M.D. OF FOOTHILLS NO. 31

Water, Wastewater and Stormwater Servicing Strategy

Highway 2A Area Structure Plan

FINAL REPORT

Revised March 31, 2010

(2210-026-00)

Prepared by:

Engineering Ltd.

March, 2010

EXECUTIVE SUMMARY

The M.D. of Foothills No. 31 (MD) requires a Water, Wastewater and Stormwater Master Servicing Plan within the Highway 2A commercial and industrial use corridor from west of the Hamlet of Aldersyde south to the Town of High River. This servicing study will be used as a guiding document and support for the Highway 2A Area Structure Plan that is currently under review by the MD.

LAND USAGE

The MD is proposing to implement low impact, light industrial, "Eco-industrial" development. A summary of the land areas and the prospective usage of each within the study area is as follows:

Table 1
Current and Future Land Usage Areas

Land Usage	Current		Future	
	Area (hectares)	Percentage of Total	Area (hectares)	Percentage of Total
Flood Plain and Environmental Reserve	267	7.2 %	267	7.2 %
Residential	248	6.7 %	248	6.7 %
Traditional	2,555	69.2 %	1,020	27.6 %
Industrial/Commercial	461	12.5 %	1,987	53.8%
Industrial Natural Resources	145	3.9 %	145	3.9 %
Municipal and Recreational	17	0.5 %	26	0.8%
TOTAL	**3,693**	**100 %**	**3,693**	**100 %**

POTABLE WATER SUPPLY

The design average daily demand potable water flows for the fully developed study area are detailed below. Design demands for Cargill Foods Ltd. (Cargill) are shown separately as they are a significant water consumer.

Table 2
Summary of Average Daily Design Flows

User	Current (m^3/day)	Phase 1 50% Build out (m^3/day)	Phase 2 100 % Build out (m^3/day)
Residential	107.4	107.4	107.4
Industrial & Commercial	149.2	2,293	4,321
Saddlebrook	0	136	136
Foothills Regional Indoor Field House	0	9.4	9.4
Residential North of ASP Area	95.8	224.5	224.5
Sub-total	***352***	***2,770***	***4,799***
Cargill	6,054	7,568	7,568
TOTAL	**6,406**	**10,338**	**12,367**

Access to raw water is required to meet the potable water demand. At full development, 2,119,300 m^3 of raw water license is required, (includes a 10% allowance for losses). The MD currently has 675,540 m^3 of raw water license allocated for this area. Acquisition of an additional 1,443,700 m^3 is therefore required to satisfy the demands of this area at full development. These numbers exclude Cargill's design demands and also exclude Cargill's current diversion licenses. Cargill requires an additional 828,600 m^3 for their future proposed long term growth (includes a 10% allowance for losses).

The two municipalities in close proximity to the ASP area are the Town of High River and the Town of Okotoks. Two alternatives were considered for potable water servicing for the area:

- ***Alternative #1: Serviced by Town of High River***
- ***Alternative #2: Serviced by Town of Okotoks***

The most cost effective alternative is to obtain potable water from High River. The conceptual design directs water to an elevated 4,900 m^3 potable water storage reservoir located within the ASP Area. The Town of High River would provide/meet the maximum day demand requirement. Peak design flows and fire flows would be met and delivered from the storage reservoir.

WASTEWATER SERVICING

Certain developed areas within the ASP area currently direct municipal wastewater to the Town of High River's wastewater treatment facility. Cargill has an independent wastewater treatment facility.

Three alternatives were examined for wastewater servicing. These are:

- Alternative #1: Direct Wastewater to High River for Treatment.
- Alternative #2: Direct Wastewater to Okotoks for Treatment.
- Alternative #3: Joint servicing - Direct partial flows to Okotoks and remaining flows to High River

The most cost effective alternative for servicing is to direct all of the wastewater flows to High River and utilize the Town's wastewater treatment facilities.

STORMWATER MANAGEMENT

The ASP area has five drainage catchments; four ultimately flow towards and into the Highwood River and the other one flows towards and into the Sheep River. The pre-development release rate for the ASP area is established at 5 L/s/ha for the 1:100 year storm event. The required storage areas required to maintain the pre-development release rate are provided below.

Table 3
Storage Requirement for 1:100 Year 24 Hour Event

ASP Catchments	Catchment Area (ha)	Required Storage[1] (m^3)	Unit Release Rate (L/s/ha)	Discharge (L/s)	Approximate Footprint Area of Pond (ha)
HW-1	690.0	345,341	5	3,450	11.4
TCHW	882.0	478,610	5	4,410	15.6
HW-2	985.6	627,439	5	4,930	20.0
HW-3	962.0	520,431	5	4,810	16.8
SR	172.9[2]	70,816	5	517	2.8
TOTAL	**3,692.5**	**2,125,200**			**66.6**

COSTS AND ECONOMICS

Net Present Value (NPV) costs over a 20 year term are summarized below.

Table 4

2010 Utility Rates and Development Levies

Parameter	NPV M.D.[1] Capital and Operating Costs	Bulk Rate from Third Party Municipality ($/m^3)	M.D.[4] Rate ($/m^3)	Total User Rate ($/m^3)	Levy per Acre [2,3]	Levy per Lot [2,3]
Raw Water Acquisition	$3,470,000	n/a	n/a	n/a	$747	$1,810
Water Supply from High River	$24,190,000 [1]	$1.00	$0.33	$1.33	$4,190	$10,100
Wastewater Directed to High River	$28,600,000 [1]	$0.67	$0.42	$1.09	$4,990	$12,030
Stormwater Conveyance Infrastructure	$2,860,000	n/a	n/a	n/a	$619	$1,470
Functional Pathway	$ 2,120,000	n/a	n/a	n/a	$457	$1,110
TOTAL	**$61,240,000**				**$11,000**	**$26,530**

1. Excludes NPV of bulk water rate.
2. Levy based on NPV of capital raw water acquisition, water supply and wastewater directed.
3. Levy based on NPV of capital and operating for stormwater and functional pathway.
4. Assumes exponential growth to full build out by 2030.
5. Net developable area 1,879 hectares.

CONSERVATION AND SUSTAINABILITY

Water conservation measures significantly reduce infrastructure costs (both capital and operating), aids in reducing the amount of raw water acquisition (a finite resource), increases the number of lots that can be serviced, and mitigates impact on the watershed. Regulatory policies on stormwater re-use are anticipated to be available in the short term but have not been established to date. Without regulatory policies, stormwater re-use as a water conservation strategy may be premature. Alberta Environment limits the use of recycled wastewater for non-potable consumption to effluent irrigation and cooling water for industrial use.

Challenges to implementing further uses of recycled wastewater for non-potable consumption include:

- Costs of infrastructure,
- Concerns of potential cross-contamination to the potable water supply,
- Regulatory hurdles.

However, for the purposes of this study, it is assumed that current water consumption levels will be maintained for the area.

CONCLUSIONS

The following conclusions are developed from the study:

1. In order to fully develop the ASP area, access to 1,443,700 m^3 of raw water license is required in addition to the existing licenses and agreements. This does not include the additional 828,600 m^3 of raw water license Cargill requires to expand their operations.

2. At full build out, the design average daily potable water demand for the study area and the residential communities to the north of the study area is 4,799 m^3/day. In addition to this, the design average daily potable water demand for Cargill is 7,568 m^3/day.

3. The design average daily flow generation of wastewater for the study area is 4,574 m^3/day. Cargill has its own wastewater treatment facility; therefore it is not included in this value. The Highwood and Sheep Rivers have limited capacity to receive treated effluent. Stringent treatment levels for the generated wastewater will be required in order to permit discharge to either of these two river basins.

4. To maintain a stormwater pre-development release rate of 5 L/s/ha at full build out of the study area, 2.13 million m^3 of stormwater storage is required. This value is based on the 1:100 year storm event.

5. The most cost effective potable water supply is from the Town of High River. High River will require a water treatment plant capacity of 44,200 m^3/day (maximum daily demand) to accommodate full build out of the study area (including Cargill); the residential communities north of the study area and the Town of High River 2030 projected population.

6. The most cost effective wastewater servicing is development of the required infrastructure such that it delivers flows to the Town of High River. The wastewater is proposed to be treated in the Town of High River wastewater treatment facility. High River will require a wastewater treatment facility of 8,942 m^3/day (average daily flow) and require a hydraulic capacity for a peak wet weather flow of 205.5 L/s in order to accommodate full build out of the study area, the residential communities north of the study area and the Town of High River's 2030 projected population. Cargill's needs are excluded because they treat their own wastewater.

7. Implementation of water conservation measures must be considered as they significantly reduce infrastructure costs (both capital and operating), aid in raw water acquisition requirements (a finite resource), increase the number of lots that can be serviced, and mitigate impact on the watershed. There may be an opportunity to use recycled tertiary treated wastewater in the cooling process at the Saddlebrook power generating facility.

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APPENDICES

1.0 INTRODUCTION

1.1 Project Overview

The M.D. of Foothills No. 31 (MD) requires a Water, Wastewater and Stormwater Master Servicing Plan within the Highway 2A corridor. The study area includes all the lands, generally from west of the Hamlet of Aldersyde and south to the Town of High River, one mile west of Highway 2A, and east of 2A to the Highwood River. This servicing study will be used as a guiding document and support for the Highway 2A Area Structure Plan (ASP). The ASP is currently under review by the MD.

With the anticipated growth in the area, the MD has requested this servicing study be undertaken. The Towns of High River and Okotoks have grown rapidly in recent years. The study area is between these communities and is anticipated to grow commercially and industrially. The MD has designated the corridor along Highway 2A for commercial and industrial use; development is already beginning.

The objective of the study is to undertake a pre-design analysis to develop alternatives for regional potable water servicing, regional wastewater servicing and regional stormwater management. Further, the study was to review the capacity of the existing infrastructure within the region and evaluate its ability to service the development.

1.2 Project Scope

The project scope consisted of:

- Review existing infrastructure;
- Evaluate servicing needs of future industrial users;
- Establish development growth parameters;
- Develop current and future potable water demands, wastewater flows, and stormwater run-off/storage requirements;
- Evaluate scenarios for potable water conservation as well as review potential water, wastewater and stormwater re-use;
- Review environmental requirements/considerations;
- Establish optimum servicing alternatives;
- Develop cost projections for infrastructure servicing.

1.3 Background

The study area is located 45 km south of Calgary. It consists of a 10 km long section of Highway 2A between the Town of High River and the Hamlet of Aldersyde and a five km long section going west along Highway 7 from Aldersyde to the Town of Okotoks. **Figure 1** (following page) illustrates the location of the study area.

The site is dominated by prairie uplands and some low lands. The elevation within the study area ranges from 1014 m near the northeast corner of the RV Park adjacent to the Sheep River to 1120 m at the northwest corner of the study area. The soil type of the study area is determined from the Soil Group Map of Alberta, and is dominated by fine textured soils comprising of clay, sandy clay, and silty clay.

This study is generated from the proposed updating of the Highway 2A Area Structure Plan (ASP) by the MD. Currently, planning for this area is guided by the Highway 2A Industrial Area Structure Plan (H2AI ASP) dated 1995. This document was completed prior to the 1998 adoption of the Municipal District of Foothills Municipal Development Plan and Land Use Bylaws. Amendments to the H2AI ASP are required in order to address and update sections pertaining to these statutory plans and land use designations.

