Town of Carstairs

Master Servicing Study

Prepared by:

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Project Number:

60148717

Date:

November, 2010

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November 22, 2010

Carl McDonnell
Chief Administrative Officer
Town of Carstairs
844 Centre St, Box 370
Carstairs, AB T0M 0N0

Dear Carl:

Project No: 60148717
Regarding: Master Servicing Study

We are pleased to provide you with a final report of the findings for the 2010 Town of Carstairs Master Servicing Study.

We trust that this report and the information presented herein is consistent with your expectations. Please feel free to contact the undersigned at 403.270.4818 if you have any questions.

Sincerely,
AECOM Canada Ltd.

Kevin Clarke.

Kevin Clarke
kevin.clarke@aecom.com

:kc
cc: file

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The Association of Professional Engineers,
Geologists and Geophysicists of Alberta.

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1. Introduction

The Town of Carstairs (the Town) recently annexed approximately ten quarter-sections of land from Mountain View County, significantly increasing the land available for municipal development within the town.

The purpose of this master servicing study is to update the *2005 Town of Carstairs Servicing Study* (Stantec, 2005) and the *2001 Town of Carstairs Master Drainage Plan,* (UMA, 2001) and bring these updates together into a single Master Servicing Study (MSS) that will enable these annexed lands to be incorporated without compromising the reliability of the existing municipal services.

This MSS also incorporates findings from the *2009 Carstairs Community Sustainability Plan* (AECOM, 2009) so that additional growth pressure does not negatively affect the provision of water, stormwater drainage, wastewater collection and treatment and that social, cultural, environmental, economic, and governance measures are included in the MSS. This MSS identifies deficiencies in the existing municipal services and provides recommendations with respect to improvements that will be required to accommodate present and future subdivision developments.

Opinions of Probable Cost for these improvements are also included to help the Town plan and manage services such as water, stormwater drainage, wastewater collection and treatment for the new development areas and to give the Town the ability to determine future servicing budgets and establish rates for off-site levies for new subdivision developments within the Town.

This MSS consists of the following sections:

- Section 1 - Introduction
- Section 2 – Study Area and Population Projections
- Section 3 – Water Storage and Distribution System
- Section 4 – Wastewater Collection / Treatment System
- Section 5 – Stormwater and Drainage Management
- Section 6 – Capital Analysis
- Section 7– Sustainable Development Checklist

2. Study Area and Population Projections

The Town of Carstairs is located in south-central Alberta just off the Queen Elizabeth II Highway approximately 50 km north of the City of Calgary's limits. The topography of the Town is relatively flat with a maximum elevation difference of 33 metres across the Town. Stormwater generally drains from west to east..

The study area includes the area within the existing Town boundaries and approximately ten quarter-sections of land annexed from Mountain View County as shown on the following page in **Figure 2.1 – Study Area**. The proposed land use is indicated in **Figure 2.2**

2.1 Historical Population

The following table shows the historical population statistics and growth rates for the Town over the past 38 years coupled with the estimated projection for 2009 as estimated in Section 2.2.

Table 2.1 Town of Carstairs Past Population Growth

		Average Annual Percent Change			
Year	**Population**	**Five Year Groupings**		**Groupings up to 2009**	
1971	884				
1976	1059	1971 to 1976	3.68%	2006 to 2009 (Last 3 Years)	9.29%
1981	1587	1976 to 1981	8.43%	2001 to 2009 (Last 8 Years)	5.53%
1986	1629	1981 to 1986	0.52%	1996 to 2009 (Last 13 Years)	4.70%
1991	1645	1986 to 1991	0.20%	1991 to 2009 (Last 18 Years)	4.23%
1996	1909	1991 to 1996	3.02%	1986 to 2009 (Last 23 Years)	3.34%
2001	2254	1996 to 2001	3.38%	1981 to 2009 (Last 28 Years)	2.83%
2006	2656	2001 to 2006	3.34%	1976 to 2009 (Last 33 Years)	3.66%
2009*	3467	2006 to 2009	9.29%	1971 t0 2009 (Last 38 Years)	3.66%

*Source: Statistics Canada, excluding population data from 2009. *Population estimate for 2009 based on Town count of garbage bins (3467) and assumption of 2.7 people per bin*

2.2 Future Population Projection

After reviewing the fluctuation of the historical population and recent growth rates with the Town, three future growth rate scenarios were arrived at: high, medium and low population growth rates. These scenarios are shown in Tables 2.2 – 2.4

Table 2.2 Low Growth Rate Scenario

Average Annual Growth Rate	2006 (Actual)	2011	2016	2021	2026	2031	2036	2041
7.50%	2,654	3,810						
4.00%		3,810	4,635	5,639				
2.50%				5,639	6,380	7,218	8,167	9,240
Additional People		1,156	1,981	2,985	3,726	4,564	5,513	6,586

