R E P O R T

CITY OF ST. ALBERT

Stormwater Management Master Plan

ASSOCIATED ENGINEERING

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EXECUTIVE SUMMARY

The City of St. Albert commissioned Associated Engineering to develop a Stormwater Management Regional Master Plan for the City of St. Albert. Since St. Albert was incorporated as a village in 1900, it has grown from a small riverside community to a City of approximately 55,000 residents. This growth has resulted in the development of large areas of land and in the expansion of infrastructure, including storm water management, to provide basic services expected of a modern municipality.

The objectives of the study were:

- to assess the capacity of the storm drainage system for present and future needs of the City,
- to recommend practices and policies for stormwater management, floodplain management, and sediment management within the Sturgeon River.

This document provides the proposed master plan for the stormwater drainage system within the existing City boundaries. Figure 7.1 of the report, which is reproduced on the following page, shows the project area, the storm trunk drainage system, the existing outfalls, and the principal elements of the stormwater management system which will be discussed below.

Table 9.1 provides a summary of the costs identified to implement system upgrading and maintenance, and sediment management.

BACKGROUND REPORTS

Technical Memoranda contain information on the technical and scientific studies.

This report is consolidated from a number of Technical Memoranda which document the background studies:

TM 1 - Review of Background and Issues
TM 2 - Conveyance System Analysis
TM 3 - Infrastructure Physical Condition Assessment
TM 4 - Hydrogeotechnical (soils) Evaluation (Thurber)
TM 5 - Storm Sewer Outfall Assessment (Sameng)
TM 6 - Sturgeon River Sedimentation Assessment (Sameng)
TM 7 - Aquatic Biology and Habitat Assessment (Westworth)

Table 9.1

System Upgrading and Maintenance Cost Estimate

Item	Year 2005	2006	2007	2008	2009	2010	2011	Future
Part A - System Upgrading Work								
Expand the existing North Campbell Industrial dry pond			$ 330,000					
Construct new SWM wetland in South Campbell Industrial area to control flows and flooding the Braeside/Forestlawn Trunk system		$ 1,200,000						
Total Annual Costs for System Upgrading Work	**$ -**	**$ 1,200,000**	**$ 330,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Part B - System Maintenance Work								
Complete inspection of trunk sewers (approx. $150,000/year)	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000			
Repair defects in the trunk sewers as they are identified before they develop into severe problems	$ 285,000	$ 380,000	$ 380,000	$ 380,000	$ 380,000	$ 380,000		
Repair storm outfalls for structural and safety concerns			$ 307,000					
Pilot rehabilitation of concrete channel in Forest Lawn Ravine	$ 400,000							
Carry out inspections of lateral sewers (assume $150,000/year for 15 years)						$ 150,000	$ 150,000	$ 1,950,000
Repair lateral sewer defects identified in inspection program (assume $200,000/year for 15 years)							$ 200,000	$ 2,800,000
Total Annual Costs for System Maintenance Work	**$ 835,000**	**$ 530,000**	**$ 837,000**	**$ 530,000**	**$ 530,000**	**$ 530,000**	**$ 350,000**	**$ 4,750,000**
Part C - Sedimentation Management Work								
Construct oil/grit separators and/or settling ponds to reduce discharge of urban sediments to the Sturgeon River	$ 1,040,000	$ 1,040,000	$ 1,040,000	$ 1,040,000	$ 1,040,000	$ 1,040,000	$ 1,040,000	$ 3,120,000
Sediment removal in vicinity of major outfalls			$ 500,000					
Total Annual Costs for Sedimentation Control Work	**$ 1,040,000**	**$ 1,040,000**	**$ 1,540,000**	**$ 1,040,000**	**$ 1,040,000**	**$ 1,040,000**	**$ 1,040,000**	**$ 3,120,000**
Part D - Further Study								
Flow Monitoring		$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000		
Local Flooding Assessment		$ 15,000						
Big Lake Regulation - Feasibility Study		$ 100,000	$ 100,000	$ 100,000				
Comprehensive Model		$ 20,000	$ 20,000		$ 100,000			
Upgrade Plan for Older Neighbourhoods						$ 50,000	$ 30,000	
Total Annual Cost for Further Study	**$ -**	**$ 160,000**	**$ 145,000**	**$ 125,000**	**$ 125,000**	**$ 75,000**	**$ 30,000**	**$ -**
GRAND TOTAL - ANNUAL COSTS FOR STORM SEWER SYSTEM	$ 1,875,000	$ 2,930,000	$ 2,852,000	$ 1,695,000	$ 1,695,000	$ 1,645,000	$ 1,420,000	$ 7,870,000

Note: Costs represented are in 2004 dollars, and do not include escalations for inflation.

SYSTEM CAPACITY
(Report Section 2)

$1.53 million is required to provide stormwater management facilities in the Campbell Industrial area - see Table 9.1(a).

The storm sewer system is generally adequate to serve the present needs of the City although older portions of the trunk sewers (in Grandin, Mission, Lacombe Park, Braeside, and Akinsdale) do not provide the service levels that would be required by present-day standards for new subdivisions.

The Forest Lawn/Braeside storm trunk is overloaded and could cause flooding in the Forest Lawn/Akinsdale area and the Campbell Industrial Area. The Oakmont/Erin Ridge storm trunks are loaded to capacity.

The following upgrading is recommended:

- expand the existing dry pond in the Campbell Industrial area (estimated cost $330,000),
- construct a new stormwater management wetland to operate as a surge pond (to regulate system surcharge levels) in the south end of the Campbell Industrial area ($1.2 million),
- explore with the Province, the possibility of a joint-use facility located in the Transportation/Utility Corridor (TUC) to serve the Campbell/Braeside system and the future Edmonton ring road,
- monitor flows in the downstream trunks to confirm the model assumptions,
- require on-lot stormwater management for any lots remaining to be developed in the Campbell Industrial Area, to reduce peak runoff rates to 35 L/s/ha, with costs to be borne by the builder/developer.

There are several locations, principally in the upper Braeside system and adjacent to Heritage Lakes Pond 1 and Havenwood Pond, where ponding could be significant. House elevations should be checked at these sites to ensure they are safe from flooding.

The City should work toward an overall comprehensive model of the storm sewer system, including the smaller lateral storm sewers and the major drainage system.

A replacement plan for the storm sewers in the old areas should be developed along with a long term redevelopment plan for these areas.

PHYSICAL CONDITION
(Report Section 3)

$9 million is required for maintenance activities over the next twenty-one years - see Table 9.1(b).

The pilot trunk sewer inspection program (6,000 m) revealed that the storm trunk drainage system is in reasonably good structural condition, but some portions require repairs due to cracked pipes and other deficiencies before they lead to more serious problems.

A phased maintenance program is recommended to:

- complete inspection of the trunk sewers (the larger pipes) over the next five years at a cost of $150,000 per year,
- repair priority defects as they are detected in the storm truck system (estimated cost $285,000 in 2004 and $380,000 per year for the following five years),
- complete minor repairs to twenty-five outfalls to deal with structural and safety-related issues ($307,000),
- conduct a pilot program to rehabilitate the concrete stormwater channel in the Forest Lawn Ravine ($400,000),
- inspect and repair the collector system (the smaller pipes) over fifteen years starting in 2009 ($5.25 million).
- locate and physically identify each outfall with a name plate in the field.

SEDIMENTATION CONTROL
(Report Section 4)

The City must reduce its discharge of sediment to the Sturgeon River.

$10.9 million is required for oil/grit separators and sediment removal over the next 10 years - see Table 9.1(c).

Sediments from urban storm runoff in St. Albert have been accumulating in the Sturgeon River to a maximum observed depth of about 0.6 m over 20 years. These sediment accumulations have led to:

- increased risk of flooding - predicted flood levels (in the event of a major flood) have risen slightly in Big Lake and in the Sturgeon River (0.1 m to date and a predicted additional 0.15 m in the next 25 years),
- the public perception that the river has become shallower and "dried up",
- sand bars which create barriers to fish migration.

The City has recently constructed one pilot oil-and-grit separator which has proven, over one year of monitoring, to be highly effective at trapping sediments. Further monitoring and expansion of the program is recommended.

The sediment management plan recommends the following:

- construction of 23 more oil and grit separators over the next 10 years to reduce the amount of sediment being carried to the river, at an estimated cost of $10.4 million,
- removal of the deepest deposits which have already accumulated at storm sewer outfalls, at an estimated cost of $500,000,
- continued vigilance in enforcement of best management practices, especially during construction activities, to reduce the runoff of sediment from St Albert.

Future development areas should be provided with wet ponds or stormwater wetlands (not dry ponds) to reduce their sediment runoff.

More detailed planning of sedimentation control work is currently being undertaken by the City.

SYSTEM EXPANSION FOR FUTURE DEVELOPMENT *(Report Sections 2 & 7)*

Stormwater management will be required for all new developments in St Albert.

A release rates of 2.5 L/s/ha is proposed for all new basins as recommended for the region in the Big Lake Basin Drainage Study.

Figure 7.1 (reproduced earlier within this section) provides the drainage concept plan for future development up to the City boundaries.

Higher release rates will be required in basins which are already partly developed with higher flow rates.

The current storm water management and conveyance system has no capacity available for future development in the Inter-Municipal Development Plan (IDP) area which lies outside the present City boundary. This area will require an independent drainage system.

Table 7.1 (reproduced on the following page) provides preliminary estimates of pond sizes and outflows.

The existing wet pond in Erin Ridge will need to be doubled in size to accommodate 20 ha of the remaining development area in this basin.

An existing wetland south of the Riel Pond should be preserved for wildlife habitat and water quality enhancement.

Costs will be borne by the respective developers.

Table 7.1
Proposed Stormwater Management Facilities for System Expansion

Development Area	Pond # (Figure 7.1)	Drainage Area (ha)	1:100 year 24 hour storm		July 1978 storm	
			Storage Volume (m^3)	Outflow (m^3/s)	Storage Volume (m^3)	Outflow (m^3/s)
Campbell Industrial	North (dry pond)	52	48,000	0.49 (-0.47)	66,000	0.58 (-0.61)
	South (wetland)	17	58,000	3.09 (-0.57)	109,300	4.52 (-9.8)
Kingswood	Regency Heights	68	44,000	0.17	47,000	0.21
Erin Ridge	1	47	29,000	0.24 to trunk 0.42 to ravine	40,000	0.26 to trunk 0.42 to ravine
	2 (dry pond)	9.7	2,700	0.13	5,300	0.18
North Ridge	3	42.2	11,700	0.51	27,100	0.66
	2	45.3	10,900	1.11	29,000	1.44
	1	77.5	32,200	1.83	56,400	2.58
	4	87.8	27,900	1.1	63,200	1.34
	5	37.1	85,000	6.31	186,000	8.41
	6	46.4	15,000	6.87	32,000	9.16
	7	55.7	17,000	0.67	38,000	0.89
	8	50.8	16,000	1.28	35,000	1.70
	9	37.0	12,000	0.44	25,000	0.59
Heritage Lakes	1	84.2	55,000	0.21	59,000	0.25
	2	60.2	39,000	0.15	42,000	0.18

Note: - all estimates are preliminary and subject to review in final design.
- negative values in table represent inflow into ponds due to system surcharge.

FLOODPLAIN MANAGEMENT
(Report Section 7)

Floodplains of Big Lake, the Sturgeon River, and Carrot Creek are valuable natural areas that must be protected and preserved.

The City should adopt a policy and a Floodplain Overlay within the City's Land Use Bylaw to prohibit filling or development of the floodplains of the Sturgeon River, Carrot Creek, and Big Lake other than limited, specified activities such as drainage facilities, parks, and roadway crossings, as recommended in the Big Lake Basin Drainage Study.

Design flood elevations around Big Lake and along the Sturgeon River should include:

- an allowance of 0.5 m for the potential impacts of sedimentation and land use changes in the basin,
- a safety factor of 0.5 m to allow for uncertainties in predicting flood levels,
- freeboard of at least 0.5 m to the main floor of dwellings and other permanent buildings.

The recommended minimum design flood elevation on Big Lake is 654.18 m and the recommended minimum building main floor elevation is 654.68 m.

The City should request the Province to prepare a floodplain map for the Sturgeon River, Carrot Creek, and Big Lake with no distinction between the floodway and flood fringe, and with adequate freeboard to allow for the potential impacts of river sedimentation, land use changes in the basin, and other sources of uncertainty.

Single-zone floodplain mapping should be adopted with no distinction between the floodway (the deeper-flooded areas) and the flood fringe (the shallow-flooded areas). The City should adopt a policy to prohibit filling of ***all*** floodplain areas including the flood fringe.

BIG LAKE WATER LEVEL REGULATION
(Report Section 7)

Regulating water levels in Big Lake and the Sturgeon River with an inflatable weir is a promising concept.

The Sturgeon River and Big Lake are naturally shallow water bodies. Public complaints about the shallow water levels are further aggravated by sediment accumulations in the river.

The installation of an inflatable weir in the Sturgeon River, downstream of St. Albert, could be a feasible means of maintaining a minimum depth of water in the Sturgeon River and in Big Lake.

The weir would be:

- lowered through the winter and spring runoff period to provide fish passage and to prevent higher flood levels,
- raised during the summer to maintain a minimum water level equal to the long-term mean in Big Lake or another specified level.

A feasibility study is recommended to fully assess the potential environmental benefits and impacts of water level regulation and to define the design parameters and operating mode for the inflatable weir.

A feasibility study and more detailed planning for waterfront development along the Sturgeon River should be undertaken in partnership with stakeholders and other jurisdictions.

ENVIRONMENTAL STEWARDSHIP
(Report Sections 4 & 7)

The stormwater management master plan contains a number of initiatives that are designed to protect and preserve the natural environment.

The floodplain management strategy aims to preserve the integrity of natural areas by preventing development within flood-susceptible areas.

The sediment management strategy provides measures to reduce the runoff of sediments to the Sturgeon River and Big Lake and to provide a deeper river channel through St. Albert, which will improve the fish and migration habitat through the City.

The stormwater management strategy will minimize the impact of urban development on Big Lake and the Sturgeon River, by reducing the peak runoff rates, increase base flows, and improve water quality discharged from these areas.

Where possible, stormwater management facilities will be integrated with adjacent parks and natural areas and will, in effect, appear to be part of the natural environment.

Stormwater management facilities should be designed to be compatible with parks and open spaces in St. Albert for the enjoyment of all the City's residents.

Integrated water management and conservation initiatives are required along the shorelines of Big Lake.

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INTRODUCTION

SECTION 1

1.1 BACKGROUND

The City of St. Albert retained Associated Engineering to develop a Regional Master Plan for its stormwater drainage system. **This document presents the findings and results of the project components that deal with the stormwater drainage system within the City boundaries.**

Since St. Albert was incorporated as a village in 1900, it has grown from a small riverside community to a city of over 53,000 people. The growth has resulted in the development of large areas of land to accommodate residences for the population as well as commercial and industrial areas. The growth has necessitated the expansion of infrastructure to provide basic services expected of a modern municipality, including:

- potable water supply and distribution
- sanitary sewage collection and disposal
- transportation
- waste management
- stormwater management

Figure 1.1 illustrates the existing SWM facilities within the current City boundary and the IDP area boundary.

St. Albert's proximity to the City of Edmonton has provided the opportunity, in many cases, to benefit from the major facilities that provide the basic services to the metropolitan area. In the case of stormwater, municipalities generally manage runoff and impacts within their own boundaries. However, the topography in an area, not municipal boundaries, dictates basins that must be considered in controlling stormwater. It is generally accepted that runoff from developed areas should be controlled to the rates that existed in the areas prior to development. This concept will transcend municipal boundaries.

Similar to many other towns and cities, St. Albert was established near a waterway - the Sturgeon River. Runoff from early growth was typically routed overland into the river. As the town grew into a city, it became necessary to provide underground pipe systems to convey stormwater to the river. These types of systems convey flows to the outlets faster and with higher volumes. This can result in the transportation and deposition of sand and gravel

at the outlets, as well as erosion in the river. The topographic relief in St. Albert has made servicing developing areas relatively easy, without the need for elaborate facilities.

Historically, storm sewer systems were designed for a relatively low level of service, typically for the storm which occurs once in two years or more frequently. Some of the older areas along the river have little or no pipe drainage, and rely on surface flow in the street system to carry the runoff from the neighbourhood. More recently, since about 1975, design standards have changed to provide pipe capacity to carry the 1:5 year (minor) storm, and to design the surface drainage system to convey the excess flows and to limit the depth of ponding so as to prevent flooding in a major storm event. Hence, some of the older areas have a lower level of service.

Stormwater management (SWM) is a concept that has been adopted by most municipalities, and is encouraged, if not required, by regulatory authorities to minimize the impacts of the changed flow regimes and patterns resulting from development. Historically, there has been little stormwater management implemented within St. Albert. However, in recent years, the City and the development community have started to consider and construct SWM facilities to handle the runoff from rainfall and snowmelt. There are currently nine (9) SWM ponds in the City (two wet ponds and two dry ponds in Heritage Lakes, one in Erin Ridge, one in Northridge, and one for the WalMart development), and new developments are including them in their planning. The Riel Pond, an old lagoon cell, is used for SWM as is the Grandin Pond, which is supplemented by groundwater wells to provide constant water levels. The Lacombe Park Lake provides no real SWM capability, but is also supplemented by pumping groundwater.

More recently, the water quality in the stormwater runoff is becoming a concern, and measures are being implemented, such as treatment in detention facilities and grit separators, to improve the quality of urban runoff discharged to the Sturgeon River.

1.2 ISSUES

Stormwater management in St. Albert faces many of the same challenges as in other municipalities. Key issues have been identified through investigations carried out in this project. They have been categorized in the following summaries; however, many are inter-related.

- **Infrastructure** - Prior to this study, the condition of the SWM infrastructure was generally uncategorized. The conveyance systems range in age from up to possibly 100 years to current construction, and design standards vary. The structural condition of the pipes and outfalls had not been assessed, and the capacity of the existing stormwater conveyance system had not been quantified (although anecdotal evidence indicated that generally there is not a significant amount of flooding in current development with the exception of some localized areas). In addition to the conveyance pipes, the system also includes SWM ponds and oil/grit separators.

- **Sturgeon River** - At present, the majority of St. Albert discharges stormwater into the Sturgeon River. The discharges result in sediment deposits, which are obvious in the vicinity of the outfalls. The impacts of these deposits, as well as natural erosion and deposition within the river, had not been assessed prior to this project. Development within the City has seen infill along the river and other encroachments in the floodplain. There have been floodplain studies carried out by the Provincial Government in the past. All of these issues could have impacts on the capacity of the river as well as flood levels. Concerns have been voiced regarding low water levels in the river and the potential impacts on fish and other wildlife.

- **Big Lake** - Development in the Big Lake basin could have impacts on the lake's water level and quality. As St. Albert continues to grow, the city will become a contributor to Big Lake either directly or through discharges from Carrot Creek. Changes in Big Lake resulting from development or seasonal impacts from high or low runoff can have an effect on St. Albert. A drainage plan is being developed for the Big Lake Basin, independently and St. Albert's SWM plans must consider and be compatible with the regional concept.

- **Water Quality** - Changes to the Sturgeon River and Big Lake from man-made or natural factors can result in changes to the water quality. These can cause aesthetic degradation and/or factors that impact the biophysical environment of the river, lake and surrounding areas; including: weed and algae growth, poor fish habitat, degraded water quality, and siltation.

- **Development** - St. Albert continues to grow, and residential and commercial/ industrial areas are expanding to support the increased population. SWM has, over time, become an important consideration when planning new development areas, and there is a greater emphasis on controlling runoff rates and improving the quality of

the water discharged to receiving bodies. Development of standards and guidelines, and consistent application across the City is important. Coordination of SWM planning by individual developers with the City and Province must be undertaken.

- **Parks and Natural Areas** - The parks and green spaces in the City are viewed by many as a major amenity. St. Albert has recognized the benefits of providing and maintaining recreational and natural areas and open spaces within the City. Current and past studies have identified plans to protect such areas. Integration of parks and natural areas into SWM planning must be considered. Design of SWM facilities can provide enhancements to green spaces, but must also address impacts on those spaces.

1.3 COMMUNITY PERSPECTIVES

Select groups and government agencies have been contacted to solicit input relating to their concerns or visions for SWM in St. Albert. The City's Public Works, Engineering and Planning departments provided background information and insight into projected growth and development issues through the terms of reference for the project and in subsequent discussions. The parks and natural areas aspect of the project has been addressed by team members in close consultation with the City.

In addition to City perspectives, several other interest groups have been contacted to ensure that all relevant issues could be identified:

- development industry representatives
- community environmental stakeholders
- Alberta Environment

1.3.1 Development Industry

Several developers control the majority of the lands that will be developed in the near future. Three of these were interviewed to gain a perspective on their concerns and plans for ongoing and future projects. Generally, they recognize the importance and requirements for SWM. Two, Genstar and Landrex, have looked into SWM in some detail for the lands that they propose to develop in the short term. Current plans do not consider expansion past the existing City limits. Qualico's plans had not progressed to the stage where definite SWM concepts had been identified.

In the case of the Northridge area, SWM planning has not been fully integrated with requirements for the proposed Western Regional Road. Some of the proposed SWM ponds are located within the flood fringe. In Erin Ridge, the current SWM concepts rely on the existing outlet for the area which runs through Oakmont to the Sturgeon River. Some stormwater runoff attenuation is provided by an expanded Erin Ridge pond.

It appears that there have been different design parameters and considerations used across the City. While all the developers recognize that SWM is a necessity, they have different visions of how SWM facilities and practices could or should be implemented.

1.3.2 Community Environmental Stakeholders

Representatives of the Big Lake Environment Support Society (BLESS) provided commentary on some of the issues that they consider important. The fragility of the Sturgeon River ecosystem is a significant concern. Recent drought conditions have resulted in lower river levels, which they believe may have contributed to recent fish kills. Sedimentation from stormwater discharges and potential source controls and upstream best management practices (BMPs) were also mentioned as areas for possible improvement. BLESS is interested in extending and expanding the natural areas near and around Big Lake to preserve the existing condition.

The potential to regulate water level in the Sturgeon River and Big Lake were viewed as having both beneficial and detrimental impacts. Similarly, dredging the Sturgeon River could be beneficial by providing a higher baseflow, but this concept did not take into account the potential impacts of lowering Big Lake if the levels were not also controlled.

1.3.3 Alberta Environment

An interview with Alberta Environment, Northern Region personnel, covered a number of issues and topics. A summary of that interview follows.

Stormwater License/Permits/Approvals

Stormwater outfalls now require permits under both the Water Act and Environmental Protection and Enhancement Act.

Those outfalls, that previously received Licenses under the Water Resources Act, are deemed approved. Such deemed approvals will expire about 2020.

Some of the older stormwater outfalls may not have any approvals.

Currently Water Act and EPEA approvals for stormwater outfalls are being considered for inclusion in the Code of Practice for Watercourse Crossings. Water quality requirements will probably be incorporated into the code as best management practices (BMPs).

Other approvals may be required from other authorities, including, but not limited to, Department of Fisheries & Oceans (DFO) and Alberta Public Lands.

Maintenance activities do not normally require approval as these are permitted under the original approval to construct the works.

Water Allocation

The Sturgeon River is not considered a reliable water source as extremely low flows are a common occurrence. Alberta Environment has an information guide explaining the allocation issues in this reach called “Water Supply in the Sturgeon River Basin.” New allocations on the Sturgeon River are difficult to obtain and are subject to many restrictions.

Floodplain Management

The Floodplain within the City has been designated under the Canada Alberta Flood Damage Reduction Program (FDRP). It is shown on the Flood Information Map produced by the FDRP in 1991 and explained on a Fact Sheet published by FDRP.

The Alberta Flood Risk Management Strategy has been wrapped into the Alberta Water Strategy and this should be released in draft format soon.

Any applications for encroachments (dykes, etc) are looked at very closely for impacts. There has only been one application for dykes on Big Lake in last 3-4 years.

There is some confusion as to who own the dykes within the City. Either the Province or the City built the dykes after the 1974 flood.

There have been some country residential developments downstream, but these are above the floodplain.

Dredging

Any proposal that involved dredging of the Sturgeon River would be looked at very carefully. It is expected that such a proposal would be very controversial with many issues and a large number of interest groups. There would most certainly be environmental and fisheries concerns.

Inter-Municipal Issues

The Carrot Creek Project, which includes the steel sheet pile drop structure for channel stabilization, upstream of St. Albert on Carrot Creek, was built in various stages and dates up to the 1970s. The project is currently the responsibility of Alberta Transportation. Alberta Environment has a file on the project.

There are several projects currently underway that involve water management in this basin, including:

- The Big Lake Basin Study that is being undertaken by a number of municipalities and is attempting to address a number of flooding and stormwater management issues.
- The Big Lake Natural Area is developing a management plan with input from many stakeholders.
- The Water Act provides a mechanism for Basin Planning in this area. Currently Alberta Environment's Northern Region is working on a Water Management Plan for Beaver River and there is at least one other priority ahead of the Sturgeon Basin. Therefore, there could be some delay before the department begins on Sturgeon Basin. However, stakeholders within the basin may be able to start the process sooner if there is a consensus on

need. Alberta Environment priorities are based on pressure on the resource, public concern, and relationship with other resources and initiatives. Details of the planning process and outcomes are published in Framework for Water Management Planning, Alberta Environment.

1.4 STUDY OBJECTIVES

The objectives of the project are to develop a Master Plan to guide the management of the City's stormwater drainage system. This was undertaken through an assessment of its hydraulic and structural condition capacity to serve existing and future development needs and the inclusion of measures to protect the natural environment of the City of St. Albert.

