Environmental Impact Study

Cataraqui Park
Kingston, Ontario

Executive Summary

MALROZ

Notice to Reader

Malroz Engineering Inc. was retained by the Corporation of the *City of Kingston* to assist in developing and implementing the environmental component of its long-term management plan for Cataraqui Park. The mandate and scope of activities carried out by *Malroz* are referenced in Volume 1 of this report.

This executive summary provides an overview of work completed during the period of January 1997 through April 1999. The overview is a precis of discussions in the main report text, which include; the site setting and background, site conditions, environmental quality of the Inner Harbour, conclusions regarding environmental impacts, and options for future site management.

The executive summary is not to be used as a replacement for the full discussion in the main report text.

Respectfully Submitted,

MALROZ ENGINEERING INC.

Executive Summary

INTRODUCTION

Cataraqui Park is a landfilled marshland that extends into the Kingston Inner Harbour from the west bank of the Great Cataraqui River to Bell's Island. The site is approximately 44 hectares (108 acres) in size. The City of Kingston used this site as a municipal landfill from 1952 to 1974. After the landfill was closed in accordance with Ministry of the Environment requirements, the City developed the site into a multiple use recreational facility that includes a nine hole golf course, tennis courts, and walking paths.

In 1993, the City received a fill permit from the Cataraqui Region Conservation Authority authorizing the importing of additional surface fill for the purpose of regrading the park, and negotiations were initiated with the Ministry of Environment and Energy concerning the placement of fill and the development of a long-term management plan for the park. In 1996, a report to the City's Environment and Transportation Committee calling for funding of the development of a long-term management plan for Cataraqui Park was approved by Kingston City Council and preparation of the plan was initiated by City staff.

On January 28, 1997, Malroz Engineering Inc. was retained by the City to assist with the environmental component of the long-term management plan for Cataraqui Park. The mandate and scope of activities carried out by Malroz included:

- implementation of interim seep management measures;
- comprehensive environmental site characterization to support a human health and ecological risk assessment; and
- evaluation of additional environmental measures to form part of the long-term site management plan.

SITE SETTING AND HISTORY

General Setting of Cataraqui Park and Former Belle Island Landfill

Cataraqui Park is located in the Kingston Inner Harbour, a 5 kilometre (3 mile) stretch of the Great Cataraqui River situated between Highway 401 to the north and the LaSalle Causeway to the south. The park is about 1.6 kilometres (1 mile) upstream from the LaSalle Causeway and Lake Ontario.

Much of the Kingston Inner Harbour (405 ha, or 1,000 acres) has been classified as a Provincially Significant Wetland. The Kingston Inner Harbour also serves as significant staging area for migratory waterfowl, supports a commercial fishery, and provides angling opportunities.

The east bank of the Kingston Inner Harbour is largely rural with some recent residential development. The waterfront on the west side of the river lies within the (historic) City of Kingston and was the focal point of much of the City's early industrial and heavy commercial activity. This land use has now largely given way to residential, retail, and light commercial enterprises.

History of Cataraqui Park Development

The Belle Island landfill was operated from 1952 to 1974. The site was opened prior to the introduction of government regulations pertaining to waste disposal. From 1970 until its closure, the site operated under provincial Certificate of Approval # 380101.

A federal waste disposal site is located along the North Shore of Cataraqui Park. This waste disposal site serves as a containment facility for contaminated river sediments which were dredged from the Kingston Inner Harbour navigational channel. The site was created in 1970 by Public Works Canada when the Ontario Water Resources Commission (OWRC) determined that the dredged sediments would be too contaminated for open water disposal. It stores approximately 65,000 m^3 (2.3 million cubic feet) of contaminated Inner Harbour sediments. The facility is located on federal land and licencing as a waste disposal site was not required.

A second waste disposal site owned by Arcom Developments Ltd. exists to the immediate south of Cataraqui Park. It occupies a portion of a 15 hectare (37 acre) parcel of land formerly occupied by Frontenac Smelting Works, a lead smelter that ceased operations in 1916, and the A. Davis and Sons Ltd. tannery that operated between 1909 and 1973. The site is still regulated by the Ministry of Environment conditions attached to a Certificate of Approval. Several studies have demonstrated that soils on the site are contaminated with hydrocarbons and severely contaminated with metals.