Table 2.3 Population Projections Medium Growth Rate Scenario

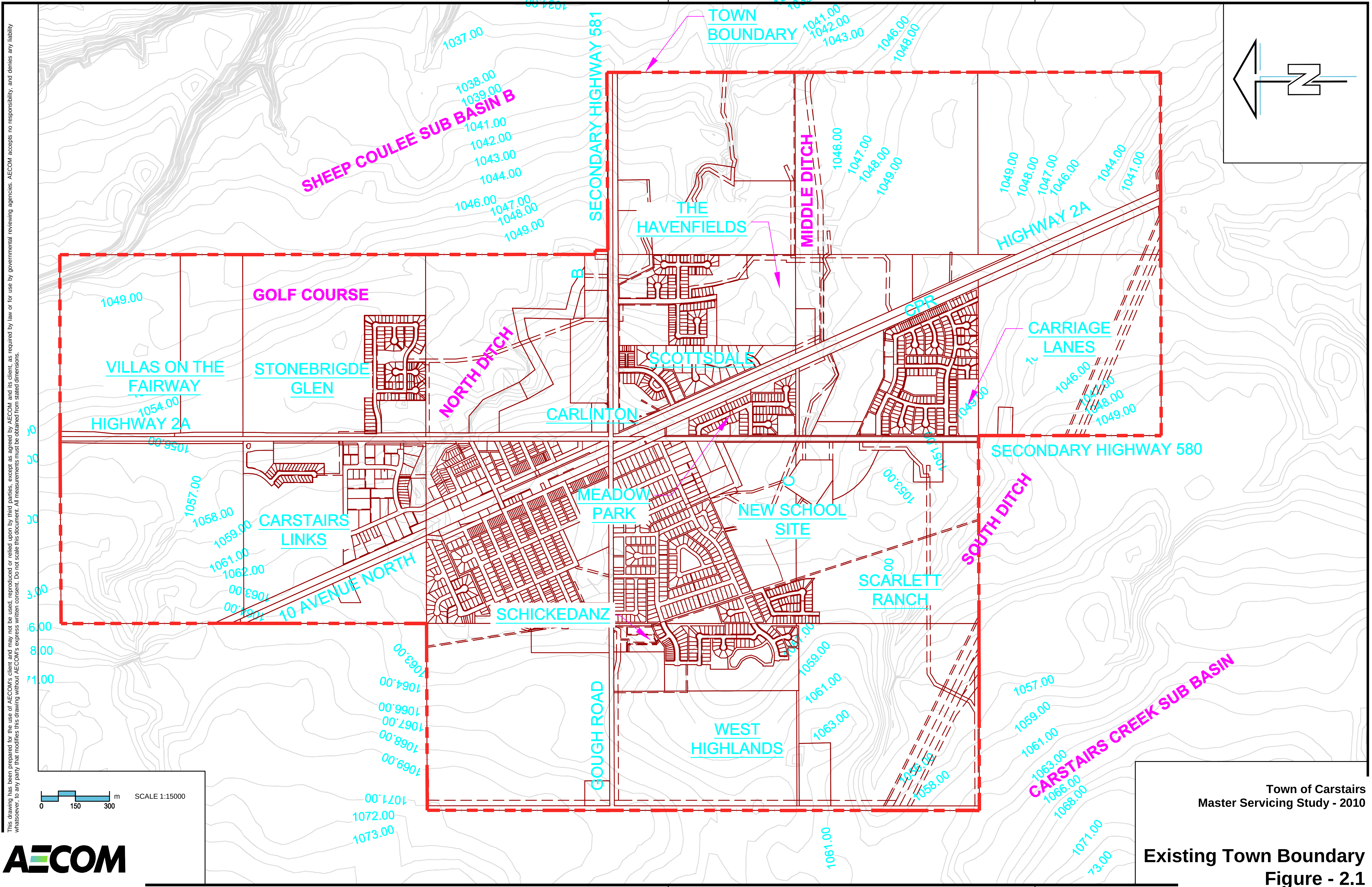
Average Annual Growth Rate	2006 (Actual)	2011	2016	2021	2026	2031	2036	2041
8.5%	2,654	3,991						
4.5%		3,991	4,974	6,199				
3.7%				6,199	7,434	8,915	10,691	12,821
Additional People		1,337	2,320	3,545	4,780	6,261	8,037	10,167

Table 2.4 Population Projections - High Growth Rate Scenario

Average Annual Growth Rate	2006 (Actual)	2011	2016	2021	2026	2031	2036	2041
9.5%	2,654	4,178						
6.5%		4,178	5,724	7,842				
4.0%				7,842	9,541	11,608	14,123	17,183
Additional People		1,524	3,070	5,188	6,887	8,954	11,469	14,529

For the purpose of determining the infrastructure requirement for the town the High Growth rate scenario was utilized.

The high population growth rate in Table 2.4 assumed a 9.5% growth rate initially, dropping to a rate of 6.5% per year from 2011 to 2021 for the medium term, and dropping further to a rate of 4.0% per year from 2021 to 2041 for the longer term. The high growth rate was selected to ensure that any infrastructure installed has the flexibility to maximize growth options within the town, and enable the variation of land uses and density as set out in the Municipal Development Plan (MDP).



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Town of Carstairs
Master Servicing Study - 2010

Existing Town Boundary
Figure - 2.1

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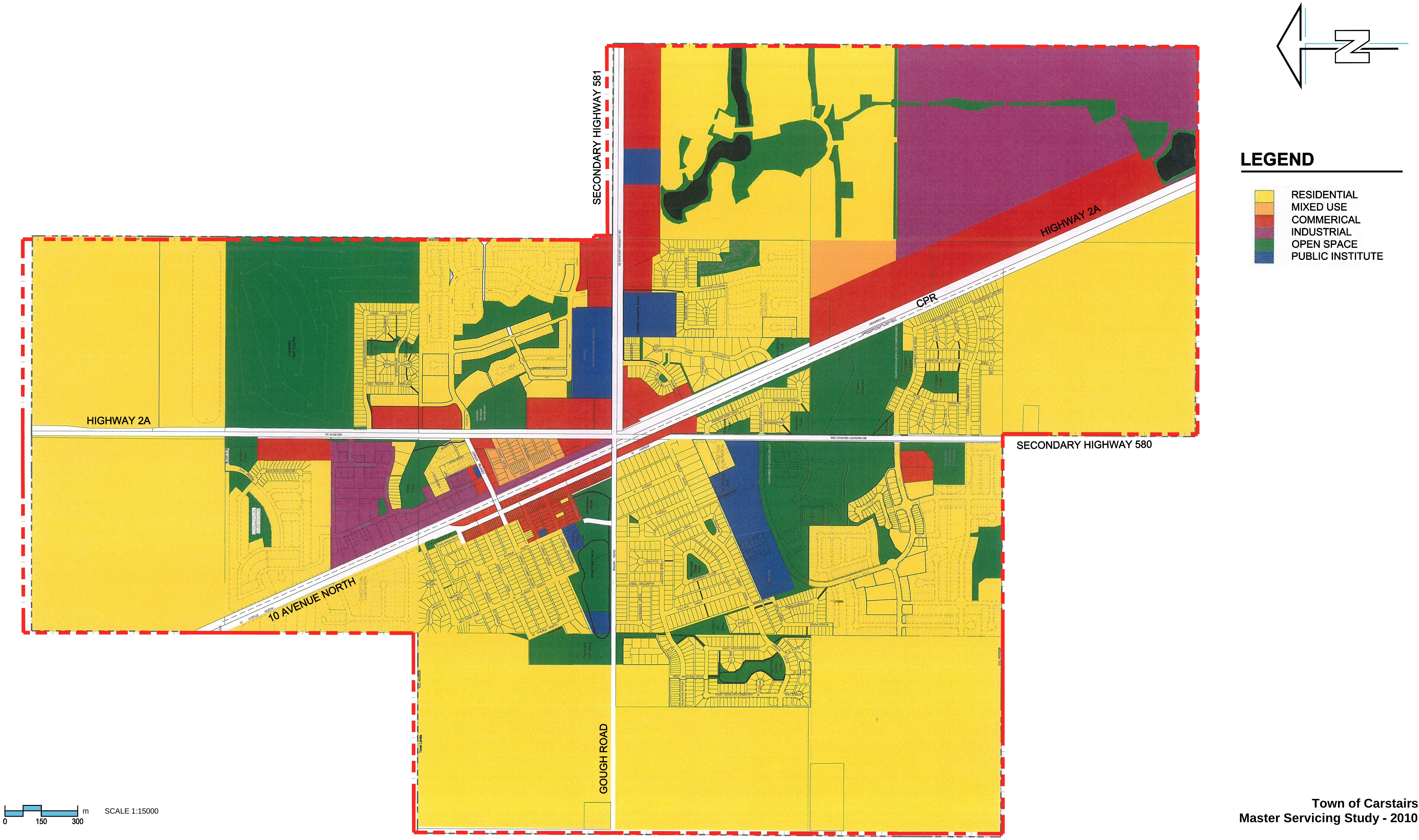

Town of Carstairs
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Municipal Development Plan Concept

Figure - 2.2

2.3 Land Use

The expected 2006 land use consumption for the town of Carstairs, (prior to annexation), were indicated in the *2005 Town of Carstairs Servicing Study* (Stantec, 2005) as shown in the following table.