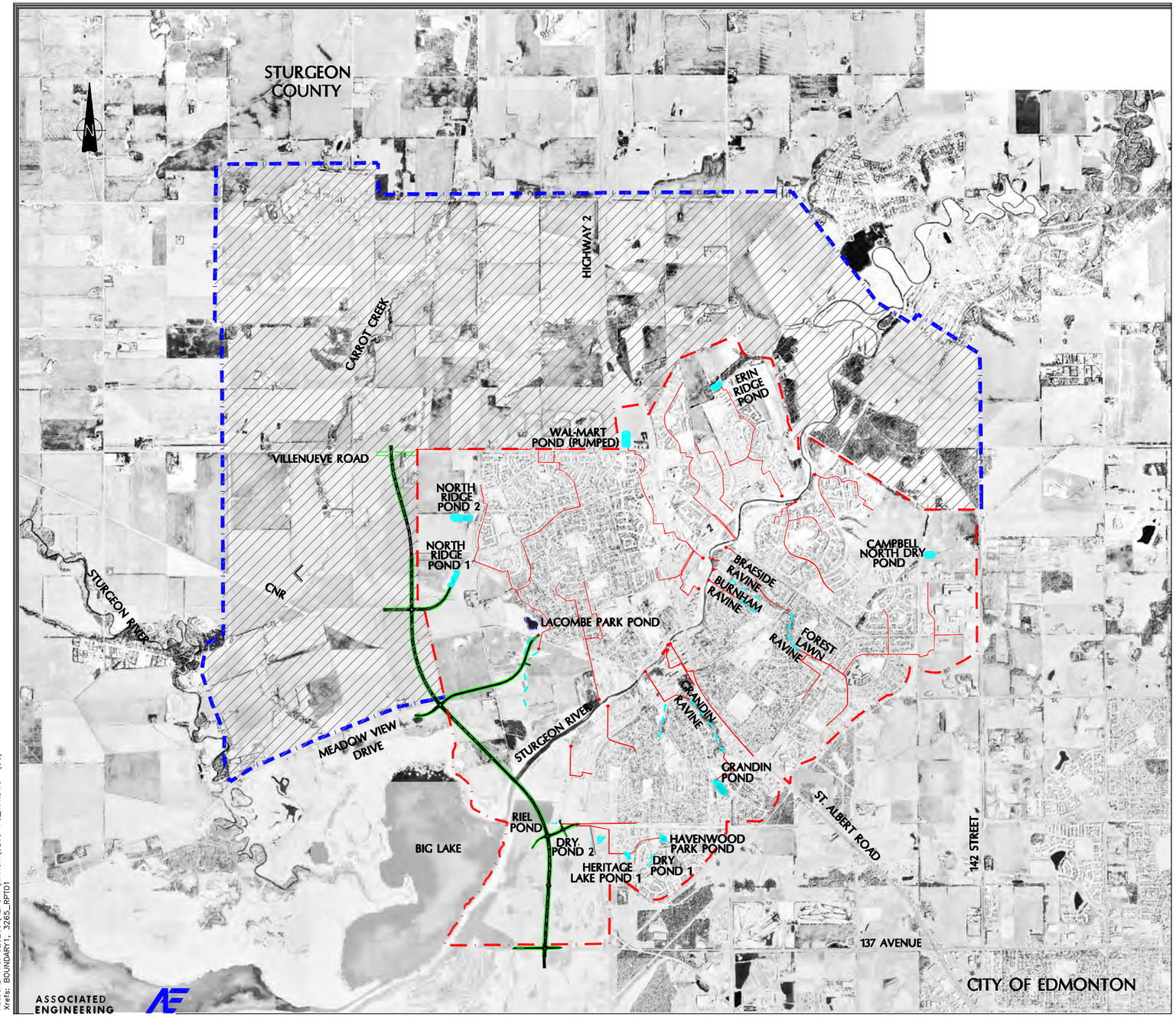
1.5 SCOPE

The study included a number of components whose results are documented in several supporting reports. These are:

- TM 1 - Review of Background and Issues
- TM 2 - Conveyance System Analysis
- TM 3 - Infrastructure Physical Condition Assessment
- TM 4 - Hydrogeotechnical (soils) Evaluation (Thurber)
- TM 5 - Storm Sewer Outfall Assessment (Sameng)
- TM 6 - Sturgeon River Sedimentation Assessment (Sameng)
- TM 7 - Aquatic Biology and Habitat Assessment (Westworth)

A summary of the relevant findings of these studies is provided within this report. For further details the reader is referred to the original documents.

Based on an analysis of the stormwater management issues and needs, a set of strategies for stormwater management in St. Albert has been developed. These are provided in Section 7 of this report.



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Plotted by: Scott Li (Paper Space)
AutoCAD File: 023265\REPORT\MARCH\3265-FG_1.1.DWG (SC)
Xrefs: BOUNDARY1, 3265_RPT01

THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

STUDY AREA

LEGEND:

- ST. ALBERT CITY LIMITS
- EXISTING SURFACE DRAINAGE CHANNELS
- EXISTING STORM TRUNK SEWERS AND OUT FALLS
- PROPOSED WEST REGIONAL ROAD AND MODIFICATIONS
- IDP AREA
- EXISTING STORMWATER MANAGEMENT PONDS

SCALE : 1 : 50,000

JULY, 2004

FIGURE 1.1

EXISTING STORMWATER MANAGEMENT SYSTEM CAPACITY ANALYSIS

SECTION 2

2.1 GENERAL

This section provides a summary of the analysis and investigations carried out in this component of the project. Detailed technical data can be accessed in Technical Memorandum No. 2.

The existing stormwater management (SWM) system was modelled to determine its hydraulic capacity to carry runoff for present and future development conditions within the present City boundary.

Figure 2.1 provides an overview of the existing storm trunk sewer system. The model includes all the major storm sewers (larger than 1200 mm in diameter), plus selected smaller storm sewers that drain relatively large sub-catchments or major street sags, or might be used to drain future development areas outside the present City boundaries. The model does not include the majority of the smaller local sewer pipes or individual catch basins.

The model includes all development within the present City boundary to date for which data is available. Storm drainage requirements for future development areas outside the present City boundary will be dealt with in subsequent sections.

The modelled system consists of:

- 275 sub-catchments ranging in size from 0.52 ha to 67.4 ha
- 635 pipes ranging in size from 300 mm to 1800 mm diameter and having a total length of more than 45,000 m
- 7 stormwater ponds
- the Braeside and Grandin Ravines plus connecting channels in the Heritage Lakes subdivision

The model does not include the Northridge storm drainage system which is currently under development, nor does it include the Western Regional Road. Detailed planning studies are being completed by other consultants in these areas and therefore we have referenced relevant information from those studies where appropriate.

The MOUSE computer model was used in the analysis. MOUSE is a fully dynamic sewer model that is developed and supported by the Danish Hydraulics Institute and is used throughout the world.

The model calculates the flow in each pipe and the water levels throughout the pipe system in a design storm event. It also provides an approximate calculation of the volume of water ponded on the ground surface in a major storm event.

The present discussion provides a summary of the hydraulic analysis. Technical Memorandum No. 2 provides a more detailed description.

2.2 MINOR DRAINAGE SYSTEM

The minor drainage system consists of the pipes and open channels which are designed to prevent water from ponding on the street surface in the relatively frequent, smaller storm events. The major system consists of the street surfaces and major channels which contain and carry any excess runoff, over and above the capacity of the minor system, in a major storm event.

The minor (trunk sewer) system was modelled for the 1:2 year and 1:5 year (4 hour duration) storms. Some of the older storm sewers in St. Albert, particularly those constructed prior to 1975, were designed for the 1:2 year storm. The 1:5 year storm is currently used for the design of storm sewer systems in most present-day standards including those in St. Albert.

Figure 2.2 provides an overview of the trunk system's capacity to handle the 1:2 year storm. The figure shows the relative degree to which any pipe is overloaded, expressed as a *flow loading ratio*. The flow loading ratio is computed as the ratio of peak flow in the pipe divided by the pipe capacity; thus, a pipe with flow loading ratio greater than 1.0 is carrying more flow than it was designed for. Pipe widths in Figure 2.2 and subsequent plots are scaled to represent their relative sizes; i.e., larger pipes are represented with thicker lines and smaller pipes with thinner lines.

The results in Figure 2.2 shows that the trunk sewer system has **adequate capacity** to handle the 1:2 year storm without surcharging, **except for some portions of the older Grandin, Mission, and Lacombe Park trunks, west of St Albert Road, and the Braeside trunk on the east side**.

Figure 2.3 shows the flow loadings in the 1:5 year storm. About one-third of the system is overloaded to some degree in the 1:5 year storm, with about 5% of the system being loaded to more than twice the design capacity. As noted previously this would be expected in older areas of the City where the trunk sewers were designed for the 1:2 year storm or less. Most of the system has adequate capacity to carry the 1:5 year storm under surcharge. **There is potential for flooding in the Campbell Industrial area, and for significant overland flows in the Mission area, along Highway 2/St. Albert Road, and in the downtown area.**

The minor drainage system was also modelled with the 1:100 year design storm. The 1:100 year storm is used for an assessment of the flood risk potential, the performance of the major drainage system, and the capacity of the stormwater management ponds, as will be discussed in the following section.

2.3 MAJOR DRAINAGE SYSTEM

The major drainage system consists of the streets, ravines, and swales that carry runoff in a major storm event, when the capacity of the minor system is exceeded. In modern drainage systems the major drainage system is designed to carry the major flows safely without flooding private property or unduly compromising public safety. In older neighbourhoods, the major drainage system was generally not designed as such but still carries runoff in a major event nonetheless.

Generally the street grades are steeper in the central regions of St. Albert, within the side slopes of the Sturgeon River valley, and flatter in the upland areas away from the river. The flatter areas outside the Sturgeon River valley tend to have more street sags where water could collect in a major storm.

A qualitative assessment was made of the major system performance during a major storm using the available contour information and the computer model. The major system was not modelled directly, as to do so would require a highly detailed model. Instead, the pipe system model was run for the 1:100 year design storm and the results of the minor system model were used as an indication of the major system performance. In the model, the excess runoff or overflow at each manhole is temporarily stored at that manhole so that there is no loss of water from the system. This gives an indication of the volume of ponding that could be expected at that location and indirectly, an estimate of the risk of flooding.

Figure 2.4 shows the manhole surcharge results for the 1:100 year storm. Manholes are colour-coded according to the level of surcharge, with the grey dots representing manholes with no surcharge (water levels are below the crown of the connecting pipes) and the red dots showing manholes where water levels reach ground surface. The green and blue dots show manholes which are surcharged to a lesser degree.

Where manholes are surcharged to grade, they are shown as larger dots which represent, approximately, the area that is likely to be affected by ponding on the street. Numbers adjacent to these manholes show the volume of ponding computed at each of these manholes. These numbers give an approximate indication of the flood potential at any given manhole. Generally, **ponding volumes greater than about 1,000 m^3 represent a significant potential for flooding of private property, depending on street slopes and local grading conditions**.

The model represents the trunk sewers and does not include local collector pipe systems. It assumes that the local system and catch-basins have adequate capacity to pass the design flow which may not always be the case, especially in more severe events. Therefore, the ponding volumes should be taken as being only indicative rather than being precise.

Model results show the following:

- A number of **locations in the upper Braeside storm trunk (Basin 17 in Figure 2.1) have ponding volumes greater than 1,000 m^3.**
- There is a **significant risk of flooding in the Campbell Industrial area,** at the top end of the Braeside trunk, where about **50,000 m^3 of water will accumulate in the 1:100 year storm.**
- **Street sags** are located at the intersection of **Carnegie Drive and Corriveau Avenue,** and in **Campbell Road,** south of the intersection with Corriveau Avenue.
- Ponding volumes are potentially significant at one location in each of the neighbourhoods of Deer Ridge, Oakmont, and Lacombe.
- There are significant street flows in older areas of St. Albert that have limited storm sewer systems.

Site inspection and detailed surveys are recommended at each of these locations to identify the maximum potential depth of ponding at each sag and the risk of flooding of private property. Depending on the results of the field inspection, detailed survey of the site,

combined with a more detailed major/minor modelling of the tributary catchment, may be required.

We recommend that the city continue to work towards a comprehensive, detailed model of its storm drainage system which would include all of the storm sewers (smaller tributary pipes which were not modelled in the present study) and the major drainage system. Priority should be placed in these areas where significant street ponding has been indicated.

2.4 MAJOR RAVINES

The major drainage system includes four natural ravines as summarized below. Table 2.1 provides a summary of the peak flows and velocities.

- The Forest Lawn Ravine is a deep, natural ravine with a 340 m long constructed concrete chute at the bottom, connecting two sections of storm sewers in the Braeside trunk sewer system. It experiences high flows and velocities that give rise to potential safety concerns. There has been one incident of a City truck being trapped by flowing water but no reports of anyone being trapped or injured. The model indicates that a substantial volume of water will pond upstream of Sir Winston Churchill Drive, reaching a depth of about 8 m in the 1:100 year storm, which is about 2 m below the roadway elevation.
- The Grandin Ravine connects two sections of trunk pipes on the west side of St. Albert Road. Peak flows, velocities, and ponding volumes are relatively small and of no great concern.
- Two channels in Heritage Lakes connect the two lakes and the dry pond. Peak velocities are of the order of 0.3 and 1.3 m/s – too low to be of much concern.

Table 2.1
Major Drainage System Results - Ravines

Location		1:5 Year Storm		1:100 Year Storm		
		Peak Flow (m^3/s)	Velocity (m/s)	Flow (m^3/s)	Velocity (m/s)	Ponding Volume (m^3)
Forest Lawn		11.6	4.7	14.5	4.8	50000
Grandin		2.7	0.7	5.9	0.9	500
Heritage Lakes	Havenwood Pond to Pond One	0.5	0.3	0.45	0.3	-
	Dry Pond to Pond 1	1	1.3	1.02	1.3- 2.1	-

2.5 STORMWATER MANAGEMENT FACILITIES

The existing stormwater drainage system in St. Albert includes three wet ponds, three dry ponds, and one stormwater wetland, plus the old lagoon site (the Riel Pond) which presently serves as a stormwater pond. Pond sizes range from 1,400 m^3 to 52,000 m^3. Table 2.2 provides a summary of their capacities and their performance in the design (1:100 year) storm event. Locations are shown on Figure 2.1.

The model results demonstrate that the design storage capacity would be exceeded in the Heritage Lakes Pond 1 and Havenwood Pond. Peak water levels in the 100 year 24 hour duration storm are 0.7 m and 0.5 m, respectively, above the design elevation. **House elevations should be checked around these ponds to ensure that they are above the 1:100 year water level**.

The Riel Pond provides storage and treatment of runoff water from Riel Park and the south Grandin area prior to its release to Big Lake. It was also used by the canoe club. Part of the lagoon may be reclaimed as a natural wetland with construction of the Western Regional Road. The remaining portion, on the east side of the roadway, may serve as a retention pond for the tributary area on the east and south as well as the regional road itself. This lagoon was not modelled.

Dry Pond #1 in Heritage Lakes collects runoff from a small park. Runoff volumes are minimal and not enough to cause the dry pond to outflow in the design event.

2.6 AVAILABLE TRUNK SYSTEM CAPACITY

Figure 2.5 provides an overview of the unused trunk capacity which is available in the various reaches to serve future development, based on the 1:5 year peak flows and the pipeful capacity. The results show that sufficient capacity is available in the Kingswood south trunk to serve the remainder of the development area in the Kingswood basin, west of the Campbell Industrial area. However, **storm trunk sewers are presently overloaded in the Campbell/Akinsdale/Braeside system**, therefore, further development of the Campbell area will require stormwater management (storage) to control flows into the existing storm sewer system. Similarly, the **Oakmont/Erin Ridge storm trunks are loaded to capacity** and stormwater management will be required to complete the development of this basin.

Stormwater management is planned for the Northridge area which will drain via a new trunk system to Big Lake. Since more detailed planning is being undertaken by the developer, this area was not modelled.

There is little or no spare capacity available to serve future development areas outside the present City boundary except, possibly, with stormwater ponds controlled with real-time control gates that will release water after the storm has passed.

Table 2.2

Stormwater Management Ponds in the Model

Number	Location	Type	Tributary Area (ha)	Storage Volume (m^3)			Peak Outflow Rate (L/s)	
				Available Storage	1:100 Year 4 hour Storm	1:100 Year 24 hour Storm	1:100 Year 4 hour Storm	1:100 Year 24 hour Storm
1	Heritage Lakes	Wet Pond 1	55.63	21,300	22,300 (673.56)	32,800 (674.15)	178	200
2	Havenwood	Wetland	53.8	23,600	20,800 (680.82)	28,300 (681.27)	188	197
3	Heritage Lakes	Dry Pond 1	4.1	1,450	25 (680.17)	25 (680.17)	0	0
4	Heritage Lakes	Dry Pond 2	9.5	7,300	1,600 (666.44)	300 (666.09)	120	13
5	Grandin	Wet Pond	42.71	42,000	9,400 (682.71)	16,614	119	130
6	WalMart Site	Dry Pond	26.92	31,500	15,800 (685.66)	24,000 (686.39)	100	107
7	Erin Ridge	Wet Pond	48.26	18,100	14,400 (682.66)	15,000 (682.71)	237	222 l/s to trunk 854 l/s to ravine

2.7 PROPOSED UPGRADES

2.7.1 Campbell Industrial Area

There are 52 ha of industrial land remaining to be developed in the upstream end of the Braeside storm trunk sewer system. Modelling shows that storm trunks downstream of the Campbell Industrial area are severely overloaded under existing conditions. Therefore, the City has constructed a 2.0 ha dry pond to control runoff from this area. The dry pond (at the north) has a storage capacity of 23,000 m^3 plus 0.5 m freeboard.

The trunk sewers were modelled with the proposed development and the dry pond. The modelling shows that the trunk sewers will flow backward into the pond when they are surcharged. This reverse flow will help to reduce flooding on the street but will add to the storage volumes in the pond.

The results show that a storage volume of 48,800 m^3 is required for the 1:100 year storm and 66,000 m^3 for the July 1978 storm, about two times the present capacity. Table 2.3 provides a summary.

The trunk sewer system was also modelled with a second pond located in the south end of the Campbell Industrial area, where about 17 ha of land remains to be developed within the City boundary. Table 2.4 provides a summary of the pond's storage capacity and outflows (and reverse flows). The south pond would operate as **a surge pond** to control surcharge levels in the trunk sewers and to control flows from the remaining development area. A surge pond allows flow from the downstream conveyance system to flow back into the pond when the downstream system is overloaded. The model results show a significant reduction in surcharge levels throughout the Campbell/Akinsdale/Braeside trunk sewer system relative to existing conditions.

Figure 2.6 shows the simulated ponding volumes in the 1:100 year storm. Comparison with Figure 2.4 shows a substantial reduction in ponding volumes and in the potential flood risk throughout the upper end of the trunk sewer system. Further reduction in street flooding would require trunk sewers to be replaced within the presently-developed area.

It is proposed that the south pond be designed as a stormwater wetland or wet pond in order to remove sediments from the runoff water. This would help to reduce siltation in the Sturgeon River and would also address Alberta requirements for water quality control.

Table 2.3
Preliminary Design Parameters for the Campbell Industrial North Pond

	Normal Water Level	1:5 year 4 hour storm	1:100 year 24 hour storm	July 1978 storm
Elevation (m)	683.9	684.48	685.5	686.0
Area (ha)	2.6	2.9	3.3	3.65
Live Storage Volume (m^3)	-	17,000	48,800	66,000
Peak Outflow (m^3/s)	-	0.29	0.49	0.58
*Peak Reverse Flow (m^3/s)		(-0.63)	(-0.47)	(-0.61)

Table 2.4
Preliminary Design Parameters for the Campbell Industrial South Pond

	Normal Water Level	1:5 year 4 hour storm	1:100 year 24 hour storm	July 1978 storm
Elevation (m)	681.5	682.12	683.15	684.47
Area (ha)	3.0	3.3	3.8	4.3
Live Storage Volume (m^3)	-	20,150	57,900	109,300
Peak Outflow (m^3/s)	-	1.29	3.09	4.52
*Peak Reverse Flow (m^3/s)		(-2.37)	(-0.57)	(-9.8)

*Reverse flows occur when the downstream system is severely overloaded, and flows back up into the pond.

The recommendations for the Campbell Industrial area are to:

- **Reserve the area on the west side of the north pond (approximately 1.2 ha) for possible future expansion** of the pond until the remainder of the area is developed and the model estimates are confirmed.
- **Construct a second stormwater pond at the south end** of the Campbell Industrial Park to reduce flows and surcharging in the downstream storm trunk system.
- **Monitor flows at two locations in the downstream trunk sewers** to confirm the discharges and surcharge levels and the model parameters as the area continues to infill.
- Explore with Alberta Transportation the possibility of **a joint use facility within the Transportation Utility Corridor (TUC)** to provide for runoff from the Edmonton ring road and the Campbell industrial area.
- **Require on-lot stormwater management** for any lots remaining to be developed within the presently-serviced area in the Campbell Industrial area to minimize the additional surcharging within the Campbell area by controlling flows to 35 L/s/ha.

2.7.2 Erin Ridge

The existing Erin Ridge wet pond was originally designed to serve an area of 27 ha to the north and southeast of the pond. The existing pond has a capacity of 20,000 m^3 and 0.6 m of freeboard from the design high water level (DHWL) to the abutting lot elevations. It has a pipe connection to the south, a piped overflow to the Oakmont Ravine to the east at the 1:5 year storm water level, and an emergency overflow over Erin Ridge Road above the high water level.

There are an additional approximately 30 ha remaining to be developed in the tributary catchment. Approximately 20 ha will drain to the existing pond which will be expanded to accommodate the additional area. The remaining 9.7 ha will drain to a new dry pond located to the northeast which will be pumped to the existing pond. The existing wet pond will trap sediment generated in the basin.

The ultimate development of this basin was simulated, based on preliminary plans and pump capacities provided by the developer. Tables 2.5 and 2.6 provide a summary of the model results and preliminary design parameters for the two ponds.

Table 2.5
Model Results for Erin Ridge Pond 1
(existing wet pond)

	NWL	1:5 year 4 hour storm	1:100 year 24 hour storm	July 1978 storm
Elevation (m)	680.65	681.25	682.35	682.98
Area (ha)	1.3	1.5	1.9	2.1
Live Storage Volume (m^3)	0	10,200	28,900	39,610
Outflow (m^3/s)				
- to trunk	0.0	0.18	0.24	0.26
- to ravine	0.0	0.0	0.42	1.03

Table 2.6
Model Results for Erin Ridge Pond 2
(proposed dry pond)

	Bottom of dry pond	1:5 year 4 hour storm	1:100 Year 24 hour storm	July 1978 storm
Elevation (m)	678.81	679.54	680.03	680.51 (above overflow)
Area (ha)	0	0.25	0.5	0.6
Live Storage Volume (m^3)	0	776	2,686	5,285
Outflow (m^3/s)	0	0.12	0.13	0.18

An emergency spillway route should be provided for each of the ponds at the design high water level and the basements of all abutting houses be at least 0.3 m (measured vertically) above the overflow elevation. The existing pond will need to be doubled in size to serve the remaining development area.

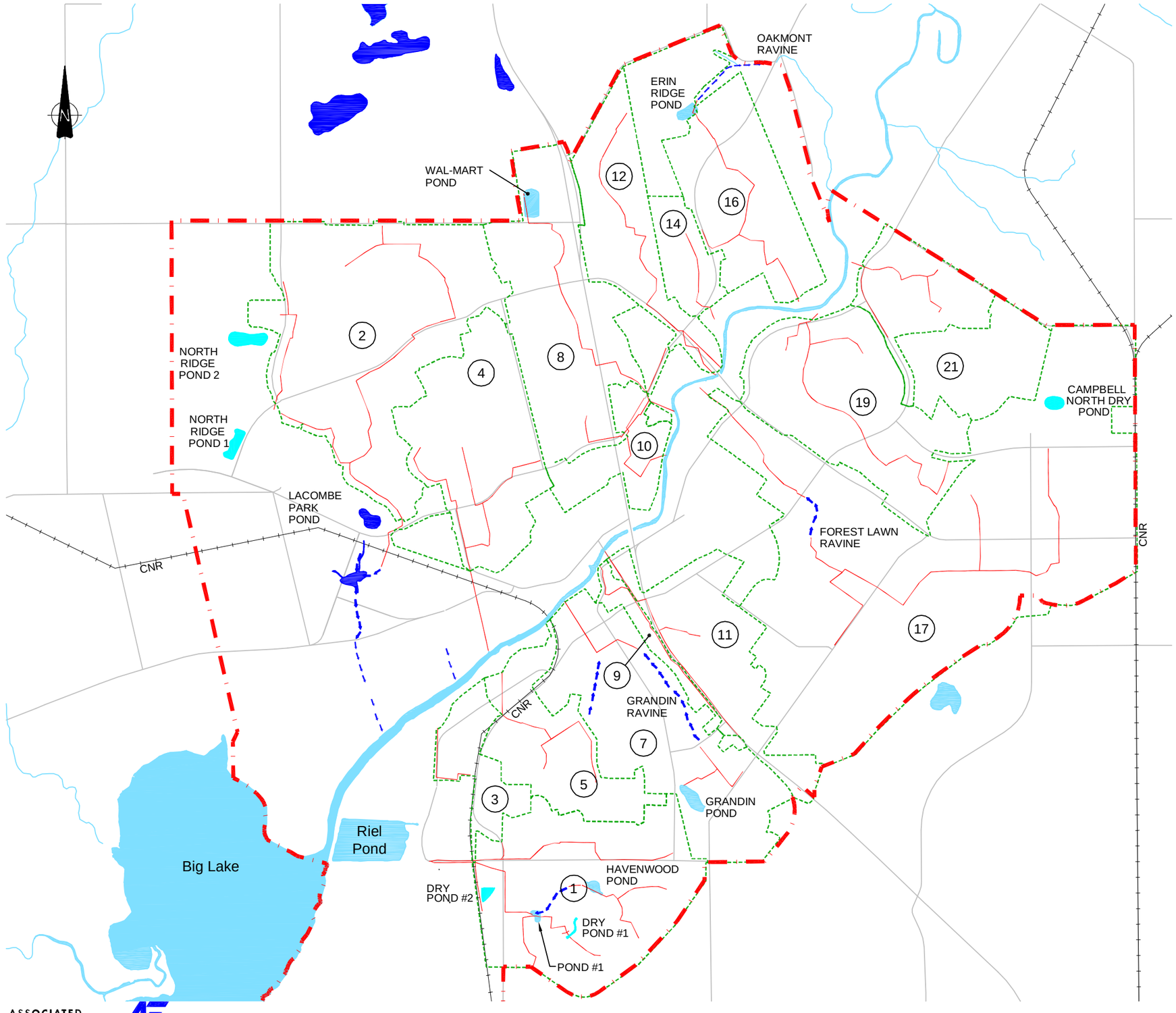
2.7.3 Kingswood

Approximately 68 ha of residential land remains to be developed in the Kingswood area. The modelling shows that the existing trunk sewers have sufficient capacity to carry the 1:5 year peak flows from this area without surcharging. However, as shown in Figure 2.4, there will be approximately 2,200 m^3 of ponding or overflow in the major drainage system in the 1:100 year storm. We recommend that the City consider a stormwater pond (wetland) to control runoff from this area, to reduce the major drainage system flows downstream of this area, and to reduce the discharge of sediment to the Sturgeon River. Currently, Alberta Environment requires removal of 80% of sediments finer than 70 microns, which can be accomplished with a wet pond or stormwater wetland. The remaining service area is large enough to support a wet pond.