Historical Overview of Kingston Inner Harbour Development

The Kingston Inner Harbour has been a focus for industrial and commercial development since the 1850s and the arrival of the railway running along the west bank of the Great Cataraqui River. Most of the industrial activity that once occupied the west banks of the Kingston Inner Harbour has now given way to residential and commercial development and the waste disposal sites along the west side of the river are no longer in use. However, the legacy of this former industrial activity includes contaminated river sediments, buried wastes, and pockets of contaminated soil and groundwater which exist as potential sources of impact to the water in the Great Cataraqui River. Historic land use along the west bank of the Inner Harbour is shown in Figure S.1.

Local Contaminant Studies

There has been an extensive variety of environmental, development, transportation, and planning studies completed in the Inner Harbour since the early 1970s. They include investigations by undergraduate and graduate students at Queen's University, RMC, and St. Lawrence College, consulting reports, and government studies.

From this extensive base of Great Cataraqui River environmental studies, a consistent pattern of findings has emerged. Like most industrialized harbours on the Great Lakes, the Great Cataraqui River surficial sediments are highly contaminated. Particular contaminants identified in Great Cataraqui River sediments include chromium, and to a lesser extent other metals, PCBs, and PAHs. In contrast, water quality studies have shown general compliance with PWQOs throughout the Kingston Inner Harbour. Investigations focusing on the Belle Island Landfill site, while providing indication of a diffuse input of leachate to the river, have failed to reveal significant surface water impairment.

During the same period over which the Belle Island Landfill was accepting wastes, several other small municipal landfills in eastern Ontario were operated in similar low-lying areas along Lake Ontario. It is likely that most of these sites received similar waste streams to the Belle Island landfill. Three former landfills which are similar to the Belle Island site are located in Belleville, Trenton, and Picton. Leachate concentrations at the Belle Island Landfill are typical of leachate concentrations found at these and other municipal landfills in Southern Ontario.

PHYSICAL SITE CONDITIONS :

Site conditions were determined through extensive investigations including routine site observations visits; soil and vegetation sampling; drilling and soil sampling; groundwater monitor installation, testing and sampling; groundwater discharge sampling; and surface water sampling and toxicity testing.

Soils Composition

Beneath the ground surface, the site is generally underlain by:

- topsoil and surface soils;
- solid municipal wastes mixed with soil and fill;
- peat;
- clayey silt;
- limestone bedrock.

The landfill area is flat lying and close to river level except in the north-central portion of the landfill where mounded wastes form a hill generally referred to as “the ski hill”.

The surficial soils are generally less than 1 metre thick. Wastes are a mixture of domestic, industrial, and construction wastes. These materials include household garbage, paper, rags, plastic, wire, wood, plywood, asphalt, cinders, brick, glass, metal, railway ties and other wastes. Tannery wastes, presumably from the former Davis tannery, were also encountered in the southwest corner of the landfill. Wastes under the ski hill are up to 20 m (65 feet) thick but vary from 0 to 4 m (13 feet) beyond the hill.

The peat is typically very fine textured with fine fibrous sections. Where present, the peat varies in thickness from several centimeters to about 2 m (6 feet). The clayey silt deposits are sometimes very finely bedded with clays and generally more massive with depth. The deepest borehole into the silt indicated that the silts are at least 6 m (20 feet) thick at that location. None of the boreholes on-site encountered bedrock.

Groundwater Flow

The water table generally occurs within the wastes from about 0.5 to 1 m (1.5 to 3 feet) below ground surface except under the ski hill. Groundwater forms a “mound” beneath the ski hill. The mound declines towards the Great Cataraqui River in all directions and indicates that the flow direction (as generally expected) is outwards from the landfill towards the river and adjacent streams. Under pre-pumping conditions, groundwater discharge into the Great Cataraqui River occurred around the perimeter of the peninsula

and in localized groundwater discharge seeps or “springs” and through diffuse subsurface flows.

A small portion of the water which infiltrates on-site moves downwards into the peat and laterally into the river. There is minimal groundwater flow between the silt and overlying deposits. Groundwater flow throughout most of the wastes is about 50 m/yr (165 feet/yr). Flow towards the North Shore at the ski hill is about twice this rate. The average rate of lateral groundwater flow in the peat is about 0.2 m/yr (8 inches/yr).

Groundwater conditions were examined using a three-dimensional computer model. Some of the main conclusions reached were that:

- almost all groundwater flow (more than 97%) occurs in the wastes
- groundwater discharge rates vary around the perimeter of the site and are greatest in several localized discharge areas consistent with natural site conditions
- the “best” estimate of the steady-state volume of groundwater leaving the site was about 200 m^3/day (approximately 30 Imp.gal/min).

