

3.6 Hydroelectric Generation in Ontario

The purpose of this part is, firstly, to outline the technical considerations for planning and developing waterpower in Ontario, secondly, to outline the potential constraints for waterpower development and finally to classify the remaining potential that could be developed within existing public policy guidelines into 5 and 10-year development horizons.

3.6.1 Key Findings

- Ontario's switch from winter to summer peaking has created limitations for hydroelectric facilities having no or limited water storage because summer peaks are sustained over longer periods of time than are winter peaks; moreover, rainfall is at its lowest, and restrictions on water use are at their greatest during the summer
- Waterpower that is "dispatchable" from a control centre is most beneficial to the power system because it can be activated when it is most needed
- Hydroelectric resources are best suited for providing frequency regulation, an essential component in keeping a steady 60 Hz frequency across the province and inadvertent power exchanges with our neighbours to a minimum
- Ontario has 190 potential waterpower sites capable of 7,521 MW but only 1,447 MW could be developed within existing public policy guidelines – another 1,501 MW are inside provincial parks and a further 4,637 MW are subject to agreement with First Nations and the federal government
- Transmission unavailability and the cost of new transmission are the largest impediments to developing potential hydroelectric sites in the northern portions of the province
- Hydroelectric facilities are renewable, sources of electricity that do not consume water
- Hydroelectric installations have three basic types – storage or pondage plants (also known as "peaking" plants), "run-of-the-river" plants and pumped storage plants
- While hydroelectric developments do have some negative environmental impacts, control dams associated with hydroelectric stations have been shown to be effective in mitigating the effects of extreme weather conditions (flood and drought)
- Ontario has close to 200 operating waterpower facilities which account for about 7,700 MW of dependable generating capacity
- Many hydroelectric facilities provide fast-response (or spinning) reserve – power that is available instantaneously and without central control action to respond to emergencies or allowing the flexibility to "load follow" (or adjust to fluctuations in demand)

3.6.2 Introduction

In Ontario, waterpower generation (also called “hydroelectric generation”, “hydro generation” or simply “hydro” in this report) accounts for approximately 7,700 MW of dependable generating capacity out of a total of over 30,000 MW of installed generation. In addition, due to rising electricity prices, untapped waterpower sites, whose potential was uneconomic to develop a few years ago, have now become viable options. There is also an increased incentive to maintain and upgrade the existing facilities, thereby ensuring that the potential of these cost-effective, renewable resources is fully utilized.

Where undeveloped sites exist, most have been considered for development at some point in the past. Location and the economics of integrating them in the power system were often the reasons why they were not developed. Transmission unavailability, and the cost of providing new transmission, is perhaps the largest impediment to developing potential hydro sites in the northern portions of the province. In fact, an enabling transmission strategy is needed for optimal development of new hydroelectric sites.

There are, however, other potential constraints that need to be carefully assessed. These potential constraints may be grouped as:

- Social – disruption of peoples' lives or the existing economy – constraints that can be collectively labelled ‘citizenship’
- Political – including institutional and legal matters, for example as conflicts with designated use, such as parks and wilderness areas, and
- Environmental – the environmental feasibility at a proposed site or in a resource area that has potential sites.

In such assessments the constraints would be quantified and a determination made of whether further assessment should be conducted and whether the constraints could be mitigated so that a hydro plant could be economically installed and operated. These potential constraints are considered in this section.

While no longer the largest portion of power production around the world, hydroelectric generation is still the most widespread in terms of number of stations. Hydroelectric generation is probably the most difficult type of generating resource to plan for. One of the factors that make it difficult is the fact that it comes in a variety of forms:

- Run-of-the-river (low-head installations)
- Peaking and super-peaking (high-head installations)
- Hydraulically isolated (a single site on a river)
- Tightly coupled stations operating “in cascade” (multiple sites on a river)
- Resources drawing their water from large perennial sources of storage
- Seasonal resources with little or no upstream storage.

What also makes planning for new hydroelectric facilities a little more difficult, in contrast with fossil or nuclear installations, is the fact that fuel supply (water) is subject to a high degree of uncertainty. An important component of operating a waterpower plant is concerned with managing the supply of water to the units of that plant. In fact, other than ensuring that turbo-generators are kept in good working order, managing the operation of that type of installation consists mostly in what is commonly known as Water Resource Management.

3.6.3 Hydroelectricity Fundamentals

Electricity is obtained from water through a process of energy conversion. Essentially, a body of water called a forebay or a reservoir held at an elevated altitude represents an amount of (gravitational) potential energy. By channelling this water down to a lower point in a controlled manner, this potential energy is realized and extracted in the form of mechanical energy by a waterwheel (turbine) located near the lowest point of this water trajectory called the tailrace. A generator attached to the rotating shaft of the waterwheel transforms the mechanical energy into electricity.

Where water is available, hydroelectric power can be a low cost and renewable option. Per unit costs, however, tend to be higher for plants where the elevation difference between the forebay and tailrace are low (known as a “low head” plant). In addition, costs for transmission add to the cost of developing sites remote from loads. Ontario has very logically already developed the most economical sites (high head, close to load centres) and future developments will therefore be more expensive than past developments were. Compared to other generating technologies, a hydro power plant is simple, reliable, easy to operate and maintain, and usually lasts “forever.”

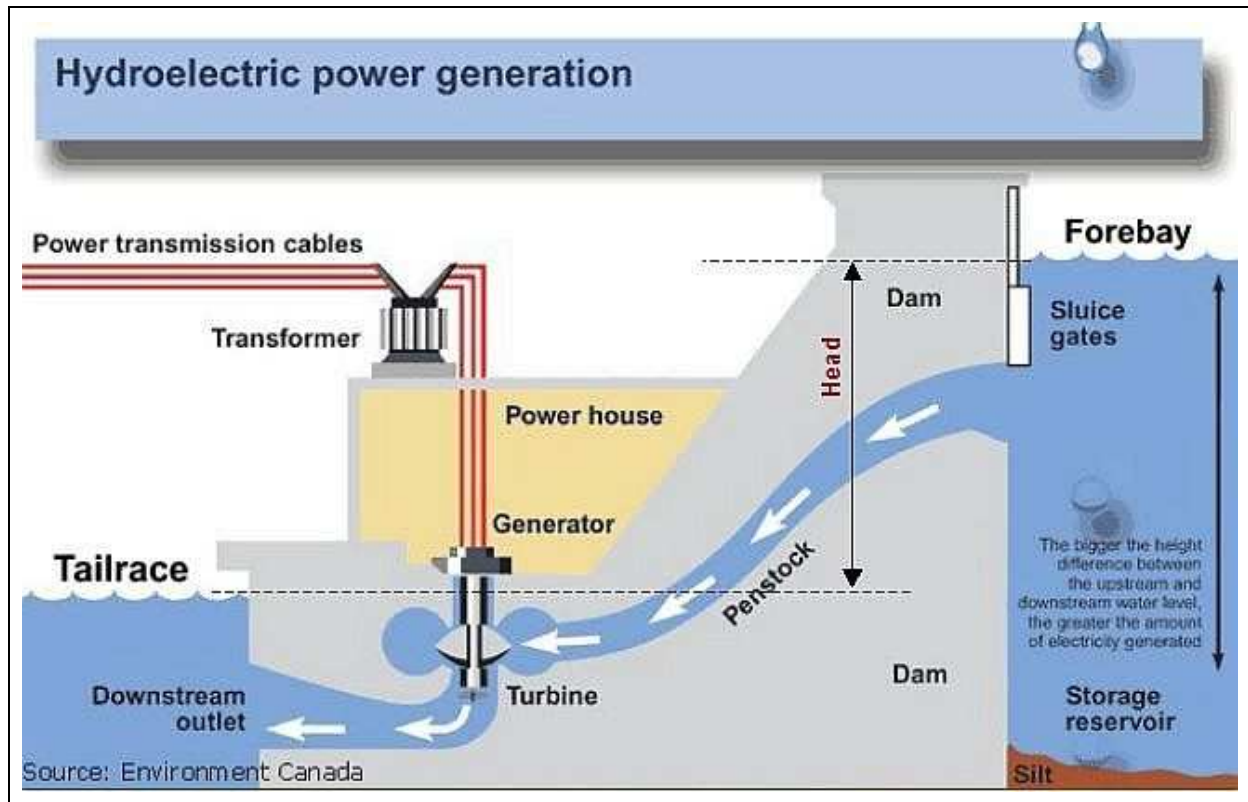
3.6.3.1 Elements of a Hydroelectric Plant

