

OVERVIEW OF REGULATED HYDROELECTRIC FACILITIES

1.0 PURPOSE

This evidence identifies and describes the regulated hydroelectric facilities, and sets out an overview of the hydroelectric mandate, objectives, organization and management framework. It also sets out OPG's approach to investing in and maintaining its hydroelectric facilities and identifies regulations, agreements and programs key to these facilities.

2.0 DESCRIPTION OF REGULATED HYDROELECTRIC FACILITIES

OPG's regulated hydroelectric facilities consist of the Niagara Plant Group generating stations (Sir Adam Beck I, Sir Adam Beck II, Sir Adam Beck Pump Generating Station, DeCew Falls I and DeCew Falls II) and the R.H. Saunders Generating Station ("R.H. Saunders"). Chart 1 presents some facts about the regulated hydroelectric facilities.

Chart 1

River System	Generating Station	Number of In-Service Units	Net In-Service Capacity (MW)	Original Unit In-Service Dates
Niagara and Welland	Sir Adam Beck I	8	417	1922 – 1930
	Sir Adam Beck II	16	1,499	1954 – 1958
	Sir Adam Beck PGS	6	174	1957 – 1958
	DeCew Falls I (station currently shut down to replace penstocks)	4	23	1898
	DeCew Falls II	2	144	1948
St. Lawrence River	R.H. Saunders	16	1,045	1958 – 1959

19
20 The Niagara Plant Group facilities and Saunders are situated on two different drainage sub-
21 basins within the Great Lakes/St. Lawrence River system. Sir Adam Beck and DeCew Falls

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1 operate on water from Lake Erie/Niagara River. R.H. Saunders uses water from the St.
2 Lawrence River.

3

4 The Sir Adam Beck and DeCew Falls facilities form the Niagara Plant Group. They are
5 controlled from a single control centre located at Sir Adam Beck I. Saunders is part of the
6 Ottawa St. Lawrence Plant Group, which also includes nine unregulated OPG hydroelectric
7 facilities on the Ottawa River and Madawaska River systems. It is operated from a control
8 centre within the station (see photos of stations in Attachments 1 to 6).

9

10 **2.1 Sir Adam Beck Facilities**

11 **2.1.1 Sir Adam Beck I Generating Station**

12 The Sir Adam Beck I Generating Station ("Sir Adam Beck I") consists of ten hydroelectric
13 generating units (eight in-service 60 Hz units and two out-of-service 25 Hz units). The station
14 receives water drawn from the upper Niagara River via the Welland River and through a
15 man-made open-cut canal that travels through the City of Niagara Falls. Water is discharged
16 from the station into the Lower Niagara River.

17

18 **2.1.2 Sir Adam Beck II Generating Station**

19 The Sir Adam Beck II Generating Station ("Sir Adam Beck II") consists of 16 hydroelectric
20 generating units. The station receives water drawn from the Niagara River via two 14-metre
21 diameter tunnels under the City of Niagara Falls. The tunnels surface at outlet portals to a
22 single open cut canal which conveys the water to the Sir Adam Beck stations. The open cut
23 canal crosses the open cut canal for Sir Adam Beck I at a location known as the cross-over.
24 Water downstream of the cross-over is capable of reaching both Sir Adam Beck I and Sir
25 Adam Beck II. Water is discharged from Sir Adam Beck II into the Lower Niagara River.

26

27 **2.1.3 Sir Adam Beck Pump Generating Station**

28 The Sir Adam Beck Pump Generating Station ("PGS") consists of six mixed-flow variable-
29 pitch reversible pump-turbines. The station was designed and built for integrated operation
30 with the other two Sir Adam Beck plants and is generally used to pump and store water
31 during off-peak periods for use during peak periods. During off-peak periods, the station

1 pumps water from the cross-over location of the Sir Adam Beck open cut canals into a large
2 man-made storage reservoir. During peak demand periods it generates electricity from water
3 stored in the reservoir and discharges water back into the Sir Adam Beck I and Sir Adam
4 Beck II open-cut canals at the cross-over location. The discharged water is then used by Sir
5 Adam Beck I and Sir Adam Beck II.

6

7 The station also assists in providing automatic generation control ("AGC") and operating
8 reserve ("OR") at the Beck complex, as well as controlling the amount of water diverted from
9 the Niagara River to the Beck complex by controlling the cross-over elevation.