2.7.4 Older Neighbourhoods

Some of the older neighbourhoods adjacent to the river (e.g. Mission) were developed without storm sewer systems, where storm runoff is carried on the street surface. This may lead to long term degradation of the streets and does contribute to large flows being carried on the street surfaces.

The City should develop a long-term plan to provide storm sewers in these neighbourhoods when they are being redeveloped.



THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

EXISTING STORM TRUNK SEWER SYSTEM

LEGEND:

- RAVINE OR CHANNEL
- CITY BOUNDARY
- CATCHMENT BOUNDARY
- STORM TRUNK SEWER
- SLOUGH OR WETLAND
- STORMWATER POND
- (1) CATCHMENT NUMBER

SCALE : 1 : 30,000

JULY, 2004

ASSOCIATED ENGINEERING

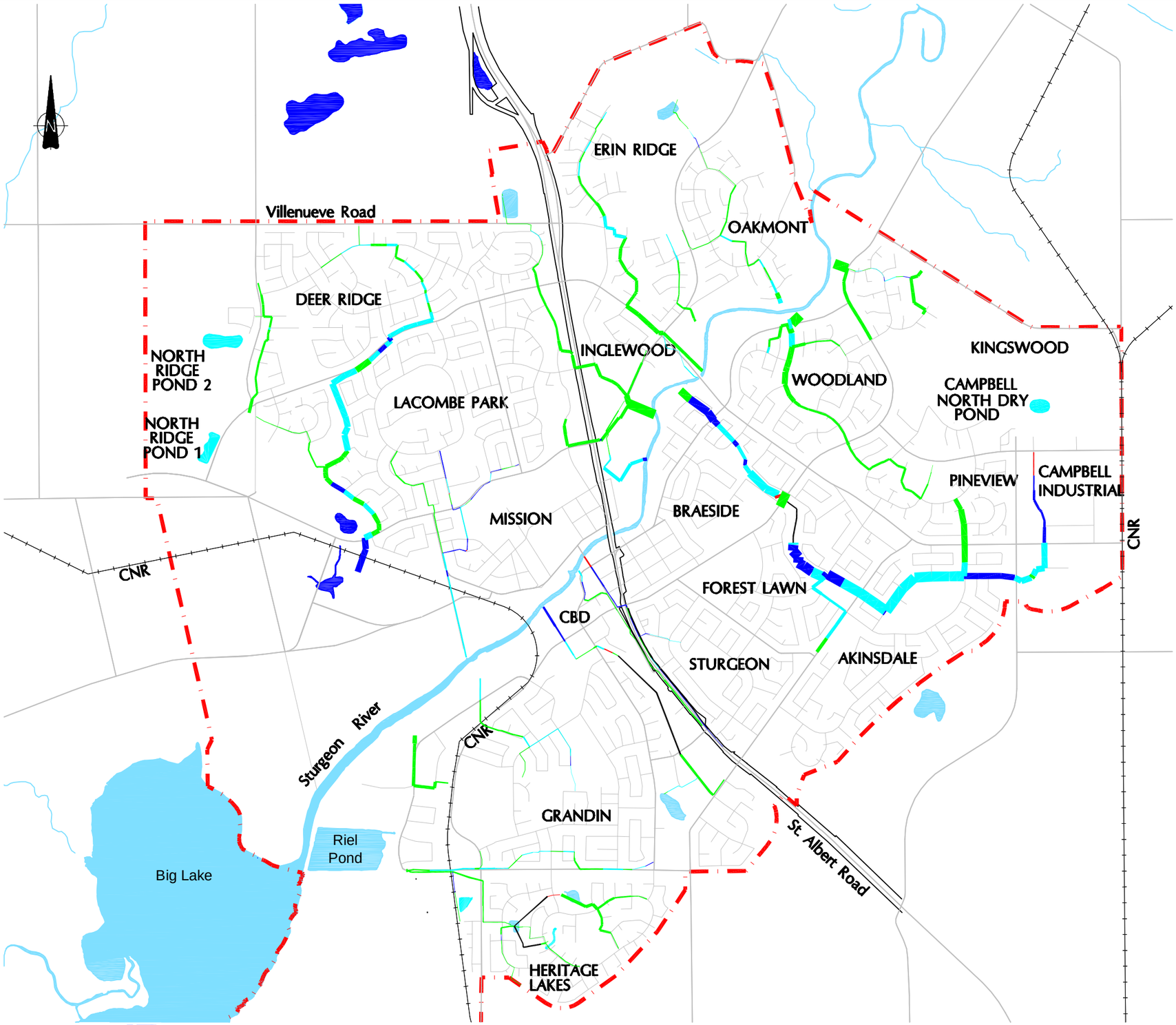
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THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

RATIO OF PEAK FLOW TO PIPE CAPACITY 1 : 2 YEAR STORM



LEGEND:

- 0 - 0.8
- 0.8 - 1.2
- 1.2 - 2.0
- > 2.0
- RAVINE
- CITY BOUNDARY

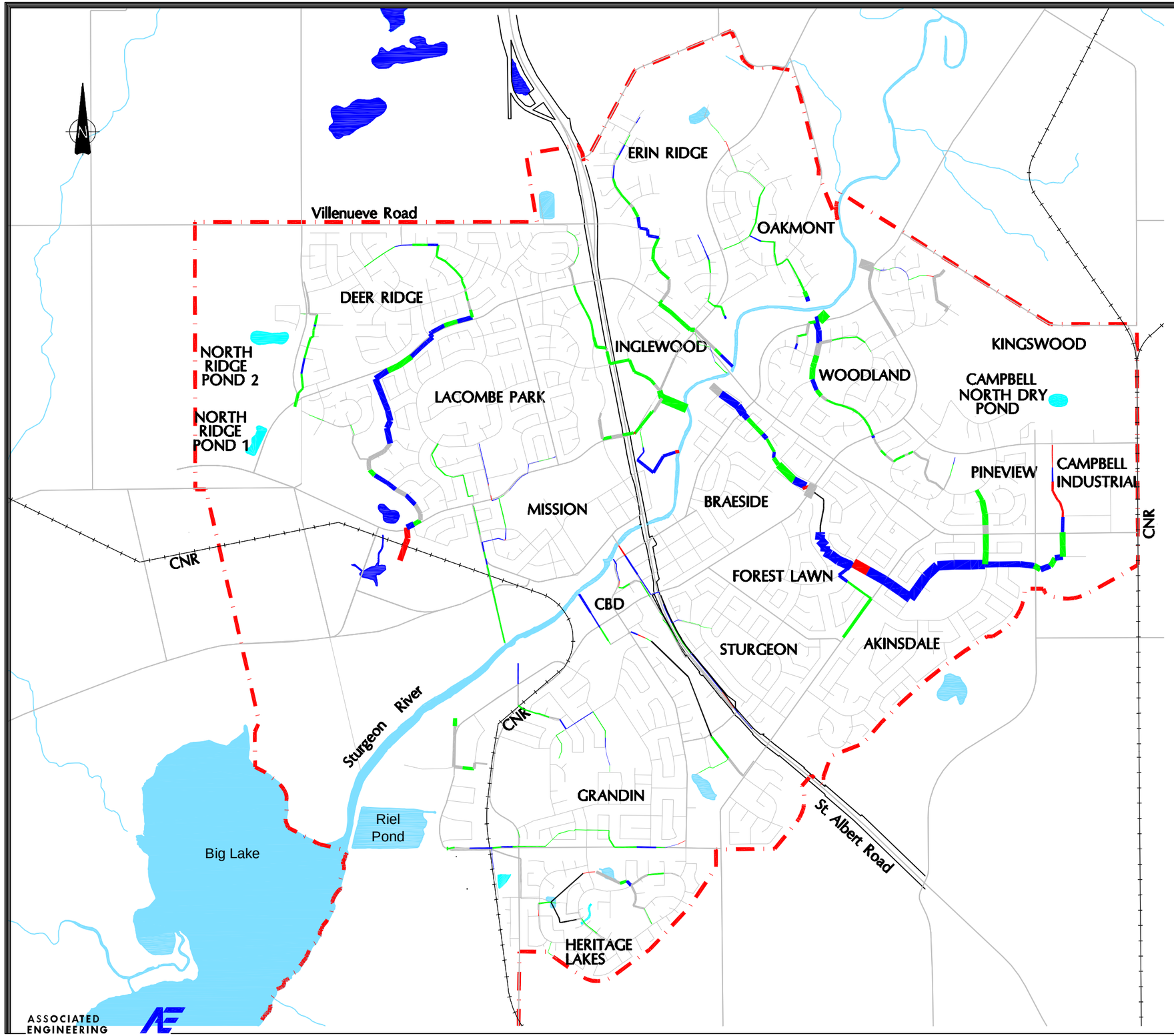
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JULY, 2004

ASSOCIATED ENGINEERING

FIGURE 2.2

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THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

RATIO OF PEAK FLOW TO PIPE CAPACITY 1 : 5 YEAR STORM

LEGEND:

- 0 - 0.8
- 0.8 - 1.2
- 1.2 - 2.0
- > 2.0
- RAVINE
- CITY BOUNDARY
- ARTERIAL STREET

SCALE 1 : 30,000

JULY, 2004

FIGURE 2.3

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THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

MANHOLE SURCHARGE RESULTS 1 : 100 YEAR STORM

LEGEND:

- NO SURCHARGE
- <=1m SURCHARGE
- >1m SURCHARGE
- SURCHARGED WITHIN 1m OF GROUND
- 6096 FLOODED MANHOLE SHOWING VOLUME OF PONDING m³
- CITY BOUNDARY
- ARTERIAL STREET

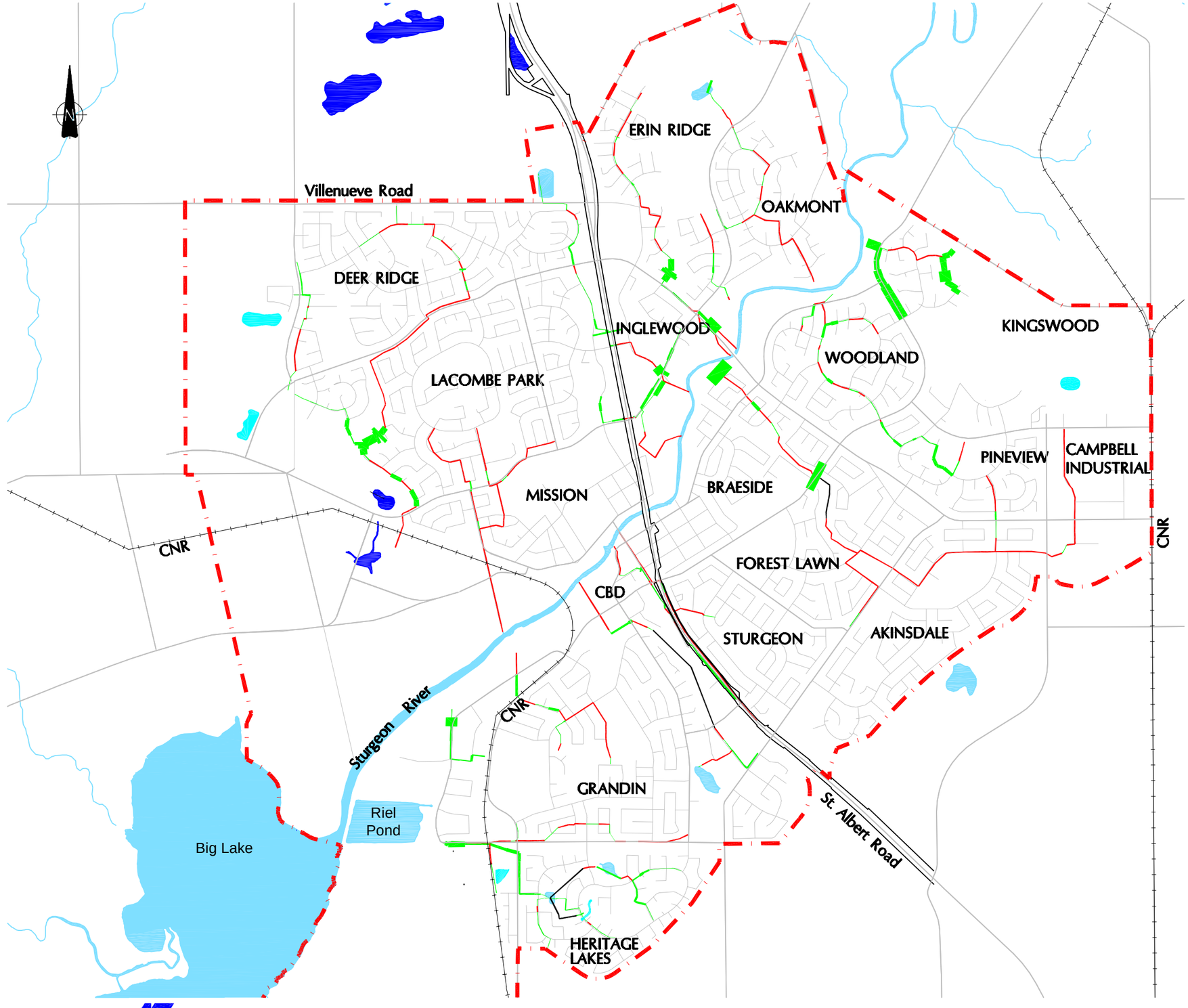
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JULY, 2004

FIGURE 2.4

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THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

AVAILABLE TRUNK CAPACITY (FOR 1:5 YEAR STORM)

LEGEND:

- OVERLOADED TRUNK
- TRUNK WITH SPARE CAPACITY
- CITY BOUNDARY

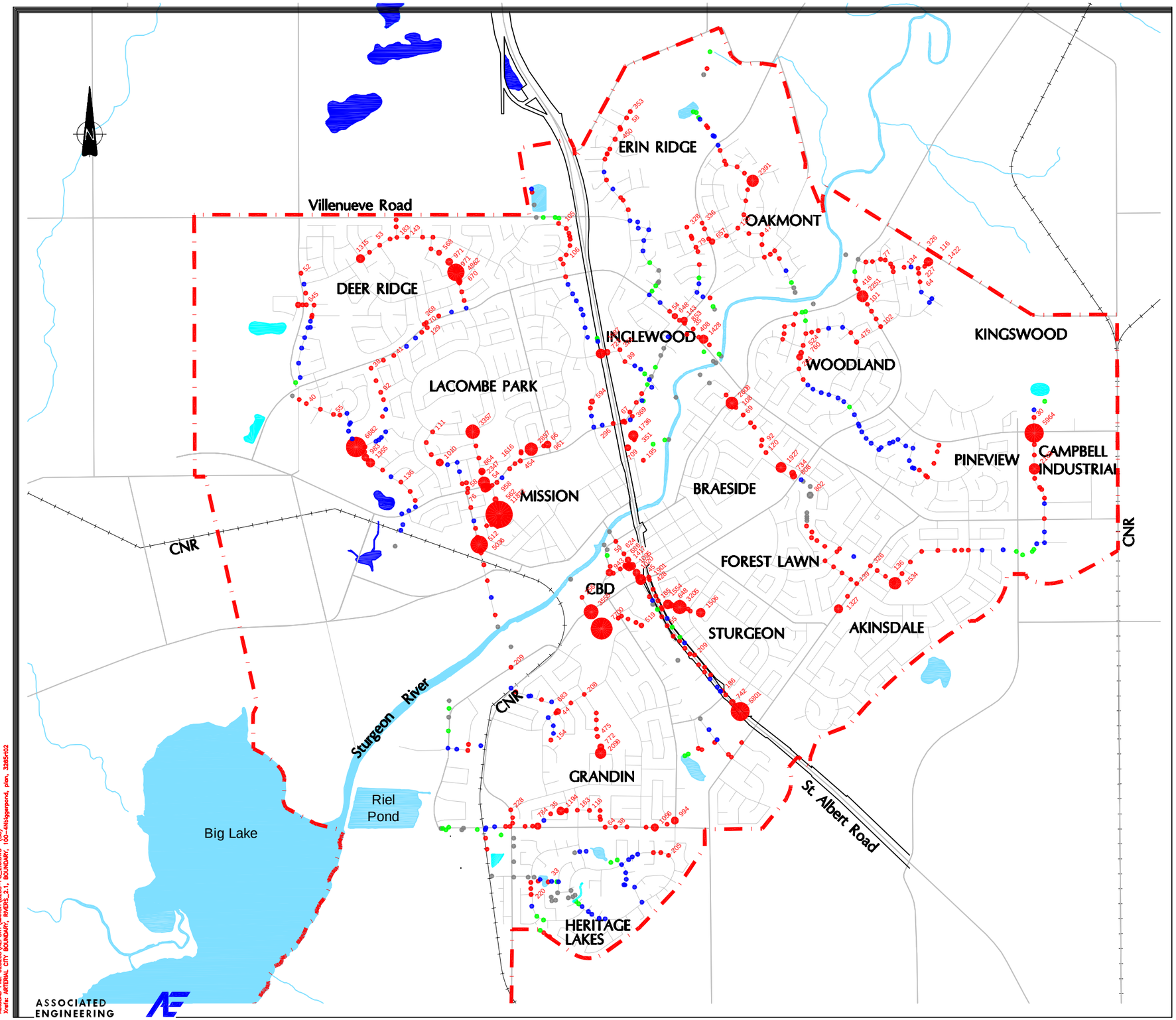
NOTE:

LINE WIDTH IS PROPORTIONAL TO SPARE CAPACITY

SCALE 1: 30,000

JULY, 2004

FIGURE 2.5



ASSOCIATED ENGINEERING

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Xrefs: ARTERIAL, CITY BOUNDARY, RIVERS_2.1, BOUNDARY, 100--4NSiggerpond, plan, 3285r02

THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

MANHOLE SURCHARGE RESULTS FOR FUTURE DEVELOPMENT WITH PROPOSED UPGRADES 1 : 100 YEAR 4 Hr. STORM

LEGEND:

- NO SURCHARGE
- <=1m SURCHARGE
- >1m SURCHARGE
- SURCHARGED WITHIN 1m OF GROUND
- 6096 FLOODED MANHOLE SHOWING VOLUME OF PONDING m^3
- CITY BOUNDARY

SCALE 1:30,000

JULY, 2004

FIGURE 2.6

STORMWATER MANAGEMENT SYSTEM STRUCTURAL AND SERVICE CONDITION ASSESSMENT

SECTION 3

3.1 BACKGROUND

The City of St. Albert contains approximately 45 km of trunk storm sewers plus the lateral sewers, which constitute a significant asset, with a replacement value in the order of $100 million.

The City requires a projected management plan for the repair and maintenance of the trunk storm sewers.

The City of St. Albert inspected 6.0 km of the existing trunk storm sewers under the 2002 CCTV (closed circuit television) Inspection Program. This represents about 13% of the total length of trunk sewers. This representative sample was assessed utilizing the City of Edmonton Standard Sewer Condition Rating System Report (March 1996). In addition, Associated Engineering conducted a visual assessment of the storm sewer outfalls and the Forest Lawn Ravine to assess their physical condition and to identify any upgrading requirements.

3.2 CONVEYANCE SYSTEM STRUCTURAL AND SERVICE CONDITION ASSESSMENT

3.2.1 Assessment

As shown in Figure 3.1 (Pipe Installation Date), most of the trunk sewer system is still fairly new, less than 30 years old, and should be in reasonably good condition. However, some portions of the trunk network that are in the downtown/Grandin area are older than 50 years.

Figure 3.2 shows the type of pipe material used in the trunk sewers. All of St. Albert's trunk sewers were constructed of concrete pipe and should be fairly durable over the long term. There are a few sections of open channel, notably in the Forest Lawn Ravine and the Grandin Ravine. The Forest Lawn Ravine has a concrete chute in the bottom to carry stormwater.

The condition assessment of the inspected trunk sewers was conducted using the City of Edmonton Standard Sewer Condition Rating (March 1996). Results were summarized in the Stantec Consulting Ltd. report titled "2002 CCTV Sewer

Inspection Program" (July 2003). The report indicates that 9% of the inspected trunk storm sewer segments which were inspected contain locations which require structural rehabilitation and/or repair. Less than 2% of the total length of inspected pipe was identified for rehabilitation or repair.

The following is a general summary of the conditions found, tabulated by neighbourhood:

- Akinsdale - good condition
- Braeside - two (2) broken pipe sections
- Deer Ridge - good condition
- Downtown - light to severe cracking, open joints, severe sagging
- Forest Lawn - no inspection available
- Grandin - good condition, light to moderate cracking in several sections
- Lacombe Park - light cracking, one segment with moderate cracking
- Mission - good condition, one segment with moderate cracking
- Riel - good condition
- Sturgeon - good condition
- Woodlands - good condition, two segments with light cracking.

In general, the inspected trunk storm sewers were found to be in good structural condition, and there was no obvious correlation with the age of the pipe.

The service condition of the inspected trunk sewers was generally good but indicative of a lack of maintenance. It is important for any municipality to adopt a regular inspection and maintenance program to extend the lifespan of their assets.

3.2.2 Rehabilitation Maintenance Program

The "2002 CCTV Sewer Inspection Program Report" (July 2003) recommended that 115 m of the inspected trunk system (sections that rated 4 or 5) be immediately repaired or replaced. The cost identified for these works was approximately $285,000 (including contingency and engineering).

To ensure a high level of reliability at the lowest possible cost, asset management systems and procedures that include effective methods for condition assessment and rehabilitation must be implemented. The "National Research Council of Canada,

Guidelines For Condition Assessment and Rehabilitation of Large Sewers" (2001) provides owners and operators of sewer systems with suggested methods of managing the assessment and repair of large sewers. Although the Guideline was created for large sewers (900 mm and larger), it can be applied to sewers of any size.

The NRC Guideline presents practical steps for managing sewer assets. The most important item to establish is an inventory of the asset.

The NRC Guideline combines the condition rating with a failure impact rating to provide a logical and systematic means of determining the priorities for subsequent inspections and upgrades. The failure impact rating is the degree of impact that would occur should a pipe fail.

The weighted failure impact factor can be calculated from several component factors, as follows:

$$I_w = (0.2)\, f_e + (0.16)\, f_s + (0.16)\, f_z + (0.16)\, f_d + (0.16)\, f_f + (0.16)\, f_q$$

Where:

- f_e - sewer location
- f_s - embedment soil
- f_z - sewer size
- f_d - burial depth
- f_f - sewer function
- f_q - seismic zone

Each failure impact factor is rated either low (1.0), medium (1.5), or high (3.0), and is multiplied by its weighting factor. The weighted impact factor (I_w) is then compared to the values shown in Table 3.1 to obtain the failure impact rating.

Table 3.1
Failure Impact Rating

Weighted Impact Factor, I_W	Impact Rating R_{imp}
1	1
1.01 - 1.60	2
1.61 - 2.20	3
2.21 - 2.80	4
> 2.80	5

A failure impact rating map can be generated which will help in identifying priorities for inspection, condition assessment, and rehabilitation. The map can also be used for planning new sewer extensions. For example, a high impact rating might suggest a new sewer extension be located away from a high failure impact rating area.

Inspection is the first step of condition assessment. The NRC Guideline recommends an inspection timing based on the condition rating and failure impact rating of the pipe, as indicated in Table 3.2.

Table 3.2
Inspection Timing

Condition Rating	Failure Impact Rating (R_{imp})	Time to Next Inspection (Years)
5	1 to 5	0*
4	5 1 to 4	0* 2 to 6
3	5 1 to 4	3 5 to 10
2	5 1 to 4	5 10 to 15
1 or 0	5 1 to 4	10 15 to 25

* Immediate Rehabilitation Required

The NRC Guideline also provides an indication of rehabilitation priority based on structural condition rating and failure impact rating as indicated in Table 3.3.

Table 3.3
Rehabilitation Priority

Structural Condition Rating (R_{str})	Implication	Failure Impact Rating (R_{imp})	Rehabilitation Priority
5	• Failed or failure imminent	1 to 5	Immediate
4	• Very poor condition • High structural risk	5 1 to 4	Immediate High
3	• Poor condition • Moderate structural risk	4 to 5 1 to 3	Medium Low
2	• Fair condition • Minimal structural risk	1 to 5	Low
1 or 0	• Good or excellent condition	1 to 5	Not Required

Although only a representative sample of the trunk sewers have been inspected, the available data may be used to prioritize the neighbourhoods using the failure impact rating. The failure impact rating is meant to be used for individual pipe links, but since a complete data inventory is not available, it can also be used to prioritize neighbourhoods for immediate action and future inspection.

Based on the criteria identified in the NRC Guide, the weighted failure impact rating was calculated for each neighbourhood. The following assumptions were used to determine the factors:

- general land use zoning was used to determine the sewer location factor
- embedment soil is assumed the same throughout
- sewer size factor is based on available pipe size range
- burial depth is assumed to be 3.0 m or less
- assumed trunk sewer function for communities adjacent to river

The failure impact for each community was assigned a rating of 2.0. The weighted impact factor sheds some light on where improvements should proceed. Based on the weighted impact factor, structural improvements and CCTV inspections may be prioritized as follows:

	Priority
• Downtown	1.0
• Grandin	2.0
• Mission	2.0
• Braeside	3.0
• Woodlands	3.0
• Akinsdale	4.0
• Deer Ridge	4.0
• Lacombe Park	4.0
• Sturgeon	5.0
• Riel	6.0

The assembly of a data inventory is of utmost importance. **Associated Engineering recommends that the remainder of the trunk storm sewers (39 km) be inspected within the next 5 years.** This translates to approximately 7.8 km/yr. Upon completion of the trunk inspections, the laterals should be inspected. In conjunction with the pipe inspections, it is important to include the structural condition of all related manholes. Special priority should be given to storm sewers along the major arterials. CCTV inspection will help to identify pipe defects that could lead to loss of bedding sand creating voids.

3.3 OUTFALLS

The 33 existing storm outfalls in the City of St. Albert were inspected in fall of 2002 under this project. Figures 3.3a through 3.3c illustrate the locations of the outfalls, with their assigned numbers. The program consisted of visual inspections to identify condition issues as well as safety-related concerns. A summary of the results, and conceptual level cost estimates to rectify condition and safety issues was prepared. A listing of the work estimated for each outfall, along with conceptual level costs, is presented in Tables 3.4 and 3.5.