Despite the diversity of forms of waterpower stations, they all include some common elements:

- A significant volume of water that is elevated, usually held in place by a dam
- A penstock (or conduit, or channel) to conduct the water to a lower level
- A turbine (waterwheel) located at the bottom of the penstock and connected to a generator
- A place where the water leaves the turbine (tailrace), and
- Some plant controls and auxiliary apparatus

The following figure shows a typical hydroelectric plant cross section:

Figure 3.6.1 - Typical Hydroelectric Installation (Diagrammatic)



Source: Environment Canada

3.6.3.2 Classes of Hydroelectric Generating Stations

Hydroelectric installations can be classified into three basic types. These are:

- Storage or Pondage plants (sometimes known as “peaking” plants)
- Run-of-the-River plants
- Pumped Storage plants

Some of the characteristics of these types are discussed below.

Storage or Pondage (Peaking) Plants: At many hydroelectric plants, production economics can be enhanced by storing water in the head pond (forebay) for a limited number of hours. This is normally done by partially or completely shutting the plant down (i.e., stopping the water flow) overnight or on weekends, when the demand for electricity is light. The stored water is used

during the peak load period of the following day. This type of operation is called peaking and is carried out routinely on most large power systems.

Peaking power installations are characterized by proportionally large units (in terms of discharge capability) and relatively small forebays (storage capability). They can only sustain continuous generation for a few hours a day before they start running out of water and need additional inflow from upstream reservoirs. Forebays of peaking installations must have large operating ranges, which has impacts on the use and environment of the shoreline of the reservoir. As well, the environment downstream of the plant must be protected against wide fluctuations in discharge flow.

Run-of-the-River Plants: Some plants are not suited to peaking operations because they do not have adequate forebay storage capacity and/or their discharge capacity must match the streamflow of the river they are on. Some examples are plants located on a waterway where shipping interests and other considerations impose restrictions on such peaking operation and where the river flow must be passed on downstream in a more uniform manner.

Run-of-the river installations are usually low-head and their operation, which is often classified as base load, does not follow the economics of supplying the load, but rather the variations of the river flow over time. Water management at this type of installation is often based on established “rule curves”.

Pumped Storage Plants: A Pumped storage generating station (PGS) represents a logical complement to load-following operations that are carried out elsewhere on a power system. A PGS time-shifts energy production by storing energy in the form of water. At night, when demand and the cost for power are low, water is diverted from a lower river or lake and is pumped up into a storage reservoir with electric motors. The water is let back down from that reservoir through a set of turbo-generators when the energy is ready to be sold (and used) during periods of high value or need.

Electricity used for the pumping operation is obtained from the system during periods of low demand. This carries an economic penalty in that it takes about 30% more energy to pump the water uphill to the reservoir than can be generated when the time comes to let it back down through the turbines. In addition, there is uncontrolled consumption of that water while it is in the reservoir, through evaporation.

PGS plants are not new. These generating stations are used extensively to time-shift energy production on a daily or weekly basis – away from weekends and into high demand weekday peak hours. One example is the PGS at OPG's Sir Adam Beck complex at Niagara Falls. Another is at the Robert Moses installation across the river in Lewiston, NY. One of the world's largest PGS installations is located at Ludington, Michigan, relatively close to the Ontario-Michigan border. PGS operation is routinely carried out throughout the year and can result in

considerable savings in system production costs, provided that prevailing water conditions and power system economics are favourable.

3.6.3.3 Operating Principles of a Hydroelectric Generating Station

Electricity generated from a hydroelectric installation makes use of a fuel (i.e., water) that is at the same time inexpensive and precious. Water is a renewable resource and its use to generate electrical energy is classified as non-consumptive. This means that other than by occasional small leaks through the various elements of the water passages, any amount of water used to actuate a turbine and produce power is returned to the river system from whence it came.

Waterpower, however, has many other positive traits that make it a very desirable component of the generation complement in a power system. Some of the more salient are:

- A renewable resource that is clean and non-polluting
- A non-consumptive use of water
- Fast response, always at the ready
- Flexible and maneuverable, right from zero output (shutdown) to maximum output (full gate)
- Run of the river is relatively benign environmentally
- Proven, reliable and long-living technology
- Effective in mitigating the effects of extreme weather conditions (flood and drought) which is typically considered of sufficient social benefit to accept the inherent changes made to the natural environment
- Can co-exist with other uses of the water.

Waterpower also has a number of negative traits, especially if corrective actions are not taken:

- Erosion, due mostly to sudden water fluctuations and excessive water velocities, occurs mostly in plant tailraces. It is minimized by well-designed outflow channels that calm the waters quickly and dampen the flow rate before it is delivered to the lower river.
- Impact on fish populations, mostly in the untimely withdrawal of vital waters from spawning beds, and in the prevention of natural fish migrations – it is minimized through careful reservoir and forebay management, ensuring that spawning occurs to completion by keeping water levels high and steady during the critical periods, aiding in the migration by providing alternate routing of the fish (ladders, etc.) during the appropriate times
- Impact on flora (including the cultivation of wild rice in Northern Ontario), and
- Impact on First Nations way of life, including agriculture and water supply.

Waterpower resources that can be controlled from an operating centre – either local or system-wide – are the most beneficial to the power system. They can be activated when it is most economical to do so, or when an emergency occurs. Such resources are said to be dispatchable.

3.6.3.4 Steady-state Operation of a Hydroelectric Generating Station

The two most important parameters in the operation of a waterpower facility are the sustainable water flow through it and the head across it. Head is defined as the level difference between the surface of the plant forebay and the surface of its tailrace.

In order to maximize the power output of a waterpower installation at a given water flow, its head must be kept at or near its maximum. This is usually done by keeping a steady supply of water coming from upstream reservoirs, and doing it in such a way that this supply matches, as nearly as possible, the water being withdrawn from the forebay and conveyed through the turbines. Full forebays usually mean maximum head, which in turn means maximum energy transformation efficiency (usually measured in kilowatts per unit of flow – e.g. kW/m³).

An inherent characteristic of a hydroelectric turbo-generator unit is that it reaches its maximum efficiency before it reaches its maximum output. Depending on the type of turbine being used and on the configuration of the water passages, maximum efficiency may be reached anywhere between 85% and 97% of the maximum flow that can be passed by the turbine. The operating point at which maximum efficiency is reached is known as the Best Efficiency Point (BEP) and this desirable operating mode is usually labeled “efficiency gate” operation.

Unless water is so plentiful that it exceeds the amount required for efficiency gate operation, and spill (i.e. waste) becomes the only recourse left for the operator, waterpower units are operated at or near their BEP a large portion of their operating hours.

That inherent characteristic of waterpower units also accounts for a very important function in their operation. That is the provision of operating reserve. The ‘idle margin’ between output at Best Efficiency and output at maximum flow (so-called Full Gate output) is considered by the system operator to be fast-response (or spinning) reserve that is available instantaneously and automatically without operator intervention when there is a system emergency such as the unexpected automatic shutdown of another generator somewhere on the system.