10

11 2.1.4 Sir Adam Beck Joint Works

12 The use of Niagara River water for power production is governed by international treaties
13 between Canada and the United States (see section 5.1). In the 1950s, the International
14 Niagara Control Works structure (also known as International Control Dam) was constructed
15 to control the volume and distribution of water flow over Niagara Falls and the elevation of
16 the upstream storage area known as the Grass Island Pool. The International Niagara
17 Control Works structure is operated and maintained by the Niagara Plant Group under a
18 Memorandum of Understanding ("Niagara MOU") between OPG and the New York Power
19 Authority ("NYPA"). OPG and NYPA equally share the costs associated with Joint Works (as
20 defined in the Niagara MOU) which includes the International Niagara Control Works. Details
21 of the Niagara MOU are provided later in this exhibit (section 5.2).

22

23 2.1.5 DeCew Falls I and II Generating Stations

24 The DeCew Falls Generating Stations ("Decew Falls") produce power with water from Lake
25 Erie diverted through the Welland Ship Canal, which is owned and operated by the St.
26 Lawrence Seaway Management Corporation. Water flow from the Welland Ship Canal is
27 controlled by two intake structures. Intake number 2 is a control dam used to control water
28 flow into Lake Gibson and subsequently into both DeCew Falls stations through a series of
29 waterways. Intake number 1 is a smaller control structure that provides water to Lake Gibson
30 and to a Region of Niagara water treatment plant. The conveyance of water is governed
31 under an agreement between OPG and the St. Lawrence Seaway Management Corporation

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1 and through an agreement signed in 1903 between the predecessors of OPG and the
2 Region of Niagara. Water is discharged by both DeCew Falls stations into 12 Mile Creek,
3 which travels through the City of St. Catharines and discharges into Lake Ontario.

4

5 DeCew Falls I is a six-unit hydroelectric station (four in-service units, two decommissioned
6 units). The station is presently shut down to replace the penstocks. DeCew Falls II is a two-
7 unit hydroelectric station.

8

9 **2.2 R.H. Saunders Generating Station**

10 R.H. Saunders Generating Station ("R.H. Saunders") is a 16-unit hydroelectric station
11 spanning half the width of the St. Lawrence River at Cornwall, Ontario. R.H. Saunders is
12 connected to the 16-unit St. Lawrence - Franklin D. Roosevelt Generating Station ("Franklin
13 D. Roosevelt"), which is owned and operated by NYPA. Together, the two stations span the
14 entire St. Lawrence River. The R.H. Saunders units are operated from a control room located
15 within the station.

16

17 **2.2.1 R.H. Saunders Joint Works**

18 Many of the structures and dams which operate in conjunction with R.H. Saunders and
19 NYPA's Franklin D. Roosevelt are operated and maintained pursuant to a Memorandum of
20 Understanding ("St. Lawrence MOU") between OPG and NYPA. Under the St. Lawrence
21 MOU, OPG and NYPA share equally in the costs of operating and maintaining the Joint
22 Works (as defined in the St. Lawrence MOU). The St. Lawrence Joint Works consist of all the
23 structures associated with R.H. Saunders and Franklin D. Roosevelt including dams,
24 headworks, dykes, the Barnhart Island bridge and ice booms, with the exception of the
25 powerhouses.

26

27 **3.0 HYDROELECTRIC MANDATE AND OBJECTIVES**

28 The Memorandum of Agreement between OPG and its shareholder provides that OPG will
29 "operate its existing nuclear, hydroelectric, and fossil generation assets as efficiently and
30 cost-effectively as possible, within the legislative and regulatory framework of the Province of
31 Ontario and the Government of Canada." The Memorandum of Agreement also states that

1 "OPG will operate these assets in a manner that mitigates the Province's financial and
2 operational risk".

3

4 With respect to investment in new generation capacity, the Memorandum of Agreement
5 provides that "OPG's priority will be hydroelectric generation capacity" and that "OPG will
6 seek to expand, develop and/or improve its hydroelectric generation capacity." It further
7 states that "this will include expansion and redevelopment on its existing sites as well as the
8 pursuit of new projects where feasible." The Niagara Tunnel project and Sir Adam Beck I
9 rehabilitation program (including generator, transformer and runner replacements/upgrades)
10 are consistent with this mandate from the shareholder. These projects are discussed in Ex.
11 D1-T1-S1.

12

13 Consistent with OPG's mandate and corporate objectives, the Hydroelectric Business Unit
14 has the following objectives:

- 15 • Sustain and improve the existing hydroelectric assets for the long term.
16 • Operate and maintain hydroelectric facilities in an efficient and cost effective manner.
17 • Seek to expand, develop, and/or improve existing hydroelectric generation where
18 feasible.
19 • Maintain and improve reliability performance where practical and economic.
20 • Maintain the existing excellent employee safety record (top quartile performance).
21 • Strive for continuous improvement in the areas of dam and waterways public safety and
22 environmental performance.
23 • Build and improve relations with First Nations and Metis.