Table 3.4
Outfall Rehabilitation Components and Costs - Condition Based (2004 Dollars)

Outfall No.	Description of Work	Estimated Construction Cost
3	Prevent flared section from separating further.	$11,000
4	Patch concrete. Place rip rap in scour hole at outfall.	$9,000
4A	No work required.	
5	No work required.	
6	No work required.	
6A	No work required.	
6B	Provide new/improved supports for the west end of the wooden bridge. Provide erosion protection from the outlet to the river.	$9,000
6C	Install a transition drop structure from concrete lined channel to earthen channel.	$5,000
7	Remove existing flared section - replace with metal flared section. Install rip rap c/w filter fabric downstream of outlet pipe.	$11,000
7A	Replace last section of concrete with corrugated metal section.	$3,000
7B	No work required.	
8	No work required.	
8A	Remove cattails on the concrete apron.	$2,000
8B	Extend gabion protection to river.	$16,000
9	No work required.	
10	No work required.	

Outfall No.	Description of Work	Estimated Construction Cost
11	Repair cavity around pipes under the bridge abutment. Note: City has undertaken repair. Reassess and determine if additional work required.	Repaired in 2003
11A	Install erosion protection from outlet pipe to river.	$2,000
11B	No work required.	
11C	Replace/repair spalling concrete outlet pipe. Install gabion erosion protection at downstream end of concrete apron.	$8,000
11D	No work required.	
12	Install drop structure; install degradation mitigation works from outlet structure to outlet channel.	$13,000
13	Repair outlet pipe concrete pad. Install drop structure.	$8,000
14	Install channel degradation mitigation.	$81,000
15	Install gabion drop structure from pipe outlet to outlet channel.	$5,000
15A	Install erosion protection downstream of outlet.	$2,000
16	No work required.	
17	Repair concrete walls.	$6,000
17A	Stabilize walkway and existing gabion structure adjacent to the west of outlet structure.	$16,000
19	Repair existing concrete support pedestal; realign last 2 segments of existing pipe.	$32,000
21	Grout gap between end and second segments of existing pipe as interim solution.	$2,000

Table 3.5
Outfall Rehabilitation Components and Costs - Safety Based

Outfall No.	Description of Work	Estimated Construction Cost
3	Install fence.	$3,000
4	Install fence.	$3,000
4A	No work required.	
5	Install safety bars/fence on top of concrete headwall. Install safety grill across pipe openings.	$9,000
6	Extend safety bars/fence on top of concrete headwall. Install safety grill across pipe openings.	$7,000
6A	No work required.	
6B	Install safety grill across pipe openings.	$3,000
6C	No work required.	
7	Install safety grill across pipe openings. Install fence around improved outlet.	$6,000
7A	No work required.	
7B	No work required.	
8	No work required.	
8A	No work required.	
8B	Fence off flared section on north side of walkway bridge.	$3,000
9	No work required.	
10	Replace existing low bar fence with full fence. Install safety grill across pipe openings.	$6,000
11	No work required.	
11A	No work required.	

Outfall No.	Description of Work	Estimated Construction Cost
11B	Fence off outlet pipe.	$2,000
11C	Install safety grill across pipe openings.	$3,000
11D	Fence off pipe outlet. Install safety grill across pipe openings.	$6,000
12	Install safety grill across pipe openings.	$3,000
13	Install fence.	$5,000
14	No work required.	
15	Install fence around outlet.	$3,000
15A	No work required	
16	No work required.	
17	No work required.	
17A	No work required.	
19	Repair existing fence.	$3,000
21	Repair existing fence.	$1,000

Cost estimates should be considered preliminary. The costs, and in some cases the rehabilitation work proposed, must be reviewed to confirm the suggested measures. This could include review of original designs, field investigations, and discussions with City staff. The variance in the complexity of the proposed rehabilitation makes defining a suitable engineering component difficult.

It is also recommended that each outfall be marked in the field with a name plate so that it can be identified and located.

The appended listing of proposed rehabilitation yields a total construction cost of $307,000, with the notable exception of Outfall #11. Cost estimates include an engineering allowance of 15%, and a contingency allowance of 40%.

Outfall 11 is located under the north approach to the Perron bridge and has recently been repaired by the City. A cavity had formed under the abutment due to erosion of the fill caused by separation of a pipe joint. The City solved the problem by inserting PVC liners into the outfall pipes and filling the cavity. This demonstrates the need for periodic inspection to identify such problems before they became more serious.

Photos 3.1 to 3.5 provide typical views of the present outfall condition and some of the problems to be addressed.

Outfall construction and maintenance activities are regulated by the Practice for Outfall Structures on Water Bodies under the Provincial Water Act, which stipulates:

- written notice of any activities must be provided at least 14 days in advance of such activities, complete with supporting plans prepared by a Professional Engineer and specifications prepared by a qualified aquatic environment specialist,
- activities are prohibited within certain dates (April 16th to June 30th for the Sturgeon River, which is designated a "Class C" water body),
- there must be no damage to fish or habitat and or net loss in productive capacity as a result of these activities,
- erosion and sedimentation from the construction/maintenance activities must be controlled.

Outfall repairs should be coordinated with the sediment control program so that all of the work at each outfall is completed at the same time.

3.4 FOREST LAWN RAVINE

The Forest Lawn Ravine is a significant component of the existing stormwater conveyance system serving Campbell Park, Akinsdale and Forest Lawn areas. Flows enter an open channel approximately 2.4 m wide and 0.3 m deep, which lines the ravine bottom. Several smaller-diameter storm sewers enter the channel from the side. The outlet structure at the south end of the ravine has a cage structure which covers the large diameter outlet, and a smaller diameter line for lower flows (see Photo 3.6). A paved walkway roughly parallels the channel on the east side, at a range of elevations above the bed.



Photo 3.1 **Outfall #6 (in good condition)**



Photo 3.2 **Outfall #11 under park trail has been lined to repair pipe separation.**



Photo 3.3 **Outfall #14. Note erosion downstream of outfall.**



Photo 3.4 **Outfall #17A - requires repair to walkways and gabions.**



Photo 3.5 Outfall #19 - note drop at outfall.



Photo 3.6 **Forest Lawn Ravine inlet structure to storm sewer under Sir Winston Churchill Drive. Note erosion of left bank.**



Photo 3.7 Longitudinal cracking of concrete channel in Forest Lawn Ravine.



Photo 3.8 Lateral cracking and heaving of concrete channel in Forest Lawn Ravine.

The channel was constructed in 1973 and 1974, and has lasted reasonably well. There are numerous longitudinal cracks along the channel (Photo 3.7), and there are several localized areas where the concrete bottom has heaved or cracked more severely (Photo 3.8). It appears that the natural banks of the channel were armoured with concrete at several locations on the outside of bends. There are a number of areas where erosion is beginning to be noticeable above the channel sides and armouring. There is also some erosion in the vicinity of the outlet structure, as shown in Photo 3.6. In some spots it appears that water flowing in the channel could soak into the substructure through cracks or holes in the concrete.

Recently there has been some concern regarding the longevity of the concrete structure, and the impacts of a failure on the ravine. This resulted in an investigation into the current condition of the concrete structure of the channel and adjacent banks.

The preliminary investigation included visual inspections, field survey and limited geotechnical and materials testing.

The materials and geotechnical testing was carried out at five randomly selected locations along the alignment. Cores were drilled in the concrete, and boreholes were drilled into the underlying soils. In addition, a technique used to identify unsound sections in bridge decks was applied to attempt to isolate areas with significant voids underneath. The procedure involved dragging several lengths of chain along the concrete, which produces different sounds depending on the homogeneity of the material.

Results of the concrete testing indicate that the material has lasted quite well, generally with little deterioration. A void was observed between the concrete and the soils, ranging from 5 to 25 mm in depth. Water flow was also observed in the void, filling some of the drill holes. The subsurface material was found to be generally very wet. The combination of the voids and soil moisture could contribute to significant frost heaving, potentially accounting for the numerous longitudinal cracks. The chain-drag test was not conclusive, likely due to the shallow voids present under the concrete.

The existing ravine is considered to be a valuable amenity in the area. Many residents walk, jog, or cycle through the ravine, and it contains a wide variety of wildlife. The City wishes to minimize any impacts on the ravine during rehabilitation.

A number of remediation alternatives were considered for the Forest Lawn Ravine channel. They ranged from the “do nothing” option where the channel would continue to be monitored

without any immediate work, to removal of the existing concrete channel, to construction of a large diameter storm sewer pipe. The latter option would require significant disturbance to the ravine. Table 3.6 provides a summary of the options and costs (in 2004 dollars, including allowances of 15% for engineering and 40% for contingencies).

Table 3.6
Forest Lawn Ravine Rehabilitation Options

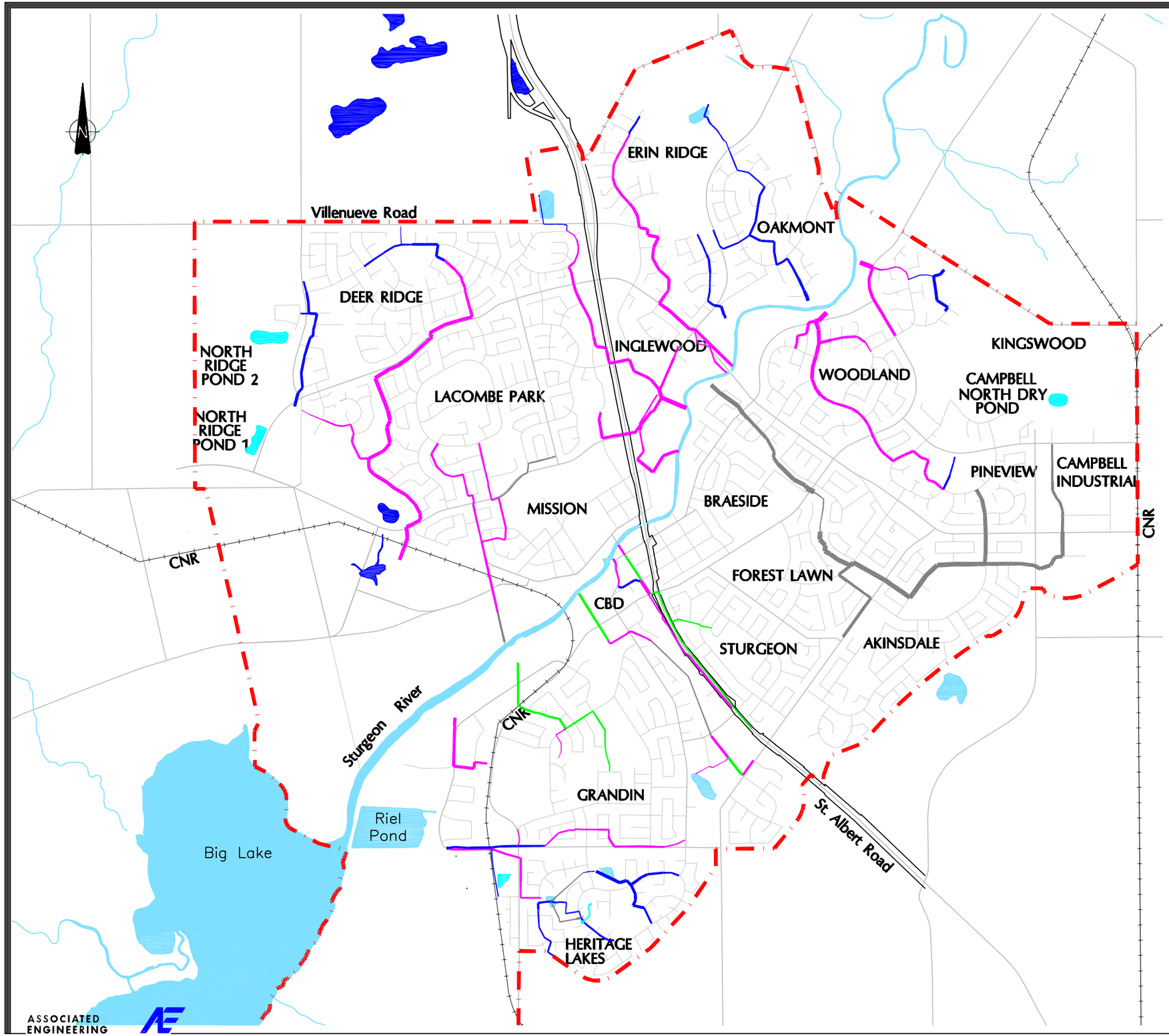
Option	Advantages	Disadvantages	Estimated Cost (2004 Dollars)
1. Crack Seal & Segmental Replacement	- Minimal disruption to ravine - Reduce percolation of water through cracks in concrete to subgrade below - Reduce frost heave	- Poor success record of achieving seal, in dry application conditions - Difficult to achieve in wet condition - Unsightly	$885,000
2. Surface Skin Coat	- Minimal disruption to ravine - Short term visual improvement	- Difficult to bond to existing concrete - Crack propagation from below likely - Delamination under high flow conditions likely, resulting in future repair & cleanup costs	$565,000
3. Elastomeric Membrane Coating	- Minimal disruption to ravine - Short term visual improvement	- Difficult to bond to existing concrete - Delamination under high flow conditions likely, resulting in future repair & cleanup costs	$483,000
4. Corrugated Metal Liner	- Minimal disruption to ravine	- Difficult to bond to existing concrete - Delamination under high flow conditions likely, resulting in future repair & cleanup costs	$565,000
5. Precast Concrete Liner	- Minimal disruption to Ravine	- Anchorage to existing concrete of limited value - Delamination under high flow conditions likely, resulting in future repair and cleanup costs	$805,000

Option	Advantages	Disadvantages	Estimated Cost (2004 Dollars)
6. 2,400 x 1,800mm Box Culvert	- Keeps major flows contained and out of sight - Allows for redevelopment of ravine above the box culvert	- Expensive - Major disruption to existing Ravine above the box culvert - Extra cost likely to be encountered during construction due to weak, wet subsoil	$1,700,000
7. 2,100 mm Diameter Concrete Pipe	- Keeps major flows contained and out of sight - Allows for redevelopment of ravine above the pipe	- Expensive - Major disruption to ravine - Requires redevelopment of ravine above the pipe - Extra cost likely to be encountered during construction due to weak wet subsoil	$2,400,000
8. Pond Storage	- Surge attenuation for downstream storm sewers	- Limited space available for ponds - Major disruption to existing ravine - Potential to raise groundwater in the ravine and potential adverse effects to adjacent dwellings	Not Estimated
9. Rip-Rap	- More natural look - Disruption limited to extent of rip-rap area - Ravine usage similar to existing	- Disruption during construction - Large size of rip-rap to resist high flows	$1,600,000
10. Gabion Mat	- Smaller size of stones - Disruption limited to extent of gabion mat area - Ravine usage similar to existing - Potential to blend in vegetation to provide natural look	- Disruption during construction	$1,300,000

Option 10, incorporating gabion mats on the existing concrete channel, was viewed to be an approach that could provide a flow channel capable of conveying significant volumes of stormwater while maintaining the natural qualities of the area.

Based on the generally sound condition of the concrete, a pilot project is proposed which involves upgrading localized areas which are in the worst condition. The damaged concrete and a shallow depth of subsoil will be removed and replaced with granular material for a base, and new concrete base and walls. This will continue to permit the substructure flow to continue, and will prevent it from pooling and potentially increasing frost heaving. In addition, gabion baskets or mats will be installed on the bank in areas where the effects of erosion are beginning to show, including the area of the downstream outlet structure. The preliminary cost estimate for this work is estimated is $400,000, including contingency and engineering (in 2004 dollars).

The effectiveness and suitability of this approach will be assessed, and a determination made whether to refine or continue with the rehabilitation. This phased approach will give the opportunity to deal with the worst areas, and ensure that the optimum solution is selected for full implementation.



THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

PIPE INSTALLATION DATE

LEGEND:

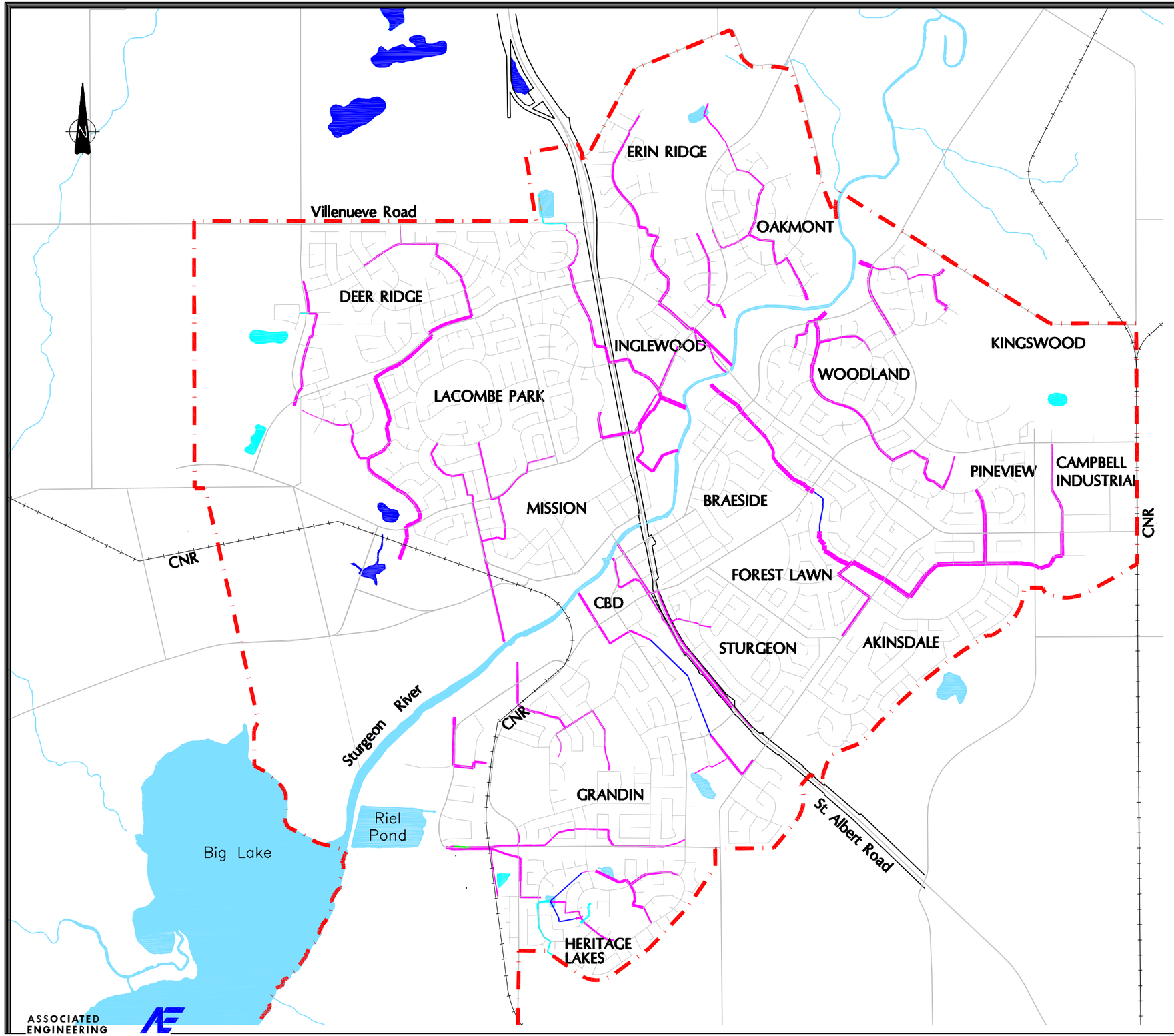
- 1950-1970
- 1970-1990
- SINCE 1990
- UNKNOWN
- CITY BOUNDARY

SCALE : 1 : 30,000

JULY, 2004

FIGURE 3.1

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ASSOCIATED ENGINEERING

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Date: 2004/7/14
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Xrefs: ARTERIAL CITY BOUNDARY, RIVERS_2.1, BOUNDARY, plan, 3265rt02, material

THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

PIPE TYPE

LEGEND:

- CMP
- CONCRETE
- CHANNEL
- CITY BOUNDARY

SCALE : 1 : 30,000

JULY, 2004

FIGURE 3.2

THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

OUTFALL LOCATIONS

LEGEND:

CROSS SECTION

YEAR 1975

YEAR 1986

YEAR 2003

DESIGNATED FLOODPLAIN

OUTFALL NUMBER 05

SCALE : N.T.S

JULY, 2004

FIGURE 3.3a

ASSOCIATED ENGINEERING

SAMENG

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Plot Scale: 1=1 (Paper Space)
Plot Style: Monochrome.ctb
Xrefs: 3285r102

THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

OUTFALL LOCATIONS

LEGEND:

CROSS SECTION

YEAR 1975

YEAR 1986

YEAR 2003

DESIGNATED FLOODPLAIN

OUTFALL NUMBER 15

SCALE : 1 : 6250

JULY, 2004

ASSOCIATED ENGINEERING

SAMENG

FIGURE 3.3b

THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

OUTFALL LOCATIONS

LEGEND:

CROSS SECTION

YEAR 1975	
YEAR 1986	
YEAR 2003	
DESIGNATED FLOODPLAIN	
OUTFALL NUMBER	21

SCALE : 1 : 6250

JULY, 2004

FIGURE 3.3c

ASSOCIATED ENGINEERING

SAMENG

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Date: 2004/7/14
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Xrefs: 32834102

SEDIMENTATION

SECTION 4

4.1 BACKGROUND

This section provides a summary of the work carried out by Sameng in the report "Sturgeon River Sedimentation Assessment." Sedimentation has been identified as a concern in the Sturgeon River. Previous studies carried out in 1975 and 1990 provide a baseline for assessment of changes in the river bottom elevations due to sedimentation.

Sediment deposition has occurred throughout the Sturgeon River within St. Albert, but is most apparent near storm sewer outfalls where the deposits are visible above water level during low flow conditions. Photos 4.1 and 4.2 illustrate the deposition at the storm sewer outfalls.

In 1975, Alberta Environment produced the report titled, "Floodplain Study - Sturgeon River through St. Albert." The study provided flood maps up to the 1:100 year return period, and documented the 1974 flood. Sixteen cross sections of the river were surveyed for use in the HEC-2 river modelling program.

In 1990, Alberta Environment prepared the "St. Albert Floodplain Study." The study also used the HEC-2 model, and provided updated flood maps. The report represented conditions up to 1986, and included 24 surveyed cross-sections. Only 7 of the cross-section locations coincided with those done in 1974. The report incorporated new areas affected by St. Albert's expansion, and reflected physical changes in the river up to 1986.

Each of the 24 cross-sections surveyed by Sameng covered at least one previously surveyed in 1974 or 1986. This study also mapped some of the more significant sediment deposits. Figures 3.3a to 3.3c illustrate the locations of current and previous surveys. The new cross-sections were used to update the Sturgeon River backwater model and to estimate the impact that sedimentation may have on flood levels.

4.2 ASSESSMENT

Figure 4.1 is a longitudinal profile showing the channel bottom (invert) in 1986 and 2003 as well as the computed water surface profiles for floods up to the 1:100 year event. Comparison of the survey results show that there has been a general tendency of aggradation in the river bed over time. This trend is apparent throughout the city, but not at the upstream or downstream sections. Between 1986 and 2003, the aggradation ranges from 0 m to 0.66



Photo 4.1 **Sediment deposits at storm sewer outfall #6, upstream of Peron Street Bridge, looking downstream.**



Photo 4.2 **Sediment accumulation across the Sturgeon River at Outfall #7, at the footbridge northwest of City Hall. Direction of flow is from right to left.**

m, with an average depth of 0.27 m between 1 km from Big Lake to the downstream city limits. This translates into a total accumulation of about 16,000 m^3, over the 17 year period, or an average rate of 950 m^3 per year (the equivalent of approximately 150 tandem dump trucks). Averaged over the area of St. Albert, this is a rate of about 0.5 m^3/ha/yr.

A number of potential sources of sediment exist. Upstream sources include agricultural related soil erosion, channel erosion, silt from urban and transportation activities, and winter road sanding programs. However, Big Lake removes the majority of the sediments from upstream inflows. The low velocities in the lake make it unlikely that a significant amount of upstream sediment is carried downstream in the Sturgeon River. Therefore, it is likely that the sediment observed in the river is the result of activities with the City.

The potential for erosion to contribute to sedimentation is considered to be minimal. A review of aerial photographs from the two previous studies, and those obtained during this work, does not show any significant erosion, and the banks are typically well protected with vegetation. Some localized bank slippage was noted, however, but the amount of sediment generated was considered to be small.

Inspections along the river show significant deposition at most storm sewer outfalls. The sediments contain a large amount of sand-sized particles, which could be attributed to two sources:

- winter roadway sanding
- soil erosion from bare ground or from construction activities

In 2003, the City installed a hydrocarbon and grit separator on a storm sewer in the downtown area. The sewer serves approximately 10.7 ha, and over the first year of operation, it appears that about 1 m^3/ha of grit was captured in the facility. Allowing for the accuracy of the estimates, this is comparable to the rate of accumulation that has been experienced in the river.

The hydraulic modelling of the river indicates that from 1986 to 2003 the water levels have increased marginally at 3 locations as a result of sedimentation in the channel. These results and projections for future accumulations are presented in Table 4.1.

Table 4.1
Impact of Sediment Accumulations
on the 1:100 Year Flood Elevation

Location	1986 - 2003	2003 - future
Big Lake Outlet	0.10 m	0.14 m
St. Albert Trail	0.08 m	0.13 m
Downstream Limit	0.0 m	0.0 m

These results indicate that the sediment deposits have caused flood levels in Big Lake to rise by about 0.1 m since 1986, and that a further rise of about 0.15 m over the next 25 years is possible if the sediment accumulations are allowed to continue.

4.3 PROPOSED SEDIMENT CONTROL PLAN

In order to provide a strategic plan to address the sediment removal from the storm sewers, all outlets were assessed according to the following factors:

- observable sediment deposition
- magnitude of flows
- location relative to sediment problems
- most efficient type of treatment available

Sediment deposits at the outlets were rated from very significant to not observable. Larger diameter outlets were rated higher. The area between the CN and Boudreau bridge has the largest sediment accumulation and is considered the problem area. The outlets that discharge in this area are therefore rated higher as they contribute to these problem areas.