In comparison, the average combined volume of water discharged from adjacent municipal storm sewers (at the southwest corner of the site and through the west stream) is about 1320 m^3/day (approximately 200 Imp.gal/min)

Surface Water Levels

Surface water levels around Cataraqui Park are controlled by Lake Ontario water levels, even during periods of peak upstream discharge from Kingston Mills.

Aquatic Habitat

There is no unique or sensitive aquatic habitat along the shoreline. Unconsolidated organic substrate in the nearshore area provides poor habitat which would restrict the diversity of the benthic community. More significantly, annual water level fluctuations - which cause seasonal wetting, drying, and freezing in the nearshore - may prevent the establishment of a permanent benthic community.

Beyond the nearshore zone, there is a healthy aquatic ecosystem which supports a recreational and commercial fishery.

SITE CHEMISTRY

Vegetation and Soils Chemistry

Vegetation and soil quality were assessed by sampling: vegetation; surface soils (composite samples from 0 to 5 cm (1 inch) below grade); and near surface soils (composites from 5 to 60 cm (1 inch to 2 feet) below grade). Samples were collected from a total of 16 sites. In general, landfill wastes appear to have had a localized effect on soils associated with areas where exposed waste is exposed at the surface. These were found to occur in the northwest and southwest sectors of the site.

Groundwater

Groundwater quality was assessed by sampling a total of 17 monitors completed in waste, 9 monitors completed in peat, and 4 monitors completed in silt. These monitors were sampled quarterly during the period of June 1997 through February 1999. Some chemical parameters occur above natural background conditions and some exceed the MOE nonpotable groundwater guideline criteria. The parameters that exhibit elevated concentrations include: chloride, iron, and ammonia.

Groundwater within the wastes is most noticeably characterized by:

- < near neutral pH;
- < slight to moderately elevated chloride concentration;
- < elevated ammonia concentration;
- < elevated iron concentration;
- < slight to moderate dissolved organic carbon concentration;
- < trace to minor PAH and PCB concentrations;
- < minor concentrations of volatile organic compounds.

Chemical concentrations of groundwater in the waste were typically higher than in the underlying peat. Waste effects in the silt were limited. Chemical concentrations in each monitor varied between the August and November sampling rounds, but overall chemical distributions were similar between these sampling rounds. The parameters of most interest with regard to potential landfill effects include ammonia and iron.

Ammonia is the dominant form of nitrogen compounds in the waste and occurs in this form due to the generally reducing conditions on-site. Ammonia may exist in ionized and un-ionized forms depending upon pH and temperature.

The highest ammonia concentrations were measured beneath the ski hill. The highest ammonia concentrations occur in the mid-upper range of municipal landfill concentrations. Ammonia concentrations decrease about ten-fold towards the perimeter of the landfill away from the ski hill.

Iron is the only metal in groundwater with consistently elevated concentrations. They vary between sampling period and location and are not concentrated in any specific area on-site. These concentrations are well below anticipated peak concentrations in municipal landfills. Elevated iron is typical of many municipal landfills and occurs due to the "reducing" conditions (or lack of oxygen) which commonly prevail in landfills. Under reducing conditions, iron is readily dissolved in the ferrous (Fe^{2+}) form. Under oxidizing conditions, iron will readily precipitate in the ferric (Fe^{3+}) form to create orange or reddish-brown deposits.

The MOE does not publish a guideline value for iron in nonpotable groundwater. A review of Provincial Water Quality Objectives (PWQOs) for surface water and Ontario drinking water objectives (ODWOs) for groundwater shows that iron objectives have been developed based on aesthetic considerations for human use.

The groundwater discharges around the landfill perimeter mainly originate from the fill or waste materials. They represent the end point of groundwater flow which originates at various locations within the landfill. The quality of these groundwater discharges varies with time and location in similar fashion to the groundwater. However, the groundwater discharges generally have lower or much lower concentrations of chemical parameters than groundwater.

Surface Water Chemistry

The surface water monitoring program around Cataraqui Park included quarterly sampling rounds from February, 1997 to February, 1999. In total, over 140 surface water samples were collected and analyzed for as many as 103 parameters. The parameters included inorganics, metals, polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), and neutral chlorinated compounds (NCCs). Approximately 8,000 laboratory analyses were performed under this surface water program.