During periods of very high flows, such as during the spring freshet (the period in the spring when water is in abundance because of snow melt and rainfall), water is utilized in the units rather than spilled and wasted. Operating hydro units beyond their Best Efficiency Point still produces additional energy (MWh), albeit at a lower efficiency. This, in effect, is a case of “use it or lose it”. It should be noted, however, that prolonged full-gate operation of a hydroelectric installation can cause a head loss and a decrease in station capacity (MW) due to a rise in the tailrace level.

Finally, while a unit carries its maximum capacity on its nameplate, once the unit is loaded to its nominal capacity, it can only sustain that output level if the supply of water is maintained. Output sustainability is a crucial requirement of current and future waterpower installations.

3.6.3.5 Dynamic Operation of a Hydroelectric Generating Station

In a power system such as Ontario's, where the daily generation mix includes units of differing flexibility, waterpower is of great benefit because of its flexibility and fast response rate. Hydroelectric units can be loaded quickly and reliably during periods of load pickup (morning, sudden changes in generating conditions) and unloaded just as quickly when load drops in the evening hours.

At most peaking stations, individual forebays are of limited volume. In years past, the Peak Capacity rating of a hydroelectric station was based on the station's ability to meet a two-hour uninterrupted period of high demand once a day, for five consecutive days. Even then, in order to avoid costly head losses, peaking operations had to be coordinated with releases from upstream reservoirs. And finally, in order to be rated with a great deal of assurance/certainty, the peak capacity of a station would be one which could be attained 98 times out of 100, or under what is known as "dependable" conditions.

Current reality is different. Ontario is now a summer-peaking system, with highest demand being reached during the hot humid days of summer. Under summer peaking operation Peak Capacity must be redefined from that of meeting demand for two hours per day, to the meeting and supplying periods of high loads that can last 10 or 12 hours each and every day. Because they result primarily from air conditioning which inherently runs for many hours in a typical day, summer peaks are more like energy peaks, where sustainability of supply is paramount.

Sustainability must recognize in particular that typical hydroelectric stations cannot operate for such long periods by simply utilizing the water contained in their forebays, that is, under these conditions there must be withdrawals of water from upstream storage sources if a high output level is to be maintained.

Unfortunately for the power generator, summer is the season when level fluctuations in provincial lakes is at best constrained, or in some cases not allowed at all. These limitations reflect both increased recreational use of lakes and waterways as well as the reduced ability of lake levels to recover due to lower seasonal precipitation levels in summer. Draw-down of most lakes is usually not permitted, and natural inflows (through rain) are at their lowest point. This is equivalent to saying that the fuel supply to these hydroelectric installations has become inadequate, leading to limitations to these facilities when they are most needed.

Last but not least, an important feature of hydroelectric resources is their ability to "load-follow". This feature, linked to the resource's inherent operating flexibility, enables automatic control systems to be applied to hydro generators (Automatic Generation Control or AGC) to continually adjust a station's power output to follow the minute-by-minute fluctuations of the provincial demand for electricity. Umbrella organizations or 'pools' of interconnected utilities, and standard-setting bodies like NERC and NPCC, specify the amount and type of AGC that must be 'carried' by the system.

Errors in AGC operations are mostly due to the slow response of resources assigned to that task. Such errors cause fluctuations in system frequency (above or below 60Hz) and lead to inadvertent power exchanges with neighbouring utilities. Thanks to its hydroelectric resources, Ontario has been able to achieve exemplary results over the years and must continue to do so in order to continue to be allowed to interconnect with its neighbouring electricity systems.

Under normal conditions, the bulk of Ontario's AGC is carried by the Niagara River installations at the Sir Adam Beck GS.

3.6.4 Applied Water Resource Management

Every power system operator who has responsibility for the operation of hydroelectric resources is a de-facto water resource manager. For the operator, what is important about managing this 'fuel' is in the following short list:

- How much precipitation will fall, where, and when?
- Of that precipitation, how much can be collected and stored?
- Of the rest of the precipitation, how much will end up in rivers and lakes feeding the station?
- Can this water be used without impacting nature or other water users?

The answer to the first question is, "One does not know, for sure". However, two separate fields of endeavour help the operator make an educated guess. These fields are meteorology and hydrometric analysis. The answer to the second question lies in the design of the water retention facilities and of the interconnecting water conveyances. The answer to the third is provided by a sub-field of water resource management: inflow forecasting. The answer to the final question varies from location to location, but can generally be summarized under the headings of care for the environment and of consideration of others.

Meteorology is the science concerned with predicting the weather. It is an important science that services various industries, from agriculture to air navigation. Meteorology deals routinely with laws of probabilities. Based on the observation of weather patterns around the world, on atmospheric and stratospheric currents, on barometric patterns (the high pressures and the low pressure fronts), and on various other variables now supplied to them by satellites, meteorologists are able to make plausible predictions extending to almost one week.

Meteorology is a short-term science: by the time a meteorologist looks beyond four days in the future, the probability of the predictions coming true is only 50%.

At this point, the notion of timeframe becomes important. The short-term is generally accepted to be the horizon of five days ahead, any horizon beyond the five-day limit and up to a year is called mid-term, and anything beyond that is called long-term.

System operators such as the IESO and OPG are usually most concerned about the short and mid terms. For the job of managing their hydro resources to be effective, the operators need to know what to expect in terms of water, both now and beyond the five-day-ahead time horizon. For that, they need to rely on a branch of hydrology known as inflow forecasting.

System planners such as the OPA, on the other hand, are mostly concerned with the longer term in order to properly design and size a prospective hydroelectric station. Climatology, or the science concerned with the study of climates, gives some clues on what to expect "in general, in the long term". It tries to forecast when the rainy and dry seasons are, it tells when and where to expect snow – and it does that by detecting patterns in the historical record. But again, it does not precisely predict deliveries of water in any given timeframe. It only gives indication of what to expect under 'normal' conditions.

Floods and droughts are what hydrologists call "extreme events". Both involve the sustained abundance of or lack of precipitation and cannot be predicted with any degree of precision as to when they will occur or how severe they will be. Factors like global warming or the incidence of "El Niño" are some of the components that are being taken into consideration in modern climatology.

3.6.4.1 Forebay and Reservoir Management

Ontario climatologists have often summarized the vagaries of inflow forecasting by a few simple rules-of-thumb:

- Ontario exhibits a modified continental weather pattern: long, cold winters, in opposition to hot, humid summers, and brief intermediate seasons (spring and fall) with wet conditions and temperate environmental conditions
- Southern Ontario lakes and rivers (south of the 50th parallel) get 60% of their natural inflows over a six-week period in the spring, when the "freshet" period combines snowmelt with periods of abundant rainfall
- Fall is usually a wet season, when flooding is most likely
- Evaporation is the single largest uncontrolled factor in the management of water resources. It is known that in a 'normal' year, evaporation from the surface of the Great Lakes is comparable in magnitude to the flow over Niagara Falls
- Summer is the time when lakes and rivers are at their maximum usage levels by navigation operators, tourism, sporting events, anglers and fishermen, etc.
- Extreme events are bad for the environment as well as for the affected populations. Flooding can cause severe property damage and loss of life, and drought can affect drinking water quality, and sewage treatment and disposal

With these rules in mind, water resource managers – including hydroelectric operators – manage Ontario’s lakes and rivers in such a way as to maximize their economic value while minimizing the negative effect of their management on the environment.

Some of Ontario’s resources, such as those at Niagara and on the St. Lawrence, are run-of-the-river. By and large, they operate 24 hours a day, 7 days a week, and their level of output depends wholly on the prevailing water flows. Any water that is allocated for power generation but is not used at these installations is effectively spilled, becoming a last resource.