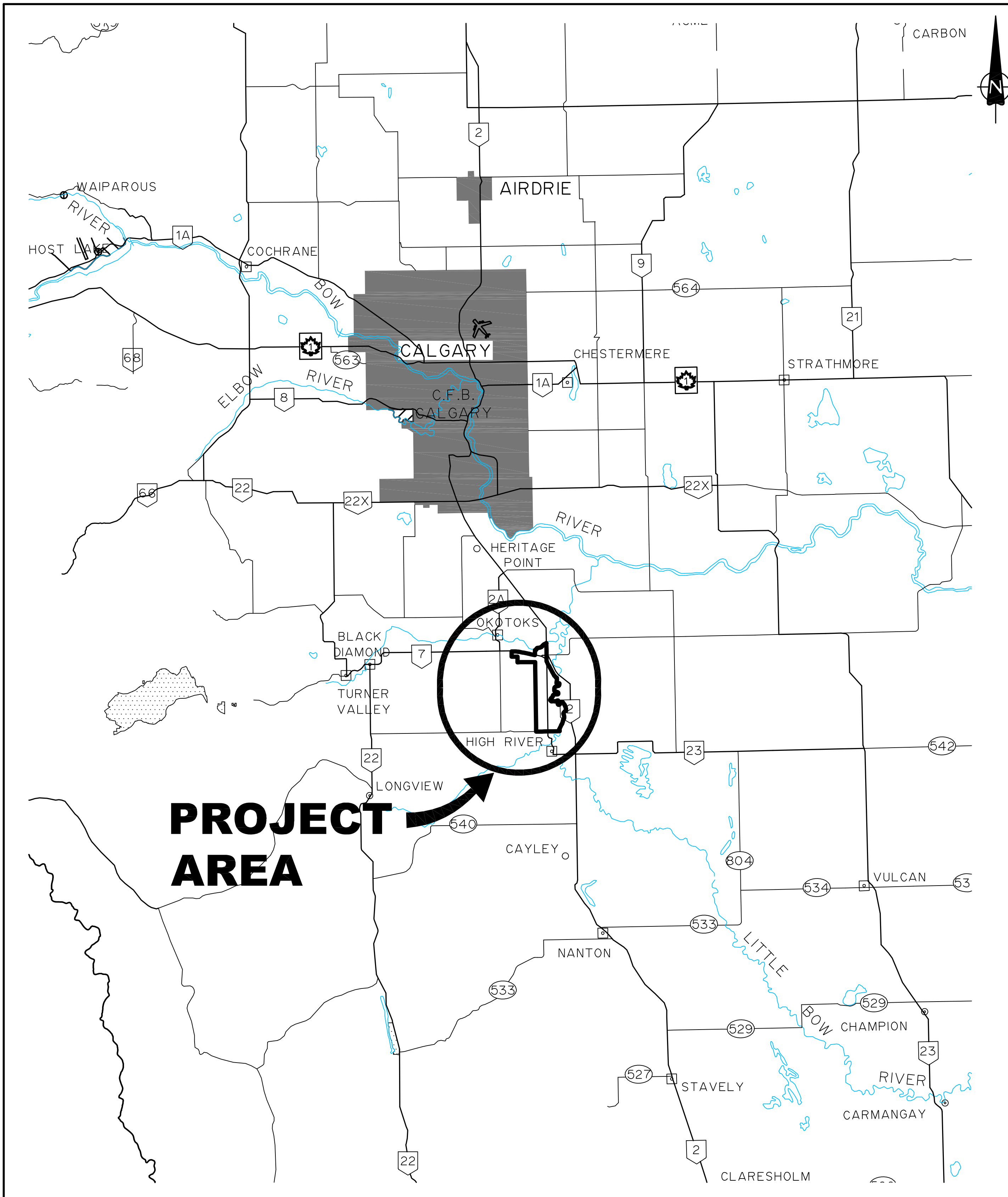
1.4 Relevant Initiatives

There are several initiatives in the Province of Alberta that are relevant to potable water supplies, treated effluent discharge, and stormwater management. These initiatives are discussed below.

1.4.1 The Calgary Regional Partnership (CRP)

The Calgary Regional Partnership (CRP) is an organization that had consisted of 18 member communities from the Calgary and surrounding area (15 urban/3 rural). The CRP now consists of 15 urban member communities. The following rural municipalities are no longer members of the organization:

- M.D. of Foothills No. 31
- Rocky View County
- Wheatland County



HWY 2A ASP SERVICING STUDY
SERVICING STUDY
LOCATION PLAN

M.D. OF FOOTHILLS NO. 31

MPE Engineering Ltd.

DATE:	MARCH 2010
PROJECT No:	2210-026-00
SCALE:	NTS
FIGURE:	1

The CRP's focus is to solve regional issues through inter-municipal cooperation. Some of the issues being addressed by the organization are; coordinating planning, monitoring the region's environmental carrying capacity, transportation pressures, and reviewing the critical infrastructure servicing needs. Various reports providing information on regional growth, population projections, economic development, transportation, and water and wastewater servicing have been developed for the CRP.

The MD was a member of the CRP up until September, 2009, and has since elected to decline membership. However, the study area is included within the CRP's service area. Hence the CRP reports have been utilized to provide relevant data for the study area.

Excerpts from the CRP work for the study region show the following:

Table 1.1
Calgary Regional Partnership Design Parameters

Parameter	Area (Year)	Value
Population	Town of High River (2006) Town of High River (2076)	10,944 people 41,572 people
	Town of Okotoks (2006) Town of Okotoks (2076)	17,498 people 58,338 people
Water Consumption	Town of High River (2005)	778[1] L/c/d
	Town of Okotoks (2005)	329 L/c/d
	M.D. of Foothills No. 31 (2005)	450 L/c/d
Wastewater Generation	Town of High River (2005)	513 L/c/d
	Town of Okotoks (2005)	311 L/c/d
	M.D. of Foothills No. 31 (2005)	400 c/d

1. Litres per capita per day (L/c/d).

1.4.2 Alberta's "Water for Life" Strategy

In 2003, the Province of Alberta unveiled its "Water for Life" Strategy. The "Water for Life" strategy is based on the following commitments to Albertans:

- Safe, secure drinking water supply,
- Healthy aquatic ecosystems, and
- Reliable, quality water supplies for a sustainable economy.

Specific goals outlined in the strategy include:

- Encouragement for communities to adopt water conservation measures which will see a 30% reduction of water use by 2030, and
- Design and implement Regional Water Systems to reduce the number of water treatment facilities.

1.4.3 South Saskatchewan River Basin Moratorium on Diversion Licenses

The ASP area is located within the Bow River Basin. This basin is a sub-basin of the regional South Saskatchewan River Basin. The ASP area is located southwest of the confluence of the Sheep River and the Highwood River. Alberta Environment (AENV) is the licensing authority for withdrawal of surface water under the Water Act. A moratorium (no new additional water licenses) has been placed on the South Saskatchewan River Basin as well as groundwater aquifers within the basin. Currently, the only method of obtaining surface water allocations is through transfer of existing water licenses. All water license transfers require approval from AENV. Ten percent of any water license transfer may be required to be returned back to the crown.

1.5 Previous Studies

Water and wastewater servicing studies have been undertaken within the ASP area for specific developments or reviewed for the entire area. These reports were utilized to gather historical and relevant data and incorporated into the ASP servicing strategy. A summary of the three reports and key findings are provided below.

Aldersyde and Area Sanitary Sewer Study, Bel-MK Engineering Ltd., December 2006

This report was commissioned by the MD to examine alternatives for wastewater collection and treatment for the ASP area as well as properties north of Highway 7 that extended to the Sheep River. Recommendations from the study were to construct sanitary trunk mains along Highway 2A and connect the collection system to either the Town of High River or the Town of Okotoks wastewater treatment facilities. The most cost effective option was to connect to the Town of High River's wastewater treatment facility. It was estimated wastewater generation at full build out of the study area was estimated to be 16,238 m^3/day. This was based on residential average day flows of 1.19 m^3/day/lot and commercial/industrial average day flows of 6.07 m^3/day/acre.

Highway 2A Industrial Area Structure Plan, M.D. of Foothills No. 31 and Interplan Strategies Inc., September 1995

The Highway 2A Industrial Area Structure Plan (H2I ASP) was adopted by the MD in September 1995, under bylaw 128/95. This ASP encompassed the Highway 2A corridor between the Hamlet of Aldersyde and the Town of High River. The H2I ASP was prepared prior to the adoption of the Municipal District Municipal Development Plan and Land Use By-laws. This report provided details of the existing infrastructure.

High River WWTP and Cargill Upgrade Conceptual Design, CH2M Hill, February 2007

CH2M Hill prepared this conceptual design report for the MD to review options for enhancing the treatment at the Town of High River Wastewater Treatment Facility and the Cargill Foods Effluent Treatment Plant. The objective was to reduce nutrient loading to Frank Lake. Currently, treated effluent from each of these facilities is directed to Frank Lake. The report established design wastewater flows for both the Town and for Cargill. The report provided alternative technologies for wastewater treatment to achieve effluent quality standards for total phosphorous limits ranging from 1.0 mg/L to 0.1 mg/L.

1.6 Current Land Usage

Figure 2* illustrates the existing land usage within the study area. Current land usage is a mixture of agricultural, residential, industrial, and commercial. The majority of the study area is pasture and agricultural land. Residential use is concentrated in the northern portion of the study area in the Hamlet of Aldersyde and on residential acreages southwest of Aldersyde. Current industrial and commercial developments in the study area are listed (from north to south):

- Volker Stevin
- Petro Canada
- Hamlet of Aldersyde – light industrial
- Sprung Instant Structures
- Mullen Trucking
- Mini Storage
- TransCanada – Saddlebrook/Magcan
- Abilds Industrial Park
- Nelson's Houses
- Cargill Foods
- Trailer Outlet
- Christianson Pipe
- Gravel Pit Extraction

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* Note: Figures 2 through 14 are located in Appendix A.

2.0 EXISTING INFRASTRUCTURE

The existing potable water, wastewater and stormwater infrastructure within the study area are detailed below.

2.1 Raw Water Supply

Sources of raw water in Alberta are defined under three categories and are as follows:

- Groundwater,
- Groundwater Under the Direct Influence of surface water (GWUDI),
- Surface water.

Water withdrawal and use is regulated in Alberta by AENV under the Water Act. Wells that have no hydraulic connection to ground surface or to surface waters are classified and require licensing as groundwater. All other water diversions of GWUDI require surface water diversion licensing approval.

2.1.1 Groundwater

A review of water wells in the area indicated that 64 wells are drilled and registered on the AENV Groundwater Data Base. Of these 64 wells, only 23 were found to produce water. All 23 wells, except one, have flows less than or equal to 0.8 L/s (10 Igpm). The average flow was 0.4 L/s (5.5 Igpm). One well located in 25-19-29-W4, depth 30.5 m (100 feet), has a pumping rate of 1.2 L/s (16 Igpm).

The 64 wells range in depth from 3.7 m to 127 m (12 to 416 feet). This cursory review indicates that groundwater supply in the study area is limited and will not sustain future development.

2.1.2 Surface Water

Due to the moratorium on water allocation/diversion licenses within the South Saskatchewan River Basin, the only method of obtaining surface water allocations is through the transfer of existing water licenses. Water licenses are currently a commodity that are bought and sold. Costs to acquire water licenses from existing holders must be considered. This cost is expected to increase over time based on an increased demand for water (as a commodity) and the limited supply of this commodity. The market for water is volatile. A recent sale was as high as $7,500/ac-ft ($6.08/m^3) having been paid. Typical rates within the South Saskatchewan River Basin have been on average approximately $3.00/m^3.

Approval from AENV is required when transferring ownership and/or the diversion point of water licenses. When licenses are transferred, 10% of the quantity acquired may be required to revert back to the crown in the interest of watershed management. Before approving a water license transfer, AENV requires that the party acquiring the diversion provide a demonstrated use for the water.

AENV can suspend water diversion during low flow periods in order to ensure instream flow objectives are met. Suspension would occur in reverse order of issuance, with those issued most recently being the first to be suspended. AENV has indicated that a water response plan will be required as part of the acquisition process of junior licenses.

Water currently being utilized/designated under current diversion licenses is being allocated either through assigned licenses to the end user or via the Town of High River's licenses "Through Agreement". **Table 2.1** provides a breakdown of the water supplies into the ASP area.

Table 2.1
Current Raw Water Allocation

Party Utilizing Diversion	As Diversion Holder or Through Agreement	Allocation (m^3/year)
M.D. of Foothills No. 31	Holder	119,650
M.D. of Foothills No. 31	Agreement (from High River)	540,890
Abild's Industrial Park	Holder	15,000
Sub-total		***675,540***
Cargill	Holder	1,110,134
Cargill	Agreement (originating from High River, though M.D. of Foothills No. 31)	414,880
Cargill	Agreement (from High River)	684,708
Cargill Sub-total		***2,209,722***
TOTAL AVAILABLE		**2,885,262**

The three water diversion licenses that are assigned/held by individual users within the study area are shown in **Table 2.2.** The MD, Abild's Industrial Park and Cargill have their own licenses. All three licenses are supplied through the Town of High River potable water system infrastructure. Details of the licenses are listed in **Table 2.2**.

Table 2.2
Water Diversion Licenses Within The Study Area

License Holder	Priority Number	Licensed Diversion (m^3/year)	Supplied by
Cargill	1988-11-23-002	1,110,134	High River WTP (groundwater)
M.D. of Foothills No. 31 (Aldersyde)	1990-01-31-03	119,650	High River WTP (groundwater)
Abild's Industrial Park	unknown	15,000	High River WTP (groundwater)
Total		**1,244,784**	

The Town of Okotoks and High River also hold water diversion licenses. These are listed in **Table 2.3**.

