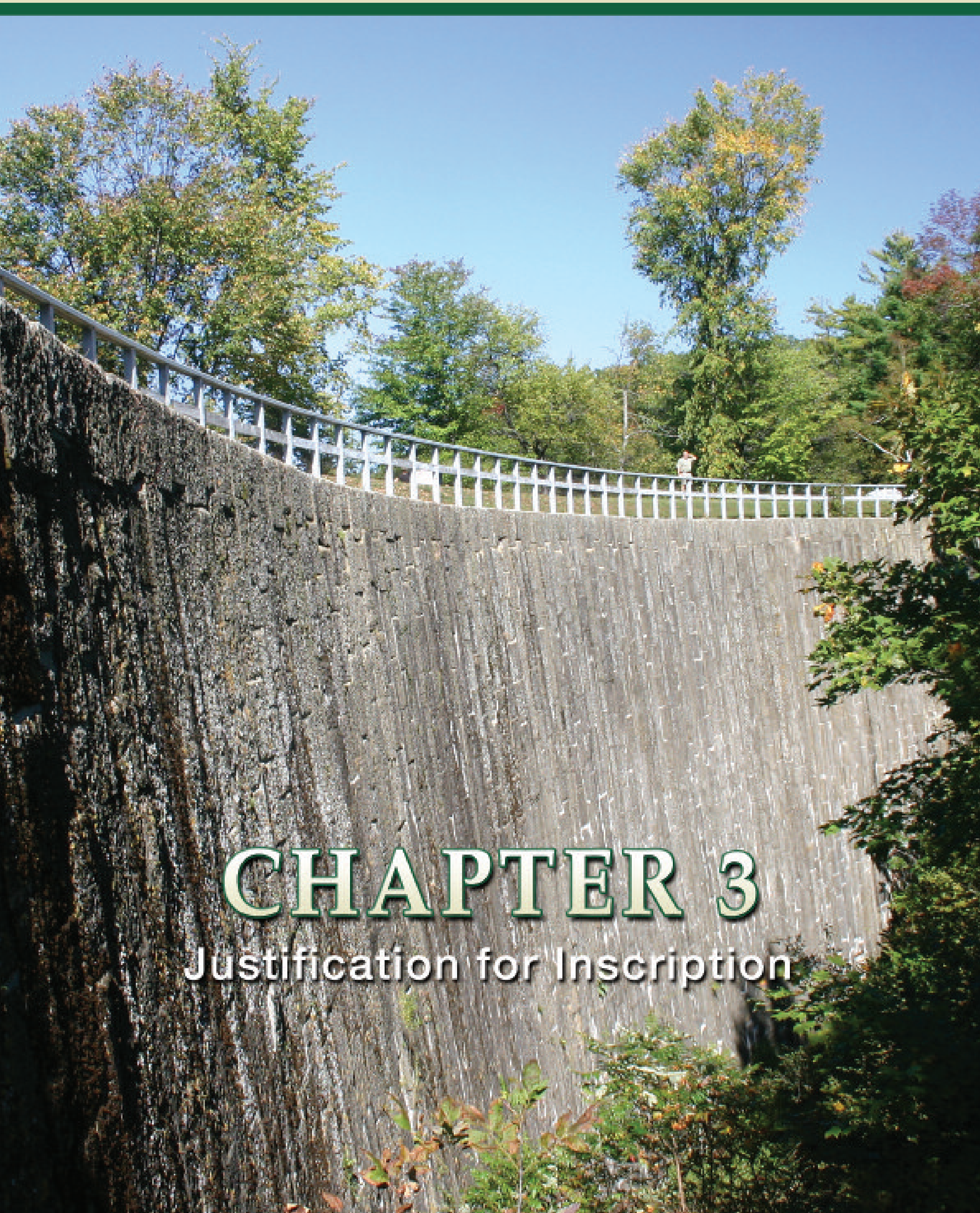
# CHAPTER 3

## Justification for Inscription



# 3. Justification for Inscription

## A. Criteria under which inscription is proposed

**Criterion (i): The Rideau Canal is a masterpiece of human creative genius.**

The Rideau Canal is a masterpiece of human creative genius, in its concept, design, and engineering. To build the canal, Lieutenant-Colonel John By, the canal's principal designer, had two options. The conventional and proven option was to use excavated channels of considerable length to link existing waterways that were navigable, bypassing falls, rapids, swamps and rocky shallows. John By dismissed this approach as being too expensive and time-consuming, given the terrain, geology and configuration of the lakes and rivers. Through a fundamental stroke of creative genius, he envisioned another option to join the watersheds of the two river systems, the Rideau and the Cataraqui: a slackwater canal, executed on a monumental scale. His decision to build a slackwater canal was highly innovative – and technologically risky. The slackwater system was virtually untried at this time in Europe. Slackwater techniques on a limited scale had been attempted in North America, but none of these canals was near the complexity of what John By conceived for the Rideau Canal.

The slackwater design that John By envisioned for the Rideau Canal required a very large number of embankments and high dams in order to inundate shallows, swamps, and rapids, and thus create a series of impoundments of sufficient depth to allow navigation along the full length of the canal. This approach dramatically reduced the requirement for extensive excavated channels, thereby reducing costs and construction time. The Corps of Royal Engineers responded with designs for an ingenious system of engineering works, including seventy-four dams and forty-seven locks at twenty-four lockstations, allowing vessels to ascend 85 m to the summit of the canal from the Ottawa River, and then descend 50 m to Lake Ontario.