In the daily dispatch of generating resources, run-of-the-river hydroelectric resources are scheduled first, along with the province’s nuclear units. No management of these resources beyond the application of static flow-to-time-of-year relationships (called Rule Curves) is done.

Run-of-the-river hydroelectric stations are least useful in terms of operating flexibility and peak load-meeting capability. They are also least useful in mitigating extreme conditions since they have to pass whatever flow they receive, as they receive it, either under flood or drought conditions. But of course they are nevertheless still useful in terms of energy production.

Dispatchable peaking hydroelectric stations, on the other hand, are among the most flexible resources in the power system:

- They are always available
- They can be scheduled (respond to operators’ orders)
- They can ramp up or down very rapidly
- They make maximum use of the available hydro potential and return all the water they use to their original river
- They are beneficial in controlling the effects of extreme conditions
- Their negative impact on the environment can be mitigated (see below)
- They can co-exist with other industries and uses of the water

For hydroelectric resources to be used at their maximum potential, judicious reservoir management is necessary. At its most rudimentary, sound reservoir management consists in:

- Maximizing plant head by keeping plant forebays at or near the top
- Drawing all reservoirs (and forebays) down to their lowest operating levels just before the start of freshet
- Keeping lake levels steady and high during the summer (tourist season)
- Lowering lake levels a little at the end of summer in order to receive fall rains
- Exercising care during spawning season so as to not adversely affect fish populations
- Accommodating other users of the affected river system in accordance with established rules.

3.6.5 Hydroelectric Potential in Ontario

3.6.5.1 General Factors

The province of Ontario has close to 200 operating waterpower facilities, geographically distributed across the province. When hydropower development began a century or so ago, these sites were generally the most economic to develop. Figure 3.6.2 provides a map of the existing waterpower sites in Ontario.

The potential for future development lies in sites which are generally more difficult and expensive to develop due to a number of limiting factors. Figure 3.6.3 provides a map of the potential waterpower sites in Ontario. The factors that must be considered for development to take place can be grouped as follows:

- Natural factors of the site, including the possible head, the available water and its variability across the seasons, and its geotechnical factors such as soil and rock conditions
- Business aspects of the would-be project, including site ownership
- Availability of transmission and distribution facilities
- Environmental and citizenship constraints related to potential impact that a hydroelectric project at a given site would have on the environment and on other users of the water, and
- Impediments to development caused by provincial and federal government policies.

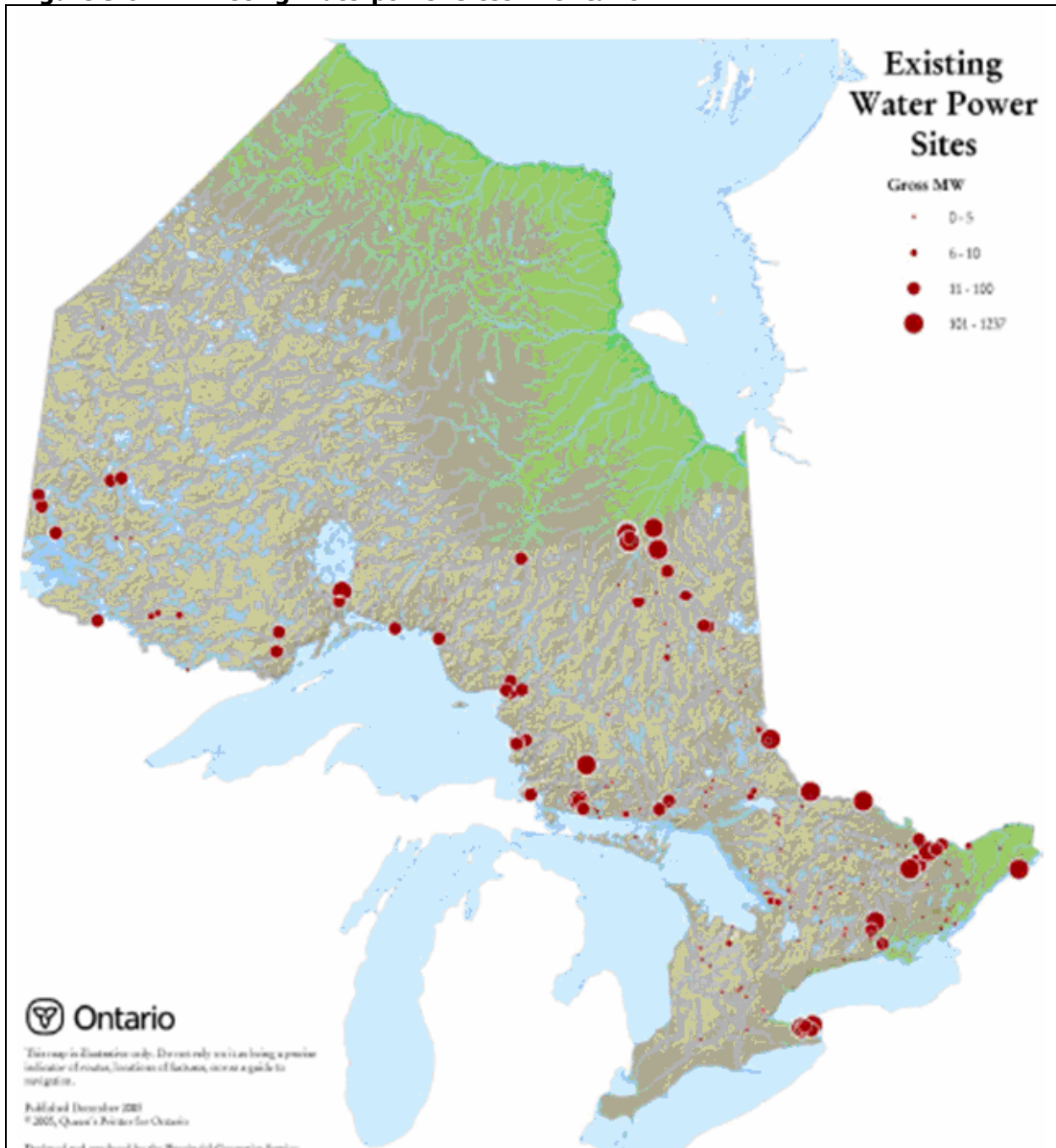
In addition, the practical consideration of the various steps that would constitute the development project for a site introduces the notion of “minimum time factor” that must be considered when estimating the timing of capacity additions. It is not realistic to assume that all potential could be realized at the same time. For this reason, a very coarse timeline was considered in this exercise to estimate how much capacity could be available within 5 years, 10 years and 20 years (and beyond).

Natural Factors

Natural factors are the first consideration to be studied when estimating the potential of a site. Without an adequate head (elevation differential), a substantial and sustained water flow, and a good geological base, a potential site will not be economic.

Of all the undeveloped sites included in this inventory, very few have undergone a formal analysis of their natural factors. Most data, especially for the northern sites, has been estimated from topographical information gathered over many years by government and crown agencies such as Ontario Hydro. Since 2004, the Ministry of Natural Resources (MNR) has used a digital elevation model (DEM) to update some of the available information. However, estimates of capacity and energy production potential are still very approximate.

Figure 3.6.2 – Existing Waterpower Sites in Ontario



Source: Ministry of Natural Resources

Business Aspects

Ownership of the land that contains a potential hydroelectric site is a major factor in its inclusion in an inventory of future resources. The following are some considerations:

- The largest portion of these sites is on Crown Land and subject to MNR Site Development Policy (see policy comments below)
- A number of sites, mostly small ones, are on private property
- A small portion of the remaining potential is under the control of the Federal Government
- Local citizenship aspects of a hydroelectric development allowances must be made to minimize the encroachment of a hydroelectric installation upon other interests along the affected river systems (“riparian” interests)

Availability of Transmission

The integration of new hydroelectric resources into the power system depends on the availability of suitable transmission facilities. While large generating centres (e.g. Mattagami River plants) can be integrated directly into the bulk power system, small hydro projects depend on the availability of smaller connection points on the distribution system.