Table 2.3

Town of Okotoks/Town of High River Water Diversion Licenses

License Holder	Priority Number	Licensed Diversion (m^3/year)	Supplied by
Town of High River	1927-12-31-001	62,910	High River WTP (groundwater)
	1939-06-30-006	148,020	
	1939-06-30-005	215,860	
	1972-07-07-001	297,270	
	1972-07-07-002	252,860	
	1977-03-02-002	4,930,	
	1978-03-15-003	128,280	
	1984-02-13-002	494,630	
	1984-02-13-003	247,930	
	1984-02-13-004	247,930	
	1995-01-27-010	840,000	
	1995-01-27-011	840,000	
	1995-01-27-012	841,230	
	TOTAL	**4,621,850**	
Town of Okotoks	1952-12-31-002	81,400	Okotoks WTP (surface water – Sheep River)
	1979-12-10-001	145,550	
	1979-12-01-002	239,280	
	1979-12-01-003	239,280	
	1985-01-22-003	330,560	
	1985-01-22-004	168,980	
	1985-01-22-005	33,300	
	1985-01-22-006	133,210	
	1985-01-22-007	330,560	
	1996-11-29-001	91,278	
	TOTAL	**1,793,398**	

2.2 Potable Water

The majority of the existing residential, commercial, and industrial developments within the ASP area are supplied potable water via the Town of High River's potable water supply system. The remaining users have individual groundwater wells for their respective supply.

2.2.1 Municipal Supply

The municipal potable water supply that is distributed through the ASP area is provided through the Town of High River infrastructure. It is distributed by a pipeline running parallel to Highway 2A on the east side. Booster stations are located at the Abild's Industrial Park and at the Hamlet of Aldersyde. The existing potable water distribution system is shown on **Figure 3.**

The potable water line extends beyond the northern boundary of the ASP area. Potable water is provided to Petro Canada, Volker Stevin and Country Lane RV Park at the northern end of the study area and beyond to the residential community of Silvertip.

The Town of High River's water supply system consists of groundwater under direct influence of surface water, (12 shallow groundwater wells). The raw water is extracted and treated by coagulant chemical addition, rapid sand filtration and chlorination. The Town's water treatment plant has a capacity of 24,200 m^3/day. The system also has a 13,630 m^3 treated water storage facility and a high lift pumping system. The plant is regulated under the Environmental Protection and Enhancement Act by AENV under Approval #777-02-00. The approval expiry date is December 1, 2016. The plant requires upgrades including the addition of UV disinfection, and upgrading the filtration backwash. These upgrades are required to be implemented by September 1, 2010. The waste stream and the backwash water are de-chlorinated and discharged into Highwood River.

Figure 4 shows the current potable water infrastructure within the MD that distributes the supply from the Town of High River.

The potable water from the Town of High River is distributed via a 300mm PVC pipe from the town along the east side of Highway 2A up to Cargill. Water is pumped into Cargill's potable water reservoir at a fixed rate of 63 L/s (833 Igpm). Cargill provides its own pumping and pipeline distribution system.

North of the Cargill delivery point a 200 mm pipe directs potable water to a booster station located in the southwest corner of Abild's Industrial Park. At this point, water is boosted in pressure to deliver water further north. At the booster station the incoming pressure is 54psi (38.0 m) and the outgoing pressure is 64psi (45.1 m). The residential area in NE and NW 1-20-29-W4M, referred to as Maple Leaf, is serviced with potable water from this pipeline. Water to Maple Leaf area is delivered via a booster station. This booster station is located 400 m south of Maple Leaf Road; west of Highway 2A. The booster station has a storage reservoir of 45m^3, and receives pressure at 35.2m (50 psi), and discharges at 63.4m (90 psi).

The Sprung Booster Station is located south of the Hamlet of Aldersyde and 700m east of Highway 2A, just south of Maple Leaf road. This booster station maintains a pressure between 14.1m – 42.3 m (20 psi to 60 psi). The booster pump services the industrial and commercial area south of the Hamlet.

A potable water reservoir with re-chlorination facilities and pump station is located at the north end of the Hamlet of Aldersyde. This station supplies potable water to the Hamlet of Aldersyde and all users north of the Hamlet. The current reservoir is sized at 320 m^3. An additional 735 m^3 of storage is being added, as well as upgrades to the pumping distribution system. The upgrades are scheduled to be completed in the spring of 2010. The proposed discharge pressure of the upgraded facility is 45.7 m (65 psi).

2.2.2 Individual Supply

Individual residences and other facilities that are not connected to the regional supply are likely utilizing individual ground water wells and/or cisterns for their water supply. Groundwater yields are limited in this area, as discussed previously in Section 2.1.1.

2.3 Sanitary Servicing

2.3.1 General

The Abild's Industrial Park and the TransCanada Saddlebrook Facility are connected to the Town of High River's Wastewater Treatment Facility located in SW 29-19-28-W4 within the study area. Cargill has its own wastewater treatment facility. Treated wastewater from the Cargill and High River wastewater treatment facilities are directed independently to Frank Lake. Remaining developments within the study area have individual septic fields or tanks for wastewater disposal. **Figure 4** illustrates the existing sanitary collection and treatment system***.***

2.3.2 Wastewater Treatment Facilities

High River Wastewater Treatment Facility

Wastewater from the Town of High River is collected by a series of gravity sewer pipes and lift stations. The main lift station is located at the north part of High River and directs the effluent through a 700 mm diameter forcemain to the treatment facility. Wastewater from the Abild's Industrial Park and the Saddlebrook site is directed to the treatment facility by a 100 mm diameter forcemain, see **Figure 4.**

The treatment facility is a conventional aerated wastewater stabilization pond. It began operation in 1987 and consists of an aerated wastewater stabilization pond consisting of one complete mixed cell, one partial mixed cell, and a lagoon with a capacity of 27,000 m^3.

The nominal design capacity of the plant is 8,400 m^3/day. Treated wastewater is directed through a 450 mm diameter forcemain to Frank Lake for disposal. The facility is regulated by AENV under the Environmental Protection and Enhancement Act and operates under Approval #776-02-00. Frank Lake is located approximately 6 km east of High River and outlets into the Little Bow River within the Oldman River sub-basin.

The existing High River wastewater treatment facility was constructed to accommodate a population of 10,000. It is currently servicing a population greater than 11,000.

Preliminary design of a new wastewater treatment facility for the Town of High River is currently underway. The new facility is required to be implemented by September 2011. The Town of High River has indicated that this new facility is to provide a design capacity for 50,000 people. The Town is currently looking into utilizing the Highwood River as an alternate location to Frank Lake for disposal of treated effluent. There are concerns with the nutrient loading to Frank Lake as a result of disposal of treated effluent; therefore, alternate disposal locations are being considered at this time.

There is a 250 mm sanitary forcemain exiting from the treatment facility to direct treated effluent flows to the Saddlebrook Plant. This forcemain is not used. It was designed to take wastewater from the High River

Wastewater Treatment Facility and send it to the Saddlebrook plant to be used as grey water in their cooling process. Saddlebrook is currently not operating and the 250 mm pipeline is not in use.

Frank Lake is a shallow lake bordered by marshes and low-lying meadows and is a popular place for bird watching. The lake is considered to be an important wetland in southwestern Alberta for breeding water birds. The water level in the lake has been known to fluctuate, but is currently controlled by the treated effluent from Cargill and High River wastewater treatment facilities. It is also supplemented through flow from the Highwood River. In the late 1980's, pipelines from the High River and Cargill's wastewater treatment facilities were constructed to transfer the treated effluent to Frank Lake. An infiltration gallery was installed in 1989 in the Highwood River to provide supplemental water to the lake during dry years. This intake was utilized until 2004/2005 when the intake became inoperable due to siltation. In the mid 1990's, AENV detected high phosphorous levels where Frank Lake discharges into the Little Bow River. This can negatively impact the lake's ecology. Stringent treatment requirements to reduce the phosphorous level in treated effluent will likely be required for any increase in discharge of treated effluent to Frank Lake.

Cargill Foods Wastewater Treatment Facility

Cargill is a beef processing plant and has its own wastewater treatment facility on site. Approximately 20%-40% of the treated effluent is recycled for use in cleaning and flushing. Treated effluent from the Cargill Plant is discharged into Frank Lake.

Individual Systems

Remaining developments within the study area, including the Hamlet of Aldersyde are serviced by individual septic fields and/or tanks. Details of individual sanitary systems on private rural residential lots are unknown. The industrial areas around the Hamlet of Aldersyde are accommodated by sealed pump-out holding tanks on each industrial parcel. The effluent will be hauled to the respective wastewater treatment facilities.

2.4 Stormwater

2.4.1 General

Stormwater Management Standards apply to all new development within the MD other than small developments, like residential and low impervious areas. Developers are required to provide stormwater retention and control for a 1 in 100 year storm event of 24 hour duration. Stormwater must be retained for 24 hours (hrs) and the post-development discharge rate is to be the same as the predevelopment discharge rate. The Stormwater Management Guidelines for the MD are attached in **Appendix B.**

3.0 DESIGN PARAMETERS

3.1 Population and Land Usage

3.1.1 Current Population

According to the 2006 census information the Hamlet of Aldersyde had a population of 66. The MD GIS information indicates that the study area had a population of 242, in 2006. Census data indicates that the population of the MD grew at a rate of 2.2% between 2001 and 2006. For the ASP area there has been no residential growth in recent years. Population data provided by the MD (GIS) indicate that the majority of the current population is located within or near the Hamlet of Aldersyde.

The residential development of Silvertip, located north of the study area, currently obtains potable water from the existing distribution line from High River that runs through the study area. The residential subdivision called Ravencrest is located north of Silvertip. This development is interested in connecting to the existing potable water supply in future. When evaluating the capacity of the infrastructure, the needs of these communities must therefore be considered.

Table 3.1 provides a summary of the current populations.

Table 3.1

ASP Area and Other Relevant Current Populations

Community	2009 Residential Population
ASP Area	242
Ravencrest, SilverTip	320
RV Park	121 (summer only – equivalent population)
Town of High River	11,370
Town of Okotoks	19,996

3.1.2 Future Land Usage

The MD has designated the land use for the corridor along Highway 2A for industrial and commercial use. **Figure 5** provides an estimate of the proposed land usage designations for the ASP areas. It is to be noted that this land usage does not represent zoning nor ultimate development. It is used as a basis for estimating servicing requirements only. Actual land use zoning will be established in the future.

The MD is proposing to implement low impact, light industrial development in the area ("Eco-industrial"). The MD also has plans to develop an inter-municipal recreational centre called the Foothills Regional Indoor Field House (FRFH). This development would require a minimum area of 12 hectare (30 acres). The centre will include indoor fields, outdoor fields, locker rooms, concession and training rooms. The anticipated location is near the intersection of Highway 2, Highway 2A, and Highway 7, close to the Hamlet of Aldersyde. The proposed location is shown on **Figure 5.**

The following points regarding potential land use are noted:

- Cargill has expressed interest in expanding its operations by 25% within the next five years. Their current restriction to their existing production is the amount of available potable water.
- The Saddlebrook Power Generating Station is expected to commence operations in 2011. Currently this facility does not generate power.
- Several development plans within the ASP area have been presented to the MD. These are identified on **Figure 5**.

Each development will require a portion of the land to be reserved as Environmental Reserves (ER) and Municipal Reserves (MR). ER reserves are required for developments on land with natural habitat and areas with slopes greater than 15%. This information is detailed in the *M.D. of Foothills Municipal Development Plan and Land Use Bylaw*. Due to limited information on natural habitats and environmental assessments in the area ER has been estimated to be 5% for all new developments. ER areas shown in **Figure 2** are the areas with slopes greater than 15% and/or known natural habitats. Under the Municipal Government Act, the MD can acquire 10% of the land being subdivided as MR. It has been assumed that 10% of all the future developable land will be designated as MR. An allowance of 15% of developable land has been reserved for transportation corridors.