Table 2.5 2006 Land Consumption Estimates

Total Land Consumption by USE	Acres	Hectares	Percent
Residential	41.00	16.6	65.87%
Commercial	6.67	2.7	10.71%
Industrial	6.67	2.7	10.71%
Public Facility & Open Space	7.90	3.2	12.70%
TOTAL	**62.24**	**25.2**	**100.00%**

The annexation of ten quarter sections and the updated MDP, will significantly alter the land consumption in the future. The updated MDP recommends that the target residential population density for the town of Carstairs, for existing and future residential areas, should average between 12 and 25 dwelling units per gross developable hectare (5 to 10 units per acre). For the purpose of this study a residential density of 10 dwelling units per hectare in the existing developed town, and 20 dwelling units per hectare in future developed units has been used. The 2005 Town of Carstairs Masters Servicing Study (2005 MSS) referenced a residential density of 10 units per hectare, however the actual density was closer to 8 units per hectare.

The figure of 20 dwelling units per hectare has been used, rather than the upper end of the target of 25, because the occupancy rate of 2.7 persons per dwelling has been retained from previous studies. In reality, as dwelling density increases, occupancy rates tend to decrease. Therefore an occupancy rate of 2.7 with a density of 20 dwellings per hectare is considered the most likely scenario, and balances the required flexibility requested by the MDP and the cost of infrastructure.

The quantity of land that will be required for industrial development and commercial development is a function of population rather than population density. The estimate for industrial consumption of land per 1,000 population from the 2005 MSS was 5.97 Hectares per 1,000 population. For the purposes of estimating future land consumption for industrial usage the same rate has been used.

The estimate for commercial consumption of land per 1000 population from the 2005 MSS was 5.96 Hectares per 1,000 population. For the purpose of estimating future land consumption for commercial usage the same rate has been used.

The estimate for public facility and open space consumption of land per 1,000 population from the 2005 MSS was 9.62 hectares per 1,000 population. However the 2010 MDP specifies that, upon subdivision, *"the Subdivision Authority shall require that 10 percent of the developable land, defined as the gross parcel area excluding land dedicated as environmental reserve, is dedicated as municipal reserve in accordance with the provisions of the Municipal Government Act"*. Therefore for the purpose of estimating future land consumption for public facility and open space usage the rate of ten percent of all other developed land has been used.

The proposed location of each of the land use types is outlined in Figure 2.2, from the current town of Carstairs MDP.

In light of the above data the following assumptions are utilized for the projection of population growth and future land use:

- Residential household occupancy remains at 2.7 persons per unit
- Residential density in existing developed town is 10 dwelling units per gross hectare of residential land
- Residential development in future developments rises to be 20 dwelling units per gross hectare of residential land
- Commercial and industrial land consumption is to remain steady at the current rate of 5.96 hectares per 1,000 people and 5.97 hectares per 1,000 people respectively
- Public facilities and open space to be 10% of total developed land
- Population growth rates are to be 9.5% per year in the short term (2006 – 2011), 6.5% in the medium term (2011 – 2021) and 4.0% in the long term (2021 – 2041)

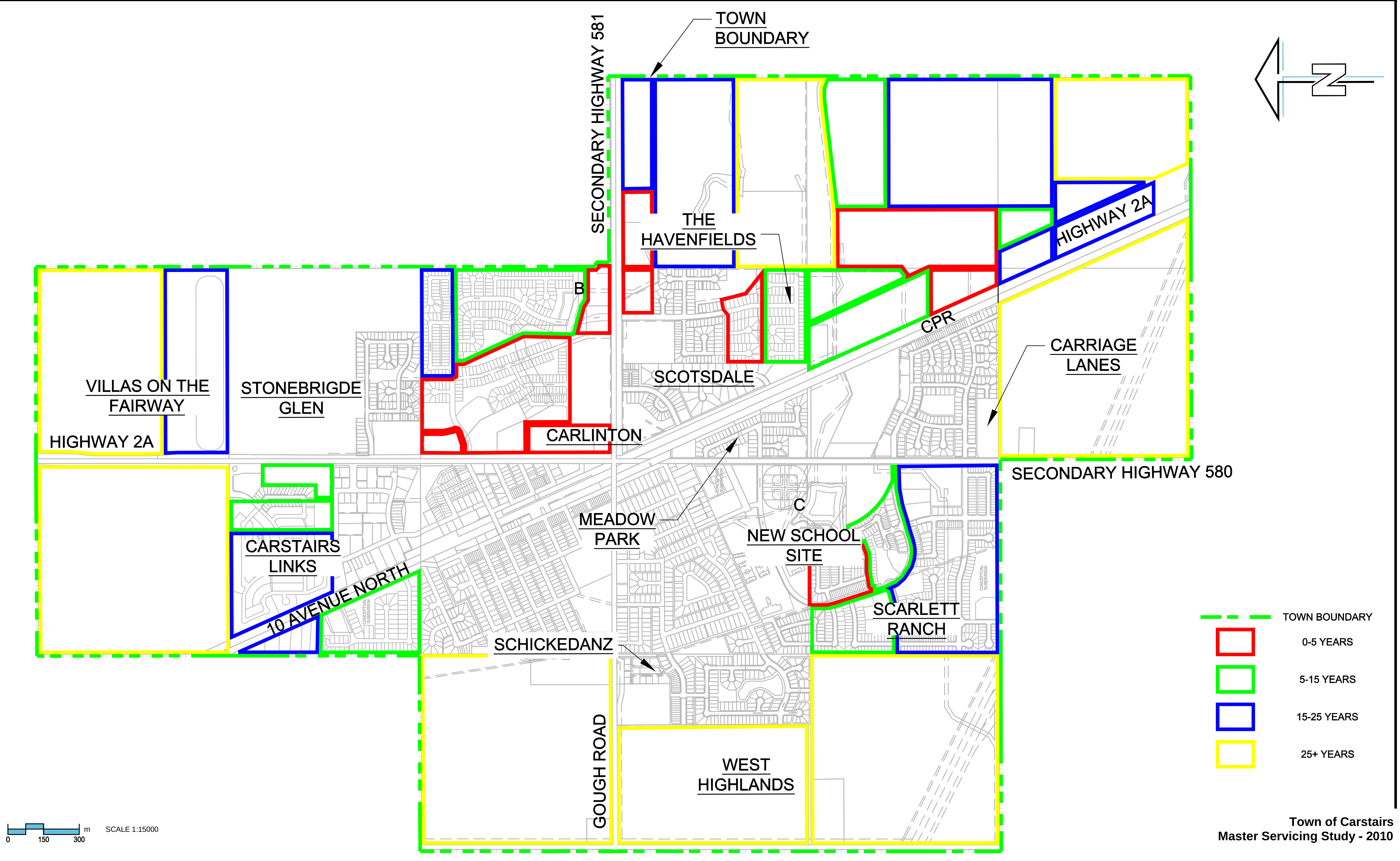
The future estimate of incremental land consumption using the aforementioned consumption rates and increased residential densities is detailed in Table 2.6 below.