Besides the difficulties inherent to developing hydroelectric resources in a remote location, the economics of integrating some of the most promising sites into the power system were most often the reasons why they were not developed originally. Today transmission unavailability remains a significant impediment to developing potential hydro sites in the northern portions of the province.

Hydro One Networks' forecast of planned facilities for the next 10 years shows very few new lines and stations north of Lake Superior and in the north eastern part of the province. For purposes of this inventory, availability of transmission and distribution for small sites has been used as a filter, but in determining the timing of some of the committed facilities, the study chooses to err on the optimistic side, and assume that it would not come in the way of the development of the most desirable sites, over the next 10 years. Since OPA's first Integrated Power System Plan (IPSP) will benefit from a decision on the preferred supply mix where Hydro One Networks' plans could not, it will be able to include appropriate transmission facilities insofar as hydroelectric development is a feature of the preferred supply mix.

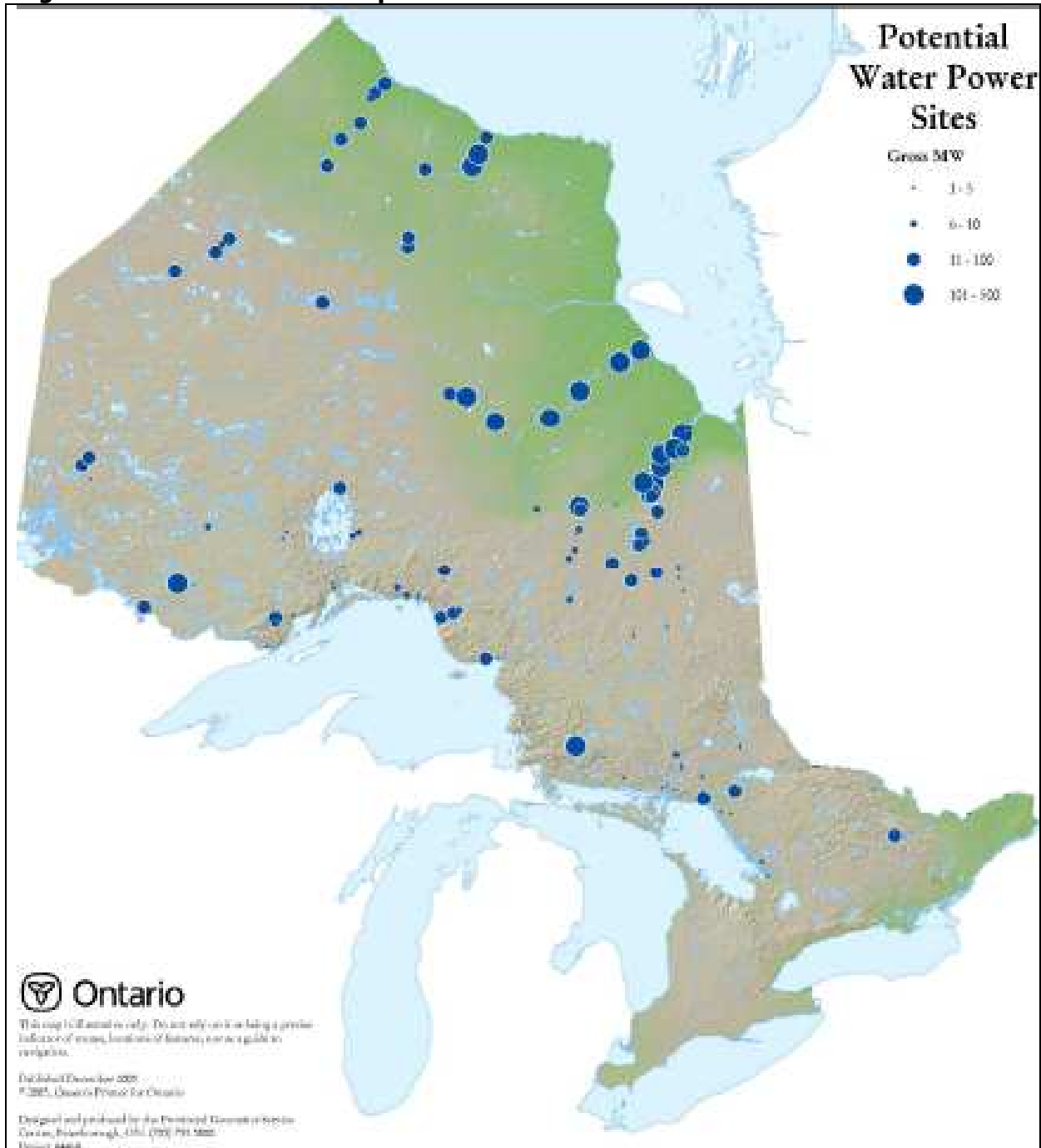
Citizenship Constraints

Citizenship constraints include making allowances for such uses as:

- Commercial and recreational navigation
- Hunting and fishing
- Water supply to towns for drinking and pollution dilution

- Sporting events
- Tourism industry – in all its forms

Figure 3.6.3 – Potential Waterpower Sites in Ontario



Source: Ministry of Natural Resources

Public Policy Constraints

Public policy, including an array of legislation, regulations, policies, and Ministerial commitments, enacted and made by the federal and provincial governments over time, and the collective effect of how these interact, will have a major influence in determining how much of Ontario's remaining waterpower potential can be realized. This includes:

Legislation: All hydro developments in Ontario are subject to environmental assessment (EA) and other pre-development reviews and approvals. An array of federal statutes, such as the Fisheries, Navigable Waters Protection, and Species at Risk Acts, as well provincial statutes, such as the Ontario Water Resources, Lakes and Rivers Improvement, Public Lands, Planning and Ontario Energy Board Acts, are automatically or frequently triggered by proposed hydro developments.

Applying the provisions of these statutes, and supporting policies, will preclude hydro development from occurring in some instances. The necessary process of balancing the local social, environmental and economic interests affected by hydro projects with the provincial interest in power generation also means that a portion hydraulic energy potential of a number of sites cannot be realized. Transmission system and distribution system codes also have an important role to play in determining whether it is economic to connect various areas of this province with renewable energy potential, such as hydro. The combined array of these requirements, in and of themselves, can also form a barrier to investment in hydro development.

On October 25, 2005, the government introduced Bill 11 (proposed amendments to the Provincial Parks Act) in the Legislative Assembly. The Bill, if enacted, would prohibit new hydro development in provincial parks and conservation reserves, subject to certain exceptions. In essence, these amendments will codify in law current provincial policy on "permitted uses" in provincial parks and conservation reserves. Under the Bill, current hydro facilities could continue to operate, be maintained and, with the approval of the Minister of Natural Resources, may be improved.

As well, subject to the Minister's approval, hydro developments arising from commitments in existing land use plans, and developments in which the electricity would be for use within a provincial park or protected area would be permitted. Unlike the current "permitted uses" policy, and with the approval of the Lieutenant Governor in Council, new developments would be permitted in provincial parks and conservation reserves to serve communities not connected to the IESO-controlled grid ("off grid" communities). Under the Bill, the government, subject to the approval of the Legislative Assembly and the Lieutenant Governor in Council, would continue to have the option of being able to deregulate a portion of a provincial park or conservation reserve to permit hydro development.

Parks and Protected Areas: This includes lands in regulated national and provincial parks, and provincial conservation reserves. In the late 1990s, as part of efforts to complete Ontario's system of parks and protected areas, MNR led an extensive Crown land-use planning exercise known as "Lands for Life." This process culminated in government decisions to greatly expand the system of provincial parks and protected areas. The area in waterway parks was increased by 175%, and includes some sites with significant hydraulic energy potential.