Any groundwater effects which might be associated with Cataraqui Park would be expected to occur in the nearshore waters or sediments around the park. Ammonia and iron are the principal landfill contaminants of concern.

Measurements of site discharges showed ammonia concentrations to be less than the acute lethality threshold in all samples collected from groundwater seeps at the site.

Groundwater discharges contribute to measurable ammonia concentrations in surface water around the landfill. Under extremely high pH and temperature conditions which occur in late summer, these ammonia concentrations would result in exceedence of the Provincial Water Quality Objective (PWQO) for un-ionized ammonia. Similar conditions exist in the upstream environment where trace ammonia levels, if combined with these

same high August pH and temperatures, would produce natural exceedences of the PWQO for un-ionized ammonia.

Discharges from Cataraqui Park have contributed to numerous exceedences of the PWQO for iron in surface water surrounding the site. The PWQO is based on aesthetic rather than toxicological considerations. Iron in surface water is not considered to be injurious to aquatic organisms at the concentrations measured.

Groundwater entering the nearshore sediments is depleted of oxygen. Under these conditions, iron present in groundwater occurs in the ferrous state. Both oxygen depletion and ferrous-iron are potentially harmful to aquatic life. The relative effects of each of these conditions are difficult to discern from each other, or from effects associated with other physical/chemical stresses on the nearshore environment.

Iron is naturally elevated in the sediments within the Inner Harbour. Iron in discharges from the site has contributed to exceedences of its Provincial Sediment Quality Guidelines. However, there is no toxicological basis for these guideline values (the lowest effect level - LEL and severe effect level - SEL). Exceedence of these criteria does not necessarily indicate impairment.

There are numerous sources of PAH contamination to the Inner Harbour, including discharges from this site. PAHs are ubiquitous in surface waters of the Inner Harbour. There are limited exceedences of PAH water quality objectives around the park, notably in the South and West Streams. Worst-case estimates of sediment loading suggest that some of the sediment quality LELs may be exceeded within a 25- to 50-year period. Cumulative sediment concentrations, including these incremental loadings to existing PAH and PCB concentrations, would be well below their respective sediment quality SELs. Neither of these chemical groups are considered to pose a risk which requires further assessment.

The most significant on-going environmental concern identified in this study relates to water quality conditions of the West Stream. Iron and ammonia concentrations are elevated as a result of inputs from the landfill. Upstream inputs of other metals and organic contaminants affect most of the West Stream.

The only potential risk to human health identified by the risk assessment was soil contamination associated with locally exposed landfill wastes. The risk assessment determined that there were no risks to the aquatic ecosystem that required remediation under current conditions at Cataraqui Park.

SITE MANAGEMENT:

Environmental management at this site is addressed in four stages

- emergency measures
- intermediate (interim) improvements
- short-term management
- long-term management

The first two of these have been implemented.

Emergency Measures and Interim Improvements

Upon learning of possible groundwater seepage from the site, the City (through Malroz) initiated site activities to characterize and manage seeps in early 1997. This work was fast-tracked on an emergency basis and six extraction wells were placed in three areas of the site. Later in 1997, interim improvements were made to this pumping system including connecting the wells to the sanitary sewer via buried discharge lines. The system was later winterized to allow pumping operations to continue on a year-round basis.

Additional pumping wells were installed in early 1999 to intercept newly identified groundwater seeps which occurred during a period of low water levels in the Great Cataraqui River adjacent to the site.

Short-Term Site Management

A short-term management plan - consisting of an interim site monitoring program, continued groundwater pumping, pumping system upgrades, and additional data gathering - can be implemented immediately.

The pumping system should remain in operation until long-term management is in effect, or until site data show that pumping is no longer required.

Long-Term Site Management Options

The environmental assessment process - which can be used as a framework to develop the long-term site management plan - involves a series of steps, including:

- problem identification
- development of management objectives
- identification of potential management options
- evaluation of relevant management technologies
- selection of a preferred option
- design, approval, and implementation of the preferred option, and
- performance monitoring.

The objectives of the environmental component of the long-term management plan include:

- preventing human health risk;
- eliminating exposed waste at the surface;
- minimizing surface seeps;
- preventing deleterious impact to aquatic organisms;
- preventing surface water quality impairment;
- minimizing visual impacts.