Table 2.6 5 Year Incremental Land Usage Projection

		Year							
		2006*	**2011**	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**
Population Estimate		2654	4178	5,724	7,842	9,541	11,608	14,123	17,183
Population Change in 5 year period			1524	1546	2118	1699	2067	2515	3060
Incremental Land Consumption Required									
	Land Use Rate								
Residential	20 units / ha		28.3	28.7	39.3	31.5	38.3	46.6	56.7
Commercial	5.96 ha / 1000 pop		5.96	11.9	17.9	17.9	29.8	35.8	47.7
Industrial	5.97 ha / 1000 pop		5.97	11.9	17.9	17.9	29.9	35.8	47.8
Public Facility & Open Space	9.62 ha / 1000 pop		4.02	5.26	7.51	6.73	9.80	11.82	15.21
TOTAL: Hectares			**44.25**	**57.82**	**82.60**	**74.02**	**107.75**	**130.00**	**167.35**
TOTAL: Acres			**17.92**	**23.41**	**33.44**	**29.97**	**43.62**	**52.63**	**67.75**

Based on the above table and the land use Figure 2.2, an assumed development phasing was developed. Figure 2.3 shows the proposed development cells at estimated periods for development. The time frames have been divided into the following four phases:

- 0 to 5 years
- 5 to 15 years
- 15 to 25 years
- 25 years +



Town of Carstairs
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Development Phase Planning

Figure - 2.3

3. Water Storage and Distribution System

3.1 Introduction

To enable the evaluation of the existing and proposed water supply and distribution requirements, the design criteria was developed after reviewing the following design reports and municipal documents:

- 2005 Town of Carstairs Servicing Study (2005 MSS)
- 2009 Town of Carstairs Community Sustainability Plan
- Municipal Development Plan 2010
- Town of Carstairs Development Agreement
- Town of Carstairs Standards
- Town of Carstairs MIMS information
- Alta LIS cadastral base plan
- Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems (Alberta Environment, January 2006)

3.2 Historical Water Consumption and Design Criteria

3.2.1 General

The historical water consumption records from 2000 to 2004 are referenced from the 2005 MSS and the Town provided the consumption records from 2005 to 2009. The review of the historical water consumption is summarised in the following table.

Table 3.1. Historical water consumption review for the Town from 2000 to 2009

Year	Population	Annual Records (m^3)	Average per capita consumption rate (litres/c/day)
2000	2,185	277,644	347
2001	2,254	294,738	358
2002	2,329	278,556	328
2003	2,406	323,147	368
2004	2,486	312,852	344
2005	2,569	292,365	312
2006	2,654	312,319	322
2007	2,906	300,537	283
2008	3,182	324,287	278
2009	3,467	352,028	278
Ten Year Average			**322**

Notes: The 2009 population is estimated based on an assumed density of 2.7 persons per household and 1,284 occupied dwelling units, which is the number of garbage bins the Town supplied in 2009.

For the purpose of evaluating the existing and proposed water supply and distribution system, as shown in Figure 3.1, the ten year average of **322 litres/c/day** shall be used for this study. This number is less than the **369 litres/c/day** used in the *2005 MSS.* This reduction is consistent with the large population growth since 2005 in newer homes that have water conservation measures such as low flow toilets and fixtures installed.

To account for significant point source water-uses an evaluation has been made of the water consumption of the golf course, the existing schools, the truck fill, and industrial and commercial usage.

3.2.2 Golf Course

The golf course is a significant water user in the town, as the golf course uses most of the water for irrigation its demand is dependent on rainfall. For example, the more it rains, the less irrigation is required; thus irrigation of the golf course varies from year to year. There is also a pond in the golf course that stores stormwater that is used for irrigation purposes. Table 3.2 summarizes the historical water consumption for the golf course.

Table 3.2. Historical water consumption review for the golf course from 2005 to 2009

Year	122 Day Records (m^3)	Average Daily Demand (m^3/day)
2005	4,315	35
2006	6,231	51
2007	1,785	15
2008	547	4
2009	79	<1
Top 2 year Average		**43 m^3/day**

For the purpose of evaluating the existing and proposed water supply and distribution system, the top two year average of **43 m^3/day** is used for this study.

3.2.3 Existing Schools

In 2009, there were 497 people including students and staff members in the Hugh Sutherland School and 282 in the Carstairs Elementary School. These two schools service a total of 779 people.

Table 3.3 Water Consumption Review for the Schools for 2009

Year	200 Day Record (m^3)	Average Daily Demand (m^3/day)	Total School Population	Average per capita consumption rate (litres/student/day)
2009	5,279	26.40	779	33.8

For the purpose of evaluating the existing and proposed water supply and distribution system, the 2009 average of **33.8 litres/student/day** shall be used for this study. This number is more than the **11 litres/c/day** used in the *2005 MSS* due to the addition of the new elementary school.

3.2.4 Commercial and Industrial

There are no records available for the Town's commercial and industrial water usage. The *2005 MSS* assumed the water consumption rate for the commercial and industrial area to be 25% of the Town's total average daily demand. The 0.12 l/s/ha average day flow used in the 2005 MSS was used for the purpose of evaluating the system.

3.2.5 Bulk Water Filling Station

AECOM reviewed the demand of the bulk water filling station based on the previous study and records provided by the Town. Therefore, as per the 2005 MSS report, an additional 10.4 l/s peak hourly demand has been included in the analysis.