Existing Commitments: MNR's current Waterpower Site Release and Development Review policy, which outlines how the province will facilitate access to new waterpower opportunities, identifies two key "policy areas": the "Northern Rivers" and that part of the Moose River basin which is north of Highway #11. These policy areas reflect government commitments that were made to First Nation communities in the early 1990s, when Ontario Hydro was preparing its Demand/Supply Plan. These commitments have been reconfirmed by each subsequent provincial government, including the current government.

- a) **Northern Rivers Commitment:** This commitment sets out that there will be no development greater than 25 MW in the basins of the Albany, Attawapiskat and Winisk Rivers; development less than 25MW can proceed if it is proposed by the local Aboriginal community or communities and/or their partner(s). This commitment was made by a Minister of the Crown in response to community concerns about the potential for extensive flooding associated with hydro development. In the interest of treating all the northern rivers in consistent manner, the Severn River was added to this commitment at the time the Waterpower Site Release and Development Review policy was approved in 2004.
- b) **Moose River Basin Commitment:** This commitment, which was made at the same time as the Northern Rivers commitment, pertains to new development (Greenfield or redevelopment) within the Moose River basin, north of Highway 11. Ontario committed that there would be no hydro development, other than the "extension" to the generating capacity of four existing (now) Ontario Power Generation-owned facilities located along the Mattagami River (as set out in an environmental assessment approval) until such time as a co-planning process is developed, agreed to and applied by the affected First Nations and Ontario.

While the Northern Rivers and Moose River Basin commitments were never enacted in legislation (as with most public policy decisions), as these commitments were made by a Minister of the Crown and reconfirmed by successive governments, it would be prudent at this time to clarify the necessary steps to move forward on meeting the Moose River Basin commitments.

3.6.5.2 Development Potential and Constraints

This section presents analysis on potential hydroelectric resources according to proximity to transmission and distribution (i.e. connections), as well as constraints regarding parks policy or agreements with First Nations. After allowance for these constraints, the potential is further reduced by considering only sites which could be developed within the timeframe of this supply mix advice. This potential in turn is divided into portions deemed suitable for development within 5 and 10-year horizons.

Ontario's total potential of 7,521 MW is shown in the following table.

Transmission Proximity of Site	Under 1 MW (50 sites)	1 - 5 MW (47 sites)	5-10 MW (22 sites)	10-100 MW (46 sites)	Above 100 MW (25 sites)	Total Potential*
Within 5 km		55	35	348	1,287	1,725
5-25 km		35	75	385	826	1,321
Beyond 25 km		59	57	864	3,465	4,445
TOTAL:	30	149	167	1,597	5,578	7,521

Source: OPA, MNR

*Includes both new sites and improvements to existing sites

Sites in Parks and Protected Areas

As described previously, lands classed as parks and protected areas, which include national/provincial parks and conservation reserves, are precluded from hydroelectric development by blanket policy prescriptions.

The precluded potential sites located in parks and other protected areas include new generation:

- On the English River (3 sites, + 68 MW)
- At Patten Post on the Mississagi River (+250 MW)
- On the Missinabi River (+215 MW)
- On the Madawaska River (+94 MW) and the Northern Rivers of the province (+100 MW)

The following table shows the breakdown of these sites in relation to the total potential.

Table 3.6.2 – Hydroelectric Potential Within Parks (MW)

Transmission Proximity of Site	Total Potential (MW)	Within Provincial Parks				Total Potential Within Parks (MW)	Total Potential Net of Parks (MW)
		1-5 MW (1 site)	5-10 MW (7 sites)	10-100 MW (17 sites)	Above 100 MW (5 sites)		
Within 5 km	1,725	8	0	0	0	8	1,717
5-25 km	1,321	18	18	235	390	661	660
Beyond 25 km	4,445	12	37	375	408	832	3,613
TOTAL:	7,521	38	55	610	798	1,501	6,020

Source: OPA, MNR

Sites Subject to Existing Commitments

This grouping includes some of the most promising sites left in the province. It includes the northern rivers commitment as well as the Moose River Basin commitments. The specific commitments are outlined above and result in the following constraints to development:

- Abitibi River (6 sites, + 905 MW)
- Albany River (10 sites, +2400 MW)
- Mattagami River (3 sites, +223 MW)
- Severn River (14 sites, + 726 MW)
- Winisk River (7 sites, + 485 MW)

The impact of removing these sites from consideration is given in the following table.

Table 3.6.3 – Hydroelectric Potential Subject to Agreements (MW)

Transmission Proximity of Site	Total Potential Net of Parks (MW)	Subject to Agreements				Total Potential Subject to Agreements (MW)	Total Potential Net of Agreements (MW)
		1-5 MW (8 sites)	5-10 MW (3 sites)	10-100 MW (21 sites)	Above 100 MW (18 sites)		
Within 5 km	1,717	12	7	27	627	673	1044
5-25 km	660	0	16	82	436	534	126
Beyond 25 km	3,613	8	0	302	3,056	3,366	247
TOTAL:	6,020	20	23	411	4,119	4,573	1,447

Source: OPA, MNR

Potential Remaining for Development

The remaining total of 1,447 MW includes 3 sites on the little Jackfish River (162 MW) and 330 MW from sites rated at less than 1 MW.

The breakdown of this 1,447 MW that is not restricted by technical, economic or policy guidelines is shown in the following table.

Table 3.6.4 - Hydroelectric Potential within Policy Guidelines by Site Size and Transmission Proximity (MW)

Transmission Proximity of Site	Under 1 MW (50 sites)	1– 5 MW (28 sites)	5-10 MW (12 sites)	10-100 MW (7 sites)	Above 100 MW (2 sites)	Total
Within 5 km		39	33	311	660	1,043
5-25 km		17	41	69	0	127
Beyond 25 km		40	20	187	0	247
Total:	30	96	94	567	660	1,447

Source: OPA, MNR

The total of 1447 MW does not eliminate sites on the basis of proximity to a transmission or distribution connection point. About two-thirds of the 1447 MW is within 5 km of the nearest connection point. However, it may not be economic to develop all of this potential, for example, some or all of the 40 MW from 1-5 MW sites that are located more than 25 km from a connection point.

The total of 1447 MW includes;

- 500 MW of pumped storage
- 385 MW of plant upgrades and extensions, and
- 562 MW at new sites, including 3 sites on the little Jackfish River (162 MW) and 30 MW from sites rated at less than 1 MW.

Planning Horizons

The total of 1447 MW has been grouped onto two time horizons: 5-year and 10-year.

5-year Horizon (2010)

The 5-year planning horizon is meant to include upgrades of existing facilities, small new build facilities, and new facilities, where the projects are either under construction or firmly committed to, or, in the case of OPG facilities, where final provincial government approval can be reasonably anticipated: :

- Beck Tunnel (about +50 MW)
- Mattagami turbine upgrades (+34 MW)
- Mattagami plant extensions and the full redevelopment of Smoky Falls GS (+357 MW)
- Turbine upgrade at Abitibi Canyon GS (+30 MW)
- Turbine upgrades at Cameron Falls and Alexander GS (Nipigon River) and at Caribou Falls GS (English River.) – (Total: +10 MW)
- Turbine upgrade at Mountain Chute GS (Madawaska R.) (+4 MW)
- New generation on the Trent and Rideau rivers/canals (+17 MW)
- New generation in northeastern Ontario – 12 sites, all small hydro (115 MW)

10-year Horizon (2015)

The mid-term planning horizon of 10 years includes additional facilities that are in the commitment process but are experiencing an indeterminate delay, or for which MNR has selected or is in the process of selecting an Applicant of Record (AoR). Specifically, these additions are :

- New generation on the Little Jackfish River - 3 sites, to be developed as a single 'reach' – (+162 MW) – Constraint: Transmission.
- New generation on the Namakan River – 2 sites – (+18 MW)
- New generation on the Namewaminikan River – 2 sites, to be developed as a 'reach' – (+8 MW)
- A pumped generating station at Steep Rock Mines (Seine River) – (+500 MW)
- Private, small hydro development on various north eastern Ontario rivers – 8 sites – (+37 MW)

3.6.5.3 Remarks on Specific Sites and River Systems

The following remarks are specific to particular existing or future potential sites, grouped by river.