24

25 **4.0 HYDROELECTRIC ORGANIZATION AND MANAGEMENT FRAMEWORK**

26 All OPG hydroelectric facilities, including the regulated facilities are under the organizational
27 authority of the Executive Vice President ("EVP") Hydroelectric and form part of the
28 Hydroelectric Business Unit (subsequently referred to as "Hydroelectric").

29

30 Hydroelectric uses a decentralized organizational model based on five plant groups –
31 including the Niagara Plant Group and the Ottawa/St. Lawrence Plant Group of which R.H.

1 Saunders is a part. The plant groups operate with a high degree of autonomy. This
2 organizational structure includes a technical and support presence located at the plants
3 wherever practical. The local technical and support resources in the plant groups are
4 augmented by central support/services organizations.

5

6 The Hydroelectric central support groups perform a dual role. First, they provide oversight
7 and due diligence support to the EVP - Hydroelectric by setting direction through high level
8 programs and other requirements (e.g., corporate policies). Second, they provide the
9 specialized support necessary for the plant groups to make effective operational and
10 business decisions and to achieve alignment with corporate policies and procedures.
11 Descriptions of the key functions and activities of the Hydroelectric central support groups
12 are provided in Ex. F1-T2-S1 section 3.4.

13

14 Each plant group is managed by a plant group manager, who reports to the EVP -
15 Hydroelectric. Plant group management establishes local governance and is responsible for
16 managing all aspects of the facilities assigned to them including:

- 17 • Operations
18 • Maintenance
19 • Water management
20 • Asset management
21 • Engineering
22 • Project management
23 • Employee health and safety
24 • Dam and waterways public safety
25 • Environment
26 • Local public affairs/relations
27 • Security
28 • Materials management

29

30 Within this decentralized organizational model, "lead" plant groups are designated and given
31 the accountability to champion certain common business issues, processes, special projects

1 and to coordinate matters on behalf of Hydroelectric. This “lead” plant group model is both
2 effective and efficient, in that it leverages the existing expertise of plant group staff in certain
3 areas, and allows for a leaner central support organization.

4

5 **5.0 KEY HYDROELECTRIC REGULATIONS, AGREEMENTS AND PROGRAMS**

6 OPG’s regulated hydroelectric facilities are subject to international treaties between Canada
7 and the United States, federal and provincial legislation and regulatory requirements, as well
8 as several contractual arrangements with third parties. Collectively these result in additional
9 costs and program needs with respect to the operation and management of the regulated
10 facilities.

11

12 This section provides an overview of:

- 13 • Regulations, treaties and agreements with regard to water rights for the regulated
14 hydroelectric facilities.
- 15 • The Niagara MOU and the St. Lawrence MOU with NYPA.
- 16 • Dam and public safety governance and programs.

17

18 A summary of the regulatory framework applicable to all OPG regulated facilities is provided
19 at Ex. A1-T6-S1.

20

21 **5.1 Water Rights**

22 **5.1.1 Regulation of Water Rights**

23 Hydroelectric generation requires ongoing access to an adequate water supply. Rights to
24 and restrictions on the use of water are determined primarily by international treaties
25 between Canada and the United States and certain orders and approvals thereunder,
26 together with the application of inter-provincial agreements, federal and provincial legislation,
27 common law as it pertains to real property and riparian rights, as well as the terms and
28 conditions of certain leases and permits with and from the Government of Canada and the
29 Province of Ontario.

30

1 5.1.2 International Rivers

2 OPG's regulated hydroelectric generating stations are directly or indirectly supplied by major
3 international waterway systems. The Niagara stations are operated pursuant to two treaties
4 between Canada and the United States, and R.H. Saunders is subject to one.

5

6 The Boundary Waters Treaty of 1909 governs all boundary waters between Canada and the
7 United States. The Niagara Diversion Treaty of 1950 between Canada and the United
8 States, among other things, provides for the termination of certain sections of the Boundary
9 Waters Treaty of 1909, provides for the construction of the International Niagara Control
10 Works, determines the priority of use for the waters of the Niagara River and Welland Canal,
11 and sets minimum flow requirements over Niagara Falls. Each of the Boundary Waters
12 Treaty of 1909 and the Niagara Diversion Treaty of 1950 continue in perpetuity, but are
13 terminable by either party on 12 months prior written notice. OPG does not expect Canada or
14 the United States to exercise their termination rights in the foreseeable future.