*Navigation of the Rideau and Cataraqui rivers was impeded by numerous rapids and waterfalls.*

One of the problems that plagued slackwater canals and discouraged their use was the difficulty of controlling water levels on such a system. Once again, John By and his engineers created an imaginative and effective solution to the problem. They included in the plan for the canal a system of dams and embankments that created lakes to serve as reservoirs, allowing water to be stored to supply the canal during dry summer months. Conversely, during periods when excess water was in the system, such as in the spring or during heavy rainfalls, the reservoirs allowed water to be held back and released gradually, preventing damage to engineering works.

*08 The lock, weir and 400-m-long earth embankment dam at The Narrows created a slackwater section allowing navigation to Newboro Lockstation.*

The genius of the slackwater canal solution to the construction of the Rideau Canal was equaled by John By's foresight regarding the future dominance of steamboats as a mode of transportation. The specifications for the canal that he was given called for locks sufficient in size to accommodate Durham boats, flat-bottomed vessels propelled by sail or oars. Soon after his arrival in Canada, Lieutenant-Colonel By sought, and was given, authorization from his superiors to build locks to accommodate vessels using the newly emerging technology of steam power. The Rideau Canal became one of the first canals in the world designed specifically for steam-powered vessels.

**Criterion (ii): The Rideau Canal exhibits an important interchange of human values, over a span of time or within a cultural area of the world, on developments in technology.**

Building the Rideau Canal and its fortifications required adapting existing European technology to the North American environment and to the specific circumstances and geography of its setting. The experience gained in the engineering of canal works and fortifications for the Rideau Canal advanced these technologies to a new level.

### *The Transfer of Canal Technology*

The concept of canals and their engineering principles and technology were well known in Europe prior to the construction of the Rideau Canal. Canals had emerged as important commercial transportation systems in the mid-18th century, closely associated with the Industrial Revolution. The Rideau Canal was built using canal technology developed in Europe and transferred to North America. However, the existing European canal technology was adapted and advanced on the Rideau in order to build a slackwater system on a scale previously untried.

There were three areas of canal-building technology in which significant adaptation and technological advancement occurred during the building of the Rideau Canal – surveying methodology, lock engineering and dam engineering.

### *Surveying Methodology*

The Corps of Royal Engineers brought European surveying methodologies to North America for the construction of the Rideau Canal. The adaptations they made in the application of the transferred technologies, to meet the exigencies of particular local conditions, was an outstanding technological advancement.

The Royal Engineers developed truly innovative methods for orienting a survey and taking levels. First, a directional fire technique was adopted, enabling the surveyors to orient a survey over great distances in the dense forest. Second, they used compass traverses rather than conventional theodolite traverses, which were impossible in the forest. Third, so-called ‘flying levels’ were taken of the rise or fall of the land, based on the vertical position of a light placed at an established height on the leveling staff. And fourth, with the impossibility of running theodolite traverses, cross-sections of the terrain were mapped using a grid survey on compass bearings. These maps allowed the canal to be routed to take advantage of the natural terrain, thereby minimizing tree clearing, excavation and embanking work.

These innovations eliminated a great deal of difficult, costly and time-consuming labour in clearing away forest growth to obtain clear sight lines. They enabled canal works, stretching throughout a 202-km-long wilderness corridor, to be laid out in a remarkably short period of time during the winter of 1826 and spring of 1827.

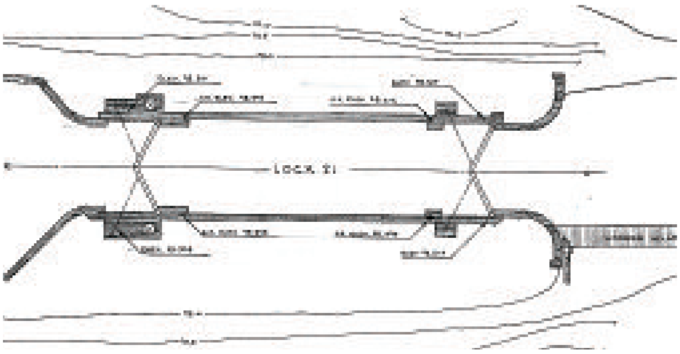
### *Lock Engineering*

The second important area of the transfer of European technology where the Royal Engineers took an established technology to a new level was in lock engineering. Engineering principles transferred from Europe were used for the construction of the Rideau. The lock-building achievement on the Rideau was, however, the design and construction of locks capable of withstanding the unprecedented force of water pressure resulting from the high lifts and large lock chambers required for a slackwater canal built for steamboats.

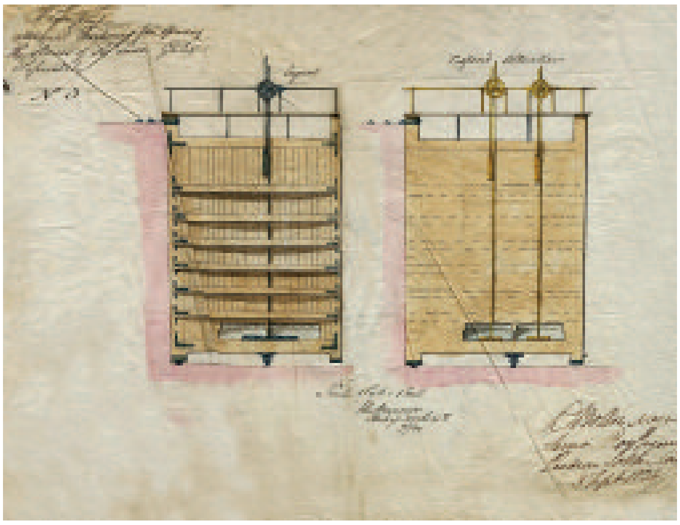
09 *The Rideau was one of the first canals designed to accommodate steamboats.*