Niagara – St. Lawrence River

Sir Adam Beck GSs

The Sir Adam Beck II Generating Station has recently undergone a rehabilitation program that increased its peak capacity slightly. Tests are still ongoing to more accurately determine this increase in efficiency.

The Sir Adam Beck I GS continues to supply a portion of its output at 25 Hz, to Stelco in Hamilton. This load, around 25MW, will remain active for the foreseeable future. A single frequency changer unit remains in service.

A new tunnel is now under construction under the City of Niagara Falls, to supplement existing tunnels and channels. By making use of Canadian water previously used by now retired generating stations, this new tunnel is expected to add in the order of 750 GWh of energy production per year. Operating dynamics after the addition of the new tunnel will cause a marginal improvement in total plant capacity (about 5 MW) due to increased dynamic head.

Pumped Generating Station

A very useful part of the Niagara complex is the station's ability to provide supplementary peak capacity to the complex at times of high electricity prices. Being a PGS, it is in fact a net load to the system. It consumes about 30% more energy during its pumping cycle than it can produce during its generating hours. The use of the PGS depends on the prevailing economics of operating the power system.

R. H. Saunders GS

Strictly a run-of-the river generating station, Saunders is run according to fixed criteria set by the International St. Lawrence Board of Control. These are embodied in a set of "Rule Curves" and a number of supplementary regulations to cover unusual or extreme circumstances.

Ottawa River and Tributaries

No new facilities are planned for the main stem of the Ottawa River. There is, however, a sizeable untapped potential in extensions to existing facilities (e.g. Chats Falls) and in new facilities.

The Ottawa River is a tributary to the St. Lawrence River, with the confluence located just upstream (west) of Montreal. The combined flow of the two rivers surrounds the island of Montreal and can on occasion cause serious flooding in that city. For that reason, and especially during high flows, the operation of facilities on that river is overseen by the Ottawa River Regulation Planning Board and its Regulating Committee.

Stations on this river draw their energy from Lake Timiskaming, its main upper reservoir. Variations in lake levels are subject to strict controls in order to accommodate its multiple uses and affected parties along its shoreline.

Possible extensions to the Ottawa River plants were considered but deemed impractical at the time of the preparation of Ontario Hydro's Demand/Supply Plan. This potential for new capacity should warrant some consideration in the near future.

Chaudiere Falls GS (Hydro Ottawa) has recently undergone a complete rehabilitation program.

Misema GS (on the Misema River) is a new small hydroelectric installation operated by the Canadian Energy Corporation. It is rated at about 4 MW.

Madawaska River

This is a prime peaking river. It draws energy from Bark Lake (Palmer Rapids), a power reservoir subject to strict environmental and citizenship limits. Mountain Chute GS is undergoing a rehabilitation program, including a turbine upgrade. This work should add about 4 MW to the total station peak capacity rating.

3.6.5.4 Current Site Development Process

The majority of promising hydroelectric sites are situated on Crown Land, and as such are under the control of the Ministry of Natural Resources. A number of these sites have been identified by the Ministry and released to a competitive bidding process.

In three separate Requests for Proposals (RFPs), a number of sites covering a range of sizes and diverse locations around the province were specifically identified, and the public at large was invited to bid by submitting Expressions of Interest to the Ministry.

- These expressions of interest would be followed by suitable pre-feasibility studies and summary business plans, and where appropriate, meeting and negotiating with First Nations representatives.

Each submission would then be assessed by Ministry staff against established criteria covering engineering, economics, social and environmental aspects.

The outcome of this assessment will be the awarding of the site (for development and exploitation) to one of the applicants, making it the “Applicant of Record” (AOR).

The AOR then needs to commit to the project (i.e. start the Full Feasibility and Environmental Assessment processes within a specific number of months) and proceed through a number of steps leading to the design and construction of the new facility.

These steps include, but are not limited to:

- Preparing a WMP
- Arranging for a connection to the grid
- Meeting with ratepayer groups and municipalities
- Investigating possible citizenship impact, including the securing of tentative agreements with other users of the water

3.6.6 Appendix 1: Listing of Sites

Table 3.6.5 lists the new sites included in the total potential of 1,447 MW that are within guidelines.

Table 3.6.5 - Hydroelectric Potential within Policy Guidelines: New Sites

Site	Potential (MW)	Connection Distance (km)	Constraint*
Abitibi River			
Sextent Rapids	16.14	< 5	A
Allan Rapids	131	5 - 25	A
Sand Rapids	131	5 - 25	A
Black Smith Rapids	140	< 5	A
Coral Rapids	192	< 5	A
Nine Mile Rapids	295.20	< 5	A
Agusabon River			
Lower Lake	9.80	5 - 25	
25.6 - 19.2 km from mouth	10	< 5	
Albany River			
Lower Limestone Rapids	10.37	> 25	A
Achapi Lake	15.75	> 25	A
Miminiaka Lake	15.83	> 25	A
Buffaloskin	76	> 25	A
Wabimeig Creek	185	> 25	A
Stooping	285	> 25	A
Chard	370	> 25	A
Biglow	480	> 25	A
Blackbear Island	490	> 25	A
Hat Island	490	> 25	A
Arrow River			
High Falls	1.18	> 25	A
Attawapiskat River			
Streatfield Iv	105.76	> 25	A
Black Sturgeon River			
at Highway 17	2.89	< 5	
Gardner Rapids	4.78	< 5	P
Current River			
Trowbridge Falls	1.07	< 5	
N. Thunder Bay	1.14	> 25	
Bentley Creek	1.72	> 25	
Dore River			
rapids in first 3.2 km from mouth	2.60	< 5	A
Englehart/Larder (Ottawa River)			
2 stations	7.10	5 - 25	
English River			
Mackenzie Lake	9.02	> 25	P
Upper Oak Falls	11.73	> 25	P
Maynard Falls	46.60	> 25	P
Fredrickhouse River			
Neelands Rapids (Twp. Fournier)	2.40	< 5	A
Wanatango Falls (Twp. Mann)	3.04	5 - 25	
Rapids (Twp. S. Clute And Leitch)	9.78	5 - 25	A
French River			
Lower Chaudiere Falls	2.87	> 25	
Dalles	17.24	> 25	P
Five Mile Rapids	20.92	5 - 25	P
Grassy River			
Timmins South	4	< 5	
Groundhog River			
Upper Ivanhoe Lake	2.97	> 25	
near middle of Reeves	3.14	5 - 25	P
Vimy Creek	4.15	5 - 25	P
South Melrose	4.38	> 25	
Whist Falls	12.47	5 - 25	P
16 km Rapids (Twp. Hicks, Stringer & McVicar)	28.41	> 25	P
Gull River			
below Roaring River	2.87	> 25	P
Roaring Rapids	5.80	> 25	P
Kaministiquia River			
Shabaqua Corners	2.88	> 25	A
Hume	4.11	> 25	A
Lot 2 Block 'A' (Twp. Paipoonge)	6.63	> 25	
Mokoman Falls	10.83	< 5	A
Big Beaver Falls	11	5 - 25	
Kopka River			
Mink Bridge Portage	3.91	> 25	

.../cont'd

*A = Agreement, P = Park. Sites having both constraints are listed under Park constraints in the previous summary tables.