15

16 The Boundary Waters Treaty of 1909 and the Niagara Diversion Treaty of 1950 grant
17 Canada and the United States equal rights to use waters available for power generation. The
18 Niagara Diversion Treaty of 1950 recognizes certain diversion waters as not being included
19 in the allotment of waters under the provisions of the treaty, and therefore this water can be
20 used solely by Canada at OPG's Niagara hydroelectric facilities.

21

22 OPG has been granted the right to exercise Canada's rights with respect to the construction,
23 maintenance and operation of generating facilities under the Boundary Waters Treaty of
24 1909 and the Niagara Diversion Treaty of 1950. The Boundary Waters Treaty of 1909
25 created the International Joint Commission ("IJC") to help prevent and resolve disputes over
26 the use of boundary waters between Canada and the United States. The IJC established the
27 International Niagara Board of Control whose main duties are to oversee water level
28 regulation in the Grass Island Pool and the installation of the Lake Erie-Niagara River ice
29 boom. The International Niagara Board of Control also collaborates with the International
30 Niagara Committee to determine the amount of water available for Niagara Falls and power
31 generation.

1 The IJC established the International St. Lawrence River Board of Control whose main duty
2 is to ensure that outflows from Lake Ontario provide dependable flow for hydropower,
3 adequate navigation depths and protection for shoreline and other interests downstream in
4 the Province of Quebec. The International St. Lawrence River Board of Control also develops
5 regulation plans and conducts special studies as requested by the IJC. Outflows are set by
6 the International St. Lawrence River Board of Control under a regulation plan.

7

8 **5.1.3 Other Niagara Plant Group Agreements**

9 OPG's use of the immediate area surrounding the Sir Adam Beck generating stations, as
10 well as the area surrounding the generating stations' intakes upstream of Niagara Falls, is by
11 way of a lease agreement with The Niagara Parks Commission pursuant to the *Niagara*
12 *Parks Act* (Ontario). The Act also grants to Niagara Parks Commission the authority to grant
13 certain rights to use the waters of the Niagara River for purposes of power generation.

14

15 The DeCew Falls stations use water that is transported along the Welland Canal from Lake
16 Erie by the St. Lawrence Seaway Management Corporation under an agreement between
17 OPG and the St. Lawrence Seaway Management Corporation that has been renewed
18 through June 30, 2038.

19

20 **5.2 Joint Works Agreements with New York Power Authority**

21 As previously discussed, OPG has agreements with NYPA with respect to cost sharing and
22 the management of joint works at each of the Niagara River and St. Lawrence River
23 hydroelectric generation developments (collectively the "Joint Works Agreements", including
24 the Niagara MOU and the St. Lawrence MOU). The Joint Works Agreements provide the
25 framework for defining, planning, executing and sharing costs for Joint Works associated
26 with their respective generating facilities on each of the Niagara River and the St. Lawrence
27 River.

28

29 The Joint Works Agreements at Niagara and R.H. Saunders are administered separately
30 from each other. Management and administration of the Agreements is carried out by means
31 of the following processes:

- 1 • High level, joint meetings of the Niagara and St. Lawrence Joint Works Committees
2 between NYPA and OPG are held every fall to discuss strategic initiatives and
3 operational concerns, to identify areas of risk and to share experience regarding “best
4 practices” for the shared maintenance, operations and project work on the Niagara River
5 and St Lawrence River systems. This meeting is attended by executives from both NYPA
6 and OPG, along with their support staff.
- 7 • The overall management of the respective Joint Works Agreements has been delegated
8 to the services manager for the Niagara Plant Group and the Saunders production
9 manager and site controller for the Ottawa/St. Lawrence Plant Groups.
- 10 • Quarterly meetings of local working committees for each of the Memoranda are held with
11 technical and finance staff from both NYPA and OPG in order to provide ongoing
12 management of the work programs.

14 **5.3 Dam Safety and Waterways Public Safety**

15 **5.3.1 Dam Safety**

16 OPG's Hydroelectric Business Unit operates a total of 240 dams in connection with its 65
17 hydroelectric plants. Of these, 25 dams, including 13 special hydraulic structures, are
18 associated with stations in the Niagara Plant Group and 2 dams are associated with R.H.
19 Saunders. In Canada, dams come under the jurisdiction of the provinces, with the exception
20 of dams situated in boundary waters and those owned by the Government of Canada. The
21 majority of OPG's dams fall within the jurisdiction of the Province of Ontario.