Typically, locks on European canals had a lift of 2,4 m to 3,0 m. To overcome the terrain on the route of the Rideau Canal, John By was faced with the choice of building numerous locks with low lifts or fewer locks with high lifts. To minimize costs and construction time, he opted for high lifts and, therefore, fewer locks. For example, rather than construct six locks or more at Jones Falls, to overcome a rise of 18,4 m, four locks were constructed, with a maximum lift of 4,6 m. In addition, to accommodate steamboats, the lock chambers had to be significantly larger than those employed up to that time on European and North American canals. The locks on the Rideau Canal were 37,8 m long and 9,1 m wide. In comparison, the contemporary Blackstone Canal in the United States of America had locks 21,3 m long and 3,1 m wide.

The force of water pressure created by the high lifts and large size of the locks required engineering advancements in design and construction. Lock walls, gates, sluice tunnels and wing walls were all designed and constructed to carry significantly greater force than in earlier canals. In later years, these advancements in lock engineering were applied elsewhere in the construction of locks, such as those built on the St. Lawrence River in the late 1840s.



*The locks of the Rideau Canal were significantly larger than those found in Europe at the time.*



*The large size of the lock chambers of the Rideau Canal required the design of massive lock gates.*

## *Dam Engineering*

The third major area of technology transfer where John By and his engineers took an established technology to new levels during the design and construction of the Rideau Canal was in the engineering of dams. The slackwater system used for the canal required a large number of dams to inundate shallows and rapids. Individually, and as a system, these dams represented a considerable advancement in dam-building technology.

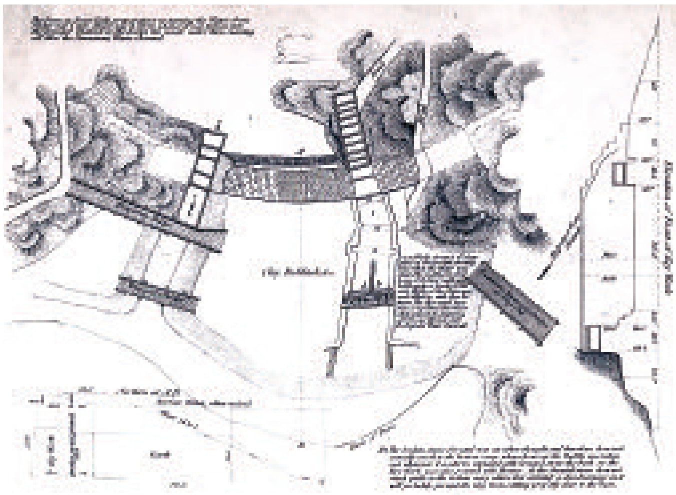
The massive Jones Falls Stone Arch Dam well illustrates the adaptation and advancement of European dam-building technology to meet the challenges of the Rideau Canal. To deal with the deep gorge, falls and rapids at Jones Falls required a dam with a span 107 m, to a height of 19 m, double the height of any dam in North America at the time. John By's design integrated stone masonry dam technology with the technology of clay core earth dams, to cope with the incredible stresses on a structure of this scale. The Jones Falls dam's international importance was recognized in the International Canal Monuments List, prepared under the auspices of The International Committee for the Conservation of Industrial Heritage (TICCIH).

10 The Jones Falls Stone Arch Dam was an astounding feat of engineering.

To establish the impoundments of water that were required for the Rideau Canal's slackwater system, sets of dams were often required at lockstations. The engineering of such dam systems involved the use of earth embankment dams, stone masonry dams and stone masonry water control weirs in combination. The system of dams at Kingston Mills illustrates John By's mastery of traditional European dam building technology and his advancement of it. He achieved the impoundment of the 15.6-km stretch of water above Kingston Mills through a system of dams that included two earth embankments dams, 1,4 km in total length, a 120-m long stone masonry arch dam, natural geological features, a water control weir, and the upper lock.

### *The Transfer of Military Technology*

The fortifications built at Kingston to defend the mouth of the Rideau Canal represent the transfer of European military technology to North America. Fort Henry was, however, a considerable advance over earlier fortifications built in British North



The construction of the Jones Falls dam was a complex feat of engineering.

The slackwater system often entailed the construction of a system of dams, as at Kingston Mills.

America. Major citadels built in the 1820s at Halifax and Quebec City conformed to the traditional Vauban design of fortification. For Fort Henry, engineers abandoned this approach, adapting newer Prussian thinking to create a fortification that was unique in British North America. The result was a powerful and compact fort, well suited to the topography of Point Henry.

The four Martello towers, built between 1846 and 1848 to protect Kingston Harbour and the entrance to the canal, were designed by Lieutenant-Colonel W. Holloway of the Corps of Royal Engineers. Martello towers had been adapted by the British from round tower fortifications found on the European continent, and built to protect the English coastlines during the period of the Napoleonic

Fort Henry was innovative in design and planned to be a self-defending redoubt.