Based on these factors the outlets were rated as follows:

- High Priority (A) - these outlets are contributing significant sediments to problem areas
- Medium Priority (B) - these outlets may be contributing smaller volumes to problem areas or larger volumes to non problem areas
- Low Priority (C) - these are contributing small volumes
- No Priority (D) - no work recommended without further review

A treatment was recommended for each outlet consisting of either in-line separators or settling ponds, depending on the availability of space to install works. Pricing graphs were developed based on conceptual level designs for the large and small installations. These costs were based on the following assumptions:

- the flow is proportional to the outlet diameter
- there are no land costs
- there are no significant utility issues (pipelines, etc.)
- there are no site specific problems (soil conditions, disturbance, reclamation costs, or accessibility issues)

Figure 4.2 provides the conceptual cost estimation graphs for settling ponds and in-line separators. These graphs show that in-line separators are more expensive than settling ponds for outfalls larger than about 900 mm.

Sameng estimated the cost estimate accuracy to be in the order of +/-30%.

It is not clear without further study what impacts (positive or negative) the development of settling ponds within the floodplain may have on fish and wildlife. Therefore, the budget item for fisheries mitigation is tentative and will require further study. Table 4.2 provides a summary of the assigned priority and cost of constructing a sediment separator at each storm outfall.

The total estimated cost for these recommendations is $10.4 million.

The high priority (A) outfalls have been identified as:

Outfall 7 Located on the south bank just upstream of a pedestrian bridge in a park, it drains a combination of industrial and residential areas (see Figure 3.3 for location). There is obvious sediment build up at this location and it forms a barrier most of the way across the river. The current outlet location does not allow for a settling pond and therefore an on-line separator is recommended. It may be a possible to install a settling pond further back if it could be adequately incorporated into the park design. The cost has been estimated at $467,000, including engineering and fisheries mitigation.

TABLE 4.2
SEDIMENT CONTROL PLAN - COST ESTIMATES

Outlet	Rating	Proposed Work	Size (mm)	Estimated Cost	Comments
7	A	Separator/POND	1050	$ 467,000	
11	A	Separator	900	$ 365,000	
10	A	Separator	1200	$ 577,000	
8	A	Separator (2)	1800	$ 1,096,000	
17	A	POND	1650	$ 572,000	
Sub-total Priority A Sites				**$ 3,077,000**	
4	B	POND (Relocate Outlet)	900	$ 312,000	
5	B	POND	750+900	$ 451,000	
6	B	Separator	750	$ 274,000	Review Drainage Basin
6B	B	Separator	750	$ 274,000	
11C	B	Separator	900	$ 365,000	
11D	B	Separator/POND	1200	$ 577,000	Investigate Combining with 11C
13	B	Separator	525	$ 156,000	
15	B	Separator/POND	600	$ 192,000	
8B	B	POND	750	$ 260,000	Investigate Combining with 12
12	B	POND	1200	$ 416,000	
16	B	POND	1200	$ 416,000	
19	B	Separator/POND	1825	$ 1,121,000	
21	B	Separator/POND	1800	$ 1,096,000	
Sub-total Priority B Sites				**$ 5,910,000**	
3	C	POND	1350	$ 468,000	
6C	C	Separator	375	$ 91,000	
8A	C	Separator	525	$ 156,000	
14	C	POND	1050	$ 364,000	
16A	C	POND	600+600	$ 347,000	
Sub-total Priority C Sites				**$ 1,426,000**	
4A	D	NA	600	$ -	
4B	D	NA	600	$ -	
11A	D	NA	300	$ -	
6A	D	NA	300	$ -	
11B	D	NA	300	$ -	
15A	D	NA	300	$ -	
17A	D	NA	300	$ -	
17A	D	NA	300	$ -	
9		Installed Separator in 2003	900	$ -	
Grand Total				**$ 10,413,000**	

Note: Cost estimates include fisheries mitigation (5%), contingencies (25%), and engineering (20%)

Outlet 11 Located on the south bank just upstream of the Perron St. Bridge, Outlet 11 drains a combination of commercial and Highway 2 areas. There is obvious sediment build up under the bridge. The current outlet location does not allow for a settling pond and therefore an in-line separator is recommended. The cost has been estimated at $365,000.

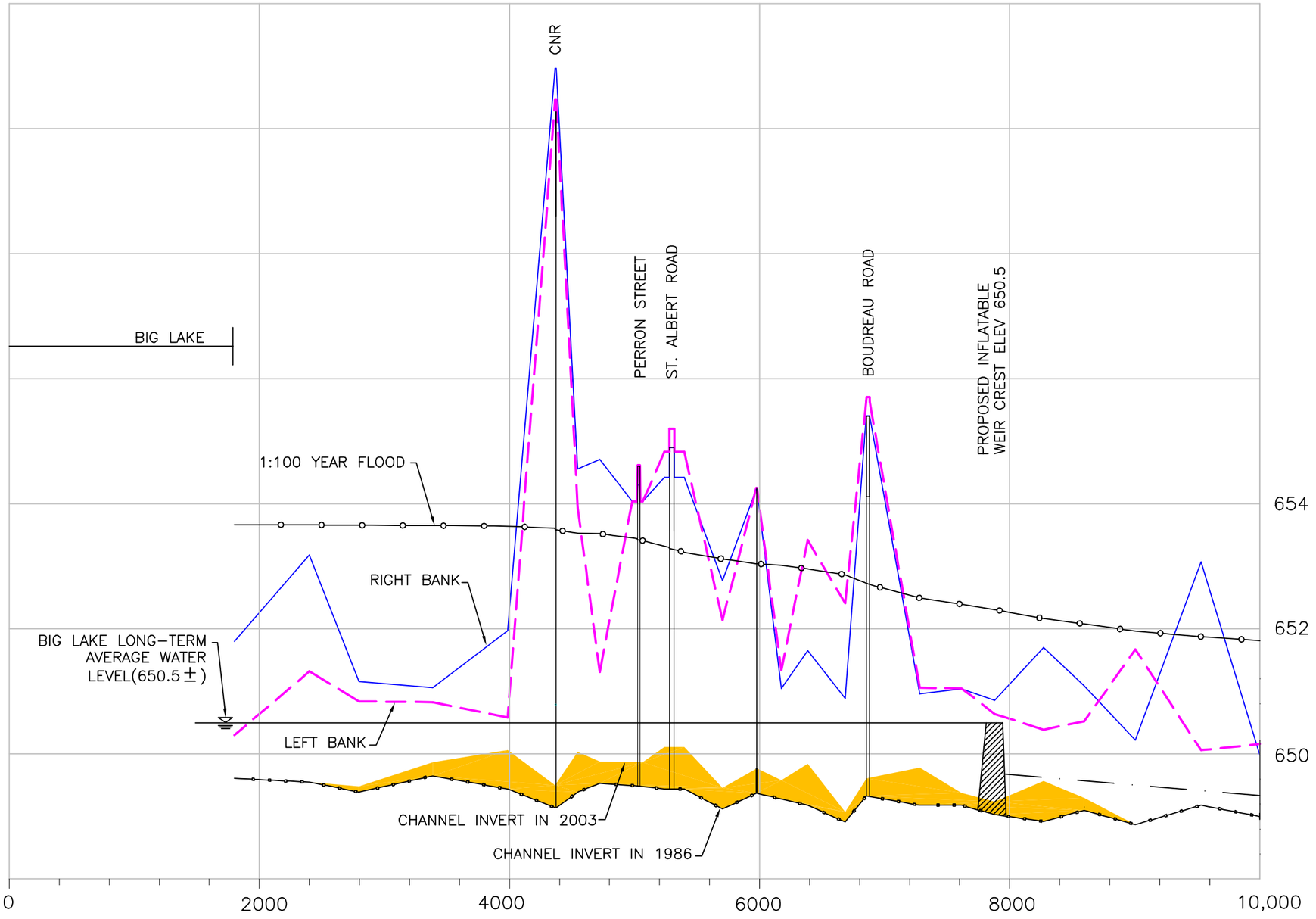
Outlet 10 Located on the north bank just south of St. Albert Center Mall, the outlet drains primarily commercial areas. There is obvious sediment build up in the river at this location. The current outlet location does not allow for a settling pond and therefore an in-line separator is recommended. The cost has been estimated at $577,000.

Outlet 8 Located on the north bank just east of St. Albert Center Mall, this outlet drains a combination of highway, commercial and residential areas. There is obvious sediment build up extending almost completely across the river at this location. The current outlet location does not allow for a settling pond and therefore an in-line separator is recommended. Conceptual investigation should consider whether it would be best to build several smaller separators. The cost has been estimated at $1,096,000.

Outlet 17 Located on the south bank about 200 m upstream of the Boudreau Road bridge, this outlet drains a very large residential area and some industrial areas. There is obvious sediment build up in the river at this location. A settling pond downstream of the outfall is recommended. The cost has been estimated at $572,000.

The total estimated cost for these high priority outfalls is $3.1 million including mitigation and engineering.

Initial investigations into the Priority A projects should be undertaken with the intention of completing them as quickly as budget constraints will allow.



THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

STURGEON RIVER SILTATION AND FLOOD PROFILES FOR CONDITIONS IN 2003

SCALE : N.T.S

JULY, 2004

ASSOCIATED ENGINEERING

AMEC

FIGURE 4.1

Time: 13:12
Date: 2004/9/29
Plot Scale: 1:1 (Paper Space)
AutoCAD File: 023285\REPORT\MARCH\3285-FIG_4.1.DWG (SC)
Xrefs: 3285rb2

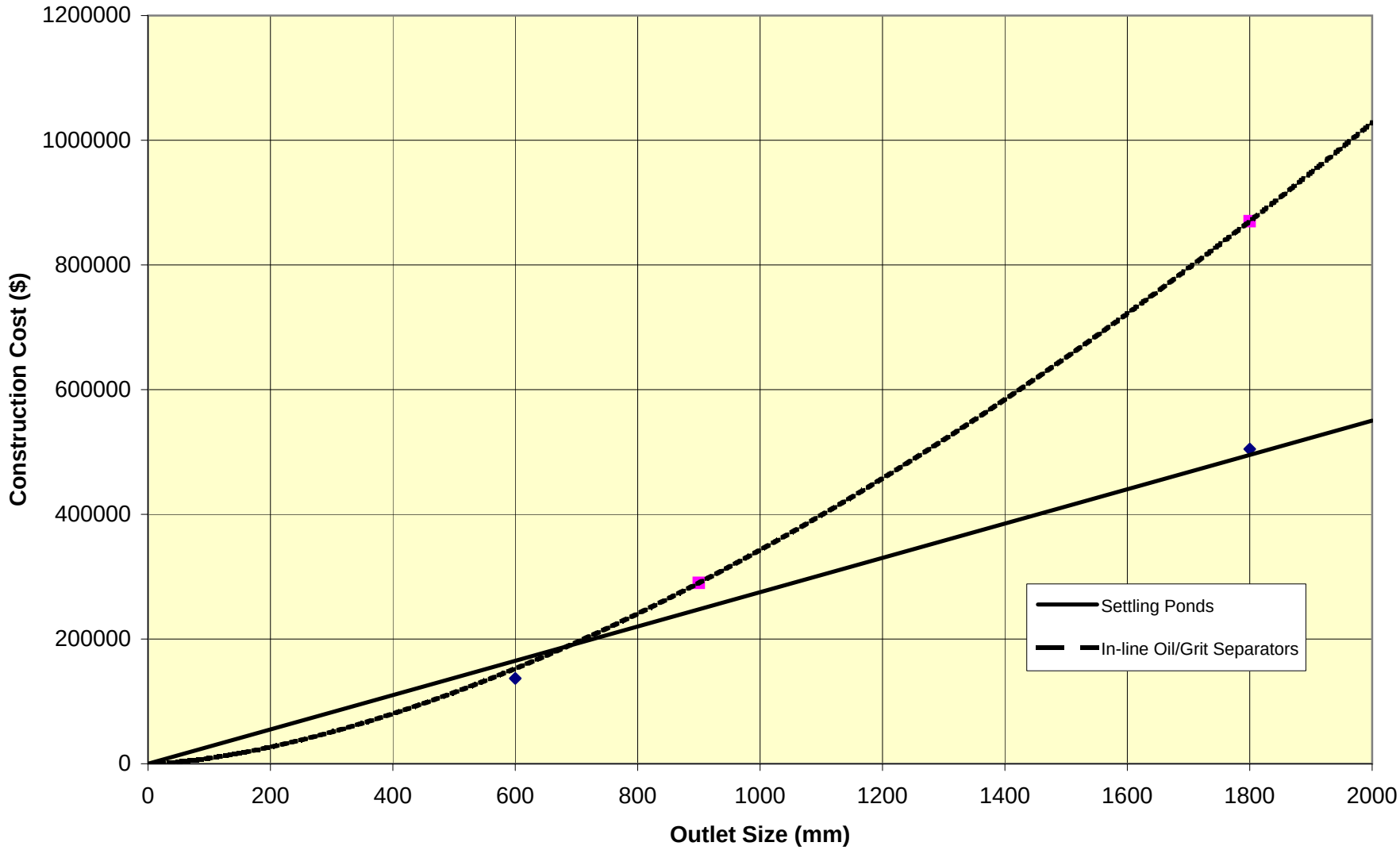


FIGURE 4.2

CONCEPTUAL COST ESTIMATION GRAPH FOR SEDIMENT SEPARATORS

Sediment Works Ponds Graph

GEOTECHNICAL

SECTION 5

The following describes the general geological and hydrogeological conditions of the existing City of St. Albert and IDP area in terms of:

- geology
- area topography and subsurface conditions
- geotechnical constraints on typical stormwater management facility construction

The information provided is an overview of the report, "City of St. Albert Stormwater Management Regional Master Plan - Preliminary Geotechnical Assessment," prepared by Thurber Engineering Ltd. in 2003. It represents a desktop review of 34 separate geotechnical reports prepared for development and construction projects, primarily within the current City boundaries. Surficial and hydrogeological maps, and stereo aerial photos for the study area were also reviewed.

The information provided herein gives an overall view of the general soil conditions in the City and may not represent local conditions.

5.1 BEDROCK GEOLOGY

Across the study area, the local bedrock generally slopes from north to south. It generally consists of sandstone, mudstone and shale.

Three tributary pre-glacial valleys exist in the area (Figure 5.1):

- the Beverly Valley running eastward through the southern portion of the area and Big Lake
- the Onoway Valley running southeasterly and joining the Beverly Valley
- the Sturgeon Valley, running southwesterly, until it joins the Beverly Valley.

These valleys were carved into the bedrock in pre-glacial times, and were then infilled with glacial till, sand, and lake deposits. Later, a glacial lake covered the area, and during glacial retreat, melt water eroded a deep channel, the present Sturgeon Valley, which over time was infilled with silts and sands.

5.2 SURFICIAL GEOLOGY

Figure 5.1 shows the distribution of near-surface soils in St. Albert. The study area surficial geology can be broadly defined in four units:

- Silts, clays and sands resulting from alluvial activity:
  - areas along the Sturgeon River in the eastern portion of St. Albert
  - low lying topography adjacent to the Sturgeon River

- Sands and silty sands resulting from glacial activity:
  - areas generally adjacent to the Sturgeon River, outside the alluvial deposits
  - topography generally slopes up from the river to the higher flatlands

- Silts and clays resulting from glacial activity:
  - covers the majority of the area
  - generally flat topography

- Lake and slough deposits resulting from alluvial activity:
  - primarily in the area of Big Lake, however smaller deposits are found throughout the area
  - topography is generally flat

5.3 SUBSURFACE CONDITIONS

A review of existing geotechnical boreholes provides an overview of soil stratigraphy in the area. The data is generally limited to the existing city lands, with the exception of one study carried out in a country-residential area northeast of the IDP boundary. The soil stratigraphy generally consists of (in descending order) of clay, silt, clay till, sand/gravel (near the Sturgeon River), and bedrock. Brief descriptions of the individual strata are presented in Table 5.1

Table 5.1
Soil Stratigraphy

STRATA	DESCRIPTION
Topsoil, Peat and/or Fill	• topsoil thickness ranging from 0.05 m to 0.4 m; • peat up to 0.5 m in the Sturgeon River floodplain; • fill up to 4 m to 5 m in the downtown area adjacent to the river; and greater than 6 m in the old landfill location.
Lacustrine Clay and Silt	• generally below the fill/topsoil/peat areas; • medium to high plastic clay, grading into silty clay or silt at depth; • clay layer generally 0 to 10 m depth; silt generally 2 to 8 m depth, with some locations adjacent to Sturgeon River extending to 20 m below ground surface; • geological mapping indicates this strata ranges from 6 m thickness from the northwest, to as much as 30 m at the south and east study boundaries; • some water bearing silt and sand layers were encountered in some boreholes.
Clay Till	• encountered below the lacustrine materials in boreholes outside river valley and Big Lake; • observed thickness from 1 to more than 5 m, at depths of 6 to 8 m below ground level; • geological mapping indicates thicknesses increasing from 6 m in the north to 30 m at the south of the study area.
Sand	• a deep sand deposit was observed at depths of 15 to 20 m in test holes in the Sturgeon River valley (north of Sturgeon River, along St. Albert Road); • extended to 64 m, underlain by 11 m of gravel in 1 test hole; • at the south edge of the study area, sand was encountered at a few locations at depths of 9 to 12 m, with one area in the southwest showing deposits within the top 5 m.
Bedrock	• in the available test holes, bedrock was observed as high as 6.5 to 8.5 m depth in some areas in the north of the city, to depths of 77 m at the same location as the deep sand layer noted above.

Figure 5.2 shows the generalized soil stratigraphy along the northward projection of 184th Street, through the Riel Industrial area on the south side of the river and Lacombe Park on the north.

There were no areas of large-scale instability noted during the studies, however, the meandering nature of the Sturgeon River lends itself to erosion and localized slumping along the outside bends.

5.4 GROUNDWATER

The three pre-glacial valleys have an important impact on the groundwater regimes in the area. The valleys can provide large quantities of water from a bedrock aquifer, the top of which is approximately 25 to 30 m below the current Sturgeon River valley.

In the vicinity of Big Lake and the Sturgeon River Valley, groundwater can be expected to flow upward, in a discharge condition. In areas away from the buried bedrock valleys, groundwater flow is downward, and near horizontal near the streams and river valleys.

Perched groundwater is common, at varying elevations, in sandy zones within clay and clayey till units.

Available geotechnical reports typically include water level measurements at drill hole completion, with some measurements in open standpipes taken at variable times after completion. The depth to groundwater ranges from 0.7 m to 12 m, with some dry holes recorded. The groundwater levels across the area are variable, and it is likely that local conditions are dependent on the presence of water bearing soils or localized perched water tables.

Limited monitoring information after drilling is available to evaluate stabilized groundwater levels. It is also noted that groundwater levels vary seasonally and may be higher following periods of high precipitation.

5.5 GEOTECHNICAL CONSTRAINTS ON CONSTRUCTION

The existing reports and available data indicate that the soil conditions can vary considerably throughout the area. Excavation for trenching and stormwater management ponds in the City, and within the IDP area is expected to vary, with poor conditions possible in some areas.

The area in the vicinity of Big Lake is generally expected to exhibit weak and wet soil conditions resulting in difficult construction conditions, even at shallow depths. In the

Sturgeon River valley floodplain excavation is likely to be feasible, but will be more difficult in deeper trenches.

The uplands, which include most of the future development areas, are anticipated to be generally more favourable with the exception of some localized variations where less desirable soil conditions are encountered.

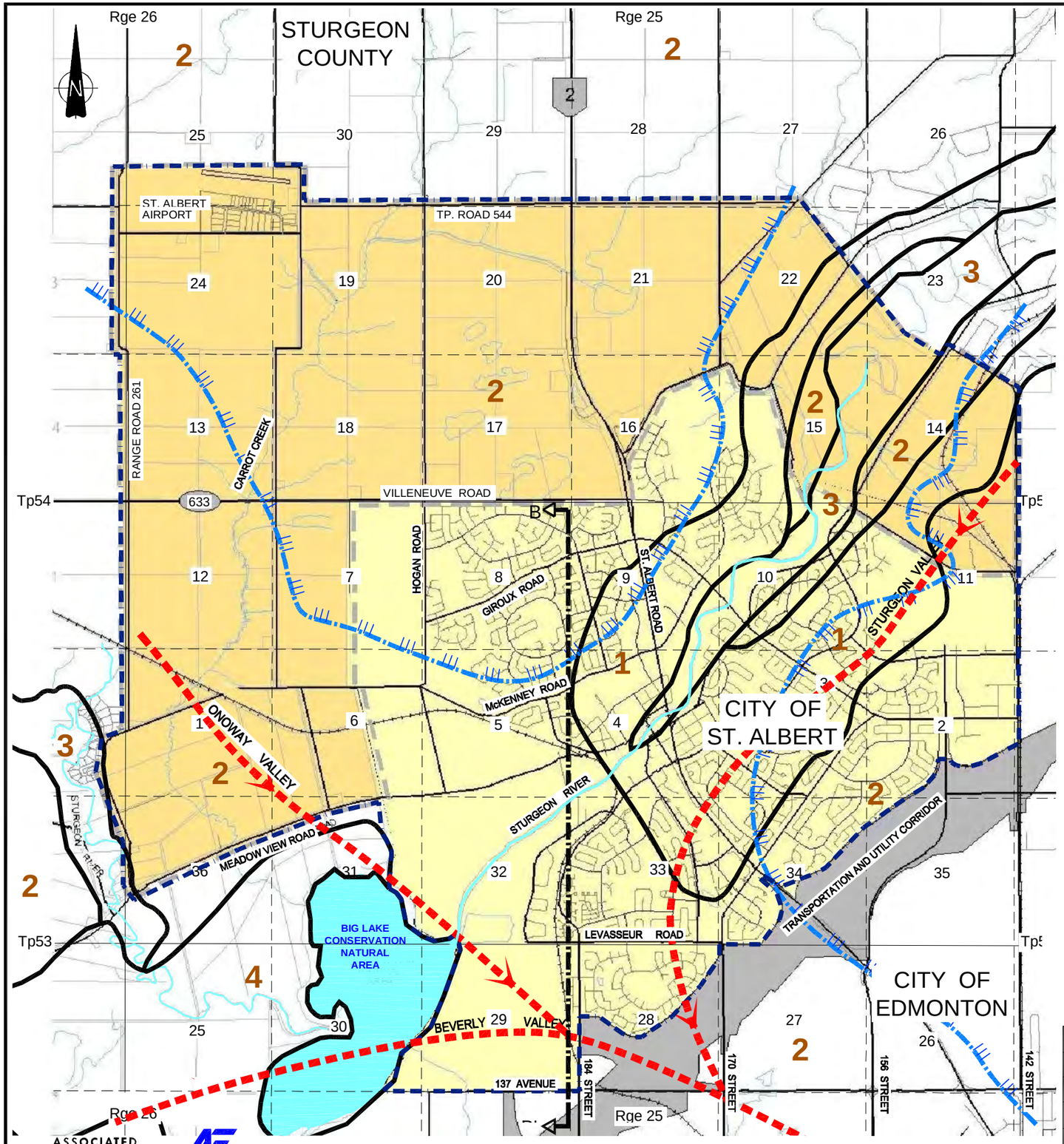
Generally, typical open trench construction practices are expected to be suitable in most areas. This may require flatter than normal trench side slopes in locations where pervious sand layers are encountered within the pipe trench area. Trench drainage and dewatering can most likely be accomplished with normal procedures. However, if excavations extend into sand layers below water table, well points or other means may be required for dewatering. Groundwater seepage is expected in trenches and in excavations remaining open for some time.

No tunnelling-specific investigations have been carried out in the area. However, the variability in local soil conditions may make tunnelling or micro-tunnelling difficult.

Construction of stormwater management (SWM) ponds or lakes will be influenced by local conditions. Available information indicates that ponds to depths of 3 to 5 m would be situated in suitable materials. However, if sand or silt is encountered, over-excavation and replacement with suitable clay will be required. It is expected that local materials in the upper portions of the clay and clay tills will be acceptable for pond liners. Groundwater levels must also be considered in the design of SWM facilities. Detailed geotechnical investigations will be required for SWM facility design.

5.6 EROSION

Location erosion has been observed at places, mostly where the Sturgeon River impinges on the outside bank in channel bends. This appears to be a minor problem that can be addressed as required, on a site-specific basis. Some erosion has been observed in Braeside Ravine and requires local armouring with gabions as described earlier.



LEGEND

- INTERMUNICIPAL DEVELOPMENT PLAN AREA
- CITY OF ST. ALBERT
- BOUNDARIES (APPROXIMATE) BETWEEN BEDROCK AND SURFICIAL AQUIFERS (TICK MARKS ARE ON THE BEDROCK SIDE)
- THALWEG, BEDROCK VALLEYS
- PROJECT BOUNDARY

1	GLACIOLACUSTRINE, SAND, SILTY SAND WITH MINOR SILT AND CLAY, MINOR POCKETS OF COARSE SAND AND GRAVEL
2	GLACIOLACUSTRINE SILT AND CLAY; BEDDED SILT AND CLAY WITH MINOR SAND
3	ALLUVIAL DEPOSITS: SILT, CLAY, AND SAND, ALONG SMALL STREAM
4	ALLUVIAL DEPOSITS: LAKE AND SLOUGH DEPOSITS, SILT, CLAY, ORGANIC MUCK AND MARL

B — B GEOLOGICAL CROSS-SECTION

0 500 1000 1500 2000 2500 3000m

SCALE 1:50000

FIGURE 5.1

ENGINEER	DMB
DRAWN	MNG
DATE	DEC. 2002
APPROVED	
SCALE	1:50000

ASSOCIATED ENGINEERING ALBERTA LTD.