22
23 The Province of Ontario currently governs dams under the *Lakes and Rivers Improvement*
24 Act, administered by the Ministry of Natural Resources (“MNR”). Sections 14 and 16 of the
25 Act require MNR's approval for activities such as the construction, alteration, improvement,
26 or repair of dams. The existing MNR criteria for approval under the *Lakes and Rivers*
27 *Improvement Act* were developed in 1977. In 1996 the MNR, through an Industry Working
28 Group, identified the need to develop a regulation governing dam safety, but to date no
29 regulation has been approved. At the present, an Administrative Directive issued by the MNR
30 in August 2006 provides dam owners with direction for the use of draft guidelines and

1 general acceptance insofar as the classification, inflow design flood and stability criteria are
2 concerned. The Ministry's consultative process to develop a regulation is on-going.

3

4 While the regulatory regime in Ontario continues to develop, OPG has well-established
5 programs based on the Canadian Dam Association ("CDA") – Dam Safety Guidelines (2007)
6 and other industry guidelines that are in many respects seen as a model for emerging
7 standards and regulatory requirements. OPG's Dam Safety Policy, approved by the OPG's
8 Board of Directors, directs that dams be designed, constructed, operated and maintained in a
9 manner that meets all regulatory requirements or, in the absence of regulations, the safety
10 guidelines published by the CDA or other industry best practice.

11

12 OPG's dam safety program includes the preparation of annual project execution plans by
13 each plant group. These plans ensure that the plant groups are accountable for their
14 respective dam safety programs, and associated activities, as follows:

- 15 • Inspection, monitoring and surveillance of dams and hydraulic structures.
- 16 • Routine testing of flow control equipment.
- 17 • Emergency preparedness plan updates, including conducting drills and exercises.
- 18 • Staff training on all aspects of emergency preparedness, operations, maintenance and
19 surveillance.
- 20 • Periodic engineering reviews of dam safety, conducted at five to ten year intervals by
21 independent consulting engineering firms, to ensure compliance with current standards
22 and practices.
- 23 • Technical audits and independent expert reviews.
- 24 • Rehabilitation projects (maintenance and dam safety improvements where necessary).
- 25 • Development and maintenance of governing documents, including policies, standards,
26 guidelines and procedures.
- 27 • Incident reporting and follow up on lessons learned.
- 28 • Development work associated with continuous improvements to the program.

29

30 Pursuant to OPG's dam safety program, periodic dam safety reviews were completed for
31 dams associated with the Sir Adam Beck facilities, and the International Niagara Control

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1 Works in 2007, and for the DeCew Falls Generating Station facilities in 2003. Periodic
2 reviews were completed for dams associated with R.H. Saunders in 2005. Costs associated
3 with the recommended maintenance and safety improvements have been incorporated into
4 OPG's business plans.

5

6 Based on OPG's preliminary review of the 2009 Draft - Technical Guidelines for the Life
7 Cycle Management of Dams from the MNR, OPG does not anticipate that major capital
8 improvements will be required for the dams or hydraulic structures associated with regulated
9 hydroelectric facilities. However, the enactment of the draft regulation, as proposed, would
10 impact the facilities by imposing an annual registration fee for dams. As well, enactment of
11 the regulation will likely require additional engineering resources to prepare applications for
12 approvals and maintenance works on the dams.

13

14 **5.3.2 Waterways Public Safety**

15 Since 2002, OPG's Hydroelectric Business Unit has developed a number of technical
16 documents concerning public safety around dams, as well as materials to educate the public
17 and raise awareness of the hazards associated with the operation of our dams and
18 hydroelectric facilities. Recognizing the leading edge achievements of OPG in that area, both
19 the MNR and the CDA are using the work developed by OPG in developing provincial and
20 national guidelines for public safety around dams.

21

22 OPG's Waterways Public Safety Program was developed to specifically guard the public
23 from exposure to risks associated with the operation of the corporation's dams and
24 hydroelectric stations and covers the following elements:

- 25 • Development of guidance documentation/standards.
26 • Clear delegation of accountabilities.
27 • Installation of physical control measures; i.e., booms, buoys, fencing, signage, audible
28 alerts.
29 • Development of operating procedures which control the release of water, as well as the
30 maintenance, inspection and testing of the physical control measures.
31 • Employee training.

- 1 • Incident reporting and follow up studies to develop lessons learned as part of the
2 continuous improvement initiatives.
3 • Development and delivery of public education and awareness materials, including such
4 items as brochures, posters, advertisements and school packages.
5 • Program reporting and oversight.

6

7 In the area of public safety around dams, OPG has worked diligently to establish a "Stay
8 Clear - Stay Safe" message as part of the public education program. OPG actively engages
9 other agencies such as the MNR, Ontario Provincial Police, St. John's Ambulance, Life
10 Saving Society, the Ontario Waterpower Association, and numerous other stakeholders in
11 water safety education to partner in delivering the message to the public.