Wars. They extended their use to British North America, eventually building twelve towers in total, the last being the four in Kingston. The Kingston towers were the culmination of decades of British development of round masonry tower design and construction. All incorporated significant innovative structural and external features to address defensive weaknesses previously associated with this type of fortification. Of the four, Murney is the best example of the final phase in this process of evolution. Like traditional Martello towers, it consisted of two floors with a gun platform protected by a high parapet. It was, however, surrounded by a deep ditch with a dry masonry counterscarp. Tower and ditch were protected by a rubble-filled glacis. Four massive caponiers projected from the base of the tower, enabling defenders to fire in to the ditch. All the Kingston towers were innovative in design and of a high quality of construction. Murney is, however, regarded as the most sophisticated Martello tower to be built in British North America.

11 Murney Tower, with ditch, counterscarp, glacis and caponiers, was a small self-contained fortress.

**Criterion (iv): The Rideau Canal is an outstanding example of a technological ensemble which illustrates a significant stage in human history.**

The Rideau Canal was built at a time when two powers, Great Britain and the United States of America, vied for the control of the northern portion of the North American continent. This significant stage in human history resulted in the creation of two distinct political and cultural entities, Canada and the United States of America.

One of very few canals in the world built primarily for strategic military purposes, the Rideau Canal and its associated defensive works were critical elements in the global strategy developed by Great Britain immediately after the Napoleonic Wars in Europe and the War of 1812 in North America. The two wars demonstrated to British political and military leaders the importance of a military defensive system to protect their far-flung global interests.

In North America, the key to the defence of Canada lay in a transportation route from Montréal to Lake Ontario, more secure than the St. Lawrence River, to supply the vital naval base at Kingston. When the British Government examined the defence of British North America, two Canadian projects were sanctioned: the Rideau Canal and the Kingston harbour fortifications.

12 The view from Fort Henry of the naval dockyards, the entrance to the Rideau Canal and the town of Kingston.

This was the context for the British decision to invest enormous financial resources in the construction of the Rideau Canal and its associated fortifications. At stake was the future security and expansion of British political and commercial interests on the North American continent. This was also the context for approval of locks large enough to accommodate steam-powered vessels. As historian Robert Passfield remarks, "steamboat navigation provided the British forces with a speed of movement superior to that enjoyed by the Americans. Had the Rideau Canal not been completed, or had it been constructed as a small gunboat canal, the whole of the military's efforts at engineering the defence of Canada would have been undermined."

The ultimate success of this strategy was fundamental to the growth of colonial Canada and, subsequently, its development as an independent nation, spanning the northern half of the continent.

13 The blockhouse built to protect the locks at Merrickville.

## B. Proposed Statement of Outstanding Universal Value

In concept, design, and engineering, the Rideau Canal is the most outstanding surviving example of an early-19th century slackwater canal system in the world, and one of the first canals designed specifically for steam-powered vessels. It is an exceptional example of the transfer of European transportation technology and its ingenious advancement in the North American environment.

A rare instance of a canal built primarily for strategic military purposes, the Rideau Canal, together with its ensemble of military fortifications, illustrates the significant stage in human history when Great Britain and the United States of America vied for the control of the northern portion of the North American continent.

## C. Comparative analysis

The earliest evidence of the development of canals dates back approximately 4 000 years to Egypt and the Middle East. The Grand Canal in China was built in the 4th century B.C.E., with several later extensions. Linking the Yangtze and Yellow rivers to Beijing, it is the longest canal in the world, the first summit level canal and had the first recorded pound lock. The Canal du Midi in France, built in the 17th century, is widely regarded as the first canal of the modern era. It was enormously influential in the design of subsequent canals in Europe, and is, at present, the only canal inscribed on the World Heritage List (although the four lift locks on the Canal du Centre in Belgium are also inscribed). Beginning in the middle of the 18th century, there was a virtual explosion in canal building in Europe. By 1850, 6 500 km of canals had been constructed in England and Wales alone.

Worldwide, canals have been built for three main purposes – irrigation, water control and transportation. The Rideau Canal is a transportation canal. The engineering and construction techniques transferred to North America for the building of the Rideau Canal were based on European canal-building experience but were significantly adapted to meet the needs of the North American environment and the particular design requirements of a slackwater canal. For purposes of comparative analysis, it is most relevant to examine other transportation canals based on the European canal-building experience of the early 19th century, in particular those built in North America.

## *A Masterpiece of Human Creative Genius: The Rideau as a Slackwater Canal*

### Slackwater Canal Experience in Europe

The slackwater concept was used only to a limited degree in Europe. Typically, 18th and early-19th century canals were excavated channels linked to natural navigable waterways, usually rivers. Locks were built in the excavated channels to overcome changes in elevation. While dams were used to control feeder channels to maintain water levels, they were rarely used to create the impoundments required for a slackwater canal. Even though slackwater systems could have been used to a greater extent, builders had the perception that it was more difficult to build and repair locks in natural or impounded watercourses. An additional factor that militated against more slackwater construction was the concern over fluctuations in water levels in slackwater systems, a problem not encountered to the same extent on excavated canals.

The most notable European slackwater system from the early-19th century canal-building era is the Gotä Canal in Sweden (1810–1832). The Gotä used slackwater techniques, with dams creating slackwater sections as part of its navigable route and reservoirs to control water levels. But, it also relied heavily on excavated channels, typical of the more common European canals. Forty-five percent of the total length of the Gotä is man-made. This is in contrast to the Rideau Canal, where only nine percent of the total length is excavated. Even though slackwater sections could have been used for a greater proportion of the length of the Gotä Canal, the builders demonstrated the same reluctance as other European canal builders to implement slackwater design and engineering. Their use of slackwater sections as the primary navigation route speaks to the ingenuity and confidence of the engineers of the Rideau Canal.