Seven alternatives for long-term site management have been reviewed for consideration at this site, the costs of these alternatives (for a 30 year operating period) range from $400,000 for monitoring to $370 million for waste removal. The most appropriate approach to long-term management may consist of more than one of the identified options applied to different “management zones” on the site.

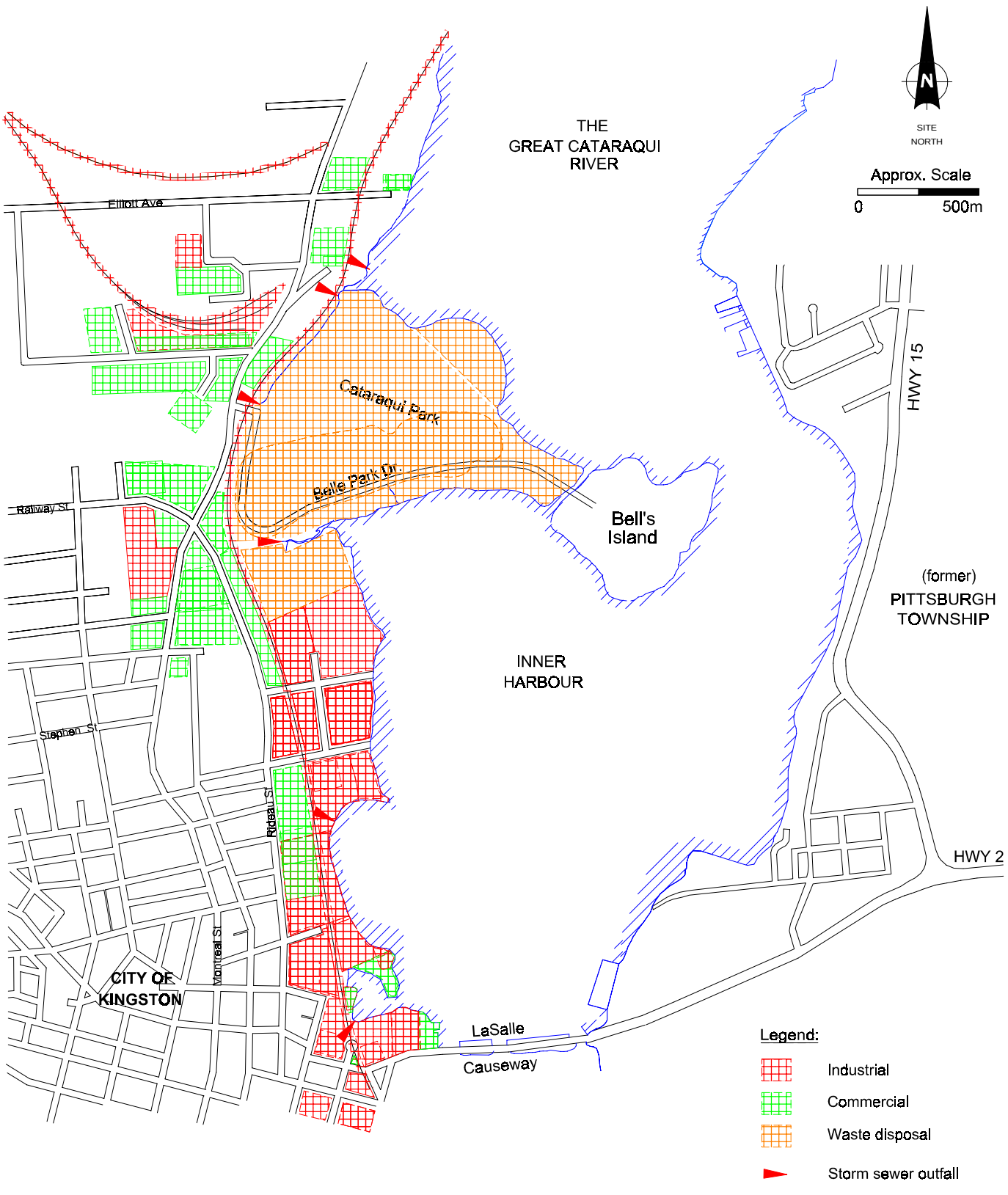
Exposed waste at the site should be covered.
The projected cost of this management option is in the range of $0.25 million.

The screening evaluation of site management alternatives indicates that long-term options that address nearshore modifications and/or leachate management are more appropriate than options for waste removal, encapsulation, or monitoring alone. The projected 30-year costs for nearshore modification and leachate management options are in the range of $0.75 million to greater than $8 million.