SITE PLAN SHOWING SURFICIAL GEOLOGY, THALWEGS AND BURIED BEDROCK VALLEYS

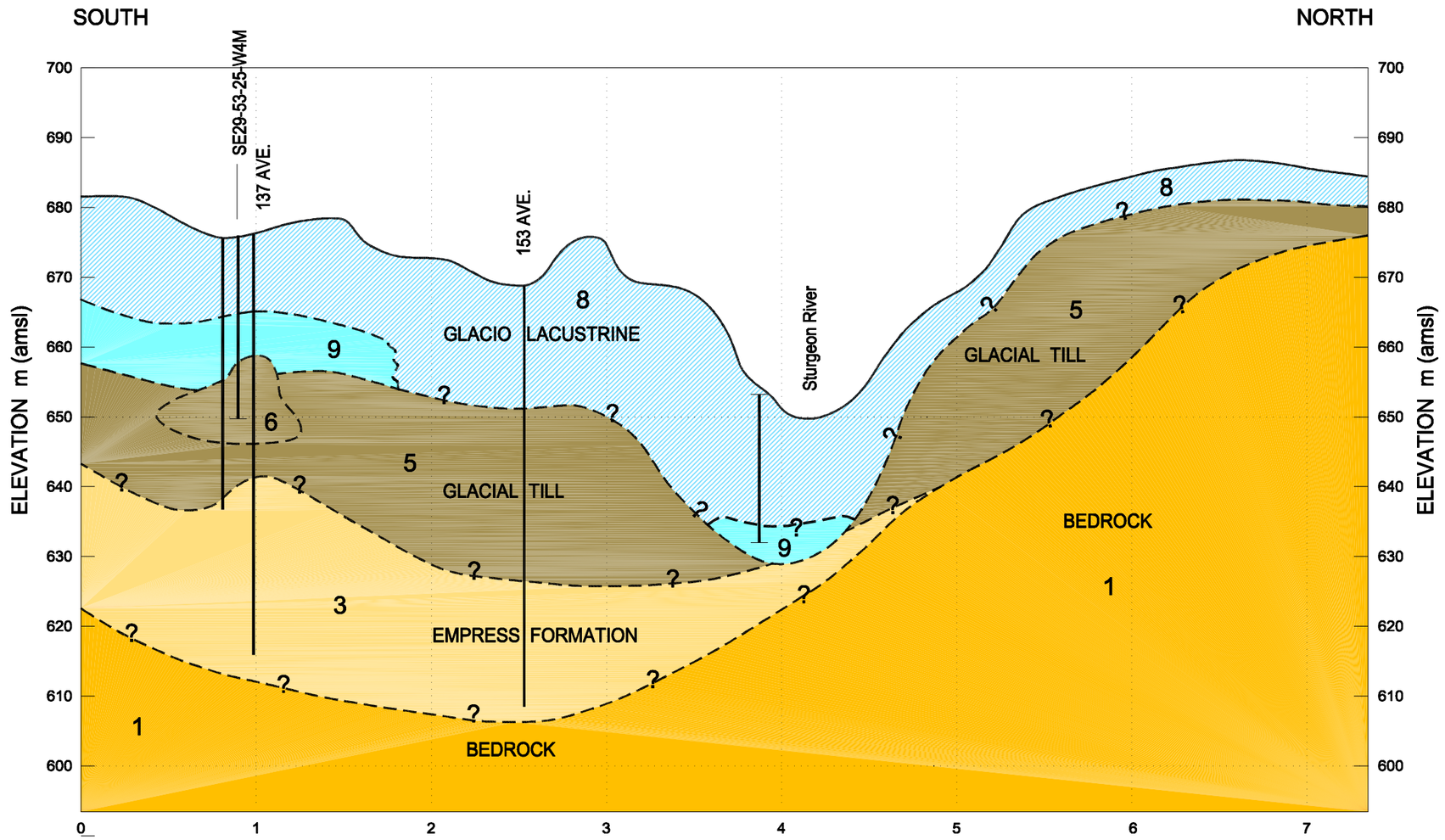
CITY OF ST. ALBERT
STORMWATER MANAGEMENT P.M.P.

THURBER

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ASSOCIATED ENGINEERING

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Date: 2004/7/9
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SCHEMATIC CROSS-SECTION

FROM FIGURE 26. GEOLOGICAL CROSS-SECTIONS, ALBERTA RESEARCH COUNCIL BULLETIN 32

FIGURE 5.2

LEGEND

1	BEDROCK
3	EMPRESS FORMATION (SAND AND GRAVEL)
5	GLACIAL TILL
6	GLACIAL SAND AND GRAVEL
8	GLACIO LACUSTRINE SANDS, SILTS AND CLAYS
9	GLACIO LACUSTRINE FINE SAND AND SILT
?	INFERRED BOUNDARY BETWEEN STRATIGRAPHIC UNITS (FOR ILLUSTRATION ONLY - MAY NOT BE ACCURATE)

ASSOCIATED ENGINEERING

ENGINEER	DMB
DRAWN	MNG
DATE	DEC. 2002
APPROVED	
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ASSOCIATED ENGINEERING ALBERTA LTD.

SCHEMATIC CROSS-SECTION B - B'

CITY OF ST. ALBERT
STORMWATER MANAGEMENT PLAN

THURBER

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AQUATIC AND TERRESTRIAL RESOURCES

SECTION 6

6.1 AREA CHARACTERISTICS

The aquatic and terrestrial resources with the City of St. Albert and surrounding area were investigated as a component of the stormwater master plan. This section provides a summary of the report entitled "Aquatic Biology and Habitat Assessment."

The City of St. Albert is situated within the North Saskatchewan River Basin, in the Central Parkland Subregion of the Parkland Region. The area around the city is characterized as closed aspen forest, however less than 5% of the area remains a natural habitat, with most having been cleared for cropland and livestock. The remaining natural vegetation is generally found in wetlands, along streams and in local aspen stands.

The area contains numerous wetlands, and the Big Lake area is the largest. This on-stream lake is located west of St. Albert on the Sturgeon River. It has a contributing area of 2188 $km^{2.}$ Carrot Creek is a smaller watercourse that drains into Big Lake from the north. Both the Sturgeon River and Carrot Creek are classified as Class C waterbodies (i.e. the habitats can support fish populations). Alberta has established a restricted activity period on both streams from April 16 to June 30 to protect local fish populations during sensitive periods.

6.2 FISHERIES

The Sturgeon River downstream of Big Lake is a relatively poor fish habitat, however, as many as fifteen native species of fish occur within the stream. In observations between 1971 and 2003, eight species were identified.

In the fall of 2002, a large number of fish were trapped in a ponded area near Perron Street. Alberta Environment was notified, and they transported a large number of fish and released them into the North Saskatchewan River. This occurrence attests to the presence of fish in the Big Lake and the Sturgeon River.

Big Lake is an atrophic lake, with an average depth of 1 m to 1.5 m, although there are sections up to 2.5 m deep. It is fed by Atim Creek, Sturgeon River, and Carrot Creek. The same fish species identified in the downstream Sturgeon River could potentially be expected in Big Lake, however, the lake has been rated as poor for sport fish species.

Little information is available relating to the fisheries in Carrot Creek. In a study carried out in October 2003, fathead minnows and brook stickleback were observed. There is a great deal of variability in the habitat along the creek, but the fish habitat is generally poor.

6.3 VEGETATION

Eight main vegetation communities have been identified in the area: aspen forest, balsam poplar forest, white spruce forest, willow-sedge, bulrush-cattail, and open water. There are few documented rare plant communities or plants in the area. White spruce forests are uncommon in the area, and one large stand is located on west of St. Albert on the north side of the Sturgeon River. Three rare plant species and seven rare moss species have been identified in previous studies in the vicinity of Big Lake and the Sturgeon River. There is no documented record of any rare species along Carrot Creek, however, there is a potential for them to occur.

6.4 WILDLIFE

White-tailed deer, mule deer, moose, and grey wolves have been identified in the area, and have been observed within the city. Coyotes are the most abundant carnivore in the area, although the potential exists for red fox, weasels and mink to habitat the area. The Sturgeon River and Big Lake area have many beavers, muskrats, and several species of voles and mice, and snowshoe hares. The area also contains habitat that is suitable for bats, skunks, porcupines, woodchucks, Richardson's ground squirrels, pocket gophers, and badgers.

6.5 BIRDS

Over 200 species of birds have been recorded by the Big Lake Environmental Support Society (BLESS) in the vicinity of Big Lake. These include twenty two species of raptors, upland game birds, twenty five species of waterfowl, and shorebirds.

6.6 AMPHIBIANS AND REPTILES

Chorus frogs, wood frogs, salamanders and Canadian toads are likely to exist in the area, however, a decline in toads has been observed. Red-sided and plains garter snakes can also be expected in the area.

6.7 SPECIES OF CONCERN

Over 30 *Species of Concern* - identified by Alberta Environment and the Committee on the Status of Endangered Wildlife in Canada may exist in the area. Table 6.2 lists these species.

6.8 ENVIRONMENTALLY SIGNIFICANT/SENSITIVE NATURAL AREAS

Big Lake and River Lot 56 are two environmentally significant areas. In addition, 51 environmentally sensitive areas and 28 significant natural areas have been identified within the existing City boundaries.

6.9 NATURAL AREA MANAGEMENT

6.9.1 Proposed Policies

The floodplains of the Sturgeon River, Big Lake, and Carrot Creek are important natural areas within and near St Albert. Previous documents provide a policy framework for the development of parks and open spaces in St Albert:

- Red Willow Urban Park Master Plan (1988 & 1991)
- St. Albert Open Spaces Standards (1994)
- St. Albert Natural Areas Review & Inventory (1999)
- City Plan St. Albert: Municipal Development Plan Bylaw 4/2000 (2000)
- A Sustainable Future for St. Albert's Parks & Open Spaces (2002)
- Intermunicipal Development Plan Sturgeon County and City of St. Albert (2001)
- Red Willow Park West Master Plan Update (2003)

These documents recognize the value that the parks and open spaces provide to the City of St Albert. They generally strive for a balance between the development of parks and the preservation of natural areas, with the following goals:

- develop a city-wide integrated system of parks, open spaces, and recreation facilities
- preserve and protect the natural environment for future generations
- minimize the impacts of development on these areas

The City's Municipal Development Plan (City Plan) suggests creating natural areas where they do not already exist (for example, by constructing naturalized wetlands for stormwater management).

Recently, the "Red Willow Park West Master Plan Update" has been accepted in principle. This plan provides guidelines for park trail extensions into the Big Lake area west of the CNR trestle. Policies relevant to storm water management systems include:

- conservation of Big Lake, the Sturgeon River and the surrounding environmentally sensitive areas
- as a mechanism for conservation, Red Willow Park should encompass all designated natural areas and flooded shore lands under the influence of Big Lake and the Sturgeon River
- Natural Area Management Plans are needed for shore lands within the park which keep with the Red Willow Park and Big Lake Natural Area goals and objectives
- flood affected lands should be included in the park
- support a policy to prohibit flood fringe filling
- the park will be managed to conserve ecosystem integrity
- environmental management will be coordinated with the Big Lake Natural Area
- maintenance and operational activities will be adapted to support environmental objectives of the park
- naturalization and restoration of disturbed natural shore lands should emulate natural ecosystems
- Natural Area Management Plans, including detailed field inventories and impact assessments, should be prepared for any areas destined for development

These documents all aim to protect the natural environment, floodplains and adjacent natural areas.

6.9.2 Big Lake & Sturgeon River Shore Lands

Ecological processes, biological diversity, and life-support systems need to be managed for the preservation of environmentally sensitive areas and designated natural areas around Big Lake. To conserve wildlife habitat, shore lands and critical

habitat should be managed in a natural state. The natural tree cover, such as the White Spruce Stand, and wildlife habitat should be maintained as much as possible.

The updated Red Willow Park Master Plan recommends the extension of the multipurpose trail in buffer zones between conserved areas and future adjacent residential development.

These shore lands are to be included in a naturalized parkland under management of the City of St. Albert with the primary purpose of natural area conservation, water management (flood storage & conveyance), and compatible recreation/tourism development. New areas will be subject to Natural Area Management Plans which will govern conservation, restoration, and appropriate recreation-related development and management practices.

Table 6.2

Potential Species of Concern in the Big Lake, Sturgeon River, and Carrot Creek Area

Common Name	Scientific Name	Provincial Status	Federal Status	General Habitat Preferences
Amphibians and Reptiles				
Canadian toad	*Bufo hemiophrys*	May Be At Risk	Not listed	Breed in the shallows of lakes, ponds, marshes, ditches and other temporary bodies of water.
Plains garter snake	*Thamnophis radix*	Sensitive	Not listed	Near ponds, lakes, dugouts, streams.
Red-sided garter snake	*Thamnophis sirtalis*	Sensitive	Not listed	Broad habitat preferences include forest, farm, or near water.
Avifauna				
Peregrine falcon	*Falco peregrinus*	At Risk	Threatened	Lakeshores, river valleys, urban areas and open fields; nesting usually on rocky cliffs or cutbanks, nest sites are traditionally reused.
Trumpeter swan	*Cygnus buccinator*	At Risk	Not at Risk	Small to medium-sized shallow, isolated lakes that have well-developed emergent and submergent plant communities.
Short-eared owl	*Asio flammeus*	May Be At Risk	Special Concern	Open country including grasslands, wet meadows and cleared forests.
Bald eagle	*Haliaeetus leucocephalus*	Sensitive	Not at Risk	Large lakes, rivers, cooling ponds and open areas
Golden eagle	*Aquila chrysaetos*	Sensitive	Not listed	Large lakes, rivers, cooling ponds and open areas.
Osprey	*Pandion haliaetus*	Sensitive	Not listed	In the vicinity of permanent lakes and rivers.
Northern goshawk	*Accipiter gentilis*	Sensitive	Not at Risk	Breeding: mature coniferous, deciduous and mixed woods; nonbreeding: forest edges, parks and farmland.
Swainson's hawk	*Buteo swainsoni*	Sensitive	Not listed	Open fields, grasslands and agricultural areas.
Great blue heron	*Ardea herodias*	Sensitive	Not listed	Forages along the edges of rivers, lakes and marshes; also observed in wet meadows and fields.
Horned grebe	*Podiceps auritus*	Sensitive	Not listed	Breeding – shallow, weedy wetlands; migration – wetlands and larger lakes.
Pied-billed grebe	*Podilymbus podiceps*	Sensitive	Not listed	Ponds, marshes and backwaters with thick emergent vegetation.
Western grebe	*Aechmophorus occidentalis*	Sensitive	Not listed	Breeding: large lakes with dense areas of emergent vegetation or thick mats of floating aquatic plants; migrations: large, deep lakes.
American white pelican	*Pelecanus erthrrhynchos*	Sensitive	Not at Risk	Typically a shallow, turbid lake remote from human activity with extensive shallows near shore and extensive rough fish populations.
White-winged scoter	*Melanitta fusca*	Sensitive	Not listed	Ponds, lakes, oxbows, and sluggish streams in treeless or relatively open country.
American bittern	*Botaurus lentiginosus*	Sensitive	Not listed	Breeds in marshes, swamps, moist meadows, alder or willow thickets.
Yellow rail	*Coturnicops noveboracensis*	Undetermined	Special Concern	Large, dense grass or sedge marshes with little or no standing water.
Virginia rail	*Rallus limicola*	Undetermined	Not listed	Lakes, ponds, marshes, and sloughs with extensive bulrushes, cattails, and sedges.
Black-crowned night heron	*Nycticorax nycticorax*	Sensitive	Not listed	Colonial species reliant on marsh habitat.
Black tern	*Chlidonias niger*	Sensitive	Not listed	Shallow lakes, marshes, ponds and wet meadows
Forster's tern	*Sterna forsteri*	Sensitive	Not listed	Marshes and marshy bays of bordering lakes.
Upland sandpiper	*Bartramia longicauda*	Sensitive	Not listed	Primarily in open, grassy uplands, hay fields, pastures, wet meadows, and old fields with minimal shrub/tree growth.
Sharp-tailed grouse	*Tympanuchus phasianellus*	Sensitive	Not listed	Open habitats, mostly grasslands, grassy meadows and agricultural areas
Common nighthawk	*Chordeiles minor*	Sensitive	Not listed	Meadows, grasslands, badlands, open cottonwood forest.
Brown creeper	*Certhia americana*	Undetermined	Not listed	Mature forests, particularly mixedwoods or coniferous forest.
Sedge wren	*Cistothorus platensis*	Sensitive	Not at Risk	Sedge meadows and grassy fields.
Purple martin	*Progne subis*	Sensitive	Not listed	Communal bird houses; tree cavities.
Pileated woodpecker	*Dryocopus pileatus*	Sensitive	Not listed	Mature coniferous, mixed wood or deciduous forests; prefers areas with dead and dying trees.
Black-backed woodpecker	*Picoides arcticus*	Sensitive	Not listed	Dense mixed or coniferous forest, nests in stumps or decaying logs
Sprague's pipit	*Anthus spragueii*	Sensitive	Threatened	Bush grassland and some moderately grazed areas.
Loggerhead shrike	*Lanius ludovicianus*	Sensitive	Threatened	Lightly wooded river valleys and coulees.
Western tanager	*Piranga ludoviciana*	Sensitive	Not listed	Open mature coniferous and mixedwood forest.
Bobolink	*Dolichonyx oryzivorus*	Sensitive	Not listed	Open meadow and pastureland, preferring moist areas of tall grass and hayfields.
Mammals				
Long-tailed weasel	*Mustela frenata*	May Be At Risk	Not at Risk	Open country forages in aspen parkland and open forests.
Canada lynx	*Lynx canadensis*	Sensitive	Not at Risk	Boreal forest.
Badger	*Taxidea taxus*	Sensitive	Not at Risk	Open country; grasslands and pastures.
Northern long-eared bat	*Myotis septentrionalis*	May Be At Risk	Not listed	Forested areas close to waterbodies.

PROPOSED MASTER DRAINAGE PLAN FOR ST. ALBERT

SECTION 7

7.1 PROPOSED UPGRADE PLAN

The hydraulic analysis conducted in this project demonstrates that the hydraulic performance of the trunk sewer system is generally consistent with the design standards which applied when the different areas were developed. Consequently, much of the storm drainage system would be overloaded by today's standards, which require the sewer pipes to have capacity for the 1:5 year storm. However, the major drainage system appears to be reasonably effective at carrying the runoffs which exceed the pipe system capacity with the exception of the Campbell Industrial area and in the upstream portions of the Braeside trunk system. There have been no reports of significant flooding in St. Albert's storm drainage system.

It is generally not cost-effective to upgrade the system to provide capacity for today's standards, nor to prevent ponding and major overland flows on the street surface. Instead, it is recommended that the City provide stormwater management (SWM) to service new development areas, and to undertake selective upgrades where it is cost-effective to do so. In the longer-term, as existing neighbourhoods are re-developed over time, their storm drainage systems should be upgraded to the latest standards.

Figure 7.1 shows the proposed upgrades and the proposed stormwater management plan for the remaining development within the present City boundary. It does not include areas which are presently outside the present City boundary and could be annexed with the present City annexation proposal.

Proposed upgrades to the existing trunk storm sewers are:

- **expand the existing dry pond** in the **north of the Campbell Industrial Area** to accommodate surcharging and reverse flows in the Campbell Trunk
- construct a **new stormwater management wetland in the south of the Campbell Industrial area** to operate as a surge facility, reduce surcharging in the downstream trunks, and control runoff from the remaining developable land in this sub-basin
- **repair the concrete chute** in the Forest Lawn Ravine

Other improvements will be required to accommodate future development within the present City boundary. These are discussed in subsequent sections.

7.2 FUTURE DEVELOPMENT AREAS

Analysis shows that there is no capacity within the current system available for areas which lie outside the present City boundary. Most of the land within the IDP area drains to Carrot Creek. The IDP plan assumed that most of this area will be provided with stormwater management facilities discharging at a controlled rate to Carrot Creek and to Big Lake. Areas northeast of the present City boundary will drain through a stormwater management system to the Sturgeon River. Stormwater management needs for these outlying areas will be dealt with separately.

Areas remaining to be developed within the present City boundary are primarily:

- approximately 30 ha in Erin Ridge in the northeast
- approximately 68 ha in Regency Heights (part of Kingswood) and 65 ha of future industrial lands in the Campbell Industrial Area, on the east side
- approximately 400 ha in Northridge on the west side of the City
- approximately 65 ha in Heritage Lakes West, on the southwest side of the City

The order in which these areas will be developed is unknown at this time. Most new developments have recognized the need for SWM facilities, and they incorporate them in development plans. There are some recent and proposed developments that have included building in the flood fringe or infill along the river.

Figure 7.1 provides an overview of the stormwater management facilities for the future development areas within the present City boundary. Table 7.1 provides a summary of the stormwater pond sizes. Stormwater management needs for the Inter-Municipal Development Plan Area will be dealt with separately.

Table 7.1
Proposed Stormwater Management Facilities for System Expansion

Development Area	Pond # (Figure 7.1)	Drainage Area (ha)	1:100 year 24 hour storm		July 1978 storm	
			Storage Volume (m^3)	Outflow (m^3/s)	Storage Volume (m^3)	Outflow (m^3/s)
Campbell Industrial	North (dry pond)	52	48,000	0.49 (-0.47)	66,000	0.58 (-0.61)
	South (wetland)	17	58,000	3.09 (-0.57)	109,300	4.52 (-9.8)
Kingswood	Regency Heights	68	44,000	0.17	47,000	0.21
Erin Ridge	1	47	29,000	0.24 to trunk 0.42 to ravine	40,000	0.26 to trunk 0.42 to ravine
	2 (dry pond)	9.7	2,700	0.13	5,300	0.18
North Ridge	3	42.2	11,700	0.51	27,100	0.66
	2	45.3	10,900	1.11	29,000	1.44
	1	77.5	32,200	1.83	56,400	2.58
	4	87.8	27,900	1.1	63,200	1.34
	5	37.1	85,000	6.31	186,000	8.41
	6	46.4	15,000	6.87	32,000	9.16
	7	55.7	17,000	0.67	38,000	0.89
	8	50.8	16,000	1.28	35,000	1.70
	9	37.0	12,000	0.44	25,000	0.59
Heritage Lakes	1	84.2	55,000	0.21	59,000	0.25
	2	60.2	39,000	0.15	42,000	0.18

Note: all estimates are preliminary and subject to review in final design.

7.2.1 Erin Ridge

There are approximately 30 ha remaining to be developed in the Erin Ridge neighbourhood. Development in the Erin Ridge area has reached the point where the existing facilities are fully used. A storm pond was constructed in part to reduce the loads on the conveyance system by reducing the peak discharge through attenuation in the pond. The next stages of Erin Ridge will be serviced through the existing pond, with some expansion of storage. A dry pond has been proposed to serve the northeast portion of the neighbourhood, and will drain to the existing lake.

The pond discharge rates are controlled by the surcharge capacity of the downstream system to about 11 L/s/ha in the 1:100 year storm. In addition, there is an overflow to the ravine in the northeast that comes into operation above the 1:5 year storm. These flows are considerably higher than the pre-development rates proposed through the Big Lake Basin study (2.5 L/s/ha).

With the existing discharge rates, **the existing wet pond will need to be approximately doubled in size to accommodate approximately 20 ha of the remaining development area.** The other 10 ha will be drained to a new dry pond in the northeast area of the development and then pumped to the wet pond. Details are provided in Section 2 of this report. If the release rates were reduced to 2.5 L/s/ha, as recommended in the Big Lake Basin study, the ponds would have to be further increased in size which would be impractical due to previous approvals and limited land availability. Therefore, a higher release rate can be adopted for this area as governed by the capacity of the downstream storm trunk.

Future development areas north of Erin Ridge which are presently outside the City boundary will require a new trunk sewer and outfall system discharging to the Sturgeon River east of the present City boundary.

7.2.2 Oakmont

About 85 ha of Oakmont have been serviced in conjunction with Erin Ridge. A major outfall that conveys flows from Oakmont and Erin Ridge discharges to the Sturgeon River. A small portion on the east side drains through a shallow swale to the river.

7.2.3 Northridge

Northridge is an area of approximately 440 ha that is undergoing development on the west side of the City.

The total drainage area is 713 ha. This includes 440 ha in Northridge itself, plus 36.1 ha from Dorchester and Deer Ridge, and 236 ha in Lacombe Park which were previously developed without stormwater management.

In the Northridge area, there has been considerable work done in preparing drainage master plans, which are being updated to reflect new concepts as the developments proceed. These plans are quite well defined for the areas north of Meadowview Road, but are not well defined for the areas to the south. Figure 7.1 includes the overall concept plan for this area.

The plans deal exclusively with flows from within the current City boundaries, and do not consider any flows from outside. It appears that there may be opportunities to synergize between the Northridge developments and the Western Regional Road by utilizing common facilities.

The development plan involves four stormwater management ponds north of the CNR. Table 7.1 provides a preliminary estimate of pond outflows and storage volumes based on modelling conducted by UMA for the four ponds north of the CNR. There will also be as many as five ponds south of the CNR, but the pond locations and catchment areas will be confirmed during detailed neighbourhood planning.

The flow rates used for the planing and design in the Northridge area are approximately 12 to 16 L/s/ha which is considerably higher than the rates recommended in the Big Lake Basin Drainage Study (2.5 L/s/ha). As the area is already partly developed to the higher release rate, and about one-third of the catchment currently has no stormwater management, a release rate of 2.5 L/s/ha will not be attainable.

The area drains to Big Lake through an existing ditch and wetland south of the CNR. The ditch and Meadowview Drive culverts have a capacity of 3.5 m^3/s but will carry flows as high as 15 m^3/s, mostly originating from the existing developed area in

Lacombe Park. The ditch and culverts through the CNR and Meadowview Drive will need to be upgraded as the area is developed.

The existing wetland south of the CNR should be preserved or expanded to provide storage to control flows and to capture sediments which would otherwise be discharged to Big Lake. Storage in the wetland could be used to reduce the ditch flows and improve the quality of runoff discharged from the existing development area. The ditch and wetland could form a drainage parkway connected to Big Lake as shown in Figure 7.1.

Stormwater management concepts for this area should be coordinated with those of the west residual road. It is anticipated that Pond 8 would serve the roadway as well as part of the development area and would therefore, need to be made larger to accommodate the roadway drainage.

7.2.4 Western Regional Road

The proposed Western Regional Road will have implications for stormwater management in the west areas of the City.

The northern section of the roadway will require stormwater management. As discussed earlier, there may be opportunities to provide common facilities for the Northridge development and the roadway. It is anticipated that the roadway will drain to a stormwater pond south of Meadowview Drive which could be shared with the Northridge area. This stormwater pond could discharge to a treatment wetland on the west side of the roadway which would help to remove nutrients and other contaminants prior to its release to Big Lake.

On the south side of the Sturgeon River, there are conceptual plans to use a portion of the existing Riel Pond to provide stormwater management for the southern portion of the roadway. The Riel Pond is to be bisected by the proposed regional road. The eastern side would be retained for stormwater management for the south portion of the roadway and for existing development to the east, and the west portion side be reclaimed as a naturalized wetland. The remaining Riel Pond could discharge to the reclaimed wetland to provide *polishing* of runoff from upstream.