A comparison of the Gotä and the Rideau canals provides a perspective on these two slackwater canals from the early 19th century.

| | Rideau Canal | Gotä Canal |
|---|---|---|
| Length | 202,1 km | 190,5 km |
| Excavated channel | 19 km | 87,5 km |
| Slackwater sections | 183,1 km | 103 km |
| Number of locks | 47 | 58 |
| Number of remaining manually operated locks | 44 | 2 |
| Year of completion | 1832 | 1832 |
| Years to complete | 6 | 22 |
| Lock length | 37,8 m[A] | 35,63 m[B] |
| Lock width | 9,1 m | 7,2 m - 7,6 m |

A. Measured in the chamber from the point of the lower sill to the face of the breastwork.

B. Most of the locks are this length measured between the lock gates. However, Mem, Tegelbruket and Söderköping Locks are all 38,6 m.

Both the Gotä Canal and the Rideau Canal were remarkable engineering achievements in the tradition of European canal-building technology of the early 19th century. The builders of the Rideau Canal, however, while using this technology, adapted it and advanced it to create a remarkable slackwater canal system. Moreover, the Gotä Canal has, unlike the Rideau Canal, been modernized to a great extent. Only two of its fifty-eight locks are operated manually, while forty-four of the forty-seven locks on the Rideau are operated using authentic hand-powered winches.

### *Slackwater Canal Experience in North America*

The European experience in canal development inspired a form of 'canal mania' in North America: approximately sixty-five canals were constructed before 1850, chiefly in the eastern United States of America. Most, however, represented a conventional application of European canal technology. American engineers demonstrated a caution similar to that of the European builders with respect to constructing a slackwater canal system. Consequently, no large-scale slackwater canals were built in the United States of America, although some canals used slackwater design for sections of their routes.

The most notable example was the Blackstone Canal, which was constructed from Providence, Rhode Island, to Worcester, Massachusetts, between 1824 and 1828. The Blackstone Canal was a towpath canal, suitable for small, heavily-laden barges, drawn between locks by horses. Forty-nine masonry locks, each 21,3 m long by 3,1 m wide, were built along its 72,4 km route.

There were some short slackwater sections on the Blackstone Canal, but its operators found that these were susceptible to flooding, freezing and low water, causing maintenance and operational difficulties. Clearly, the Blackstone lacked the sophistication of design to manage water flows that was developed for the Rideau Canal.

Due to the emergence of railways in the New England states, the canal closed in 1848 and was abandoned. Very little remains of its original works, much of the stone having been hauled away for other construction uses.

Another historically important American canal was the Schuylkill Canal, built from Philadelphia, Pennsylvania, 160 km along the Schuylkill River to the coal mining area of the Allegheny Mountains. The builders of the canal used excavated channels to bypass rapids and rocky shallows, but, in some locations, dams were built to create slackwater sections in the river. Completed in 1825, the Schuylkill was a towpath canal.

The canal was an immediate commercial success but declined in the late 19th century with the introduction of railways to the area. The State of Pennsylvania acquired the canal in 1931 but saw no economic value in it. Many sections were drained and abandoned. Only a few are still evident today.

In Canada, an early canal project that used elements of slackwater design was the first Welland Canal, built from Lake Ontario to Lake Erie between 1824 and 1829. The route of the canal followed Twelve Mile Creek from Lake Ontario and connected to the Welland River through a series of locks. It then joined the Niagara River above Niagara Falls before reaching Lake Erie.

The use of slackwater design was undertaken to a limited degree on the Welland. Ultimately, however, the slackwater components were abandoned in favour of a series of excavated channels. There are, now, no intact remains of the original slackwater works, and the canal's original line has been abandoned.

The Blackstone, the Schuylkill and the Welland canals are examples of early North American attempts to use slackwater canal-building techniques. None of them, however, was a fully functioning slackwater system. None advanced canal technology as did the Rideau, through its creative and ingenious slackwater engineering.

In considering European and North American examples of the same time period, it is quite clear that no other canal is comparable to the Rideau Canal as a slackwater system. The Gotä Canal was a project of comparable scale but depended much more heavily on conventional excavated channel sections than did the Rideau and has been largely modernized. The Blackstone, Schuylkill and the Welland canals had only limited slackwater elements and have little historic authenticity today. The Rideau Canal is clearly the most outstanding surviving example in the world of an early-19th century slackwater canal, and the best preserved.

### *The Transfer of Canal Technology to North America*

The International Canal Monuments List identifies seven canals as being of technological significance worldwide: "These are the most influential waterways in this document. All are landmarks in the world history of canals." (p. 65) The Erie Canal in the United States of America and the Rideau Canal in Canada are listed among these landmarks, which also include the Grand Canal in China, the Canal du Midi in France, and the Bridgewater, Ellesmere and Birmingham canals in Great Britain.

According to the authors of the list, the Erie Canal "was significant for being the product of the intercontinental transfer of technology." (p. 65) Located between Albany and Buffalo, New York, it was considered a triumph of early engineering in

The Canal du Midi in Languedoc, France was designed with curved walls to resist the pressure of the earth and allow a larger number of boats into the lock.

the United States of America and one of the most ambitious construction projects of 19th century North America. Built as an excavated towpath canal, the first Erie Canal was completed in 1825. It included eighteen aqueducts to carry the canal over ravines and rivers, and eighty-three locks with a rise of 177,7 m from the Hudson River to Lake Erie.