3.2.6 Residential Lands

It has been established that the average daily consumption on a per population basis for the town as a whole is 322 l/capita/day. It is assumed that the growth of residential water demand will stay in line with that of population growth. To develop the future demand on the water system a residential demand per area was used in the analysis.

- (322 l/capita/day x 20 units/ha x 2.7 capita/unit) / 86400 = 0.201 l/s/ha

Thus the figure of water consumption of 0.20 l/s/ha has been utilized in the study of the water distribution system for undeveloped land not classified as commercial or industrial.

3.3 Future Water Demand

The *2005 MSS* used 1.8 as the maximum day peaking factor, 4.0 as the peak hourly factor and the report recommended the inclusion of an additional 10.4 l/s to the peak hourly demand, which is the bulk water filling station's demand at the Town's pump station. Using the high population growth rate scenario as set out in Section 2.2 of this report, and the average daily demand of 322 litres/capita/day from Section 3.2.1 the future water demand was calculated and is shown in the following table.

Table 3.4 Future Water Demand for the Town from 2009 to 2041

Year	Population	Average Daily* Demand (m^3/d)	Maximum Daily Demand (m^3/d)	Peak Hourly Demand + 10.4 (L/s)
2009	3,467	1,116	2,009	62
2010	3,796	1,222	2,200	67
2011	4,179	1,345	2,422	73
2012	4,475	1,473	2,652	77
2013	4,739	1,526	2,747	81
2014	5,047	1,625	2,925	86
2015	5,375	1,731	3,115	91
2016	5,724	1,843	3,318	96
2017	6,096	1,963	3,533	101
2018	6,492	2,091	3,763	107
2019	6,915	2,227	4,008	113
2020	7,364	2,371	4,268	120
2021	7,843	2,525	4,546	127
2022	8,157	2,626	4,728	132
2023	8,483	2,731	4,916	137
2024	8,822	2,841	5,113	142
2025	9,175	2,954	5,318	147
2026	9,542	3,073	5,531	153
2027	9,924	3,195	5,752	158

Year	Population	Average Daily* Demand (m^3/d)	Maximum Daily Demand (m^3/d)	Peak Hourly Demand + 10.4 (L/s)
2028	10,321	3,323	5,982	164
2029	10,734	3,456	6,221	170
2030	11,162	3,594	6,470	177
2031	11,610	3,738	6,729	183
2032	12,073	3,888	6,998	190
2033	12,557	4,043	7,278	198
2034	13,058	4,205	7,569	205
2035	13,581	4,373	7,872	213
2036	14,124	4,548	8,186	221
2037	14,689	4,730	8,514	229
2038	15,277	4,919	8,854	238
2039	15,888	5,116	9,209	247
2040	16,524	5,321	9,577	257
2041	17,184	5,533	9,960	267

**Based on historical annual records which includes all uses*

3.4 Water Supply and Treatment

The Town of Carstairs receives water from the Mountain View Regional Water Service Commission (MVRWSC) through the Anthony Henday Water Treatment Plant located in Innisfail. Findings from the *2005 MSS* indicate that the water supply is assumed to satisfy the Town's future requirements.

3.5 Water Storage

Currently the Town has a 2,270 m^3 circular shaped, half buried reservoir, located at the intersection of Hammond Street and 12th Avenue Figure 3.1. This reinforced concrete structure holds the treated water from the Anthony Henday Water Treatment Plant and the distribution pump station supplies the Town's water through a single 300 mm diameter pipe.

3.5.1 Water Storage Calculation Design Criteria

Reservoir storage in a distribution system includes water volumes for the following:

- Equalization so that the peak demands which exceed the capacity of the supply facilities can be met
- Fire fighting
- Maintenance and emergency events that may result in a shut-down of the water supply and distribution. These events might include such things as power outages or supply line failures

Due to the above reasons, extra volumes are added to Alberta Environment's empirical formula that is used to size potable water reservoirs as shown below:

$$S = A + B + C + E$$

Where,

S= Total storage requirement (m^3)
A= Fire storage (m^3). 233 L/s for 3 hours (2,516 m^3) as per the *2005 Town of Carstairs Servicing Report*
B= Equalization storage. 25% of the maximum daily demand, MDD (m^3)
C= Emergency storage. 15% of the average daily demand, ADD (m^3)
E= Emergency storage for MVRWSC supply interruption. 125% of the average daily demand (m^3)

3.5.2 Storage Requirements and Upgrades

The town currently does not have any major industrial areas, and the existing fire pump can pump at 86 l/s. Therefore, the storage requirements for the immediate future have been assessed using the requirement of 75 l/s for 3 hours for residential fire protection. The Town's reservoir storage requirements for the population growth forecast from the year 2009 to 2041 are shown in Table 3.5 for the scenario where only the residential fire protection is provided. In Table 3.5, the storage provided by the existing 2,270 m^3 reservoir in Carstairs and the additional 1,750m^3 of capacity that is available at Olds is included in assessing the towns storage capacity.

Table 3.5 Reservoir Storage Requirements for the Town from 2009 to 2041 with Residential Fire Protection Only (75l/s)

Year	Population	ADD (m^3/d)	MDD (m^3/d)	[A] Fire Storage (m^3)	[B] 25% MDD Storage (m^3)	[C] 15% ADD Storage (m^3)	[E] 125% ADD Storage (m^3)	Storage Requirements (m^3)	Storage In System (Carstairs & Olds) (m^3)	Deficient Storage Including Olds Reservoir (m^3)
2009	3467	1116	2009	810	502	167	1395	2,875	4,020	0
2010	3796	1222	2200	810	550	183	1528	3,071	4,020	0
2011	4179	1346	2422	810	606	202	1682	3,299	4,020	0
2012	4475	1441	2594	810	648	216	1801	3,476	4,020	0
2013	4739	1526	2747	810	687	229	1907	3,633	4,020	0
2014	5047	1625	2925	810	731	244	2031	3,816	4,020	0
2015	**5375**	**1731**	**3115**	**810**	**779**	**260**	**2163**	**4,012**	**4,020**	**0**
2016	5724	1843	3318	810	829	276	2304	4,220	4,020	200
2017	6096	1963	3533	810	883	294	2454	4,442	4,020	422
2018	6493	2091	3763	810	941	314	2613	4,678	4,020	658
2019	6915	2227	4008	810	1002	334	2783	4,929	4,020	909
2020	7364	2371	4268	810	1067	356	2964	5,197	4,020	1177
2021	7843	2525	4546	810	1136	379	3157	5,482	4,020	1462
2022	8156	2626	4727	810	1182	394	3283	5,669	4,020	1649
2023	8483	2731	4917	810	1229	410	3414	5,863	4,020	1843
2024	8822	2841	5113	810	1278	426	3551	6,065	4,020	2045
2025	9175	2954	5318	810	1329	443	3693	6,275	4,020	2255
2026	9542	3072	5530	810	1383	461	3841	6,494	4,020	2474
2027	9924	3195	5752	810	1438	479	3994	6,721	4,020	2701
2028	10321	3323	5982	810	1495	498	4154	6,958	4,020	2938
2029	10733	3456	6221	810	1555	518	4320	7,204	4,020	3184
2030	11163	3594	6470	810	1617	539	4493	7,460	4,020	3440
2031	11609	3738	6729	810	1682	561	4673	7,726	4,020	3706
2032	12074	3888	6998	810	1749	583	4860	8,002	4,020	3982