Based on previous preliminary work and discussions with the MD, the total developable commercial and industrial land area within the ASP has been developed. These areas are depicted on **Figure 5.**

A summary of the land areas and the respective usage within the ASP area is provided in **Table 3.2**:

Table 3.2
Current and Future Land Usage Areas

Land Usage	Current		Future	
	Area (hectares)	Percentage of Total	Area (hectares)	Percentage of Total
Flood Plain and Environmental Reserve	267	7.2 %	267	7.2 %
Residential	248	6.7 %	248	6.7 %
Traditional	2555	69.2 %	1020	27.6 %
Industrial/Commercial	461	12.5 %	1987	53.8%
Industrial Natural Resources	145	3.9 %	145	3.9 %
Municipal and Recreational	17	0.5 %	26	0.8%
TOTAL	**3693**	**100 %**	**3693**	**100 %**

The MD and the Town of High River also have conceptual plans to implement a pathway system throughout the corridor. Two options of the pathway system were developed and are shown on **Figure 5.**

3.1.3 Project Phasing

It is envisioned that the ASP area would be developed in two phases, **see Figure 5**. This was based on discussion with the MD. Phase 1 consists of current development plus 50% of total available developable land including all currently approved developments. Phase 2 consists of 100% of total available developable land. Timing for the completion of these development phases was not determined.

3.1.4 Summary of Design Land Usage Parameters

Table 3.3 provides a summary of the design parameters used to establish the areas for each projected future land usage.

Table 3.3

Proposed Land Usage Designation

Parameter	Value
Reserves on Future Developments Environmental Municipal Roads and Services	 5% 10% 10%
Commercial/Industrial Lot Density	0.98 hectares/lot
Design Residential Population	242 people
Residential Developable Area Current Phase 1 Phase 2 Total	 248 hectares 0 hectares 0 hectares 248 hectares
Commercial/Industrial Developable Area Current Phase 1 Phase 2 Total	 461 hectares 572 hectares[1] 572 hectares[1] 1605 hectares
Municipal/Recreational Developable Area Current Phase1 Phase2 Total	 17 hectares 9 hectares 0 hectares 26 hectares

1. 25% in reserves has been allowed for.

The design commercial/industrial lot density was established based on the density of the existing Abild's Industrial Park which is 0.98 hectares per lot (2.4 acres per lot).

3.2 Potable Water Demands

3.2.1 Current

Residential

Current residential potable water consumption from nearby municipalities were reviewed and adopted in order to establish the design potable water consumption for the study area. The CRP estimates that the current water consumption in the MD is 449 L/c/day. The design value for the study area was established to be 444 L/c/day. This value is used to estimate current residential water consumption. The residential population is estimated at 242 people. The populated regions are centered in the Maple Leaf and Hamlet of Aldersyde areas. There are brief scatterings of other residences throughout the ASP area.

The residential developments located to the north of the ASP must be included when establishing potable water demands as they are connected to the potable water supply from High River. Total population from these two subdivisions, Ravencrest and Silvertip, is approximately 320 people.

Design flows for the residential component is summarized in **Table 3.4.**

Commercial and Industrial

Potable water demands were generated for the proposed commercial and industrial land areas. These demands were developed based on the actual measured wastewater volumes generated from the Abild's Industrial Park. Typically wastewater generation is 90% of potable water demand. Therefore, to arrive at a projected water demand, on a per hectare basis for the "commercial and industrial" lands, the following calculation was made:

The measured Abild's wastewater flows divided by 0.9 and divided by
the developed area of Abild's equals the projected design water demand

Using this conversion, the average daily potable water consumption for the Abild's Industrial Park is 3.7m^3/ha/day.

Cargill currently uses their maximum allotted raw water allocation of 2.210 million cubic meters per year. The Saddlebrook Power station is not in service and doesn't use a significant amount of water; however the plant is scheduled to be operational in 2011.

Summary

The following provides a summary of the current potable water demands for the area.

Table 3.4
Current Potable Water Demands

Development	Average Daily Demand (m^3/day)
Residential (Aldersyde, Maple Leaf and Miscellaneous)	107.4
Residential North of ASP Area (Ravencrest, Silvertip, RV Park)	95.8
Volker, PetroCan, ACP	85.0
Abilds Industrial Park	54.0
Other industrial	10.2
Subtotal	***352***
Cargill	6,054
TOTAL	**6,406**

3.2.2 Potential Future Potable Water Demand

Residential

The proposed land usage for the ASP area does not anticipate an increase in residential development beyond the current residential area. The area north of the ASP that is connected to the potable water line from High River is expected to have an increase in residential development with an additional 48 lot subdivision.

Industrial/Commercial

The MD is proposing to implement "Eco-Industrial" development and development similar to the Abild's Industrial Park. Apart from the proposed large industrial users of Saddlebrook and Cargill, the design potable water demand will be based on the current estimated consumption at Abild's of 3.7 m^3/ha per day (see Section 3.2.1).

The Saddlebrook Power Plant is anticipated to have a design average daily demand of potable water of 11.94 m^3/hr for 16 hours/day, 5 days per week with a peak demand of 34 m^3/hr. Saddlebrook is currently reviewing if they would be able to use recycle tertiary treated wastewater in their new facility. The steaming cycle in the Saddlebrook power station requires de-mineralized water. Water will be de-mineralized in the plant and run through the steaming process. The water recovered after the steam cycle will be mixed with other wastewater, for example from their oil/water separator, and then recycled and utilized for the plant's cooling process. If Saddlebrook is able to use tertiary treated effluent in the cooling process, this will reduce their potable water consumption and reduce the quantity of treated effluent to be disposed of. Saddlebrook only requires cooling water when the plant is generating power with the ambient, outdoor temperature above 15°C. The annual quantity of water required for cooling is unknown at this time, therefore it is unknown how much the potable water consumption and wastewater generation will be impacted if Saddlebrook is able to utilize tertiary treated effluent for cooling purposes.

Within the next 5 years, Cargill has identified opportunities to grow and would like to increase their water usage by approximately 25%. This would increase their water demand to 2.76 million m^3/year. Cargill does not have a sufficient diversion license to permit this nor is there sufficient delivery infrastructure of potable water to permit this expansion.

The MD plans for development of a potential recreational centre. It is referred to as the proposed *Foothills Regional Indoor Field House* (FRFH).

The facility's anticipated water demands were developed with respect to the anticipated general/office usage, locker room usage, concession/cafeteria, and outdoor field maintenance. The outdoor fields are estimated to be irrigated at a rate of 300 mm/year. The total water usage for this facility is provided in **Table 3.5**.

Table 3.5

Design Water Consumption Foothills Regional Field House

Usage	Water Consumption (ADD)	
	m^3/day	m^3/year
Consumption (general office, showers, cafeteria)	9.7	3,541
Irrigation:		
Outdoor Facilities/Fields (10 hectares)	93.9[1]	34,271
Total	**103.6**	**37,812**

1. For calculation purposes, the irrigation quantity is spread out over the entire year. Realistically irrigation would occur over a four month period.

3.2.3 Summary of Design Flows

Based upon the above, design average daily demands for potable water flows for the ASP area were developed. They are provided as follows in **Table 3.6**:

Table 3.6
Summary of Average Daily Design Flows

User	Current (m^3/day)	Phase 1 50% Build out (m^3/day)	Phase 2 100% Build out (m^3/day)
Residential	107.4	107.4	107.4
Industrial & Commercial Water Usage	149.2	2,293	4,321
Saddlebrook	0	136	136
Foothills Regional Indoor Fields House	0	9.4 [1]	9.4 [1]
Residential North of ASP Area	95.8	224.5	224.5
Sub-total	***352***	***2,770***	***4,799***
Cargill	6,054	7,568	7,568
TOTAL	**6,406**	**10,338**	**12,367**

1. Assumes irrigation is by non-potable means.

3.3 Sanitary Flows

3.3.1 Current Sanitary Flows

Sanitary flows are established in accordance with AENV requirements. Sanitary flows include an allowance for infiltration into the collection system in wet weather.

The following flow parameters are established:

- Average Dry Weather flow
- Peak Dry Weather Flow
- Peak Wet Weather flow

Residential

Estimated wastewater generation from the CRP is provided below in **Table 3.7**.

Table 3.7

Area Wastewater Generation

	Wastewater Generation, 2005 (L/c/d)
M.D. of Foothills No. 31	400
Town of High River	513
Town of Okotoks	311
City of Calgary	500
CRP overall	314

Utilizing the above data, the estimated average daily sanitary flow for residential use in the study area is 400 L/c/day. This equates to 90% of the potable water demand which is typical for south-central Alberta. The current residential average dry weather flow is estimated at 96.8 m^3/day; based on a residential population of 242 people.

Industrial/Commercial

Records of the effluent volumes Cargill directs to Frank Lake indicates an average discharge of 6,164m^3/day based on flow records from 2004 to 2008. These records indicate that the current potable water demand for Cargill is their current water allotment of 2.210 million m^3/year or 6,054 m^3/day. They are returning more than 100% of their potable water usage as treated effluent. This anomaly may be attributed to either infiltration into the system or flow meter measurement error. For the purpose of this study, it is assumed that Cargill is returning 99% of their water consumption as wastewater.

For all remaining existing residential, industrial and commercial development, the wastewater generated is assumed to be 90% of the design water demand (see Section 3.2.1).

3.3.2 Future Sanitary Flows

Residential

Development within the study area is anticipated to be Industrial/Commercial with little or no increase in residential population. The projected residential Average Dry Weather Flow (ADF) is therefore 96.8 m^3/day. This is equivalent to the existing Average Dry Weather Flow.

Industrial Commercial

Apart from the proposed large industrial users of Saddlebrook and Cargill, the design sanitary flow for the purposes of this study will be similar to the discussion in Section 3.2.1.

Effluent data from the Abilds Industrial Park from 2006 through 2009 was utilized to find the average daily wastewater flow. A flow rate of 38 m^3/day is estimated for the 12 lots built out over this time period. Therefore the design ADF for the industrial commercial land usage is 3.2 m^3/day/lot or 3.3 m^3/day/hectare. This is significantly lower than the AENV Standards and Guidelines of 30 to 40 m^3/day/hectare. This is also much lower than the design industrial flow used in the Bel-MK Report for the area of 15 m^3/day/hectare. The MD has indicated that no large water using industries will be developed within the study area.

Peak flows were evaluated and included infiltration and peak demand analysis. Historical data from 2003 to 2009 was utilized. The recorded peak discharge from Abild's was 107 m^3/day; this occurred in October 2007. Based on this, a peaking factor of 2.8 is typical for the area. Peak flows based on AENV guidelines establish a peaking factor of 3.5.

Wastewater effluent volumes are usually influenced by infiltration, however during the 2005 storm event the Cargill effluent volumes increased by only 5%. After averaging the effluent data and adding the 5%, peak wet weather design sanitary flow from the Cargill Plant is 6,472 m^3/day (74.9 L/s).

Table 3.8 provides a summary of the design sanitary flows established for this study.

Table 3.8
Design Sanitary Average Dry Weather Flows

User	Current	Phase 1 50% Build out (m^3/day)	Phase 2 100% Build Out (m^3/day)
Residential in ASP Area	96.7	96.7	96.7
Industrial & Commercial Water Usage	134.3	2,063.2	3,888.4
Saddlebrook	0	65	65
Foothills Regional Indoor Fields House	0	8.5	8.5
Sub-total (generated within ASP area)	***231***	***2234***	***4059***
Residential North of ASP Area	86.2	202.1	202.1
TOTAL without Cargill	**317.2**	**2436**	**4261**
Cargill	5,993	7,492	7,492

Cargill is calculated separately, as it is assumed they will continue to maintain their own collection, wastewater treatment, disposal facilities and pipeline to Frank Lake.

Sanitary peak flows are calculated in accordance with AENV Standards and Guidelines and are summarized below in **Table 3.9**. An infiltration allowance of 0.02 L/s/ha has been allowed for in calculating peak wet weather flows.

Table 3.9
Design Peak Wastewater Flows Excluding Cargill

Parameter	Current (L/s)	Phase 1 50% Build out (L/s)	Phase 2 100% Build Out (L/s)
Residential Peak Dry Weather Flow (AENV STDS)	0.01	0.01	0.01
Commercial/Industrial Peak Dry Weather Flow	3.4	96.0	160.3
Infiltration Allowance (0.02 l/s/ha)	0.7	30.6	45.2
Peak Wet Weather Flow	4.1	126.6	205.5

3.4 Stormwater

3.4.1 Scope of Analysis

In order to establish the existing design parameters, the following analysis is undertaken:

- Define the existing drainage system and site conditions.
- Identify sub-catchment boundaries for major system flows.
- Determine pre-development peak runoff rates.

3.4.2 Methodology

The 1:100 year and 1:5 year storm event peak runoff rates are typically used for major and minor systems (storm sewer) stormwater analysis respectively. The design of the stormwater detention facility is based on runoff rates and volumes up to and including the 1:100 year storm event under the post-development condition of the study area.