7.2.5 Heritage Lakes West

The area adjacent to Big Lake in the southwest corner of the City is also being considered for development. Plans for this area are still vague and the land use will have to be resolved. For preliminary pond sizing, we have assumed this area will be residential.

There is **an existing wetland on the fringe of the lake which should be preserved for wildlife habitat and water quality enhancement.** These wetlands provide a buffer zone to Big Lake and should be protected. Much of this area is being considered for park or green space by other City initiatives.

Tentatively, **two new stormwater management ponds are proposed** for this area – one to drain the area east of the regional road and one to drain the area on the west. A release rate of 2.5 L/s/ha should be adopted as proposed in the Big Lake Study. These ponds could be discharged to the existing wetland on the fringe of Big Lake which could provide final treatment (polishing) of runoff water. Associated Engineering recommends that the east pond outflow be discharged to the remaining portion of the Riel pond before being released to the wetlands.

7.2.6 Regency Heights (Kingswood)

Approximately 68 ha of residential land remains to be developed in the Regency Heights (Kingswood) area. This is one of the last areas within the current City boundaries to be developed. It appears that the undeveloped areas will utilize existing trunks to discharge to the Sturgeon River. Analysis of the trunks indicate that there may be a capacity issue in the downstream segments. The modelling shows that the south Kingswood trunk sewers have sufficient capacity to carry the 1:5 year peak flows from this area. However, as shown in Figure 2.6, there will be approximately 2,500 m^3 of ponding or overflow in the major drainage system in the 1:100 year storm.

Associated Engineering recommend a stormwater pond (wetland) to control runoff from this area, designed for a release rate of 2.5 L/s/ha to reduce the major drainage system flows downstream of this area and to reduce the discharge of sediment to the Sturgeon River. This pond would also meet Alberta Environment's objectives to improve the quality of runoff from all new development areas.

7.2.7 Campbell Industrial Area

There are about 65 ha remaining to be developed in the Campbell Industrial area. The hydraulic analysis showed that the existing trunks downstream of the Campbell Industrial area are overloaded and therefore stormwater management will be required to control runoff from the remaining development areas.

A stormwater management pond has been provided to serve an area of approximately 50 ha in the north end of the Campbell Industrial Area. The analysis shows that **the dry pond will need to be expanded as the area is developed**, as shown in Table 7.1.

Associated Engineering recommends a **new stormwater wetland for the south end of the Campbell Industrial area**. This wetland would reduce surcharge levels in the existing trunk, store runoff from the remaining development area (approximately 15 ha), and provide treatment of runoff water quality. Wetlands achieve a higher degree of treatment than do dry ponds, therefore, this stormwater pond should be a constructed as a wetland. The wetland would contain a permanent pool of water and wetland vegetation that will help to remove sediments and nutrients from the runoff water.

Both these stormwater management facilities will operate a surface pond which will permit the storm sewer system to flow backward into the pond and reduce surcharging in the Akinsdale/Braeside storm trunk. Details are provided in Section 2.

7.3 FLOODPLAIN MANAGEMENT STRATEGY

Encroachment of development within the floodplain is a concern in St. Albert. Some of the flood fringe areas have been filled in Oakmont. Dikes have been constructed to protect the existing development area in downtown St. Albert. Sedimentation is also occurring as a result of urban runoff.

The Big Lake Basin study provides drainage criteria for the basin which also apply to St. Albert. **This report recommends that the City adopt the recommendations in the Big Lake Basin study,** including:

- **the floodplains of the project area be protected and preserved**
- **the Province develop a floodplain map to be developed for Big Lake, Sturgeon River, and Carrot Creek**
- **single zone floodplain mapping be adopted with no distinction between the floodway and flood fringe**
- **adequate freeboard be provided in floodplain mapping to allow for uncertainties in the analysis (0.5 m) and for potential impacts of sedimentation and land use changes (an additional 0.5 m)**
- **the floodplains of the Sturgeon River be protected and preserved**
- **a *Floodplain Overlay* be adopted within the Land Use Bylaws of all the basin's municipalities to regulate development of the floodplain and that no development be permitted within the floodplain except as permitted in the *Floodplain Overlay***
- **stormwater management be provided for all new developments and that it be designed for a release rate of 2.5 L/s/ha**

Figure 7.2 provides a conceptual cross-section which defines the floodway and flood fringe. As defined by the Alberta Flood Drainage Reduction Program (FDRP):

- the **floodplain** is all the area that is flooded in the 1:100 year flood. It **includes the floodway and the flood fringe**
- the **floodway** is the deeper, faster-moving portion of the floodplain (essentially the main channel and the adjacent deeper over-bank areas, which are required for conveyance of the flood discharge) – no development or filling is permitted by the FDRP in the floodway
- the **flood fringe** is the shallower, slower-moving portions of the floodplain that do not provide significant conveyance

The FDRP suggests that the flood fringe could be developed provided that such development was flood-proofed and that it did not cause a significant rise in water levels.

The FDRP restricts itself to issues of hydraulic conveyance. It does not specifically regulate development, as this is an area of municipal responsibility, but it does recommend some minimum policies that any development should meet.

The Big Lake Basin Drainage Study (2004) looks at other issues and recognizes that there are several other reasons why floodplains need to be protected:

- Floodplains and flood fringes provide floodwater storage which slows down the flow of water and reduces the downstream peaks. This is particularly true of Big Lake, which provides a large amount of floodplain storage.
- Floodplains and adjacent riparian areas provide valuable wildlife habitat and corridors (80% of all wildlife in Alberta use riparian floodplain areas for all or part of their natural life cycle).
- Floodplains provide valuable stream buffers which trap contaminants and shelter the river channel, reducing water temperature and improving water quality and fish habitat.

The Big Lake Basin Drainage Study recommended that the floodplains of the project area, including the flood fringe and adjacent riparian areas, must be protected and preserved. It recommended no development or filling of lands lying below the 1:100 year flood level, plus a 0.5 m factor of safety to allow for uncertainties and approximations in the analysis.

Table 7.2 summarizes the design flood levels in Big Lake and the proposed development limits around Big Lake. Figure 7.3 illustrates the proposed development limits and minimum recommended building elevations.

Table 7.2
Design Flood Elevations in Big Lake

Description	Source	Minimum Elevation
Base case - 1:100 year flood for 1986 conditions	Alberta Environment Floodplain Study Sturgeon River at St Albert, 1990	653.20 m
Hydrology review	Big Lake Basin Study, Associated Engineering, 2003	- 0.06 m
Impact of land use changes	Big Lake Basin Study, Associated Engineering, 2003	+ 0.30 m
Sedimentation in Sturgeon River - 1986 to 2003 - 2003 to 2028	Sameng (in St Albert Regional Stormwater Management Plan, 2004)	 + 0.10 m + 0.14 m
Estimated 1:100 year flood level for future conditions	Sum of the above	653.68 m
Design Flood Level	Minimum 0.5 m factor of safety	654.18 m
Lowest development limit	Design Flood Level	654.18 m
Basement floor	> 1:100 year flood	653.68 m
Main floor elevation	Minimum freeboard 0.5 m	654.68 m (subject to lot grading requirements)

Ultimately, the Municipal Government Act provides that the floodplain areas (lands subject to flooding) may be taken as Environmental Reserves by the Municipality upon subdivision. As parcels of land come into the custody of the municipality, Natural Areas Management Plans and Area Master Plans should be developed together prior to detailed planning and implementation.

The City should adopt a policy to prohibit filling of flood fringe areas. These areas are valuable for natural wetland processes and habitats and are the land base for Red Willow Park and are clearly protected under the Environmental Reserve provisions of the Municipal Government Act (Section 664).

7.4 SEDIMENTATION MANAGEMENT STRATEGY

Deposition of sediment carried by urban runoff is a concern in St Albert.

Some people in St. Albert are concerned that the river is shallow, stagnant, and weedy. This perception seems to originate from the fact that normal (base) flows in the Sturgeon River are naturally low, and therefore the depth of flow is naturally shallow. This perception is compounded by the presence of sand bars at the storm sewer outfalls, which draws attention to the deposition caused by the storm runoff.

The potential impacts of sedimentation in the river include the following:

- In-channel deposition leads to higher flood levels in Big Lake. The sedimentation study estimated that flood levels have risen by about 0.1 m since 1986 and that, if left un-checked, they could rise another 0.15 m over the next 10 to 25 years. The potential impact is greatest at Big Lake and diminishes at the downstream end of St. Albert.
- The shallow depth of flow in the river leads to increased light penetration and greater weed growth. This contributes to public concerns and the perception that the river has become too shallow.
- Deposition gives rise to potential impacts on fish habitat.

Currently, Alberta Environment requires removal of 80% of sediments larger than 70 microns from all new development areas.

Recently the City has constructed an oil/grit separator in the downtown area which serves an area of about 10 ha. Preliminary monitoring over one year indicates that the oil/grit separator has removed about 1 m^3 of grit per hectare of contributing area which is somewhat higher than the rates of sediment runoff normally experienced in an urban area. This confirms that the sediment separator has been reasonably effective at removing sediments from runoff. However, more monitoring is recommended.

It is recommended that:

- **The City reduce the discharge of sediments to Sturgeon River.** Five high priority outfalls have been identified where the cost of sediment separators have been estimated at $3.1 million (± 30%). Adding separators over time at other outfalls will increase the cost to $10.4 million. Details are provided in Section 4. Generally,

settling ponds are recommended for outfalls larger than 900 mm diameter, if the required land area is available, otherwise in-line oil/grit separators may be constructed. Settling ponds should be landscaped to blend in with the park environment. Properly designed, these ponds will provide water features in Red Willow Park.

- Some improvement are also possible in the form of best management practices (BMPs) in the tributary catchment to reduce the runoff of sediment at the source, including:
  - better **management of construction practices**
  - more frequent **street sweeping and catchbasin cleaning.**

- **Future development areas should be provided with wet ponds or wetlands,** rather than dry ponds, to reduce their sediment runoff. Wet ponds and wetlands are more effective than dry ponds at removing of suspended sediments and other contaminants.

Once the runoff of sediment has been reduced, Associated Engineering recommends that **the City remove**, **the larger accumulations at the storm outfalls, at a cost of about $500,000.** This would remove the major barriers to fish passage and the more obvious accumulations, but would have a negligible impact on water levels. The sediments would be removed once the grit separators were installed. The program could be implemented as each separator is installed, or as sections of the river have separators installed.

Removal of the remaining sediments between the outfalls within the existing City limits would probably not be feasible as it would entail a significant cost and a large scale disturbance of the river bed. The cost of such a large scale dredging program is difficult to estimate, but is likely to exceed $2 million. If the City wishes to consider such a program, a detailed feasibility study is recommended to identify access points to the river, methods of removing the material, and restoration and mitigation measures.

7.5 WATER LEVEL REGULATION

An inflatable weir in the river channel downstream of St Albert could be a feasible means of regulating water levels in the Sturgeon River to maintain a greater depth during low flow conditions. The benefits of such a program could include:

- improved water quality and reduced weed growth by reducing penetration of sunlight,
- greater depths of water in Big Lake and expanded water fowl nesting and feeding areas,
- reduction in public complaints about the shallow river.,
- a more pleasant river environment and greater enjoyment of the river valley.

The weir would be raised in the summer months to maintain a reasonable depth of water in the river channel and it would be lowered in late fall so that it would not affect flood levels the following spring. The weir could also be managed to contain additional water in Big Lake that could be released during dry periods to maintain a riparian flow in the Sturgeon River. The foundation of the weir can be designed so that it is fully submerged when the weir is deflated.

Should the City wish to consider regulating the river and lake levels, an extensive environmental impact assessment would be required. The environmental assessment would include:

- potential impacts on fisheries and review with Department of Fisheries and Oceans (DFO)
- waterfowl habitat assessment to establish the optimum operating water levels on Big Lake
- hydrologic modelling to define the weir's operation and confirm lake operating levels
- design of the structure

Photo 7.1 shows a schematic side view of an inflatable weir. Photo 7.2 shows how the weir would look when inflated and Photo 7.3 shows the weir deflated.

The City may wish to consider encouraging high-value waterfront development such as restaurants and boutiques along the river front walkway in the central portion of St. Albert to take advantage of the improved and deeper river. High-value development would be compatible with the nature of the downtown area, would help to attract people to the downtown area, and could help to pay for the improvements through an increased tax base. Photos 7.4 to 7.6 show some views of the Riverwalk development in San Antonio, Texas, to illustrate the type of development that is possible.

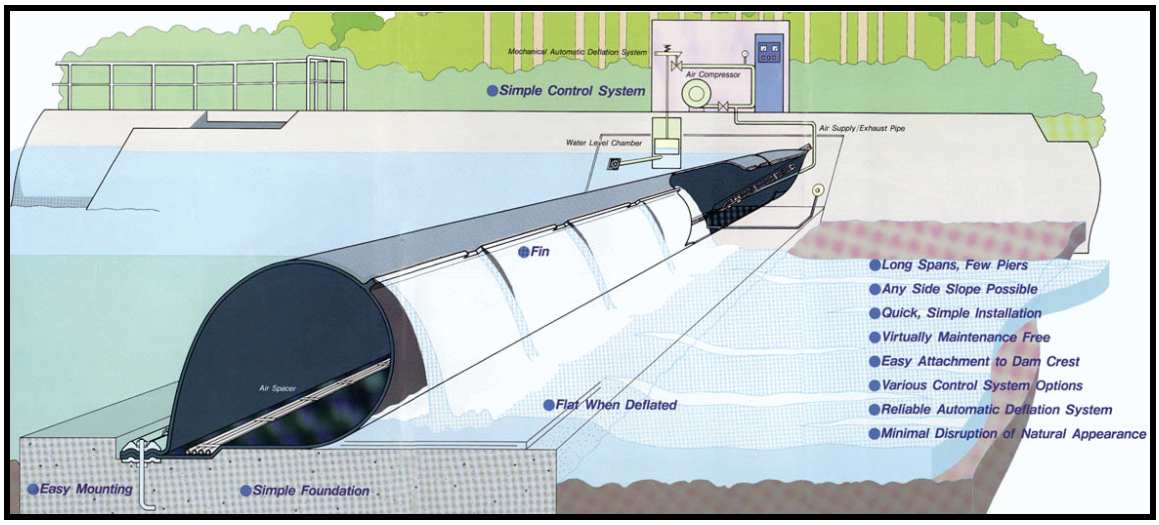


Photo 7.1: Schematic side view of an inflatable weir.

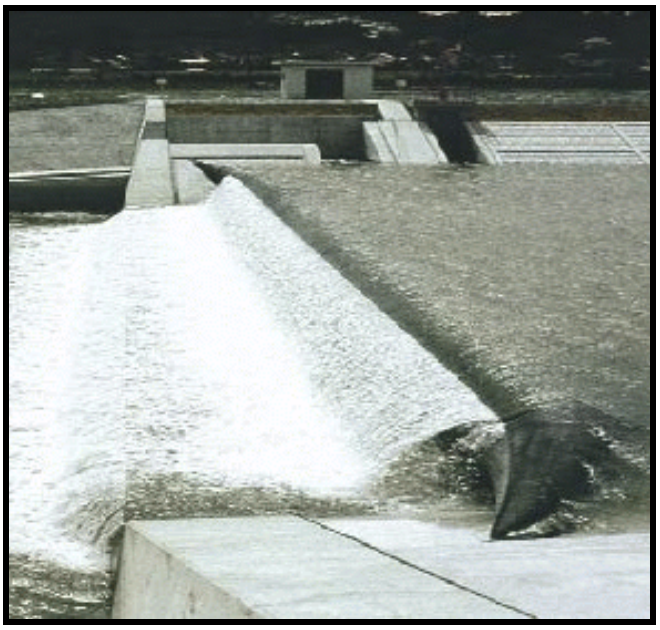


Photo 7.2: View of weir when it is inflated.



Photo 7.3: View of weir when it is deflated.

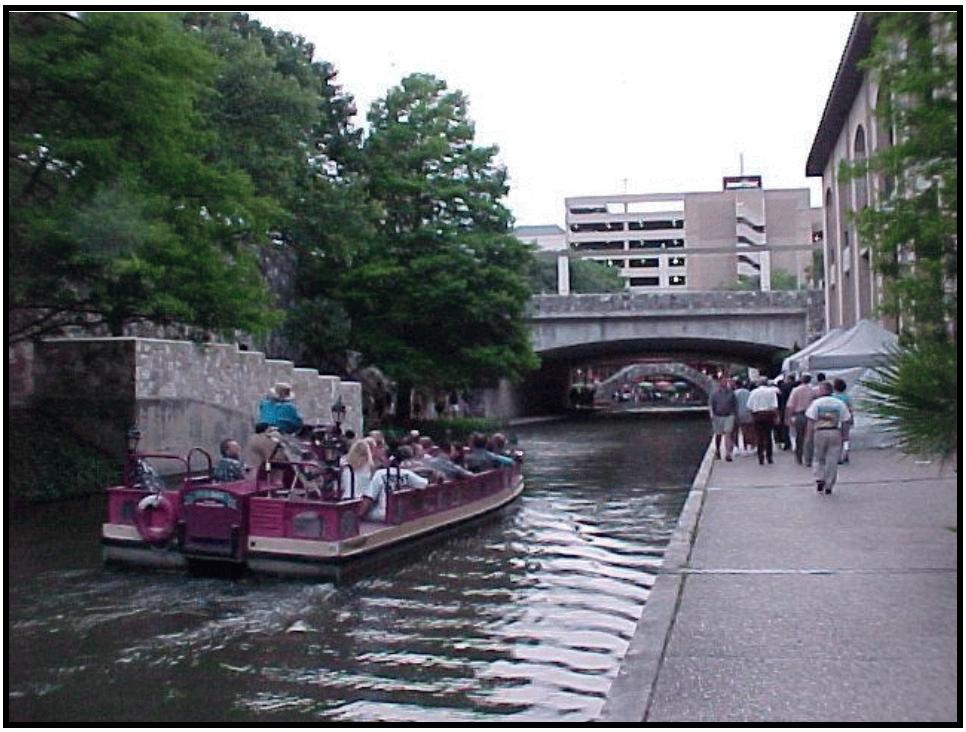


Photo 7.4: Riverwalk in San Antonio, Texas.

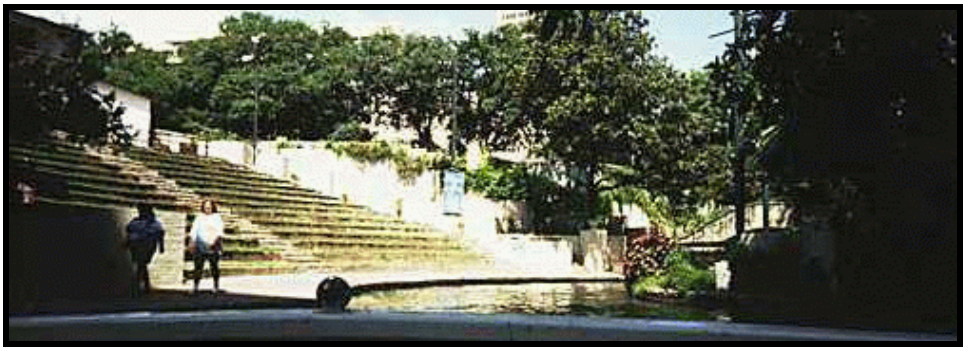


Photo 7.5: San Antonio Riverwalk.



Photo 7.6: San Antonio Riverwalk.

7.6 ASSET MANAGEMENT STRATEGY

Every municipality should have a regular inspection and maintenance program to extend the lifespan of their assets. This is especially important in older areas of the City where some of the storm sewers may be reaching the end of their theoretical service life expectancy.

The major capital works which are required to upgrade or maintain the trunk sewer system over the next 5-year period are:

Trunk sewer inspection	$150,000/yr
Trunk sewer repairs	$285,000 to $380,000/yr
Outfall repairs	$307,000 (one-time cost)

These costs do not include the stormwater management (stormwater ponds) or costs which were addressed separately above. Details are provided below.

7.6.1 Trunk Sewer System

The City of St Albert started the first systematic CCTV inspection of its storm sewer system in 2001. Approximately 6 km of trunk sewer (approximately 13% of the total trunk length) was inspected. In general, the inspection results show that the trunk sewers are in reasonably good structural condition considering their age and type of pipe. About 2% of the total length of the inspected pipes require immediate repair or rehabilitation at an estimated cost of $285,000. These repairs will correct the most serious defects such as broken pipes which could collapse and cause further damage or loss of service.

The City should address the priority repairs and continue to inspect the remainder of its storm sewer system as follows:

- **The remainder of the trunk storm sewers (39 km) should be inspected within the next 5 years**. This translates into approximately 8 km/yr or an **annual cost of inspection of approximately $150,000 per year.** In addition, assuming that the results to date are representative, the City should **budget approximately $285,000 for 2004, and $380,000 per year over the next 5 years for high-priority repairs**.
- Upon completion of the trunk inspections, **the laterals should be inspected, with the goal to complete the storm sewer inspection**

program within 10 to 15 years. Priority defects should be repaired as soon as possible in order to maintain service and to prevent further damage to the pipe system.

- Based on the results of the inspection and the initial rehabilitation requirements, **a program to re-inspect the storm sewers should be developed. The City should re-inspect the trunk sewers no less than once every 10 years and the laterals once every 20 years.** The timing of the re-inspection program should be refined on the basis of the inspection results as recommended by the National Research Council.
- In conjunction with the pipe inspections, it is important to include the structural condition of all related manholes.
- Stormwater management facilities should be constructed to serve new development areas as outlined in the previous section.
- In the longer term, some of the older storm sewers will reach the end of their service life expectancy. As older neighbourhoods are planned for re-development, storm sewers should be replaced with larger pipes as required to meet present-day standards.
- Programs and business cases should be developed for phased implementation of these initiatives.

7.6.2 Outfalls

Recently the City has had to repair a cavity caused by a broken pipe at a storm sewer outfall under the Perron Street bridge. The outfall inspection program revealed that **about two-thirds of the storm sewer outfalls require structural repairs or rehabilitation due to safety concerns.**

Following is a summary of the outfall rehabilitation costs (in 2004 dollars, including engineering and contingencies):

Structural defects	$241,000
Safety issues	$ 66,000
Total	$307,000

7.6.3 Forest Lawn Ravine

A shallow concrete channel conveys the stormwater runoff from the Braeside Trunk between Forest Drive and Sir Winston Churchill Drive. Inspection of the concrete

channel indicates that there are several areas that have heaved and cracked, and there are a number of locations where erosion of the bank is occurring above the channel. Failure of the channel could lead to more severe erosion problems and potentially to bank slope failure and, therefore, the worst areas should be addressed.

The City has indicated that they wish to minimize the disturbance of the ravine during rehabilitation, and to preserve the natural characteristics of the ravine. Therefore, the recommended long-term solution is to install gabion mats on top of the existing concrete structure and on the lower banks of the ravine.

In the short term, a limited rehabilitation project is proposed which involves:

- replacing the concrete in the critical, localized problem areas
- installing gabions on the bank in places where serious erosion exists
- monitoring and evaluating the effectiveness of the program before committing to rehabilitation of the entire channel

The estimated cost for the limited rehabilitation project is $400,000.

This program will also provide the opportunity for the City staff to gain experience working with gabions that could be applied to rehabilitation of the ravine.

7.7 INTEGRATION WITH PARKS AND OPEN SPACES

The parks and open spaces are important to the residents of St. Albert, and the Red Willow Park is a source of pride for the community. Stormwater management facilities are often linked to these parks and open spaces and need to be planned with this in mind.

Figure 7.4 shows the primary parks and green spaces in St. Albert. The Sturgeon River and Red Willow Park form the major focus of parks and open spaces in St. Albert. In the future, Red Willow Park will extend to Big Lake and Carrot Creek upstream of the present City boundary, and the Sturgeon River downstream of the present City boundary. There are also several major ravines which carry stormwater. Other parks and open spaces occur throughout the City.

Stormwater management facilities provide important environmental benefits by controlling peak flows discharged to the river and by removing sediments and other contaminants from urban runoff. By virtue of their drainage function, they are located in the low areas of

development and are often located within or adjacent to natural areas. They can and should be integrated into these green spaces. Some examples in St Albert include:

- stormwater lakes in Grandin and Heritage provide neighbourhood amenities
- stream courses within ravines convey urban runoff flows and form part of the park environment (Forest Lawn and Grandin Ravines)
- The North Campbell dry pond provides space for outdoor soccer field. Its proximity to the Campbell arena gives rise to the possible development of an indoor soccer facility and a regional recreation centre.

The City should continue to explore opportunities to integrate their stormwater management facilities with parks and open spaces. Some suggestions are:

- Locating stormwater ponds adjacent to the floodplains and open spaces and within parks spaces and greenway corridors. Stormwater lakes are important water features that offer visual amenities to their neighbourhoods and can provide a greater amenity to the City at large.
- Sedimentation ponds (micro pools) located at outfalls within the river valley should be landscaped and designed as water features to complement the adjacent park features.
- Continuous greenway corridors can be provided in future development areas by linking stormwater management facilities with drainage parkways. These greenways can be designed with floodplains to integrate storage and conveyance of stormwater and to provide a linear park/walkway corridor.
- Existing wetlands and green spaces can be used for polishing of runoff that has been pre-treated in stormwater ponds or stormwater wetlands. This will help to remove nutrients from the runoff water and will help to sustain the wetland itself (for example, the Riel wetland south of the Riel pond).
- The South Campbell stormwater pond should be designed as a naturalized wetland. Its primary role is to operate as a surge facility to control flows in the Braeside trunk and Forest Lawn Ravine and to prevent flooding in the Campbell and Braeside area. It will also control runoff from the remaining development area in the south Campbell area. As a stormwater management wetland, it will also help to remove sediments, hydrocarbons, and nutrients from the industrial area runoff prior to its discharge to the river. The wetland could be developed as a demonstration site that could be used for school trips and for research into ways to treat runoff from industrial areas.

- In the Northridge area a system of stormwater management ponds, linked with storm sewers, is being provided to control runoff to Big Lake. These stormwater ponds act as part of the park space for the community. South of Meadowview Drive, this system drains through an existing drainage channel and an existing wetland.
- Existing storm sewer outfalls should be rehabilitated to deal with structural problems, safety issues, and erosion.