Year	Population	ADD (m^3/d)	MDD (m^3/d)	[A] Fire Storage (m^3)	[B] 25% MDD Storage (m^3)	[C] 15% ADD Storage (m^3)	[E] 125% ADD Storage (m^3)	Storage Requirements (m^3)	Storage In System (Carstairs & Olds) (m^3)	Deficient Storage Including Olds Reservoir (m^3)
2033	12556	4043	7278	810	1819	606	5054	8,290	4,020	4270
2034	13059	4205	7569	810	1892	631	5256	8,589	4,020	4569
2035	13581	4373	7872	810	1968	656	5466	8,900	4,020	4880
2036	14124	4548	8186	810	2047	682	5685	9,224	4,020	5204
2037	14689	4730	8514	810	2128	709	5912	9,560	4,020	5540
2038	15277	4919	8854	810	2214	738	6149	9,910	4,020	5890
2039	15888	5116	9209	810	2302	767	6395	10,274	4,020	6254
2040	16523	5321	9577	810	2394	798	6651	10,653	4,020	6633
2041	17184	5533	9960	810	2490	830	6917	11,047	4,020	7027

The table shows that with no industrial development, the town, once a population of 5720 (2016 based on current population projections) is reached, will have inadequate storage capacity. The excess at 5375 people (2015) is only $8m^3$, so once a population of 5375 people is reached (2015) is the real time by which additional storage should be added.

By 2015, it is recommended that the town add additional storage capacity to its water infrastructure. The additional storage capacity should be within the town's boundaries such that it can *all* be used for fire protection purposes. Presently not all of the additional capacity at Olds can be used for fire fighting measures, as it is limited by the rate at which the water can be pumped from Olds to Carstairs.

If the town wishes to develop an industrial and commercial capability, it is recommended that the reservoir be located in the proposed industrial area, and at the same time, the pumping capability be added to satisfy the requirement of 233 l/s for industrial & commercial fire protection. In this scenario, adding an additional 3,000 m^3 of storage is recommended. With the industrial fire protection, the storage requirements increase, as illustrated in Table 3.6 below.

Table 3.6 Storage Requirements with Industrial Fire Protection

Year	Population	ADD (m^3/d)	MDD (m^3/d)	[A] Fire Storage (m^3)	[B] 25% MDD Storage (m^3)	[C] 15% ADD Storage (m^3)	[E] 125% ADD Storage (m^3)	Storage Requirements (m^3)	Storage In System (Carstairs & Olds) (m^3)	Deficient Storage Including Olds Reservoir (m^3)
2015	5,724	1731	3115	810	779	260	2164	4,012	4,020	0
2015*	**5,375**	**1731**	**3115**	**2516**	**829**	**276**	**2304**	**5,718**	**7,020**	**0**
2016	5,724	1843	3318	2516	829	276	2304	5,926	7,020	0
2017	6,096	1963	3533	2516	883	294	2454	6,148	7,020	0
2018	6,493	2091	3763	2516	941	314	2613	6,384	7,020	0
2019	6,915	2227	4008	2516	1002	334	2783	6,635	7,020	0
2020	7,364	2371	4268	2516	1067	356	2964	6,903	7,020	0
2021**	**7,843**	**2525**	**4546**	**2516**	**1136**	**379**	**3157**	**7,188**	**7,020**	**168**
2022	8,156	2626	4727	2516	1182	394	3283	7,375	7,020	355
2023	8,483	2731	4917	2516	1229	410	3414	7,570	7,020	550
2024	8,822	2841	5113	2516	1278	426	3551	7,772	7,020	752
2025	9,175	2954	5318	2516	1329	443	3693	7,982	7,020	962
2026	9,542	3072	5530	2516	1383	461	3841	8,201	7,020	1181
2027	9,924	3195	5752	2516	1438	479	3994	8,428	7,020	1408
2028	10,321	3323	5982	2516	1495	498	4154	8,664	7,020	1644
2029	10,733	3456	6221	2516	1555	518	4320	8,910	7,020	1890
2030	11,163	3594	6470	2516	1617	539	4493	9,166	7,020	2146

Year	Population	ADD (m^3/d)	MDD (m^3/d)	[A] Fire Storage (m^3)	[B] 25% MDD Storage (m^3)	[C] 15% ADD Storage (m^3)	[E] 125% ADD Storage (m^3)	Storage Requirements (m^3)	Storage In System (Carstairs & Olds) (m^3)	Deficient Storage Including Olds Reservoir (m^3)
2031	11,609	3738	6729	2516	1682	561	4673	9,432	7,020	2412
2032	12,074	3888	6998	2516	1749	583	4860	9,709	7,020	2689
2033	12,556	4043	7278	2516	1819	606	5054	9,996	7,020	2976
2034	13,059	4205	7569	2516	1892	631	5256	10,295	7,020	3275
2035	13,581	4373	7872	2516	1968	656	5466	10,607	7,020	3587
2036	14,124	4548	8186	2516	2047	682	5685	10,930	7,020	3910
2037	14,689	4730	8514	2516	2128	709	5912	11,267	7,020	4247
2038	15,277	4919	8854	2516	2214	738	6149	11,617	7,020	4597
2039	15,888	5116	9209	2516	2302	767	6395	11,981	7,020	4961
2040	16,523	5321	9577	2516	2394	798	6651	12,359	7,020	5339
2041	17,184	5533	9960	2516	2490	830	6917	12,753	4,020	8733

** At a population of 5374 (year 2015), an additional 3,000m^3 of storage capacity is added, to the system, and the industrial area is developed to increase the fire protection to satisfy the requirement of 233 l/s for 3 hours. ** At a population of 7843 (year 2021), the additional 3,000 m^3 of storage capacity is in-adequate.*