The pre-development peak runoff rates from a study area is typically determined using hydrologic models such as SWMHYMO and QHM for the existing land use condition. Typically, both the pre-development and post-development runoff rates determined from the QHM model are lower than those determined from the SWMHYMO model. Hence, QHM was used for pre-development runoff estimations and SWMHYMO for post-development runoff estimations as a conservative and reasonable approach in this study. Tongue Creek flows through the ASP area. It has an extremely large catchment area upstream of the ASP area, see **Figure 6.** Based on the large off-site catchment area (89%), draining through the ASP area (11%), it was realized that the typical stormwater models such as SWMHYMO for event based simulation and QHM for continuous simulation, would not be adequate to determine pre-development peak runoff rates. Therefore, an alternate method typically used in establishing pre-development peak runoff rates in the Calgary Region, the Regional Flood Frequency Analysis (McElhanney, 2008; Golder, 2006; Westhoff, 2004) was adopted in this study. The Regional Flood Frequency Analysis was conducted using the historic instantaneous peak flow data from five Water Survey of Canada (WSC) Streamflow Gauging Stations near the study area.

As part of pre-development peak runoff rate establishment, a continuous watershed simulation model using QHM was set up for the study area and immediate off-site catchments using historic rainfall data.

Each of these methods (i.e. Regional Flood Frequency Analysis and QHM Modeling) was used to establish the 1:100 year pre-development peak flow rates. The minimum peak runoff rate between the above two methods was then chosen as the allowable 1:100 year pre-development release rate from the ASP area.

3.4.3 Hydrologic Modeling of Pre-Development Runoff Rates

The use of hydrologic models to simulate pre-development runoff rates involves some degree of uncertainty while selecting the appropriate input parameters for large drainage catchments. Considering the basin characteristics information and the enormous level of effort required to calibrate hydrologic models for the off-site catchments (especially the Tongue Creek watershed) and the study area, regional historic peak runoff rates were used to estimate the Unit Release Rate (URR) (litres per second per hectare) for pre-development condition. In this method, estimation of the pre-development peak runoff rate for the study area is based on interpolation of URR's from the nearby gauged watersheds. The Water Survey of Canada (WSC) Streamflow Gauging Stations selected for this analysis are presented in **Table 3.10**.

Table 3.10
Hydrometric Stations used for Regional Frequency Analysis

Station No.	Station Name	Location		Drainage Area (km^2)	Period of Record
		Latitude	Longitude		
05BL014	Sheep River at Black Diamond	50° 41′ 16″ N	114° 14′ 37″ W	592.2	1911-1916 & 1969-2008
05BL023	Pekisko Creek Near Longview	50° 28′ 26″ N	114° 12′ 26″ W	231.9	1967-2008
05BL004	Highwood River Below Little Bow Canal	50° 35′ 08″ N	113° 52′ 09″ W	1953.4	1909-1915 & 1986-2008
05BL009	Highwood River Near Aldersyde	50° 41′ 58″ N	113° 51′ 23″ W	2311.5	1912-1993 (1932 missing)
05BL024	Highwood River Near the Mouth	50° 46′ 59″ N	113° 49′ 15″ W	3952.2	1970-2008

For each of these stations, a frequency analysis was performed on maximum annual instantaneous flows using Hydrofreq1 (Hydro Tools Software, 2000).

This frequency analysis program determines the flows associated with the typical return period events such as: 2, 5, 10, 25, 50, and 100 year. Since the streamflow data did not have annual instantaneous flows for all the years in record, a regression analysis was used to derive instantaneous flows from the annual maximum daily flows for the missing years. The peak flows associated with the return period events were converted into the URR values by dividing the peak flow by the gross drainage area of each gauging station to allow easier comparison and use in the analysis. The 1:5 year and 1:100 year return period URRs typically used for minor and major drainage system design derived from this analysis and are presented in **Figures 6 and 7** respectively.

3.4.4 Establishing Catchments

For the purpose of stormwater modeling analysis, the total study area of 3,692.5 ha is divided into five major sub-catchments.

Among them, one sub-catchment drains north into the Sheep River and the other four sub-catchments drain into the Highwood River directly. One exception is the "TCHW sub-catchment", which drains partly via Tongue Creek.

The off-site catchments immediately west of the study boundary that drain through HW-1, TCHW, HW-2, and HW-3 sub-catchments are shown on **Table 3.11**. It is assumed that these off-site catchments will have their own stormwater detention facilities when they develop in the future. It is however, recognized that the channels/ditches built within the study area will require allowance for flow-through conveyance capacity of the allowable pond release from these off-site upstream catchments. Summary of the study area catchments and immediate off-site catchments is provided in **Table 3.11**.

Table 3.11
Summary of Catchment Areas

ASP Catchment	Area (ha)	% of ASP Area	Off-Site Catchment	Area (ha)
HW-1	690.0	18.7	HW1-Off-site	30
TCHW	882.0	23.9	TCHW-Off-site*	120
HW-2	985.6	26.7	HW2-Off-site	740
HW-3	962.0	26.0	HW3-Off-site	690
SR	172.9	4.7	None	--
TOTAL	**3,692.5**	**100.0**	**TOTAL**	**1,580**

1. This area does not include Tongue Creek catchment area at the ASP Boundary.

The ASP sub-catchments and the immediate off-site catchments that drain through the study area are modeled to estimate the 1:100 year peak flow rates that would occur under the pre-development (existing) conditions using the computer programs QHM Version 3.1.

The SWMHYMO Version 4.02/July 1999 model was used to estimate the 1:100 year peak flow rates that would occur under the post-development conditions and required runoff volume to control outflow at the 1:100 year pre-development release rate from the ASP catchments. The SWMHYMO model uses the "Chicago" synthetic design storm parameters for the City of Calgary, whereas, the QHM model uses continuous precipitation data from 1960 to 2007 (47 years) at the Calgary International Airport.

The modeling approach and parameters used in the analysis are based upon a combination of locally accepted practices, previous stormwater studies near the study area, AENV and the City of Calgary guidelines, as well as past experience.

The input and output files for the pre and post-development computer runs are included in **Appendix C**.

3.4.5 Summary of Pre-Development Conditions

Under the pre-development conditions, runoff from the off-site catchments and onsite catchments drain from the west to the east as shown on **Figure 8**. No detailed survey was undertaken to verify culverts, swales, etc.

The 1:5 year and 1:100 year peak runoff rates from the off-site and onsite catchments (1,580 ha, 3,692.5 ha respectively) determined by the Regional Analysis and QHM modeling are shown in **Table 3.12**. The 1:100 year and 1:5 year peak runoff rates are typically used for major and minor system (storm sewer) drainage analysis respectively.

Table 3.12

Pre-Development 1:5 and 1:100 Year Peak Runoff Rates

Model / Alternate Peak Runoff Rate Analysis	1:5 Year		1:100 Year	
	Peak Runoff Rate (L/s)	Unit Release Rate (L/s/ha)	Peak Runoff Rate (L/s)	Unit Release Rate (L/s/ha)
Regional Streamflow Analysis	6,327	1.2	26,363	5.0
QHM Continuous Simulation Modeling	26,363	5	48,507	9.2

The minimum unit release rate between the above two methods was then chosen to be the allowable 1:100 year pre-development release rate (i.e. 5 L/s/ha) to establish storm pond outflows from the study area.

4.0 INFRASTRUCTURE SERVICING ALTERNATIVES

4.1 Potable Water

4.1.1 General

The two municipalities in close proximity to the ASP area are the Town of High River and the Town of Okotoks. The following alternatives are considered for potable water servicing for the ASP area:

- ***Alternative #1: Serviced by Town of High River***
- ***Alternative #2: Serviced by Town of Okotoks***

A stand-alone water treatment facility was not considered feasible due to the proximity of these municipalities. Utilization of nearby infrastructure is in keeping with the province's "Water for Life" strategy to regionalize water treatment infrastructure.

4.1.2 Raw Water Supply

Regardless of the point of treatment, development cannot proceed unless there is an adequate supply of raw water to service the development. **Table 4.1** provides an overview of the available raw water supply and the design demand at full build out. Cargill is listed separately because of the large volume of water required by this user.

Table 4.1

Raw Water Supply and Design Demand

User	Existing Available Raw Water (m^3/year)	Current Raw Water Demands (m^3/year)	Raw Water Demand Upon Completion of Phase 1 (m^3/year)[1]	Raw Water Deficit Upon Completion of Phase 1 (m^3/year)	Total Raw Water Demand Upon Completion of Phase 2 (m^3/year) [1]	Total Raw Water Deficit Upon Completion of Phase 2 (m^3/year)
ASP Area	675,540	93,600	1,124,420	(448,900)	2,020,200	(1,344,600)
Users North of ASP Area	0	35,000	99,110	(99,100)	99,100	(99,100)
Sub-total	***675,540***	***128,600***	***1,223,530***	***(548,000)***	***2,119,300***	***(1,443,700)***
Cargill	2,209,720	2,209,720	3,038,400	(828,600)	3,038,400	(828,600)
TOTAL (rounded)	**2,885,300**	**2,338,300**	**4,261,900**	**(1,376,600)**	**5,157,700**	**(2,272,300)**

1. Includes 10% allowance for losses through the water treatment process.
2. Cargill would like to expand operations by 25%.

The above analysis indicates that in order to develop Phase 1, an additional 548,000 m^3 of raw water license in addition to existing licenses would be required. In order to fully develop the ASP area as outlined, 1,443,700 m^3 of raw water license is required in addition to the existing licenses. This does not include the additional 828,600 m^3 of raw water license that Cargill would require to expand their operations by 25%.

4.1.3 Servicing Alternatives

The following alternatives were evaluated to provide potable water to satisfy the ASP's future potable water demands:

- ***Alternative #1: Serviced by Town of High River***
- ***Alternative #2: Serviced by Town of Okotoks***

Alternative #1: Serviced by Town of High River

Figure 9 provides the proposed potable water servicing from the Town of High River. The conceptual design directs water to an elevated 4,900 m^3 potable water storage reservoir within the ASP area. It is assumed the Town of High River would provide/meet the maximum day demand. Peak design flows and fire flows would be provided via gravity from the elevated storage reservoir.

Water Treatment Plant

As previously discussed, a portion of the ASP area is currently serviced by the Town of High River for potable water under agreement.

Water treatment plants are required to provide the Maximum Day Demand (MDD) through the treatment process. Peak flows and fire flows are handled by potable water storage within the distribution system. The Town of High River's treatment plant has a capacity of 24,200 m^3/day (CRP). Assuming a typical industry standard Maximum Day Factor (MDF) of 2.0, this plant has an average day capacity of 12,100 m^3/day.

Based on the current population, per capita consumption, and the Town's commitments to supply water beyond its borders the plant is currently at capacity. The Town is looking to reduce its potable water consumption through conservation efforts as well as implementing an aggressive watermain replacement program.

Design Parameters if Supplied by High River

Table 4.2 shows the future required capacity of the High River Water Treatment Plant for Alternative #1.

Table 4.2
Town of High River Water Treatment Capacity

	2009	**2030** [2]
Existing Plant Capacity (m^3/day)	**24,200**	
Town Population	11,000	22,355
Town Required ADD (m^3/day) [1]	4,884	9926
M.D. ASP ADD (m^3/day)	257	4574
Cargill ADD (m^3/day)	6,054	7,568
Total Required Plant Capacity (M.D.D) Assuming M.D.F =2x (m^3/day)	22,390	44,136

1. Assumes High River can reduce potable water consumption to 444 L/c/day.
2. Assumes full build out of the ASP area.

The above table indicates that if the Town of High River were to reduce their consumption to 444 L/c/day (from the current 778 L/c/day) then the WTP would have a current surplus capacity of 1,810 m^3/day. This surplus capacity could sustain current commitments plus an additional 2,000 people.

If the Town of High River were to service the fully developed ASP area plus the residential communities to the north, plus the proposed Town population, the water treatment facility's capacity would need to be 44,100 m^3/day by Year 2030.

In an aggressive water conservation scenario, where by the 2030 consumption is reduced by another 25% (except Cargill). The 2030 plant capacity could be reduced to 36,900 m^3/day.

Alternative #2: Serviced by Town of Okotoks

The Town of Okotoks has nine shallow groundwater wells that are collected in a receiving station. The raw water is considered groundwater under direct influence of surface water. It is treated through direct filtration, chemical pre-treatment, rapid sand filters, and chlorination, its three reservoirs has a combined capacity of 20,629 m^3. The Okotoks Water Treatment Plant doesn't distribute to the study area, but is located close to the northern part of the study area. The treatment capacity is currently 15,712 m^3/day. Assuming an M.D.F. of 2.0, this plant has an average day capacity of 7,856 m^3/day.

