater extraction from these smaller wells. Maps of private water wells are somewhat useful in visualising the distribution of self-supply water use across the study area, but in general do not provide information about the amount of groundwater pumping.

In some studies it has been possible to use the distribution of private domestic wells outside of serviced areas to provide an independent estimate of domestic self-supply water use. This is typically accomplished by applying standard water-use coefficients to each domestic well. However, this approach depends on the availability of digital maps of serviced areas, and these were generally not available in either Essex or Chatham-Kent.

The MOE water well database is unlikely to include all existing private wells, nor is there any reliable way to distinguish and eliminate wells that are no longer in use. In addition, the geographic coordinates assigned to each well vary greatly in their reliability.

Agricultural Water Use Data

Agricultural water use estimates, together with a description of the methodology used to derive them, were prepared by Rob de Loë Consulting Services for the Ontario Ministry of Natural Resources (MNR). The methodology, including assumptions and limitations, is described in a brief report entitled 'Agricultural Water Use in Ontario by Watershed: Estimates for 2001' (de Loë, 2002). The agricultural water use estimates provide breakdowns by municipality and watershed, and by type of use, including livestock watering and various crop types. ***It is noted that this compilation is based upon MNR estimates, and the grouping of crop types may vary and, as a result, seem to provide disparate values.*** However, the data provided can be useful in providing a preliminary assessment of the recorded water use data.

Municipal Water Use and Pricing Survey

Another important source of information comes from the water use information submitted by each area municipality to the Municipal Water Use and Pricing Survey (MUD), conducted by Environment Canada every two or three years since the early 1980s. This survey includes all municipalities in

Canada with populations greater than 1000 (over 1300 municipalities on the latest survey). Questions on the survey relate to wastewater and water – use, treatment and pricing (Environment Canada 2002). The data submitted to the MUD include a comprehensive picture of public supply water use. Such details include:

- plant name;
- number of persons served by the system;
- deliveries by categories, domestic, commercial and institutional, industrial, and unaccounted and system losses;
- problems with quantity and quality;
- number of water use restrictions;
- sources of water;
- average daily flows; and
- type of treatment.

Survey results for 2001 are not yet available for the majority of municipalities within the Essex-Chatham-Kent study area. As such, the water use estimates and figures presented here are based on the most recent available data, which is from 1998.

4.7.4 Public vs. Private Water Use

The results of the water use estimates, and the various breakdowns by location and type, are summarised in this section. The results are presented graphically in Figures 30 through 36, and summarized in Tables 4.3 through 4.8.

Based on information from the 1998 MUD survey, the majority of the residents of Essex and Chatham-Kent obtain their domestic water supplies from municipal water systems (Public Supply), which in turn derive their water from Lake Erie, the St. Clair River, or the Detroit River. Currently, only the communities of Highgate and Ridgetown in Chatham-Kent are supplied by municipal groundwater.

The proportion of the population that obtains their domestic water from private or non-municipal communal wells (Domestic Self Supply) ranges from 26% in Lakeshore, to less than 1% in Leamington and Windsor. This is illustrated graphically on Figure 36, and summarized in Table 4.3.

Total Water Use

The estimates of total water use, including both surface and groundwater use, were arrived at by combining information from a number of sources. Tables 4.4 and 4.4a summarize the total water use broken down into five categories:

1. Public Supply – This represents water supplied from municipal water systems. The figures were derived from Environment Canada's 1998 MUD Survey, and are considered to be relatively accurate.
2. Self Supply Domestic – This represents water supplied from domestic or small communal wells. These figures were arrived at by multiplying the total population not served by municipal water (Environment Canada 1998 MUD Survey) by the average per capita water use number of 175 L/person/day as specified in the MOE ToR.
3. Self Supply Agricultural – This figure includes water used for both livestock and crop irrigation. These figures were provided by de Loe (2002) Agricultural Water Use in Ontario Watershed: Estimates for 2001.
4. Self Supply Commercial and Industrial – This category includes industrial process water, bottled water, golf course irrigation, quarry dewatering and aggregate washing, and a variety of other commercial uses. These figures were derived from the PTTW database, and are probably the least reliable component of the water use estimate, since they represent the maximum permitted water usage rather than actual totals. In most cases, there is no requirement for permit holders to record or report actual water usage under the PTTW system, and usage figures are not provided in the PTTW database.
5. Self Supply Other – This category captures a variety of miscellaneous water uses, the most significant in the study area being wildlife conservation (wetland flooding) and water used for oilfield injection. These figures were also derived from the PTTW database, and therefore are affected by issues of permitted vs. total water usage.

In general, water use is greatest in the two largest municipalities, Windsor and Chatham-Kent, with total water use of 168 million m³/yr and 106 million m³/yr, respectively (Figure 31 and Tables 4.4 and 4.4a). However, the total for Chatham-Kent is artificially enlarged by the inclusion of a number of very large water taking permits issued to Ducks Unlimited for wetland flooding. According to Mr.