Table 3.6 also shows that by 2021 the 3,000m^3 of storage that was added in 2015 has been consumed by the growth in population. There are two potential ways to address this issue. One option would be to keep adding additional reservoir capability as and when the population growth requires it. The second option would be to install a second supply feed to the reservoir located in the industrial area. With two feed lines into the town, to two different reservoirs, the storage requirement needed to deal with a supply interruption falls to 0 m^3. The storage requirements with a secondary supply line are illustrated in Table 3.7

Table 3.7 Storage Requirements When Secondary Supply Line is Added

Year	Population	ADD (m^3/d)	MDD (m^3/d)	[A] Fire Storage (m^3)	[B] 25% MDD Storage (m^3)	[C] 15% ADD Storage (m^3)	[E] 125% ADD Storage (m^3)	2nd Line Added Y/N	Storage Requirement (m^3)	Storage In System (Carstairs & Olds) (m^3)	Deficient Storage Including Olds Reservoir (m^3)
2009	3467	1116	2009	810	502	167	1395	N	2,875	4,020	0
2010	3796	1222	2200	810	550	183	1528	N	3,071	4,020	0
2011	4179	1346	2422	810	606	202	1682	N	3,299	4,020	0
2012	4475	1441	2594	810	648	216	1801	N	3,476	4,020	0
2013	4739	1526	2747	810	687	229	1907	N	3,633	4,020	0
2014	5047	1625	2925	810	731	244	2031	N	3,816	4,020	0
2015*	**5375**	**1731**	**3115**	**2516**	**779**	**260**	**2163**	**N**	**5,718**	**7,020**	**0**
2016	5724	1843	3318	2516	829	276	2304	N	5,926	7,020	0
2017	6096	1963	3533	2516	883	294	2454	N	6,148	7,020	0
2018	6493	2091	3763	2516	941	314	2613	N	6,384	7,020	0
2019	6915	2227	4008	2516	1002	334	2783	N	6,635	7,020	0
2020	7364	2371	4268	2516	1067	356	2964	N	6,903	7,020	0
2021**	**7843**	**2525**	**4546**	**2516**	**1136**	**379**	**0**	**Y**	**4,032**	**7,020**	**0**
2022	8156	2626	4727	2516	1182	394	0	Y	4,092	7,020	0
2023	8483	2731	4917	2516	1229	410	0	Y	4,155	7,020	0
2024	8822	2841	5113	2516	1278	426	0	Y	4,221	7,020	0
2025	9175	2954	5318	2516	1329	443	0	Y	4,289	7,020	0
2026	9542	3072	5530	2516	1383	461	0	Y	4,360	7,020	0
2027	9924	3195	5752	2516	1438	479	0	Y	4,434	7,020	0
2028	10321	3323	5982	2516	1495	498	0	Y	4,510	7,020	0

Year	Population	ADD (m^3/d)	MDD (m^3/d)	[A] Fire Storage (m^3)	[B] 25% MDD Storage (m^3)	[C] 15% ADD Storage (m^3)	[E] 125% ADD Storage (m^3)	2nd Line Added Y/N	Storage Requirement (m^3)	Storage In System (Carstairs & Olds) (m^3)	Deficient Storage Including Olds Reservoir (m^3)
2029	10733	3456	6221	2516	1555	518	0	Y	4,590	7,020	0
2030	11163	3594	6470	2516	1617	539	0	Y	4,673	7,020	0
2031	11609	3738	6729	2516	1682	561	0	Y	4,759	7,020	0
2032	12074	3888	6998	2516	1749	583	0	Y	4,849	7,020	0
2033	12556	4043	7278	2516	1819	606	0	Y	4,942	7,020	0
2034	13059	4205	7569	2516	1892	631	0	Y	5,039	7,020	0
2035	13581	4373	7872	2516	1968	656	0	Y	5,140	7,020	0
2036	14124	4548	8186	2516	2047	682	0	Y	5,245	7,020	0
2037	14689	4730	8514	2516	2128	709	0	Y	5,354	7,020	0
2038	15277	4919	8854	2516	2214	738	0	Y	5,468	7,020	0
2039	15888	5116	9209	2516	2302	767	0	Y	5,586	7,020	0
2040	16523	5321	9577	2516	2394	798	0	Y	5,709	7,020	0
2041	17184	5533	9960	2516	2490	830	0	Y	5,836	7,020	0

**At population of 5374, (2015) an additional 3,000m^3 of storage is added and fire pump capability is increased to deal with industrial fire protection requirement of 233 l/s for 3 hours. **At population of 7843, (2021) a second feed line is added to the second reservoir reducing storage requirement significantly*

The fire protection requirements of the town if the infrastructure is developed as set out above, would be as set out in Table 3.8:

Table 3.8 Fire Protection Requirements / Capability with an additional 3,000m^3 storage, industrial & commercial development and second supply line added.

Year	Population	MDD (m^3/d)	MDD (l/s)	Fire Pump Demand (l/s)	Fire Event Demand (l/s)	Available Storage for Fire Fighting (m$^{3)}$	Time to 0 m^3 (hrs)	Remaining Capacity in System after 3 hrs fire pumping (m$^{3)}$
2009	3647	2009	23.3	75.0	98.3	2658.8^	7.5	1598
2015~	5374	3115	36.1	233.0	269.1	2658.8^	2.7	0
2015*	5374	3115	36.1	233.0	269.1	5658.8	5.8	2753
2021**	7843	4546	52.6	233.0	285.6	5658.8	5.5	2574
2031	11609	6729	77.9	233.0	310.9	5658.8	5.1	2301
2041	17184	9960	115.3	233.0	348.3	5658.8	4.5	1897

*^Available storage for fire fighting is derived from the existing storage in the towns reservoir of 2,270 m^3 and the maximum that the store at Olds can feed into the reservoir in 3 hours, which is estimated to be 388.8m^3. ~Available storage for fire fighting with industrial and commercial fire protection and no reservoir upgrade. *At population of 5374, (2015) an additional 3,000m^3 of storage is added and fire pump capability is increased to deal with industrial fire protection requirement of 233 l/s for 3 hours. **At population of 7843, (2021) a second feed line is added to the second reservoir reducing storage requirement significantly*

Table 3.8 also illustrates that with industrial and commercial development, and the forecast population growth, a phased upgrading of the non-fire pumps is required to ensure that the pumping capability can satisfy the towns Maximum Daily Demand (MDD) at each stage of development. Refer to section 3.7 for further discussion on the pumping requirements for the towns forecast population growth.