The Town of Okotoks has a very low per capita consumption rate of 329 L/c/day. At this consumption rate, the plant can service an estimated population of 23,800.

Potable water servicing from Okotoks for the Highway 2A ASP area is illustrated in **Figure 10.** The conceptual design directs water to an elevated 4,900 m³ potable water storage reservoir located within the ASP area. The Town of Okotoks would provide/meet the maximum day demand requirement. Peak design flows and fire flows would be provided via gravity from the elevated reservoir storage. **Table 4.3** shows the future capacity of the Okotoks Water Treatment Plant for Alternative #2.

Table 4.3

Okotoks Water Treatment Capacity

	2009	2030
Plant Capacity (m^3/day)	**15,712**	
Okotoks Population	21,700	30,000
Okotoks Required ADD (m^3/day) [1]	7,139	9,900
M.D. ASP ADD (m^3/day)	257	4574
Cargill ADD (m^3/day)	6,054	7,568
TOTAL Required Plant Capacity (m^3/day)[2]	26,900	44,084

1. Assumes current consumption of 329 L/c/day.
2. Plant capacity is Maximum Daily Demand (MDD) and assumes a maximum day factor of 2.0.

4.2 Wastewater

AENV requires mechanical wastewater treatment facilities to be hydraulically capable of handling the peak design flow rate (PWWF). The following alternatives were evaluated for servicing the ASP's future sanitary demands:

- ***Alternative #1: Direct Wastewater to the Town of High River for Treatment***
- ***Alternative #2: Direct Wastewater to the Town of Okotoks for Treatment***
- ***Alternative #3: Joint Servicing: Direct a Portion of the Flows to Okotoks and Remaining Flows to High River***

Alternative 1: Direct Wastewater to the Town of High River for Treatment

Table 4.4
Design Sanitary Demands for Servicing by the Town of High River

	2009	2030 [2]
Existing Aerated Lagoon Capacity (m^3/day)	**8,400**	
High River Population	11,000	22,355
High River Required ADF (m^3/day) [1]	4,400	8942
M.D. ASP ADF (m^3/day)	257	4261
TOTAL ADF (m^3/day)	4,657	13,203
Peak Wet Flow High River	200.8 l/s	341.8 l/s
Peak Wet Flow M.D. ASP	6.3 l/s	205.5 l/s

1. Assumes generation of 400 L/c/day.
2. Assumes full build out of ASP area.
3. Infiltration and Inflow at 0.02 L/s/ha.

A major hurdle to overcome in development and expansion is disposal of treated effluent. The Town of High River is looking at alternative disposal methods rather than directly to Frank Lake. This is due to the concern of nutrient loading and high total phosphorous in the lake. At first glance, a mechanical plant with disposal of treated effluent to the Highwood River, placed in the location of the existing lagoon, would be the logical choice. This is because of the existing collection system infrastructure already in place. However, the Highwood River is currently showing signs of increased temperature and reduced oxygen therefore it may not be the optimum point of treated effluent discharge. Further evaluation is required by the Town of High River to evaluate this option as it is also dependent upon the level of treatment proposed for the wastewater treatment facility upgrades.

AENV requires that the disposal rate be no greater than 10% of the instream flow of the receiving watercourse. In discussions with AENV, there may be some flexibility in this requirement because the disposal of treated effluent into a receiving water body must be based on the quality of the treated effluent; and the water quality and physical characteristics of the water body at the point of receiving.

The river was modeled utilizing data from flow station 05BL004. The lowest flow month for the river is January with a one-tenth (1/10) historical minimum mean monthly flow of 149,000 m^3/month (4,890 m^3/day).

Thus in order to meet the disposal rate of no more than 10% of instream flow, the allowable continuous discharge into the Highwood River is 4,890 m^3/day in January. If storage of treated effluent were provided such that a greater release could occur during the river's spring freshet, the river could sustain a greater annual discharge. This is illustrated in **Appendix D.**

Figure 11 illustrated the conceptual service layout for sanitary collection directed to the Town of High River wastewater facilities. The Town of High River owns a 30 m wide parcel of land east of and immediately adjacent to the CN Rail Line from Saddlebrook southerly to Cargill which could potentially be used as a pipeline corridor.

<u>Alternative 2: Direct Wastewater to the Town of Okotoks</u>

The Okotoks Wastewater Treatment Plant currently does not service the study area, but is an option for wastewater treatment from the area because of its close proximity to the ASP area. This mechanical treatment facility discharges treated effluent into the Sheep River. The current facility in Okotoks is a Tertiary Sewage Treatment Plant, with rotating biological contractor units, oxidation ditch, and sewage lift station. It was completed in 2006 and has a capacity of 24.5ML/d. It includes a bioreactor, UV-light disinfection, biological nutrient removal process, and composting of bio-solids sludge. After treatment the effluent is discharged into Sheep River. (Bel-MK, Town of Okotoks).

Table 4.5

Design Sanitary Demands for Servicing by the Town of Okotoks

	2009	**2030** [2]
Existing WWTP Capacity (m^3/day)	**24,500**	
Okotoks Population	21,700	30,000
Okotoks Required ADF (m^3/day) [1]	6,750	9,000
M.D. ASP ADF (m^3/day) [2]	257	4261
TOTAL ADF	7,007	13,591
Peak Wet flow Okotoks	289 l/s	367 l/s
Peak Wet flow M.D. ASP	6.3 l/s	205.5 l/s

1. Assumes Generation of 311 L/c/day.
2. Assumes Generation of 400 L/c/day.

Modeling of the Sheep River utilizing data from Flow Station 05BL012 indicates that the lowest flow month is February with a 1/10 minimum mean monthly flow of 108,000 m^3/month (3,540 m^3/day), see **Appendix D.**

Figure 12 provides the conceptual servicing layout for sanitary collection within the ASP area if all wastewater was directed to the Town of Okotoks wastewater treatment facilities.

Alternative 3: Joint Servicing by the Towns of High River and Okotoks

To optimize gravity flow of sanitary lines in the MD, joint servicing could be considered as illustrated in **Figure 13.** The dividing line for servicing would be such that roughly all areas north of Twp 20 is directed to Okotoks and roughly all areas south of Twp 19 is directed to High River. Under this scenario design flows would be as follows:

Table 4.6
Design Sanitary Demands for Joint Servicing by the Towns of Okotoks and High River

	2030 [2]
High River ADF (m^3/day)	8,942
M.D. ASP ADF Twp 19(m^3/day)	2,765
Total Directed to High River(m^3/day)	11,707
M.D. ASP ADF Twp 20 (m^3/day) [2]	1,495
Okotoks ADF (m^3/day) [1]	9,000
TOTAL directed to Okotoks (m^3/day)	10,495

1. Assumes Generation of 311 L/c/day.
2. Assumes Generation of 400 L/c/day.

4.3 Stormwater

4.3.1 Scope

In order to establish post-development conditions, the following analysis was undertaken.

- Establish post-development stormwater release rates and runoff volumes.
- Identify most suitable locations for future stormwater management facilities and approximate footprint area to accommodate the post-development runoff volume operating at a pre-development release rate that has minimal impact on the existing downstream watercourse, while controlling stormwater quality issues, and meets or exceeds the current requirements of Alberta Environment (AENV) and the MD.
- Prepare a Stormwater Management Concept Plan.

For the post-development condition, only the SWMHYMO model was used to simulate peak runoff rates and determine runoff volume for the study area sub-catchments. This determined the size of stormwater management ponds required to maintain the allowable pre-development release rate for the study area catchments. Tentative location of stormwater detention facilities have been identified at the lowest elevation in each of the five sub-catchments.

4.3.2 Methodology

Modeling post-development conditions using SWMHYMO includes determining various drainage characteristics of the study area including: imperviousness ratio, slope, depression storage, and SCS curve numbers (CN). The existing imperviousness estimation for the study area is based on the latest Google Earth Image (December, 2009). For the post-development condition, the imperviousness for the proposed land usage is based on the Alberta Environment Stormwater Management Guidelines (January, 1999) and the City of Calgary Stormwater Management Guidelines (December, 2000).

4.3.3 Post-Development Conditions

The average slope of the sub-catchments is calculated from the available contour map, and depression storage losses (initial abstraction) of 1.0 mm for the impervious areas and 3.4 to 5 mm for the pervious areas are used. For the post-development condition modeling (STANDHYD routine in SWMHYMO), an average CN value of 72 suggested in the City of Calgary Stormwater Management Guidelines (Dec, 2000) is used. For land usage with imperviousness less than 20 percent (NASHYD routine in SWMHYMO), aggregated CN value or most reasonable value found in the literature is used.

The assumed imperviousness and CN values used in the SWMHYMO modeling for the proposed land use under post-development conditions are summarized in **Table 4.7** below.

Table 4.7
Summary of Imperviousness and CN Values used in the SWMHYMO Model

Proposed Land Use	% Imperviousness	CN Value
Industrial/Natural Resources	50	72
Residential	50	72
Industrial/Commercial Including Planned Development	80	72
High River Water Treatment Plant Site	80	72
Traditional Low Intensity	< 20	78
Environmental Reserve & Recreational	< 20	67
Flood Fringe	< 20	67

Table 4.7 presents, under post-development conditions, the proposed average imperviousness for the proposed land usage. As per the proposed development concept plan, all the storm runoff from the study area will be directed to the designated storm ponds located at the most downstream elevation within each sub-catchment. **Figure 14** illustrates the overland flow directions and the most strategic location of the stormwater detention facilities for the ASP area.

Table 4.8 summarizes the water quality and storage quantity requirements as well as approximate footprint area of the stormwater management facilities within the study area for the 1:100 year 24 hour event.

Table 4.8
Storage Requirement for 1:100 Year 24 Hour Event

ASP Catchments	Catchment Area (ha)	Required Storage[1] (m^3)	Unit Release Rate (L/s/ha)	Discharge (L/s)	Approximate Footprint Area of Pond (ha)
HW-1	690.0	345,341	5	3,450	11.4
TCHW	882.0	478,610	5	4,410	15.6
HW-2	985.6	627,439	5	4,930	20.0
HW-3	962.0	520,431	5	4,810	16.8
SR	172.9[2]	70,816	5	517	2.8
TOTAL	**3,692.5 (100 %)**	**2,125,200**			**66.6 (1.8%)**

1. Required storage includes water quality enhancement (AENV requirement of 85% TSS removal) and active storage for the 1:100 year pre-development release rate at 5 L/s/ha.
2. Although the total catchment area draining to the Sheep River is ± 172.9 ha, there are about 40 ha of environmental reserve and 29.5 ha of existing RV park areas that drain to the Sheep River directly. Hence, the effective catchment area for stormwater retention and detention has been assumed to be 103.4 ha.

4.3.4 Off-Site Catchments and Future Stormwater Management

It is assumed that when the off-site catchments “HW1-Off-site”, “TCHW-Off-site”, “HW2-Off-site”, and “HW3-Off-site” develop in future, they will need their own stormwater management detention facilities to release stormwater at 5 L/s/ha. A summary of catchment areas and allowable release rates is shown in **Table 4.9** below.

Table 4.9

Future Off-Site Catchment Areas, ASP Catchment Areas, and Release Rate

Catchment Name	Area (ha)	Unit Release Rate (L/s/ha)	Allowable Release Rate (L/s)
HW1-Off-Site	30	5	150
TCHW-Off-Site[1]	120	5	600
HW2-Off-Site	740	5	3,700
HW3-Off-Site	690	5	3,450
HW-1	690.0	5	3,450
TCHW	882.0	5	4,410
HW-2	985.6	5	4,928
HW-3	962.0	5	4,810
SR[2]	172.9	5	517
TOTAL	5,272.5		26,015

1. This area does not include the Tongue Creek catchment area at the ASP Boundary.
2. Although the total catchment area draining into the Sheep River is ± 172.9 ha, there are about 40 ha of environmental reserve and 29.5 ha of existing RV park areas that drain into the Sheep River directly. Hence, the effective catchment area for stormwater retention and detention has been assumed to be 103.4 ha.