12

13 Currently there is no provincial or federal regulation with respect to public safety around
14 dams. However, the Province of Ontario has indicated that it intends to incorporate
15 waterways public safety into proposed dam safety regulations. The *Navigable Waters*
16 *Protection Act* requires OPG to obtain approvals for the installation of all in-water works,
17 such as safety booms and buoys. In the absence of government regulations, OPG has
18 exercised due diligence in undertaking a major Waterways Public Safety program described
19 above.

20

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1 **LIST OF ATTACHMENTS**

2

3 Attachment 1: Photo of Niagara Plant Group

4

5 Attachment 2: Photo of Niagara – Sir Adam Beck (SAB) Complex

6

7 Attachment 3: Photo of Niagara – DeCew Falls 1 and 2

8

9 Attachment 4: Niagara Tunnel – Overview

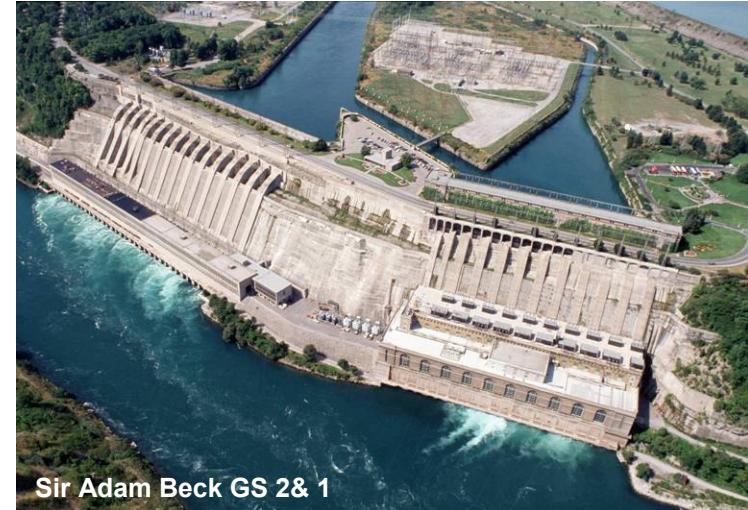