Like the Erie Canal, the Rideau Canal is recognized in the International Canal Monuments List as demonstrating the "intercontinental transfer of technology and the adaptation of advanced, highly financed engineering to the circumstances of a developing country." (p. 56) Unlike the Erie, however, the Rideau Canal is a well-preserved example of this early-19th century transfer of technology. Ten years after it was built, the Erie was enlarged, a process that altered the size of the locks and widened and deepened the excavated channel. The Erie Barge Canal, built between 1903 and 1918, bypassed the first and second Erie Canals. While some sections of the original canal have been preserved, the overall authenticity of the original line of the Erie Canal is severely impaired and most of its original engineering structures have disappeared.

A comparison of the two canals resulted in the conclusion by the authors of the list that, "the differing states of preservation of the waterways may well mean that the Rideau, rather than the original Erie Canal, is selected as an illustration of this process of intercontinental transfer and development." (p. 57) In addition, they observed that the Rideau Canal "is particularly important in international terms because it is the only canal dating from the great North American canal-building era of the early nineteenth century that remains operational along its original line with most of its original structures intact." (p. 70)

### *A Technological Ensemble which illustrates a Significant Stage in Human History*

The Rideau Canal is a rare example of a canal that was built primarily for military purposes. Many canals in Europe and North America had some form of military use during their history. The Gotä Canal, discussed earlier, included military components and was viewed as having strategic importance in the defence of Sweden. For the most part, however, canals were built primarily for commercial purposes.

The idea that a canal could serve as an effective and secure military supply route began with the Royal Military Canal in Great Britain. This canal was constructed between 1804 and 1809 during the Napoleonic Wars, along the Romney Marsh in Kent. This 45,1-km excavated canal was considered a third line of defence against the possible invasion of south-eastern England, the Royal Navy and the system of Martello towers along the coastline being the two main lines of defence. The level of importance that British authorities assigned to the Royal Military Canal is questionable. Along its length, the canal was protected by nothing more than earthworks and defensible 'station houses'. Its construction, however, signaled that British military and government leaders had grasped the concept of the use of canals as part of a defensive system. This understanding of the strategic role of canals was transferred to Canada for the construction of the Rideau Canal in the 1820s. It was envisioned by strategists as a major component in the defence of British North America against an attack from the United States of America. In contrast to the Royal Military Canal, it was heavily fortified with blockhouses, defensible lockmaster's houses, Fort Henry and four Martello towers. The willingness of the British to invest enormous financial resources in the construction and defence of the Rideau Canal clearly demonstrates its fundamental importance in the on-going rivalry for control of the northern half of North America.

## *D. Authenticity*

In addition to its historical and technological significance, the nominated property fulfils the conditions of authenticity set out in Section II E of the Operational Guidelines. The authenticity of the nominated site can be attributed, in large measure, to the high degree of engineering skill and workmanship in the construction of the original engineering works, fortifications and buildings. In addition, ownership of the nominated site by the Government of Canada since the later decades of the 19th century has been a major factor in the survival of original structures and ensembles of structures, and their high state of conservation. Aspects of the Rideau Canal as they relate to the conditions of authenticity set out in the guidelines are described below.

## *1. Authenticity in form and design*

### *The Slackwater System*

The Rideau Canal, as a slackwater canal system, has a high degree of authenticity, since the original plan and layout of the route, as well as the depth and width of channels, have remained completely intact. During construction, watercourses and adjacent lands along the route were significantly modified by the construction of dams and locks. Rapids, rocky shallows and swamps were flooded to create navigable channels, lakes and rivers. These features all remain in evidence today.

*Large areas were flooded during the construction of the canal. Dead tree stumps are still visible in many locations.*

### Engineering Works

#### *Locks*

The original forty-seven lock structures of the Rideau Canal have retained their locations and dimensions as built. In the 1880s, two locks were built at Beveridges Lockstation as part of the Tay Canal. They also have retained their locations and dimensions as built. To facilitate the road crossing of the canal at Smiths Falls Combined Lockstation, a single-chamber concrete lock was built in the 1970s in proximity to the original three locks in flight, which have been preserved in their original form and location.

Including the two locks at Beveridges and the single-chamber lock at Smiths Falls, there are now fifty lock chambers on the canal. Forty-one of them are classified as Level 1 cultural resources, and two are Level 2 cultural resources, according to the Parks Canada Agency's *Cultural Resource Management Policy*. These numbers are indicative of the high level of authenticity of the Rideau Canal's locks. (CRM levels are explained in chapter 2, section A).

### *Lock Gates*

Due to deterioration of the wood from harsh winters and regular use, the timber-frame gates on the Rideau Canal have a life span of approximately twenty to twenty-five years. This frequency of replacement is similar to the replacement schedule during the canal's historic period. Replacement gates are manufactured by skilled Parks Canada Agency craftsmen, who pattern the new gates after the original design.

*Gates have a life span of up to twenty-five years. New gates are made by Parks Canada Agency staff, following the design of the originals.*

### *Dams*

With very few exceptions, the canal's dams, consisting of earthen embankments, stone masonry dams, spillways and weirs, exist today in their original locations and still play their original roles in creating the slackwater system. In response to water management and public safety requirements, some dams have undergone varying degrees of replacement.