The input and output files for the pre and post-development computer runs are included in **Appendix C.**

5.0 CONSERVATION AND SUSTAINABILITY

5.1 General

Challenges facing development in south-central Alberta are as follows:

- Supply of raw water,
- Disposal of treated effluent,
- Control of stormwater run-off,
- Impact of development to watersheds and the general environment,

The "Water for Life" strategy has been implemented to mitigate these issues. A key objective under "Water for Life" is to encourage communities to adopt water conservation measures with the goal of achieving a 30% reduction in potable water consumption.

5.2 Design Parameters Conservation

A reduction of 30% in water consumption by 2030 would affect the design parameters for the ASP area. **Table 5.1** illustrates the design water demands with a 30% reduction in potable water consumption.

Table 5.1

Design Water Demands Conservation Scenario of 30% Reduction in Consumption

User	Current (m^3/day)	Phase 1 50% build out (m^3/day)	Phase 2 100% Build out (m^3/day)
Residential in ASP Area	107.4	82.6	82.6
Industrial & Commercial Water Usage	149.2	1763	3324
Saddlebrook	0	105	105
Foothills Regional Indoor Fields House	0	7.2 [1]	7.2 [1]
Sub-total	***256.6***	***1,958***	***3,519***
Cargill	6,054	5,298	5,298
Residential North of ASP Area	95.8	172.7	172.7
TOTAL	**6,406**	**7,429**	**8,990**

A 30% reduction in water consumption will also impact wastewater generation. **Table 5.2** illustrates the design wastewater flows with the 30% reduction utilized.

Table 5.2

Design Wastewater Generation Scenario of Conservation.

User	Current	Phase 1 50% build out (m3/day)	Phase 2 100% Build out (m3/day)
Residential in ASP Area	96.7	74.4	74.4
Industrial & Commercial Water Usage	134.3	1587	2991
Saddlebrook	0	81	81
Foothills Regional Indoor Fields House	0	6.5	6.5
Sub-total (generated within ASP Area)	***231***	***1,749***	***3,153***
Residential North of ASP Area	86.2	155	155
TOTAL without Cargill	**317.2**	**1,904**	**3,308**
Cargill	6,054	5,297	5,297

Water conservation can significantly reduce the capital and operating costs of both the potable water and the sanitary infrastructure. Savings can be achieved by:

- Reduced volume of raw water diversion license acquisition,
- Reduced water treatment plant capacity,
- Smaller potable water distribution pipeline and potable water storage requirements,
- Smaller sanitary collection forcemains,
- Reduced wastewater treatment plant capacity.

The environmental benefits of water conservation include:

- Reduced raw water quantity diverted from the river basin
- Reduced discharge of treated effluent into the river basin

5.3 Reducing Stormwater Run-off

Development typically leads to a significant increase in the imperviousness of the landscape. This creates an increase in stormwater surface flows which can result in:

- Increased flooding
- Increased sediment and a general reduction in stormwater quality entering a water body

Developers are required to retain surplus stormwater that results from the development. Stormwater is typically retained in storm retention and/or storm detention ponds. Minimizing the quantity of stormwater run-off will reduce the size of the required stormwater storage facility.

In order to minimize stormwater run-off, a reduction in imperviousness is required. This is referred to as "Low Impact Development". Methods to achieve this include:

- Sub-surface on-site storage (e.g. under parking lots)
- Maximizing vegetated grounds on the site.

5.4 Sustainability

The following methods for sustainability are discussed in this section:

1. Reduction in Water Consumption,
2. Low Impact Development and Stormwater Re-use,
3. Recycling of Wastewater.

<u>1. Reduction in Water Consumption</u>

The implementation of water conservation measures significantly reduce infrastructure costs (both capital and operating), aid in raw water acquisition (a finite resource), increase the number of lots serviceable, and mitigate impact to the watershed.

Achieving a 30% reduction in water consumption will require changes in building requirements and development guidelines. Methods for water conservation currently being considered include:

1. Individual site rainwater harvesting for irrigation use.
2. Low flow plumbing fixtures including point of use water heaters.
3. Tiered billing of water rates.
4. Implementing mandatory low water use landscaping.
5. Implementing policies of no potable water use for irrigation.

The above water conservation methods are within current legislative policies.

The City of Calgary is aiming to reduce its potable water consumption (including municipal/commercial and industrial use) to 350 L/c/day by 2033. This will be achieved through water conservation education and awareness and through the installation of water efficient fixtures through the low water use fixture by-law. Of note, the Town of Okotoks has reduced its water consumption by 20% from 400 L/c/day in 2003 to 329 L/c/day in 2005 through the implementation of low flow fixtures in all new and renovated houses.

2. Low Impact Development and Stormwater Re-use

At present, non-potable water re-use including stormwater is practiced in Canada on a relatively small scale, and mostly in isolated cases. Typical examples of such reuse include: agricultural cropland irrigation in British Columbia (BC), Alberta, Saskatchewan and Manitoba; golf course irrigation and landscape irrigation in BC and Alberta. As water demands increase and readily available supply decreases, the water re-use as a whole and stormwater re-use in particular will increase. Therefore, it is important to address water re-use science and policy to provide some guidance for future developments (Marsalek *et al*, 2002). Further information on Low Impact Development and Stormwater Re-use is provided in **Appendix F.**

3. Recycling of Wastewater

Recycled water consists of tertiary treated wastewater for use as irrigation supply and other non-potable uses. Recycling of wastewater as an alternative non-potable water source affects (reduces) water consumption. Further information on recycling of wastewater is provided in **Appendix F.**

It is noted that the City of Calgary has entered into a 25-year pilot project agreement with the Blue Devil Golf Course, where the City will provide chlorinated, tertiary treated effluent from the new Pine Creek Wastewater Treatment Plant for golf course irrigation purposes. It is estimated that a typical 18 hole golf course consumes 1,300 m^3/day (237,000 m^3/year) for the irrigating months of the year (generally April to October 30). There may be turf management issues that need to be addressed when using recycled water for golf course irrigation. There may also be potential for future irrigation of the proposed Foothills Regional Indoor Field House utilizing tertiary treated, recycled wastewater or treated stormwater that is generated from within the ASP area.

5.5 Summary

Water conservation measures should be implemented regardless of the utility servicing alternative chosen. To promote conservation, the MD could adopt conservation measures including:

- Implement an Irrigation Policy – (no potable water for irrigation).
- Required installation of low flow plumbing fixtures and appliances in new developments.
- Establish a tiered billing system involving higher rates for higher household consumptions.
- Implement mandatory low water use landscaping with irrigation by captured rainwater.
- Promote water conservation through community education and advertising.
- Future installation of purple pipe recycled water system (once regulations allow it) for non-potable use including irrigation.
- Design of water connections within buildings to facilitate separation of potable water from recycled water.

6.0 COSTS, ECONOMICS AND OPERATIONS

This section reviews the capital expenditures and operational costs associated with providing water, wastewater and stormwater infrastructure to the ASP area. Costs associated with the proposed functional pathway are also included in this section as requested by the MD.

6.1 General

For the purposes of this study, the following assumptions are made:

- Raw water diversion license acquisition is obtained by the MD and recovered by development levy.
- Capital and operational costs for potable water distribution (pipes, storage reservoir, booster stations) are financed by the MD and recovered by development levy.
- Capital and operational costs for sanitary collection infrastructure (pipes, lift stations) are financed by the MD and recovered by development levy.
- Capital and operational costs for potable water treatment and wastewater treatment are provided by a third party (either the Town of High River or the Town of Okotoks) and are recovered through the respective bulk water and bulk wastewater rates assessed to the MD.
- Capital and operational costs for stormwater retention are borne by the developer (retention ponds to be located within the development site).
- Capital and operational costs for stormwater conveyance infrastructure are financed by the MD and recovered by development levy.

6.1.1 Capital Expenditure

Costs represented in the report are in 2010 dollars. Costs include a 25% allowance for contingencies and a 15% allowance for engineering. Detailed cost estimates are located in **Appendix E** of the report.

6.1.2 Operational and Maintenance

The following parameters were used to establish the operational costs to service the ultimate build out for the ASP area:

- Labour ($120,000 year);
- Utilities (Power costs $ 0.15/KWh);

The following **Table 6.1** specifies the bulk potable water rates and bulk wastewater rates that were obtained from the potential suppliers:

Table 6.1
Third Party Bulk Supplier Rates

Item	Town of High River		Town of Okotoks	
	Quantity	Rate	Quantity	Rate
Bulk Potable Water	Monthly Flat Rate	\$800	N/A	\$1.54/m^3
	0 to 18.2 m^3	\$4.12/ m^3		
	18.3 to 682 m^3	\$0.50/ m^3		
	682.1 – 2,273 m^3	\$0.75 m^3		
	> 2,273 m^3	\$1.00/ m^3		
Bulk Wastewater			N/A	\$1.47/m^3
	0 to 22.7 m^3	\$2.49/m^3		
	> 22.7 m^3	\$0.67 m^3		

6.1.3 Net Present Value (NPV)

The following economic factors were used to establish the NPV of the capital expenditure and operating costs over 20 years:

- Capital costs of the infrastructure include the spine for water and wastewater infrastructure (main pipelines and lift/booster stations) and the spine for the stormwater (main ditches, culvert crossings and outfalls).

- Capital costs for the infrastructure spine are assumed to be development driven and therefore not eligible for provincial grant funding.
- Discount Rate 5.125%.
- Inflation Rate 2.0%.
- Debenture Rate 4.462% over 20-year term.
- Raw water diversion license acquisition is estimated to be valued at \$3.00/m^3 (\$3,700/ac-ft).
- Annual maintenance, equipment and supplies are estimated at 1% of capital for water and wastewater infrastructure.
- Annual operational costs for stormwater infrastructure include labour for litter removal, grass cutting, weed control, facility inspections and major ditch cleaning at a frequency of once every ten years. This is estimated to equate to 0.5% of capital of capital for stormwater infrastructure.
- Annual maintenance for the functional pathway is estimated at 1% of capital.

6.2 Potable Water Servicing

Raw Water Demands

Acquisition of an estimated additional 1,443,700 m^3 (1,170 ac-ft) of raw water diversion license is required to satisfy the design demands for the ASP area and commitments north of the ASP area (excludes Cargill's requirements). Raw water diversion license acquisition is estimated to be valued at \$3.00/m^3. Hence, requiring projected capital expenditure of \$4.33 Million is projected. If this cost is debentured over 20 years, the NPV is \$3.47 Million.

Water Alternative #1 –Town of High River Supply

The following capital components were included in the cost estimate if the water supply was from the Town of High River:

- Booster Stations,
- Pipelines,
- Potable Water Storage Reservoir.

The total capital cost in 2010 dollars to construct the infrastructure is estimated at $18,900,000. Costs to the MD are summarized in **Table 6.2** as follows.

Table 6.2

Water Alternative #1 Net Present Value (NPV) of Capital Expenditure and Operating Costs

Parameter	Cost
NPV of Capital Expenditure	$ 19,400,000
NPV Bulk Potable Water	$ 5,800,000
NPV 20 Years Operating	$ 4,800,000
TOTAL	**$ 30,000,000**

Water Alternative #2 –Town of Okotoks Supply

The following capital components were included in the cost estimate if the water supply was from the Town of High River:

- Booster Stations,
- Pipelines,
- Potable Water Storage Reservoir.

The total capital cost in 2010 dollars to construct the infrastructure is estimated at $18,600,000. Costs to the municipality are summarized in **Table 6.3** as follows.

Table 6.3

Water Alternative #2 Net Present Value (NPV) of Capital and Operating Costs

Parameter	Cost
NPV of Capital	$ 19,000,000
NPV Bulk Potable Water	$ 8,800,000
NPV 20 Years Operating	$ 4,800,000
NPV TOTAL	**$ 32,600,000**

6.3 Wastewater Servicing

Alternative #1 – Direct to Town of High River

The following capital components were included in the cost estimate if the wastewater collection and delivery was to the Town of High River:

- Lift Stations,
- Collection Pipelines.

The total capital cost in 2010 dollars to construct the infrastructure is estimated at $22,600,000. Costs to the MD are summarized in **Table 6.4** as follows.

Table 6.4

Wastewater Alternative #1 Net Present Value (NPV) of Capital and Operating Costs

Parameter	Cost
NPV of Capital	$ 23,000,000
NPV Bulk Wastewater Treatment	$ 3,500,000
NPV 20 Years Operating	$ 5,600,000
TOTAL	**$ 32,100,000**

Wastewater Alternative #2 – Direct to Town of Okotoks

The following capital components were included in the cost estimate if the wastewater collection and delivery was to the Town of Okotoks:

- Lift Stations,
- Collection Pipelines.