Integrated water management and conservation initiatives are required along the shorelines of Big Lake. These should include:

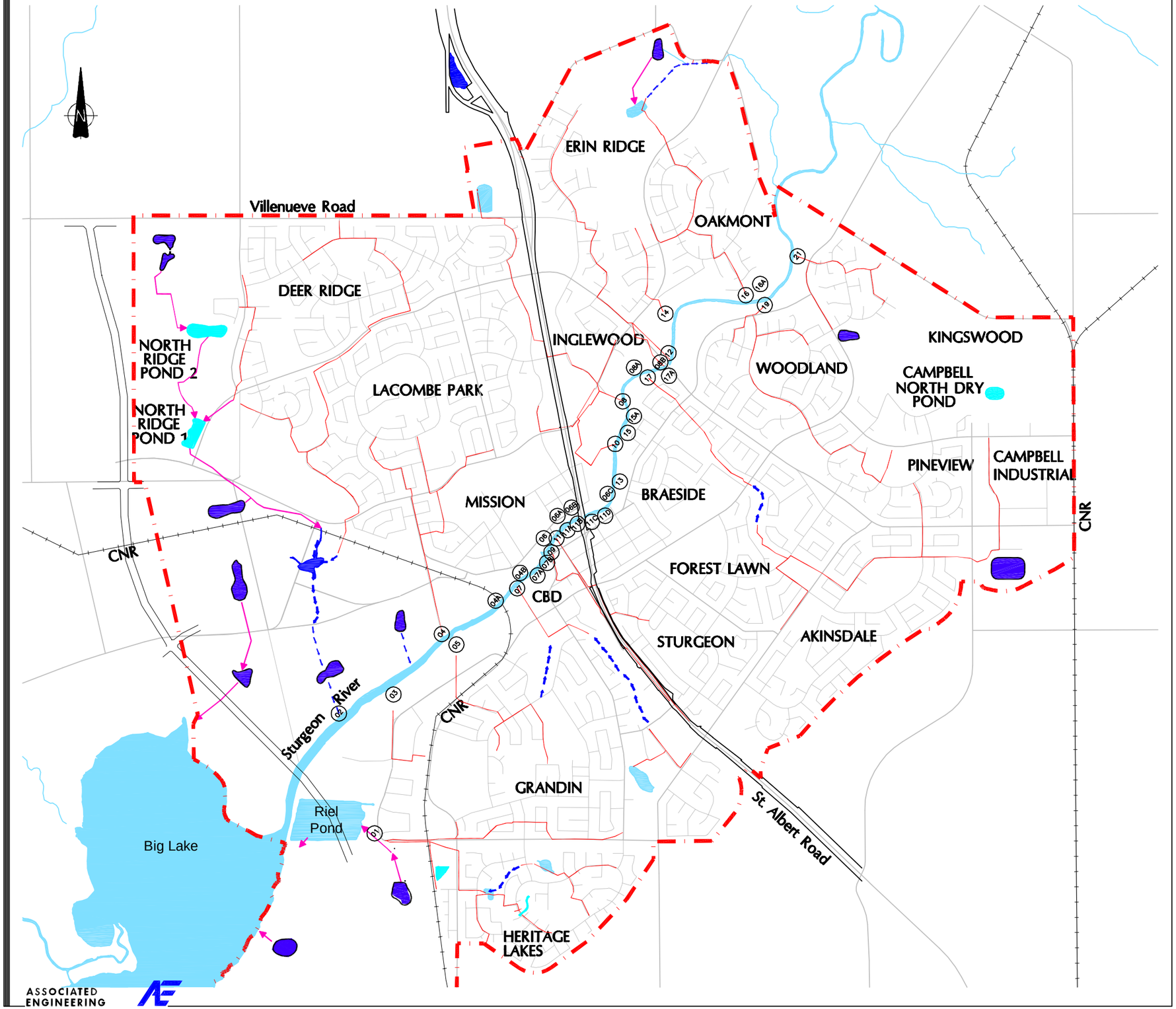
- restriction to development and fill of the floodplain
- conservation of shore lands and riparian areas for flood control and conservation of wildlife habitats
- preparation of shoreland natural area management plans
- water management for water quality and flows
- greenway extension along Carrot Creek

Proposed policies affecting Storm Water Management Systems are:

- Storm Water Management Facilities (SWMF) serving adjacent residential areas should be included in those adjacent residential areas and excluded from Red Willow Park. Stormwater Management facilities may be located in buffer zones between natural areas and adjacent residential developments.
- Storm water should be pre-treated through settling or natural filtering to remove organic compounds, nutrients, heavy metals, and pollutants before being released to existing wetlands. These wetlands may serve as additional filters to further improve the water quality. Prior to approval of release of storm water into wetlands by the city, a study of effects by a Qualified Aquatic Environmental Specialist (QAES) is recommended.

7.7.1 Remediation of Existing Outfalls

Improvements such as sediment basins placed within the park natural area should be landscaped to serve as park amenities. The design sedimentation ponds and stormwater management facilities should be reviewed by a qualified Aquatic Environmental Specialist.



THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

PROPOSED STORMWATER MANAGEMENT CONCEPT PLAN FOR FULL DEVELOPMENT

LEGEND:

- RAVINE OR CHANNEL
- STORM TRUNK SEWER
- CITY BOUNDARY
- PROPOSED POND
- EXISTING STORMWATER POND
- 16A — OUTFALL NUMBER

SCALE : 1 : 30,000

JULY, 2004

FIGURE 7.1

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Date: 2004/7/15
Plot Scale: 1=1 (Paper Space)
AutoCAD File: 023265\REPORT\MARCH\3265-FG_7.1.DWG (SC)
Xrefs: ARTERIAL_CITY BOUNDARY, plan, BOUNDARY, 3265rt02, trunks, RIVERS_7.1

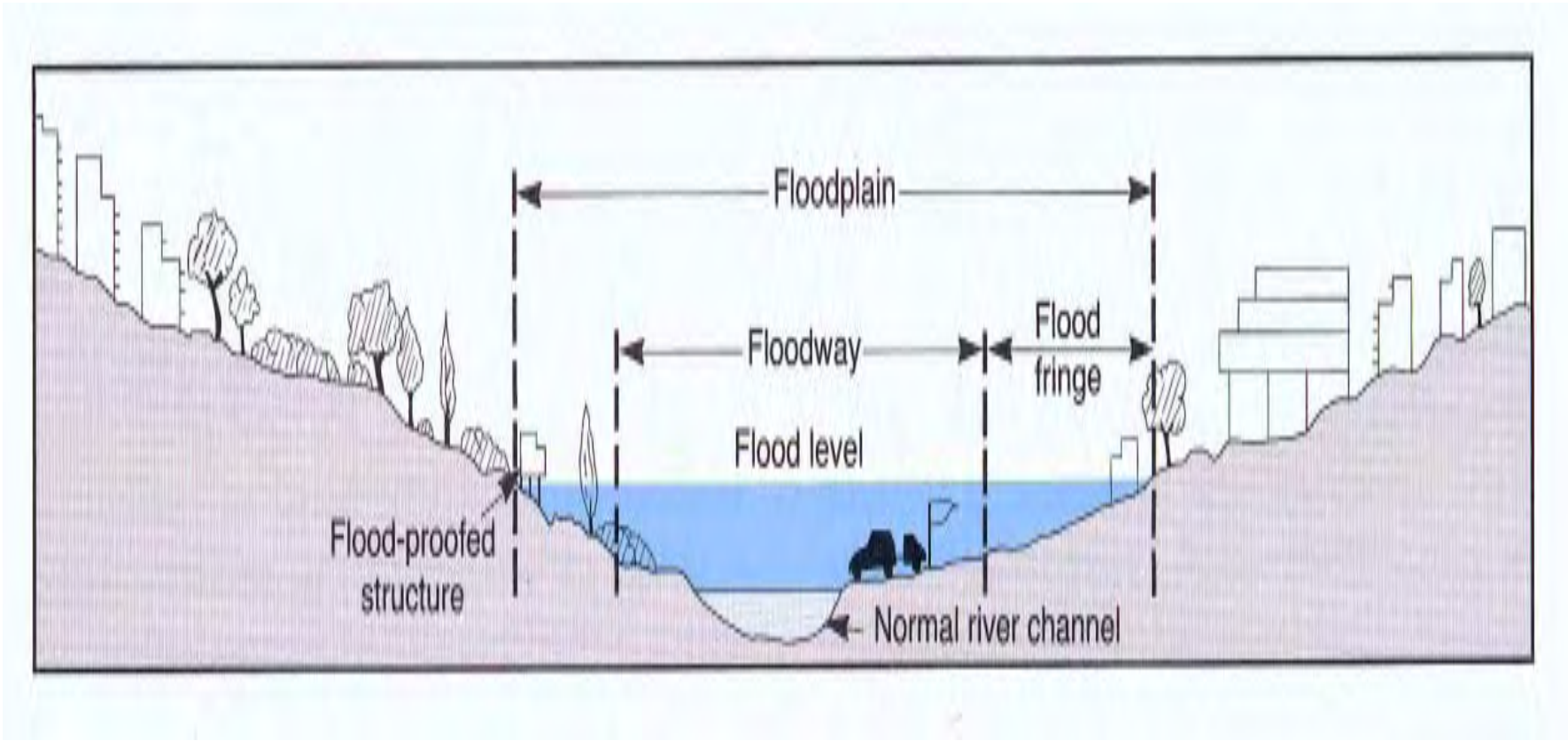
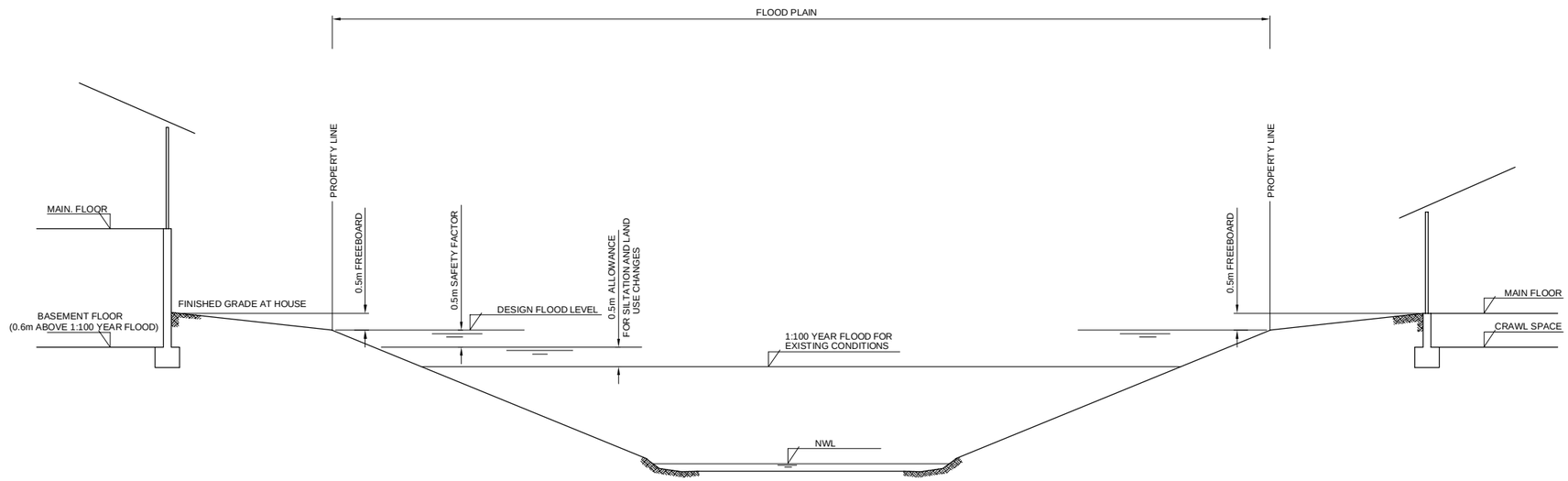


FIGURE 7.2
CONCEPTUAL FLOODPLAIN CROSS-SECTION



THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

RECOMMENDED MINIMUM DEVELOPMENT SETBACKS ON BIG LAKE AND STURGEON RIVER

SCALE 1:30,000

JULY, 2004

ASSOCIATED ENGINEERING

FIGURE 7.3

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Date: 2004/5/10
Plot Scale: 1=1 (Paper Space)
Author: Date: I:\2003\03265\REPORT\MARCH\3265-FG_7.3.DWG (SC)
Xrefs: 3265x102

THE CITY OF St. Albert
PLANNING & ENGINEERING SERVICES

STORMWATER MANAGEMENT MASTER PLAN

PARKS AND OPEN SPACES

LEGEND

Proposed	Existing	
		Regional Greenways
		Municipal Open Spaces
		Natural Areas
		Waterbodies & Watercourses
		Stormwater Management Facilities
		Existing Trails
		Stormwater Trunk System
		City Boundary
		Ravine or Channel

SCALE : 1 : 30000

JULY, 2004

FIGURE 7.4

ASSOCIATED ENGINEERING

GIBBS & BROWN LANDSCAPE ARCHITECTS LTD.

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Date: 2004/7/5
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AutoCAD File: 023365 MEPORT\MARCH\3285-FIG_7.4.DWG (SC)
Xrefs: ARTERIAL CITY BOUNDARY, RIVERS_21, BOUNDARY, roads, plan, 3265r102

CONCLUSIONS

SECTION 8

Following is a summary of the principal conclusions made in the study. Details are provided within the main body of the report.

8.1 SYSTEM CAPACITY

The existing storm trunk sewers generally have capacity (without surcharging) for the 1:2 year to 1:5 year storm, which is generally consistent with the design standards which applied when the storm sewers were developed. Although some are theoretically overloaded by today's standard, these trunk sewers can carry substantially more flow by surcharging (flowing under pressure).

It would not be cost effective to upgrade the storm sewer system to provide the level of service required by present standards. The analysis to date demonstrates that the pipe system generally provides an adequate level of service, and that observation is supported by the lack of flood reports from the field or flooding complaints from the public. However, the modelling indicates that there are a number of locations where a significant volume of water can collect on the ground surface in a major storm. These areas should be reviewed in the field to determine if they have potential for flooding of private property. More detailed analysis, including modelling of major drainage system flows, may be required in some areas.

Some of the older areas, adjacent to the river, were developed without storm sewers. There is potential for large flows on the street and for deterioration of the street surfaces in these areas. The potential exists to cause flooding or surface flows entering private property.

The Braeside/Forest Lawn trunk sewer which serves the Campbell Industrial Area is severely overloaded and there is significant risk of flooding in the upstream areas. Therefore, future development in this basin will require stormwater management to control peak flows discharged to the river.

8.2 TRUNK SEWER SYSTEM STRUCTURAL CONDITION

Based on the pilot sewer inspection program, which covered about 5% of the storm sewer pipes, the pipe system appears to be in reasonably good condition. About 2% of the total length of inspected pipes need to be replaced or repaired. Minor repairs are also required at about two-thirds of the storm sewer outfalls to correct structural or safety-related issues.

The concrete channel in the Forest Lawn Ravine, which carries stormwater runoff from the Forest Lawn, Akinsdale, and Campbell Industrial areas, is beginning to deteriorate and this could lead to erosion of the ravine. The recommended solution in the short term is to replace the most critical sections and to provide erosion protection in critical areas. In the longer term, subject to further assessment and monitoring, the preferred solution is to replace the existing concrete channel with gabion mats or to place gabion mats directly on top of the existing concrete channel.

8.3 SEDIMENT MANAGEMENT

Sediments from urban runoff have been accumulating in the Sturgeon River and have contributed to portions of the river, near the storm sewer outfalls, becoming noticeably shallower and in some instances, impeding the river flow. These sediment accumulations also have the potential to cause higher flood levels in a major flood, in the order of 0.1 m higher than would otherwise occur. Sediments will continue to accumulate as the river flows and velocities are too low to flush these sediments downstream.

A large-scale dredging program to remove the accumulated sediments would not be feasible due to the large costs (at least $2 million) and major environmental disturbance that would be involved. Instead, a limited excavation program at the outfalls, combined with measures to reduce the further accumulation of sediment, are recommended.

8.4 FLOODPLAIN MANAGEMENT

The floodplains of Big Lake, Carrot Creek, and the Sturgeon River provide valuable environmental benefits including flood conveyance and storage, wildlife habitat, and water quality benefits that must be preserved and protected.

The floodplains also provide valuable natural areas that are a source of pride to the community and form the land base for the Red Willow Park.

Stormwater management facilities should be designed to be compatible with the parks and open spaces of St Albert and ideally, should be integrated to form water features that add amenity value to these open spaces and natural area.

8.5 WATER LEVEL REGULATION

Installing a 1-2 m high inflatable weir downstream of St Albert could be a viable means of controlling water levels in the Sturgeon River and maintaining a deeper channel through the City. The weir would have to be lowered prior to each spring runoff to prevent raising flood levels in Big Lake. A number of environmental issues would have to be addressed before such a project could be undertaken.

8.6 GEOTECHNICAL

The geotechnical assessment indicates that sub-surface soil conditions are generally favourable for the construction of storm sewers and stormwater ponds. Excavation will be more difficult in the weaker soils near Big Lake and the Sturgeon River. This assessment was done on an area-wide basis, using limited available date and, therefore, local conditions may vary.

8.7 AQUATIC AND TERRESTRIAL RESOURCES

The fish and wildlife and the natural habitat of Big Lake and the Sturgeon River are valuable natural resources that must be protected and preserved. Stormwater management activities should be compatible with, and ideally should compliment, the natural area management plans of St. Albert, especially the Red Willow Park Master Plan.

RECOMMENDATIONS

SECTION 9

9.1 SYSTEM UPGRADES

The recommended upgrades and maintenance activities to the existing storm drainage system are described below, and summarized in Table 9.1. Costs included contingency and engineering, but do not include inflation factors.

- Expand the existing dry pond in the north Campbell Industrial area to accommodate runoff from the development area and to reduce the risk of flooding in the Campbell Industrial area (estimated cost of $330,000).
- Construct a stormwater management wetland in the south Campbell Industrial area to reduce flows, surcharge levels, and the risk of flooding in the downstream drainage system and to provide stormwater management for the remaining development area in this basin (estimated cost $1.2 million).
- Complete the inspection of the storm trunk sewers over the next five years, and the collection system over the next 15 to 20 years (cost approximately $150,000 per year).
- Rectify significant pipe defects (those which threaten the integrity of the pipe system and which, if left unattended, could lead to further damage and remedial costs) in the storm sewer trunk system as they are identified (estimated cost $285,000 for 2004 and $380,000 per year for five subsequent years). This program should be extended to the lateral sewers, with annual costs of $150,000 for inspections, and $200,000 for rehabilitation (assume 15 years).
- Repair storm sewer outfalls for structural and safety-related concerns (estimated cost $270,000).
- Undertake a limited project to replace the critical sections of the concrete channel in the Forest Lawn Ravine, install gabions in areas where bank erosion is occurring, and monitor and continue to evaluate the longer-term options (estimated cost $400,000), before committing to a full-scale upgrade program.
- In other areas where the storm sewers are overloaded by today's standards, it is recommended that the trunk sewers be replaced over the long term as neighbourhoods redevelop, with new trunks designed to suit the standards which will apply at the time.
- Monitor flows in the downstream trunks to confirm the model assumptions.

Table 9.1

System Upgrading and Maintenance Cost Estimate

Item	Year 2005	2006	2007	2008	2009	2010	2011	Future
Part A - System Upgrading Work								
Expand the existing North Campbell Industrial dry pond			$ 330,000					
Construct new SWM wetland in South Campbell Industrial area to control flows and flooding the Braeside/Forestlawn Trunk system		$ 1,200,000						
Total Annual Costs for System Upgrading Work	**$ -**	**$ 1,200,000**	**$ 330,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Part B - System Maintenance Work								
Complete inspection of trunk sewers (approx. $150,000/year)	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000			
Repair defects in the trunk sewers as they are identified before they develop into severe problems	$ 285,000	$ 380,000	$ 380,000	$ 380,000	$ 380,000	$ 380,000		
Repair storm outfalls for structural and safety concerns			$ 307,000					
Pilot rehabilitation of concrete channel in Forest Lawn Ravine	$ 400,000							
Carry out inspections of lateral sewers (assume $150,000/year for 15 years)						$ 150,000	$ 150,000	$ 1,950,000
Repair lateral sewer defects identified in inspection program (assume $200,000/year for 15 years)							$ 200,000	$ 2,800,000
Total Annual Costs for System Maintenance Work	**$ 835,000**	**$ 530,000**	**$ 837,000**	**$ 530,000**	**$ 530,000**	**$ 530,000**	**$ 350,000**	**$ 4,750,000**
Part C - Sedimentation Management Work								
Construct oil/grit separators and/or settling ponds to reduce discharge of urban sediments to the Sturgeon River	$ 1,040,000	$ 1,040,000	$ 1,040,000	$ 1,040,000	$ 1,040,000	$ 1,040,000	$ 1,040,000	$ 3,120,000
Sediment removal in vicinity of major outfalls			$ 500,000					
Total Annual Costs for Sedimentation Control Work	**$ 1,040,000**	**$ 1,040,000**	**$ 1,540,000**	**$ 1,040,000**	**$ 1,040,000**	**$ 1,040,000**	**$ 1,040,000**	**$ 3,120,000**
Part D - Further Study								
Flow Monitoring		$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000		
Local Flooding Assessment		$ 15,000						
Big Lake Regulation - Feasibility Study		$ 100,000	$ 100,000	$ 100,000				
Comprehensive Model		$ 20,000	$ 20,000		$ 100,000			
Upgrade Plan for Older Neighbourhoods						$ 50,000	$ 30,000	
Total Annual Cost for Further Study	**$ -**	**$ 160,000**	**$ 145,000**	**$ 125,000**	**$ 125,000**	**$ 75,000**	**$ 30,000**	**$ -**
GRAND TOTAL - ANNUAL COSTS FOR STORM SEWER SYSTEM	$ 1,875,000	$ 2,930,000	$ 2,852,000	$ 1,695,000	$ 1,695,000	$ 1,645,000	$ 1,420,000	$ 7,870,000

Note: Costs represented are in 2004 dollars, and do not include escalations for inflation.

- Require on-site stormwater management for any lots remaining to be developed in the Campbell Industrial Area, with costs to be borne by the builder/developer.
- Field assessment of localized flooding potential at locations where the model indicates significant ponding.
- Outfalls should be located and physically marked with a name plate in the field.
- Work towards a comprehensive model of the storm drainage system, including the smaller lateral pipes and details of the major drainage system.
- Develop a replacement plan for storm sewers in the older neighbourhoods along with a long term redevelopment plan for these areas.

Table 9.1 provides a summary of the upgrade requirements and projected costs.

9.2 SYSTEM EXPANSION

Stormwater management is recommended for all new development areas with a design release rate of 2.5 L/s/ha of contributing area as recommended in the Big Lake Drainage Study) to:

- meet Alberta Environment's standards to control flows and water quality in all development areas
- reduce the runoff of sediment to the Sturgeon River and Big Lake
- prevent increasing flows and water levels in Big lake and the Sturgeon River

Figure 7.1 provides the preliminary pond locations and Table 7.1 provides preliminary pond sizes for the areas remaining to be developed within the existing City boundaries. The cost of this work will be the responsibility of the respective developers. Detailed site specific geotechnical studies will be required in the engineering design of these facilities.

All estimates of pond sizes are conceptual level and subject to review at the design phase.

9.3 SEDIMENT MANAGEMENT

Associated Engineering recommends that the City of St. Albert continue to work towards reducing the discharge of sediment to the Sturgeon River before removing the sediments that have already accumulated. Specific recommendations are:

- install oil/grit separators at storm sewer outfalls to reduce the discharge of sediment to the river (specifics will vary according to local conditions and could include

underground in-line tanks or surface settling ponds); estimated cost $3.1 million dollars for the five highest priority sites and $7.3 million for eighteen other sites (over 10 years)
- design settling ponds to be compatible with and provide a water feature adjacent to the park
- conduct pre-design studies to develop the conceptual designs at the high-priority sites
- require stormwater management (wet ponds or wetlands) for all new development areas
- continued vigilance in regulating construction practices which generate inordinate amounts of sediment
- remove the deepest deposits of sediment that have accumulated at the storm sewer outfalls (estimated cost $500,000)
- increase the frequency of street sweeping and cleaning catchbasins

9.4 FLOODPLAIN MANAGEMENT

Floodplains of Big Lake, Sturgeon River, and Carrot Creek must be protected and preserved. Specific recommendations include:

- that the City request the Province to prepare a floodplain map for the Sturgeon River, Big Lake, and Carrot Creek, to include single-zone mapping (no distinction between the floodway and flood fringe), and to provide adequate freeboard to allow the potential impacts of sedimentation and land use changes in the basin and other sources of uncertainty
- pending the results of the floodplain study, that the City adopt a policy that permits no filling or development of the floodplains, including lands lying below an elevation of 654.18 m around Big Lake, other than specified activities such as parks, drainage facilities, and road crossings
- that the City, jointly with other area municipalities, develop a Floodplain Overlay within its Land Use Bylaw (a land use policy instrument that specifies the permitted and prohibited land uses in the floodplain and apply to all underlying land use districts)
- that stormwater management facilities, discharging at a rate of 2.5 L/s/ha, be provided for all future development areas
- that stormwater management facilities be designed to enhance and to be integrated with the parks and open spaces of St. Albert, and be used to provide buffer zones between Red Willow Park and adjacent development

9.5 BIG LAKE WATER LEVEL REGULATION

- conduct a feasibility study for regulating water levels in Big Lake and the Sturgeon Lake in partnership with stakeholders and other jurisdictions
- consider establishing a riverfront walkway with restaurants, coffee shops, and boutiques to take advantage and help to support the enhanced riverfront environment through the downtown area

CLOSURE

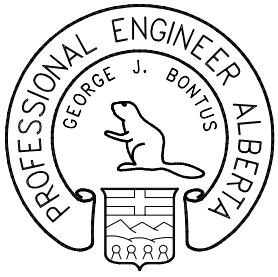
SECTION 10

This report has been prepared for the City of St. Albert to provide the Stormwater Management Master Plan for the City of St. Albert.

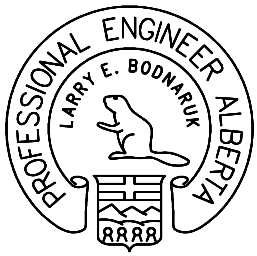
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Respectfully submitted,

ASSOCIATED ENGINEERING ALBERTA LTD.



[Signed and Dated]
George Bontus, P. Eng.
Project Manager



[Signed and Dated]
Larry E. Bodnaruk, P. Eng.
Senior Resource Engineer

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