In order to evaluate long-term options, additional information will be required to confirm our conclusion that site impacts are minimal.

Any preferred long-term management option will require testing under controlled conditions before full implementation.

Consultation is recommended with regulators and the public for input with regard to the level of environmental controls warranted at this site.



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Inner Harbour Development 1880 - 1997

Environmental Impact Study
Cataraqui Park, Kingston, Ontario

Figure
S.1
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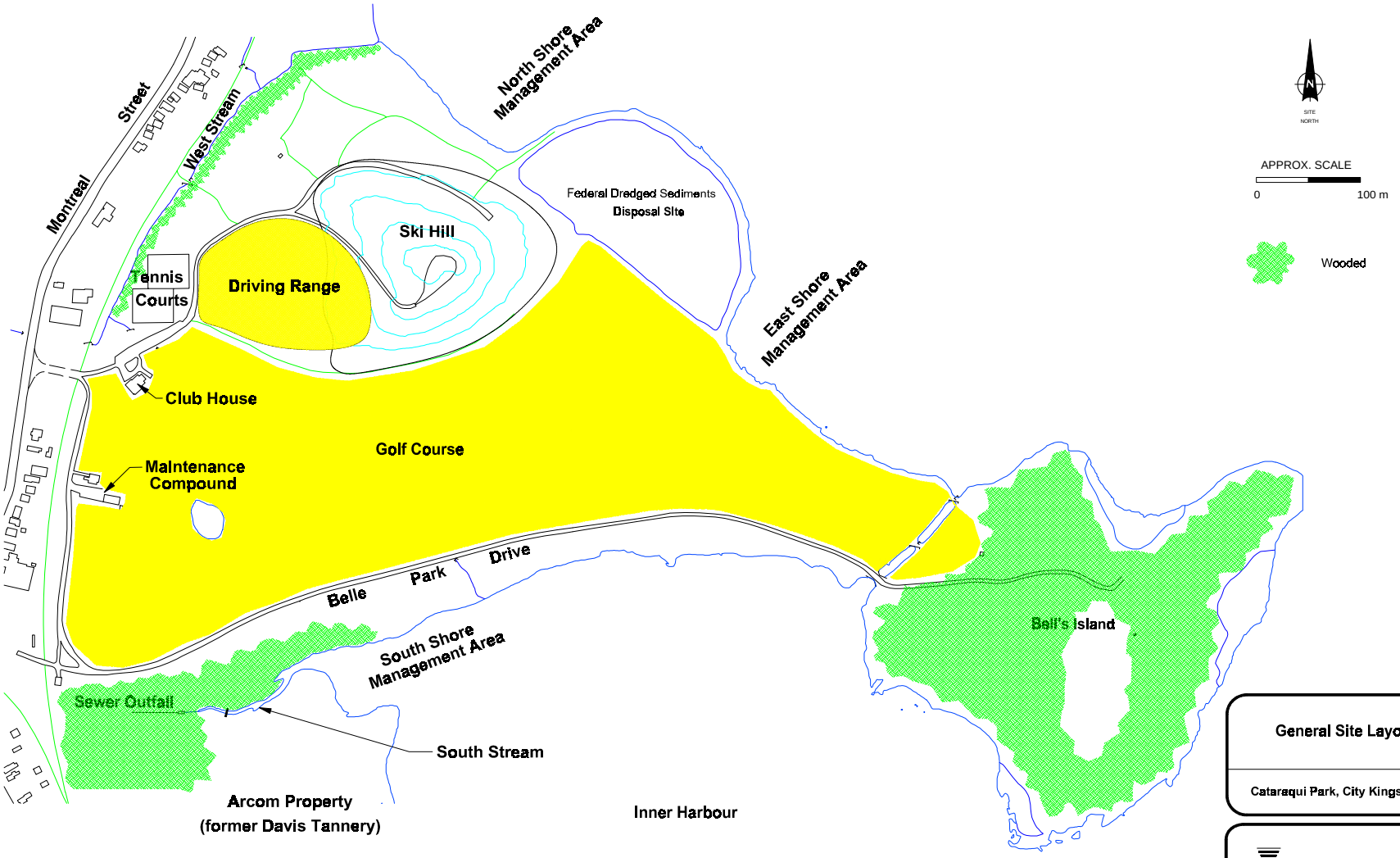

General Site Layout

Cataraqui Park, City Kingston, Ontario

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Figure: S.2

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