The total capital cost in 2010 dollars to construct the infrastructure is estimated at $25,300,000. Costs to the MD are summarized in **Table 6.5** as follows.

Table 6.5

Wastewater Alternative #2 Net Present Value (NPV) of Capital and Operating Costs

Parameter	Cost
NPV of Capital	$ 25,800,000
NPV Bulk Wastewater Treatment	$ 5,800,000
NPV 20 Years Operating	$ 5,900,000
TOTAL	**$ 37,500,000**

Wastewater Alternative #3 – Shared Service to Okotoks and to High River

The following capital components were included in the cost estimate if the wastewater collection and delivery shared service:

- Lift Stations,
- Collection Pipelines.

The total capital cost in 2010 dollars to construct the infrastructure is estimated at $24,700,000. Costs to the MD are summarized in **Table 6.6** as follows.

Table 6.6
Wastewater Alternative #3 Net Present Value (NPV) of Capital and Operating Costs

Parameter	Cost
NPV of Capital	$ 25,200,000
NPV Bulk Wastewater	$ 5,500,000
NPV 20 Years Operating	$ 5,800,000
TOTAL	**$ 36,600,000**

6.4 Stormwater Servicing

Capital Costs for the stormwater ponds are excluded from the cost estimates because they will be required to be installed by the developer. Municipal stormwater costs are the costs to install the spine infrastructure of ditches, outfalls and storm piping. Costs include culvert installation at Hwy 2A and CP Railway. Operational and maintenance costs over 20 years include the costs to maintain the ditches and piping including grass cutting and litter removal. Major ditch clean-outs every 10 years are included.

The Net Present Value for stormwater spine is provided in **Table 6.7**.

Table 6.7
Net Present Value of Stormwater Conveyance

Catchment	NPV Cost
HW-1	$570,000
TCH-W	$ 480,000
HW-2	$130,000
HW-3	$900,000
SR	$800,000
TOTAL	**$2,900,000**

6.5 Functional Pathway

The MD has tentative plans to install a functional pathway within the ASP area. Capital costs and levies associated with the Functional Pathway Option 1 have been prepared. The pathway is assumed to be 2.3 m wide with a paved surface. Maintenance costs are estimated at 1% of capital per annum. Land acquisition costs are estimated at $11,000 per hectare. The NPV of the pathway is estimated at $2,120,000 or $167/m of pathway.

6.6 Utility Rates and Development Levies for Water and Wastewater

For each of the above alternatives, the NPV's of the MD operating costs have been used to establish water and wastewater user rates. Operating costs include labour, utility costs, and annual maintenance valued at 1% of capital. MD bulk rates are established based on full build out in 20 years. This equates to approximately 14% exponential growth per year. These utility rates developed are listed in **Table 6.8** and **Table 6.9,** water and wastewater respectively.

Table 6.8
2010 Water Utility Rates

Alternative	NPV M.D. Operating Costs	Bulk Water Rate from Municipality ($/m³)	M.D. Water Rate ($/m³)	Total User Rate ($/m³)
#1 Water Supply from High River	$4,800,000	$1.00	$0.33	$1.33
#2 Water Supply from Okotoks	$4,800,000	$1.54	$.32	$1.86

Table 6.9

2010 Wastewater Utility Rates

Alternative	NPV M.D. Operating Costs	Bulk Wastewater Rate from Municipality ($/m³)	M.D. Wastewater Rate [1]	Total User Rate ($/m³)
#1 Wastewater Directed to High River	$8,600,000	$0.67	$0.42	$1.09
#2 Wastewater Directed to Okotoks	$10,100,000	$1.47	$0.45	$1.92
#3 Shared Service	$9,400,000	$1.07	$0.44	$1.51

1. Wastewater rates established excluding the quantity of wastewater generated by Cargill.

Table 6.10 provides an overview of projected development levies. These levies are only for the MD costs of developing the various infrastructure; they are calculated for water and wastewater servicing only. The levies are further broken down into a per-acre and a per-lot basis.

Table 6.10

Development Levies and 2010 User Rate Summary

Alternative	NPV of Capital and Operating	Levy/Acre [1]	Levy/Lot [1]	Total User Rate per Alternative ($/m³)
#1 Water from High River	$19,400,000	$4,200	$10,100	$1.33
#2 Water from Okotoks	$19,000,000	$4,110	$9,910	$1.86
#1 Wastewater to High River	$23,000,000	$4,990	$12,030	$1.09
#2 Wastewater to Okotoks	$25,800,000	$5,590	$13,460	$1.92
#3 Wastewater Shared	$25,200,000	$5,460	$13,160	$1.51

1. Based on an average lot size of 0.98 hectare/lot, and total developable hectares of 1879 ha.
2. Based on exponential growth to full build out by 2030.

Based on the above analysis, the capital costs for the water supply are relatively equal between High River and Okotoks. When user rates are included in the analysis, it is more economical to obtain water from High River. There is a large discrepancy in the bulk water rates charged by Okotoks and High River. It is possible that there could be a significant increase in the water and wastewater rates in future to High River due to their infrastructure and the necessity for upgrades, particularly with the WWT Plant. High River bulk water rates would need to increase by 50% to equate to the Okotoks bulk water rate.

For wastewater, the most cost effective alternative is to deliver and have the wastewater treated by High River. This is primarily due to the proximity of the High River WWT facility to the ASP area. Another key factor is the Town of High River's lower wastewater rates. As with the water rates, it is possible that there could be a significant increase in the High River wastewater rates due to their aging infrastructure and the necessity for upgrades, particularly with the wastewater treatment facility. High River bulk wastewater rates would need to more than double to equate to the Okotoks bulk wastewater rate.

6.7 Summary of Costs and Development Levies

A summary of the projected utility rates and development levies is provided below in **Table 6.11**.

Table 6.11

2010 Utility Rates and Development Levies

Parameter	NPV M.D.[1] Capital and Operating Costs	Bulk Rate from Third Party Municipality ($/m^3)	M.D.[4] Rate ($/m^3)	Total User Rate ($/m^3)	Levy per Acre [2,3,5]	Levy per Lot [2,3,5]
Raw Water Acquisition	$3,470,000	n/a	n/a	n/a	$747	$1,810
Water Supply from High River	$24,190,000 [1]	$1.00	$0.33	$1.33	$4,200	$10,100
Wastewater Directed to High River	$28,600,000 [1]	$0.67	$0.42	$1.09	$4,990	$12,030
Stormwater Conveyance Infrastructure	$2,860,000	n/a	n/a	n/a	$619	$1,470
Functional Pathway	$ 2,120,000	n/a	n/a	n/a	$457	$1,110
TOTAL	**$61,240,000**				**$11,000**	**$26,530**

1. Excludes NPV of bulk rate.
2. Levy based on NPV of capital for raw water acquisition, water supply and wastewater directed.
3. Levy based on NPV of capital and operating for stormwater and functional pathway.
4. Assumes exponential growth to a full build out by 2030.
5. Net developable area of 1,879 hectares.

7.0 CONCLUSIONS

The following conclusions are observed from the study:

1. In order to fully develop the ASP area, access to 1,443,700 m^3 of raw water license is required in addition to the existing licenses and agreements. This does not include the additional 828,600 m^3 of raw water license Cargill requires to expand their operations.
2. At full build out, the design average day potable water demand for the study area and the residential communities to the north of the study area is 4,799 m^3/day. In addition to this, the design average day potable water demand for Cargill is 7,568 m^3/day.
3. The design average day flow generation of wastewater for the study area is 4,574 m^3/day. Cargill has its own wastewater treatment facility; therefore it is not included in this value. The Highwood and Sheep Rivers have limited capacity to receive treated effluent. Stringent treatment levels for the generated wastewater will be required in order to permit discharge to either of these two river basins.
4. To maintain a stormwater pre-development release rate of 5 L/s/ha at full build out of the study area, 2.13 million cubic meters of stormwater storage is required. This is established based on the 1:100 year storm event.
5. The most cost effective potable water supply is from the Town of High River. High River will require a water treatment plant capacity of 44,200 m^3/day (maximum day demand) to accommodate full build out of the study area (including Cargill), the residential communities north of the study area and the Town of High River 2030 projected population.
6. The most cost effective wastewater servicing is development of the required infrastructure to deliver flows to the Town of High River facilities. The wastewater would be treated in the Town of High River wastewater treatment facility. High River will require a wastewater treatment facility of 8,942 m^3/day (average day flow) and require a hydraulic capacity for a peak wet weather flow of 205.5 L/s in order to accommodate full build out of the study area, the residential communities north of the study area and the Town of High River 2030 projected population. Cargill's needs are excluded because they have their own WWTP.
7. Implementation of water conservation measures will significantly reduce infrastructure costs (both capital and operating), aid in reducing the amount of raw water acquisition (a finite resource), increase the number of lots that can be serviced, and mitigate impact on the watershed. There may be an opportunity to use recycled tertiary treated wastewater in the cooling process at the Saddlebrook power generating facility.

8.0 REFERENCES

Documents and studies that served as referencing material in the preparation of this report are listed as follows.

1. Aldersyde and Area Sanitary Sewer Study, *Bel-MK Engineering Ltd.,* December 2006.
2. Highway 2A Industrial Area Structure Plan, *M.D. of Foothills No. 31 and Interplan Strategies Inc.,* September 1995.
3. High River WWTP and Cargill Upgrade Conceptual Design, *CH2M Hill,* February 2007.
4. Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, *Alberta Environment*, January, 2006.
5. Water Sensitive Urban Design Engineering Procedures Stormwater, *CSIRO Melbourne Water*, 2005.
6. Recycled Water User Manual, *Los Angeles County Recycled Water Advisory Committee,* 2005.
7. Planning and Technical Study on Water and Wastewater Servicing in the Calgary Region (submitted to the Calgary Regional Partnership (CRP), *CH2M Hill*, June 2007.
8. CRP Regional Servicing Study: Decision Analysis, Technical Memorandums 2.1, 2.2, 3.1, 5.3-Revised Draft, *CH2M Hill*.
9. Town of Okotoks Water Management Plan, *Town of Okotoks,* updated May 25, 2004.
10. Agricultural Region of Alberta Soil Inventory Database, *AGRASID, Government of Alberta*.
11. Alberta Low Impact Development Partnership (ALIDP), 2009 Winter Communiqué, Water Centre, *City of Calgary,* Dec. 2009.
12. HydroFreq1, *Hydro Tools Software*, Edmonton, Alberta, 2000.
13. Hwang, A.H.S, C. Valeo, and D. Draper. 2006. Public Perceptions and Attitudes Toward Stormwater Recycling for Irrigation. *Canadian Water Resources Journal*, 31(3):185-196).
14. Water Reuse and Recycling. Canadian Council of Ministers of the Environment, Winnipeg, Manitoba. CCME Linking Water Science to Policy Workshop Series. Report No. 3 39p. *Marsalek, J. K. Schaefer, K. Exall, L. Brannen, and B. Aidun,* 2002.
15. Pirmez Creek Master Drainage Plan, Prepared for Progressive Engineering Limited, *Golder Associates Ltd*, 2006.
16. QHM User's Manual, *Centre for Water Resources Studies, Dalhousie University,* 1998.
17. Springbank Airport Stormwater Management Plan, Prepared for Calgary Airport Authority, *McElhanney Consulting Services Ltd*., 2008.
18. Stormwater Management Guidelines for the Province of Alberta, *Alberta Environmental Protection,* 1999.

19. Stormwater Management & Design Manual, *City of Calgary Wastewater & Drainage,* 2000.
20. SWMHYMO User's Manual, *J-F Sabourin & Associate Inc.,* 2000.
21. The City of Calgary's Environmental Action Plan, March 2007, *City of Calgary*, Alberta.
22. A Report on Drainage Strategies for Springbank Airport, Prepared for Municipal District of Rocky View No. 44, *Westhoff Engineering Resources Inc*., January 2004.

Websites Cited:

www.calgary.ca/ Accessed on December 22, 2009
www.thebridges.ca/ Accessed on December 22, 2009
www.calgary.ca
http://www.telusgeomatics.com/tgpub/ag_water/
http://envext02.env.gov.ab.ca/misc/index.html
http://www.calgaryregion.ca/crp/
http://www.ch2m.com/corporate/worldwide/assets/ProjectPortfolio/canada/Pine_Creek_WWTP.pdf
http://content.calgary.ca/CCA/City+Living/The+Environment/Water+and+Wastewater/Wastewater+and+Drainage/Wastewater+Treatment.htm
www.crd.bc.ca/reports/water_/2004_/crdgreywaterreuse