There are seventy-four dams along the Rideau Canal, of which twenty-three have received a CRM Level 1 rating, indicating their authenticity with respect to form and design. Fourteen dams have received a CRM Level 2 rating. The most significant dam engineering achievement on the canal was the seven stone arch dams built as part of the original plan. All of these survive in their original form and design.

*The Jones Falls weir is part of the complex system of dams at this lockstation.*

### *Bridges*

When the Rideau Canal was built in the wilderness of eastern Ontario, there was virtually no need to include bridges in the design of engineering works for the lockstations. As the population of the area increased and the road system developed, swing bridges were built at a number of lockstations to cross the canal. Twelve such bridges are included in the nominated property and together demonstrate the evolution of bridge form and design. Three of the twelve are original steel swing bridges. They are located at Burritts Rapids Lockstation (1897), The Narrows Lockstation (1898) and Long Island Lockstation (1903) and classified as CRM Level 2 resources. Four of the original timber bridges were replaced using authentic designs. The remaining five bridges are steel replacements that were

*Authentic designs were used to construct the king post swing bridges found today at some lockstations.*

installed to meet vehicle traffic needs or because of the physical condition of the originals.

### *Lock Operating Mechanisms*

When the canal opened in 1832, three different operating mechanisms were used, all operated by hand-powered winches. In addition, hand-powered winches were used to operate the sluice valves for the locks. These operating systems are still in use today at most locks on the canal. Only three of the canal's fifty locks now have hydraulic/electric operating systems for gates and sluices. These are Black Rapids, Smiths Falls Combined, and Newboro.

*Lock gates and sluice valves are still operated using hand-powered winches.*

### *Canal Buildings and Fortifications*

Twenty-three buildings associated with the nominated property date from the construction period and demonstrate the strategic military purpose of the canal. They have been assessed under the CRM Policy as Level 1 resources. In addition, there are buildings from the post-construction period included in the nominated property. Their form and design reflect the evolution of the property, the different periods of their construction and the specific functions that they were intended to serve. Sixteen of these buildings are CRM Level 2 resources.

The CRM Level 1 buildings include the fortifications at Kingston and the canal's blockhouses and defensible lockmaster's houses. In form and design, Fort Henry and the four Martello towers are as built in the 19th century, except that the main floor of both Shoal Tower and Cathcart Tower is now missing and partition walls of the storage level have collapsed. Of the six blockhouses built to defend the Rideau Canal, four survive (Merrickville, The Narrows, Newboro and Kingston Mills). Although they were adapted for other uses when no longer needed for defensive purposes, all have now been restored to their original appearance.

The defensible lockmaster's houses were small, square, one-storey stone buildings, with small window openings and incorporating loopholes for rifle fire. When it became clear that they were no longer needed for defensive purposes, they were altered to make them more habitable. Many were enlarged through the addition of a second storey. A large number of these houses survive with their original form and design retained as part of the adapted structure.

The CRM Level 2 buildings associated with the nominated property date from later in the 19th century to the 1930s. Following the military era, additional houses were built for lockmasters, and several lockmaster's houses were built in the first decades of the 20th century. They are all similar in design: plain, rectangular, two-storey frame

*Later in the 19th century, stone gave way to wood for the construction of lockstation buildings.*

structures. Also in the early 20th century, a few houses were built for the accommodation of canalmen. They resembled the lockmaster's houses of that period, but were smaller in size.

In the early days of the canal and for many years thereafter, lockmaster's houses were the lockstation offices as well. In the late 19th century, buildings intended to serve as separate lockstation offices were introduced. The lockstation office at Davis was built in 1875 and, in design, was similar to a domestic building. In contrast, the lockstation office built at Ottawa Locks in 1884 is, despite its small size, an impressive stone-built structure. Purpose-built lockstation offices continued to be constructed up to the 1970s, although a number of lockstation offices in use today were adapted from existing lockmaster's houses.

## *2. Authenticity in materials and substance*

### *Locks*

Nearly all of the Rideau Canal's locks are in their original state of construction with a high percentage of original stone. At the time of their construction, locks had either stone-masonry or timber floors. While it has been possible to retain the stone masonry, the timber floors were replaced with concrete at an earlier time. These evolved lock structures are now conserved in their current state as part of the life-cycle maintenance program.

In the past, the periodic stabilization of lock walls was undertaken by dismantling the walls and reconstructing them. The Parks Canada Agency has since adopted new maintenance techniques that conserve original stone-masonry lock walls. The current technology uses core drilling and pressure grouting techniques so the wall can be stabilized in place. As a result, there is less damage to original stone blocks and greater protection of original fabric. When, however, it is necessary to replace stone blocks, it is normal practice throughout the canal to use new stone similar in composition to the original.

Only one original lock (Black Rapids) has been entirely rebuilt with the use of concrete, and five locks (Ottawa Locks 1–5) have been rebuilt with stone matching the original.

*Original masonry floors survive at many locks. The timber floors used at some locks have been replaced by concrete.*

New techniques are now used for grouting, causing less damage to original fabric.

### *Gates*

The wood originally used for building lock gates was native oak, but now, when gates are replaced on a twenty to twenty-five year cycle, British Columbia Douglas Fir is used, due to the scarcity of oak large enough to fashion the timbers. Iron and steel fittings are conserved from one set of gates to the next to the greatest degree possible. When replacement pieces are required, the original material and form are duplicated.

Originally made of oak, lock gates are now made of Douglas Fir due to the lack of oak of sufficient size.