Table 3.6.5 - Hydroelectric Potential within Policy Guidelines: New Sites

Site	Potential (MW)	Connection Distance (km)	Constraint*
Little Jackfish River			
Mileage 2.5	22	> 25	
Mileage 12.5	62	> 25	
Mileage 7.9	78	> 25	
Little Pic River			
7.2 km from Mouth	1.11	< 5	P
near mouth	2.40	< 5	P
Madawaska River			
Highland Falls	94.10	5 - 25	P
Magnetawan River			
Farm Rapids	3	5 - 25	P
Bying Inlet	4.40	5 - 25	
Mattagami River			
Poplar	6.62	5 - 25	A
Yellow/Island Falls	18	5 - 25	A
Cypress Falls	42.40	5 - 25	A
Grand Rapids	174	5 - 25	A
Missinaibi River			
Black Feather Rapids (Twp. Sanke)	4.84	5 - 25	P
Albany Rapids	6.59	> 25	P
Split Rock Rapids	7.39	> 25	P
Devil Rapids	7.78	> 25	P
Kettle Falls (Twp. Sankey)	9.47	5 - 25	P
Glass Falls	10.37	5 - 25	P, A
Thunder House Falls & Chute	42	> 25	P, A
Long Rapids	126	> 25	P
Patten Post	250	5 - 25	P, A
Moose River			
Renison	135	> 25	A
Grey Goose	140.40	5 - 25	P, A
Mooseland River			
Mooseland Rapids 1	4.30	> 25	P
Mooseland Rapids 2	4.58	> 25	P
Muskoka Musquash			
Gray Rapids	6.73	< 5	A
Muskoka River			
North Bala	4	> 25	
Namakan River			
Myrtle Falls	4.80	> 25	
Hay Rapids/High Falls	13.10	> 25	
Nanewaminikan River			
km 8 & km 12.8 (#286 & 288)	8	5 - 25	
Dragonfly Lake	9.80	5 - 25	
Nettogami River			
Nettogami Falls	12.26	> 25	
Newpost Creek			
Mawhinney	6.40	> 25	
Newpost Creek	26.83	5 - 25	P, A
North French River			
Nettogami Island	1.87	5 - 25	
First Rapids	10.26	5 - 25	A
Onaping River			
High Falls	10.38	5 - 25	A
Opatatika River			
Opatatika Rapids I	2.56	> 25	
Breakneck Falls & Rapids	3.77	5 - 25	
Ottawa River			
Chaudiere Falls	7.40	< 5	
Chaudiere Falls#1	7.92	< 5	
Petawawa River			
Crooked Rapids	2.75	< 5	A
Pic River			
Manitou Falls	58	5 - 25	
Rideau River			
Rideau Falls	2	< 5	
Saugeen River			
Port Elgin	7.30	> 25	
Seine River			
Island Falls & rapids above	2	5 - 25	
Steep Rock Mine PGS	500	< 5	

.../cont'd

*A = Agreement, P = Park

Table 3.6.5 - Hydroelectric Potential within Policy Guidelines: New Sites

Site	Potential (MW)	Connection Distance (km)	Constraint*
Serpent River			
McCarthy Chute	2.77	5 - 25	P
Severn River			
Port Severn	2.90	< 5	A
19 km below Muskrat Dam Lake	10.14	> 25	A
36.8 km from mouth	10.48	> 25	A
3 km below Muskrat Dam Lake	13.53	> 25	A
8 km from mouth	14.10	> 25	A
12.8 km below Sandy Lake	15.89	> 25	A
9.6 km below Witegoo River	17.05	> 25	A
16 km above Sachigo River	18.83	> 25	A
56 km below North Channel	19.72	> 25	A
5.2 km below Asipoquobah Lake	19.88	> 25	A
2 km above North Channel	30.03	> 25	A
Sachigo	104.44	> 25	A
Blackbear	123.35	> 25	A
Limestone Rapids I	157.55	> 25	A
Limestone Rapids II	170.73	> 25	P
Steel River			
Santoy Lake	6	5 - 25	
Sturgeon River			
Island Lake	2.50	> 25	
Ragged Chute	3.60	> 25	
Trent River/Canal			
Fenelon Falls	2.60	< 5	
Trent University	4.10	< 5	
Glen Miller	8	< 5	
University River			
Denison Falls	35.50	5 - 25	P, A
Vermilion River			
at Soo Crossing	1.49	< 5	A
Cascade Falls	1.54	< 5	

Site	Potential (MW)	Connection Distance (km)	Constraint*
Wabigoon River			
Wabigoon Falls	2.70	> 25	
Wanapitei River			
km 4.8 - McVittie S	1.60	5 - 25	
Welland River/Canal			
Gibson	5	< 5	
White River			
3.2 km below White Lake	8.50	5 - 25	P
1.6 km below Chicagonce Falls	11.50	5 - 25	P
Umbata Falls	23	5 - 25	P
Whitefish River			
below Cross Lake	2.20	< 5	
Lang Lake (La Cloche Mts.)	2.30	> 25	
Winisk River			
Wunnummin Lake 2	14.12	> 25	A
Gneiss Rapids	32.88	> 25	P, A
Seashell Rapids	37.05	> 25	P, A
142.2 km from mouth (Atik Island)	64.34	> 25	P, A
12.8 km from mouth (Winisk P.O.)	94.74	> 25	P, A
33.6 km from mouth (Shamattawa River)	111.57	> 25	P, A
59.2 km from mouth (Maminiska River)	130.15	> 25	A
Fractional MW Sites	30		

Source: OPA, MNR

*A = Agreement, P = Park

The following table lists the portion of the 1,447 MW of potential that would involve the upgrading or extension of existing sites.

Table 3.6.6 - Hydroelectric Potential within Policy Guidelines: Upgrades and Extensions

Site	Potential (MW)
Nipigon River	
Runner Upgrade - Alexander	0.6
Runner Upgrade - Cameron	4
Madawaska River	
Runner Upgrade - Mountain Chute	4
English River	
Runner Upgrade - Caribou Falls	4.9
Mattagami River	
Runner Upgrade - Little Long	10
Runner Upgrade - Harmon	12
Runner Upgrade - Kipling	12
Abitibi River	
Abitibi Canyon	30
Niagara River	
Beck Tunnels	50
Mattagami River	
Extension - Little Long	61
Extension - Harmon	68
Extension - Kipling	68
Total (MW)	324.5

Source: OPA, OPG

3.6.7 Appendix 2: References and Credits

The following sources of information were used in the compilation of the hydroelectric input to the Generation Mix Report:

References:

- Hydropower Engineering, C.C. Warnick © 1984 Prentice Hall
- Ontario Hydro's History and Description of Hydroelectric Generating Stations, © 1991 Ontario Hydro
- Hydroelectric Resources, A Quick Reference Guide, © 2001 Ontario Power Generation
- Hydroelectric Power Resources of the Province of Ontario, Report no. 87360
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- A report on Hydroelectric Potential in Ontario, © 2005 Hatch-ACRES
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- A 10-year Outlook : "An assessment of the Adequacy of Generation and Transmission Facilities to Meet Future Electricity Needs in Ontario", © 2005 IESO – Report IESO_REP_0245 Ver 1.0

Credits:

- The Renewable Energy Section, Lands and Water Branch, Ministry of Natural Resources, Peterborough, Ontario.
- Ontario Waterpower Association 380 Armour Road, Peterborough, Ont. Paul Norris, President
- Hydro One Networks, Inc. Transmission Regulation Division, David Curtis, Director.
- Hatch-ACRES International, Small Hydro Division, Niagara Falls, Ont., Murray McFarlane, Director.