10

11 Attachment 5: St. Lawrence River

12

13 Attachment 6: Photo of Saunders Generating Station

Niagara Plant Group

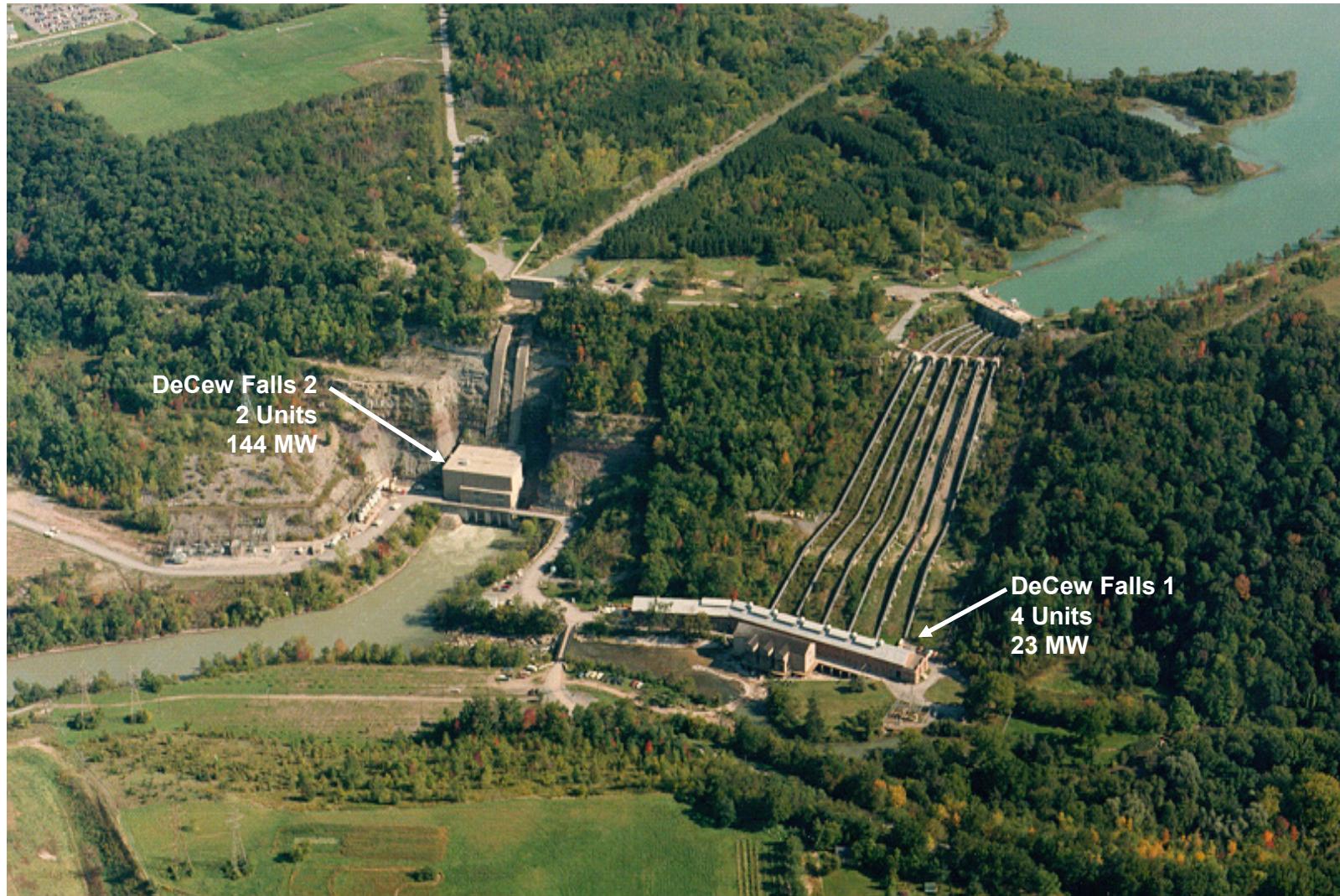


**ONTARIO POWER
GENERATION**

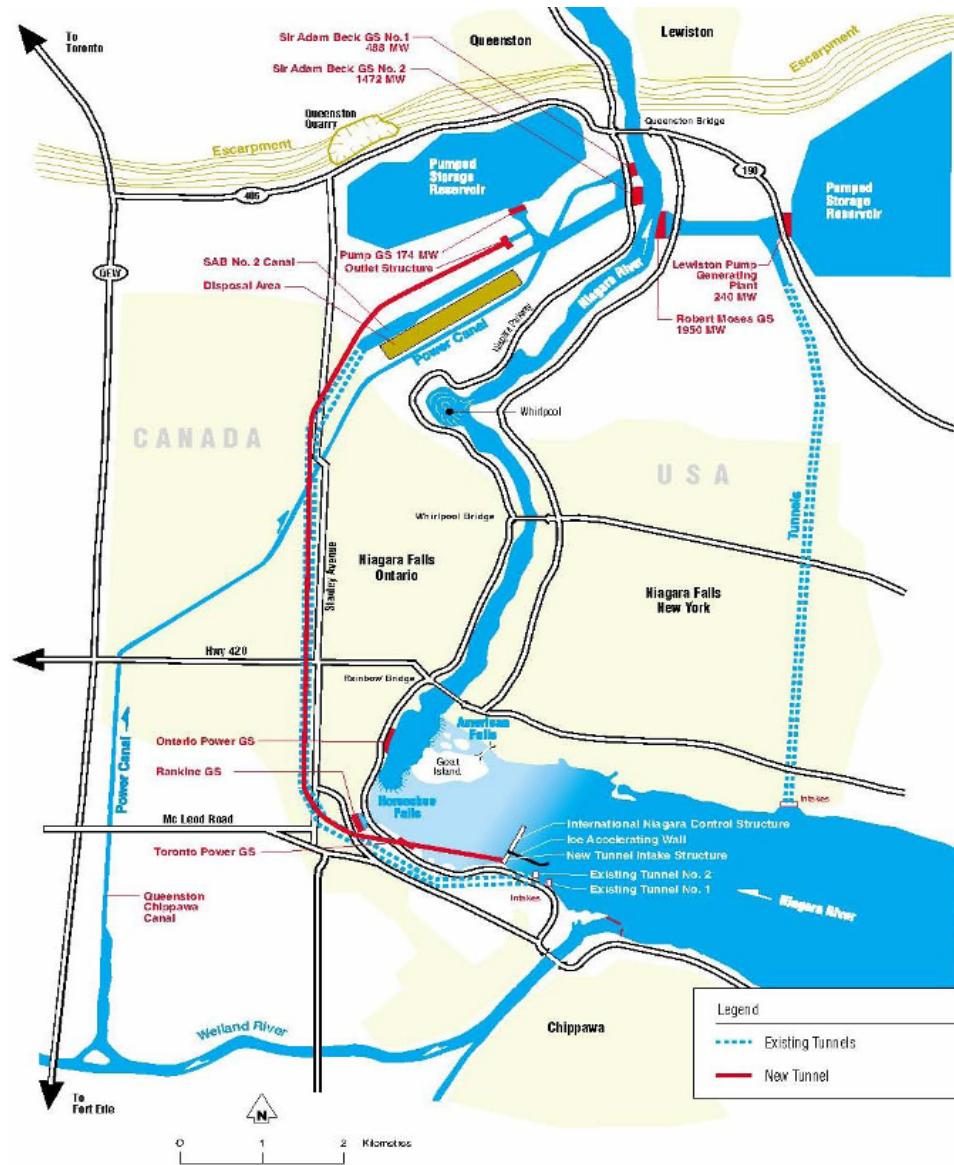
Niagara – Sir Adam Beck (SAB) Complex



Niagara – DeCew Falls 1 & 2

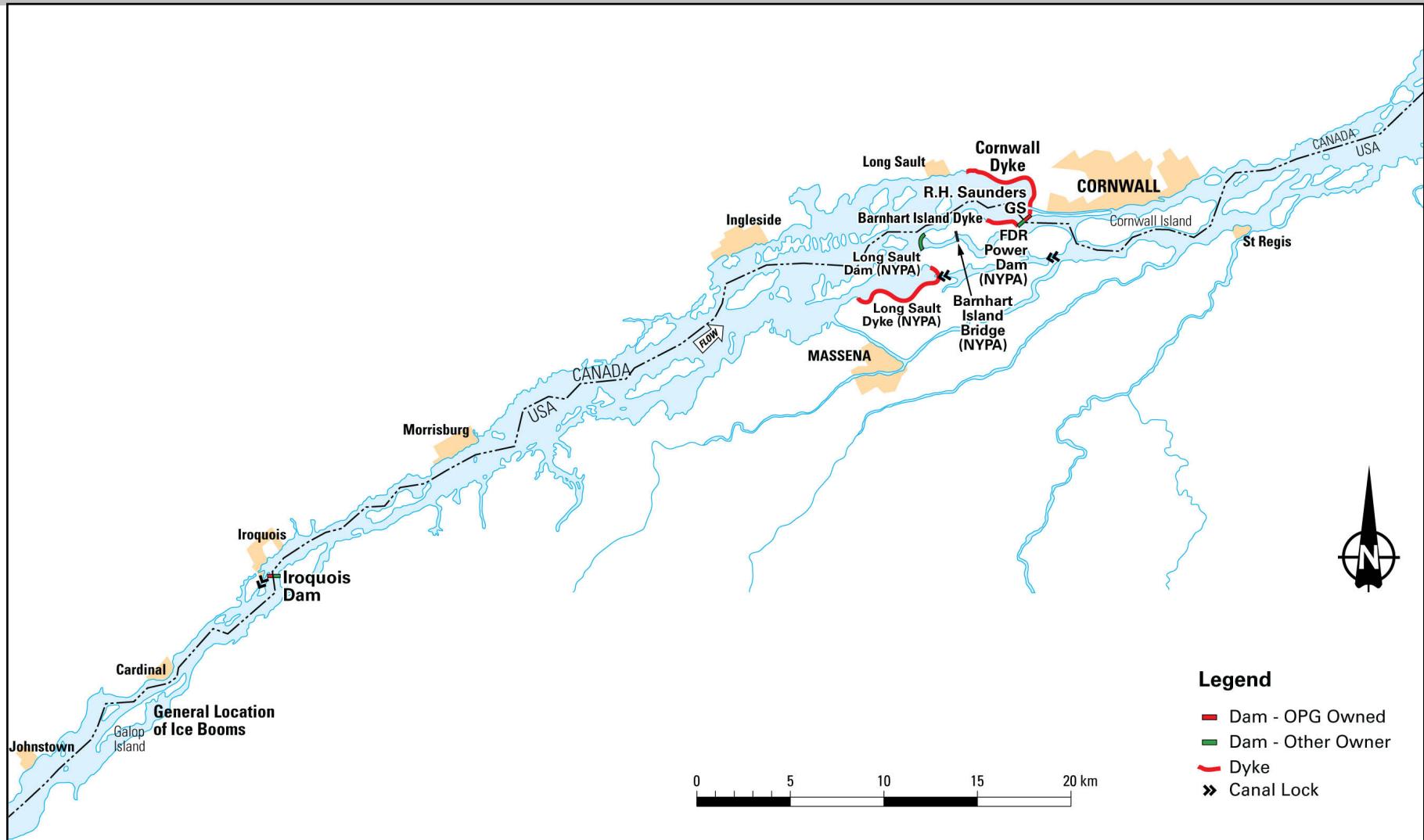


Niagara Tunnel - Overview



ONTARIO POWER
GENERATION

St.Lawrence River



Saunders GS