### *Dams*

Twenty-three of the seventy-four dams of the Rideau Canal, including the seven stone arch dams, retain their original materials. Because of the importance of the dams as water control structures and in order to meet evolving safety standards for such structures, some of the original stone- masonry dams have been replaced over time using concrete. Fourteen of these early concrete dams represent the evolution of canal engineering and have been classified as CRM Level 2. The canal's earth embankment dams retain their original materials, including their clay puddle cores, but have, in some instances, been reinforced with additional earth or stone.

### *Bridges*

The oldest surviving bridges on the canal date from the 19th and the early 20th centuries and were made of steel. When repairs are necessary, steel is used. The timber bridges now found on the canal are, in design, authentic replacements of the originals and use authentic materials to the greatest degree possible.

### *Lock Operating Mechanisms*

As components of lock operating mechanisms age and wear, they are repaired to conserve original material such as timber, cast iron, wrought iron and steel. When necessary, they are replaced using authentic materials.

### *Canal Buildings and Fortifications*

Most buildings dating from the construction period of the canal are made of stone, although the four surviving blockhouses were stone on the first level, with a frame second level. The fortifications at Kingston are stone, although the four Martello towers have wooden roofs. Of the two lockstation offices dating from the 19th century, one is stone, the other, frame. For the most part, the 19th century alterations made to canal houses consisted of adding to them a frame second storey. Houses built in the early 20th century are frame.

Repairs made to these buildings aim to conserve the original material as much as possible; if replacement of fabric is necessary, the original materials are duplicated.

### *3. Authenticity in use and function*

In 2007, the Rideau Canal will celebrate its 175th year of continuous operation. Over its entire history, the transportation function of the canal has been maintained. While military and commercial uses have given way to recreational boating, the experience of using the canal, travel distances, and travel time have remained the same. Today's pleasure boater experience the process of 'locking through' the canal in much the same way that the earliest travellers did.

By the 1860s, Fort Henry and the four Martello towers, and the blockhouses and defensible lockmaster's houses along the canal were outmoded for defensive purposes although some buildings continued to be used by the military, in Fort Henry's case until after the First World War. Today, several of these fortifications are used for the interpretation of their original military function. Fort Henry is used to convey the life of the garrison stationed there in 1867. Fort Frederick and Murney Tower are museums and part of their programming is devoted to the history and significance of the fortifications at Kingston. Kingston Mills Blockhouse, the defensible lockmaster's houses at Jones Falls and Chaffeys, and the Merrickville Blockhouse present the military function of these small-scale fortifications.

### *4. Authenticity in traditions, techniques and management systems*

Built by the British government, the Rideau Canal was transferred to the Province of Canada, and then to the Dominion of Canada in 1867. The British government retained possession of Fort Henry and the Martello towers until 1870, at which time they, too, were transferred to the Canadian government. Both the canal and the fortifications are still the responsibility of the federal government, and this continuity of government ownership has been a major factor in the survival of original structures and ensembles of structures, and their high state of conservation.

For nearly 175 years, without interruption, the Rideau Canal has been an operating waterway, fulfilling its original function as a transportation route between Ottawa and Kingston. While management methods have evolved over time, there has been considerable continuity in the operation of the canal. For example, the job of the lockmaster has existed since 1832, and lockmasters of the Rideau continue to exercise their responsibilities in a manner that is continuous with their line of predecessors, and a part of a long tradition of service to the public. Moreover, most locks are still operated in the traditional way with hand-powered winches used to open gates and sluice valves.

The property is managed in accordance with conservation principles, which means that, to the greatest degree possible, techniques used in the maintenance and conservation of the cultural resources of the property respect the integrity of the original workmanship. Cultural resources that demonstrate the authentic techniques of construction are conserved. While lock gates and other wooden structures must be re-structured or replaced from time to time, the designs used are authentic. Modern tools are often used for efficiency, but the methods of layout and fabrication follow the original construction techniques.

### *5. Authenticity in location and setting*

The course followed by the Rideau Canal along its 202-km route from Ottawa to Kingston is unchanged, but the setting through which it passes has, in some areas, evolved considerably since the canal was completed. The Rideau now passes through cities and towns that were small communities in 1832: Ottawa, Merrickville, Smiths

Falls and Kingston. Extensive farms are found along the route, particularly in the region between Ottawa and Smiths Falls. Cottage and resort development has taken place, notably in the area of the Rideau lakes. Nevertheless, almost half of the canal's shorelands exists today in a natural state.

The location of the canal's twenty-four lockstations is also unchanged as is the location of the various Level 1 and Level 2 buildings and dams dating to the 19th and the early 20th century. In the case of the fortified lockmaster's houses and the blockhouses, this means that their defensive function is still clearly evident. The grounds around the locks are better maintained than in the 19th century and, in contrast to their treeless state in the construction period, lockstations now are well-treed, especially those outside of urban settings.

Except for Cathcart Tower, located on an uninhabited island off the shore from Point Henry, the setting within which the Kingston fortifications are found has changed considerably as the city has grown around them. Property to the north of Fort Henry has been developed. Shoal Tower, set in the midst of Kingston Harbour, is bordered by a public marina. Fort Frederick is just south of the extensive campus of the Royal Military College of Canada and the Queen's University campus is to the north of Murney Tower. Because of their locations on the water, the fortifications are, however, still understandable in terms of their original function. They exist today with their geographic distribution, tactical logic and fields of artillery fire immediately observable.