3.6 Water Distribution Network

The Town's water distribution network piping system consists of one potable water reservoir, one pump house and the distribution pipe network. Distribution pipe sizes range from 150 mm to 250 mm diameter, with 50 mm pipes in Park Avenue and Park Road north of Centre Street and a 100 mm pipe serving the Town's Golf Course. Hydrants are installed for fire protection and isolation valves are installed to enable the operator to isolate different areas of the distribution system.

The reservoir is at an approximate elevation of 1,056.5 m. Findings from the *2005 Town of Carstairs Servicing Report* require a 58 metre pumping head to produce a 1,114.50 m hydraulic grade line (HGL) to enable the delivery of water from the reservoir to the Town's water users. Therefore, the HGL of the existing and future reservoirs were both set at 1,114.5 m.

For planning purposes, *2008 Bentley®WaterGEMS®V8i* was used to simulate and analyze the Town's existing and proposed future water distribution system. **Figure 3.1** shows the existing distribution network, the reservoir and the pump house.

3.6.1 Servicing and Fire Flow Design Criteria

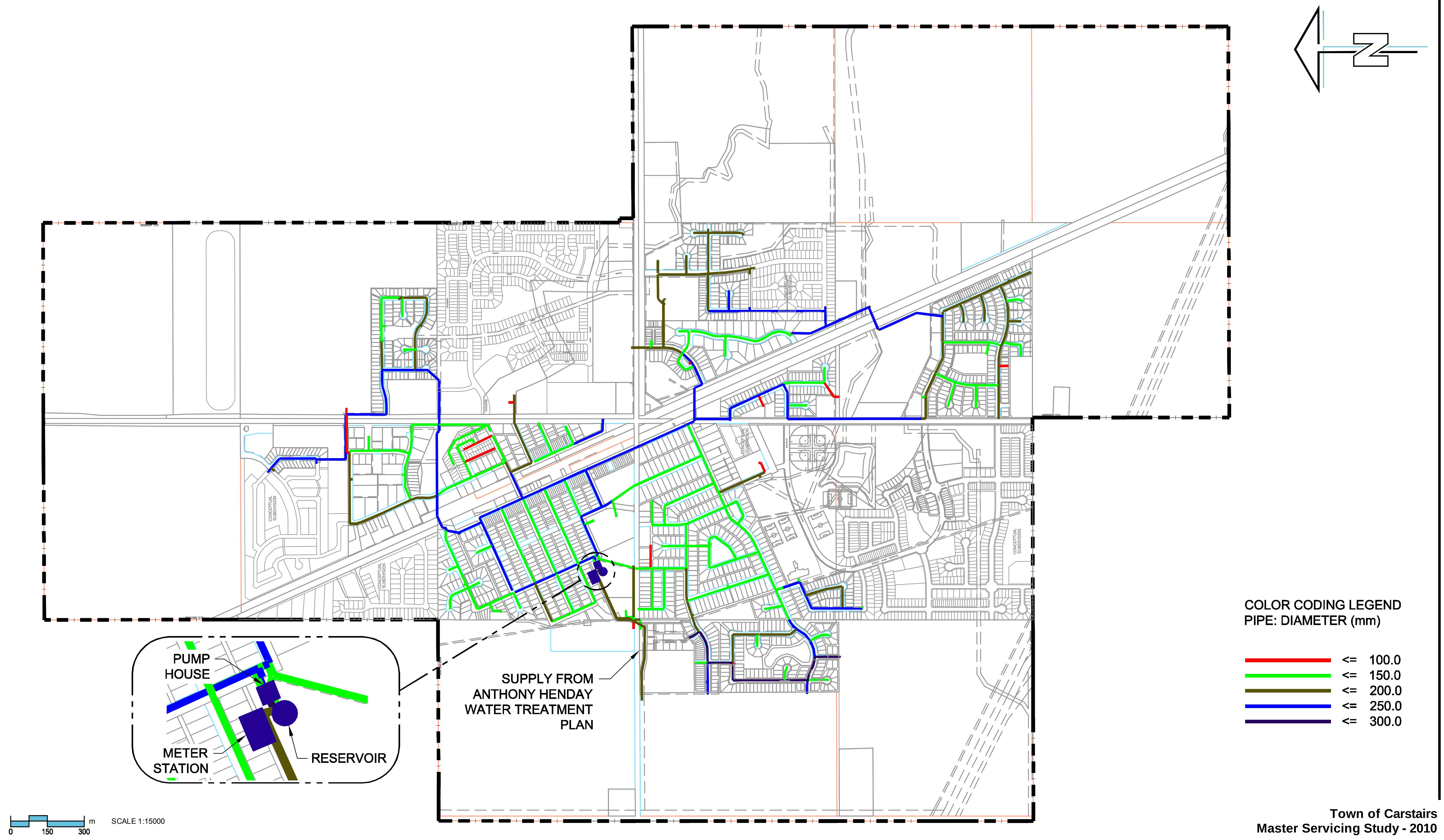
The servicing and fire flow design criteria used to simulate and analyze the water distribution network are summarized in the following table:

Table 3.9. Servicing and Fire Flow Design Criteria

	Water Pressure	Max Water Velocity	Min Flow
Fire Flow	Minimum 20 psi	2.5 m/s	75 L/s for residential areas and 233 L/s for commercial, industrial and institutional areas
Peak Hourly Demand	Between 40 and 100 psi	2.0 m/s	-

3.6.2 Hazen Williams "C" Factor

In 2005, SFE Global and the Public Works personnel of the Town conducted hydraulic testing of the water pipes and determined that the Hazen Williams "C" factor of the PVC pipes is 123 and that it is 110 for the cast iron pipes. It is assumed that the C values remain unchanged for pipes installed before 2005 and that the C value for pipes installed after 2005 have of C factor of 130.



Town of Carstairs
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Existing Water Distribution Network
Figure - 3.1

3.6.3 Existing Water Distribution System Review

Since 2005, the Town has undergone significant development. AECOM used the Town's municipal infrastructure management system to update the water model to include data from the pipes installed in the Town since 2005. The piping network for the Carlinton Area Structure Plan was also included in the model. The modeling results are shown in Appendix 4 and are summarised in the following table:

Table 3.10 Existing Water Distribution System Review Summary Results

Modelling Scenario	Results
Peak Hourly Demand	The water distribution system meets the demand requirement as the water pressure in the system ranges from 73 to 95 psi
Maximum Daily Demand plus Fire Flow (75 L/s) for Residential Areas	The water distribution system has the required capacity to provide the minimum fire flow throughout the Town except in the Scottsdale community
Maximum Daily Demand plus Fire Flow (233 L/s) for Commercial/ Industrial/ Institutional Areas	There is insufficient fire flow in various locations in the commercial/ industrial/ institutional areas

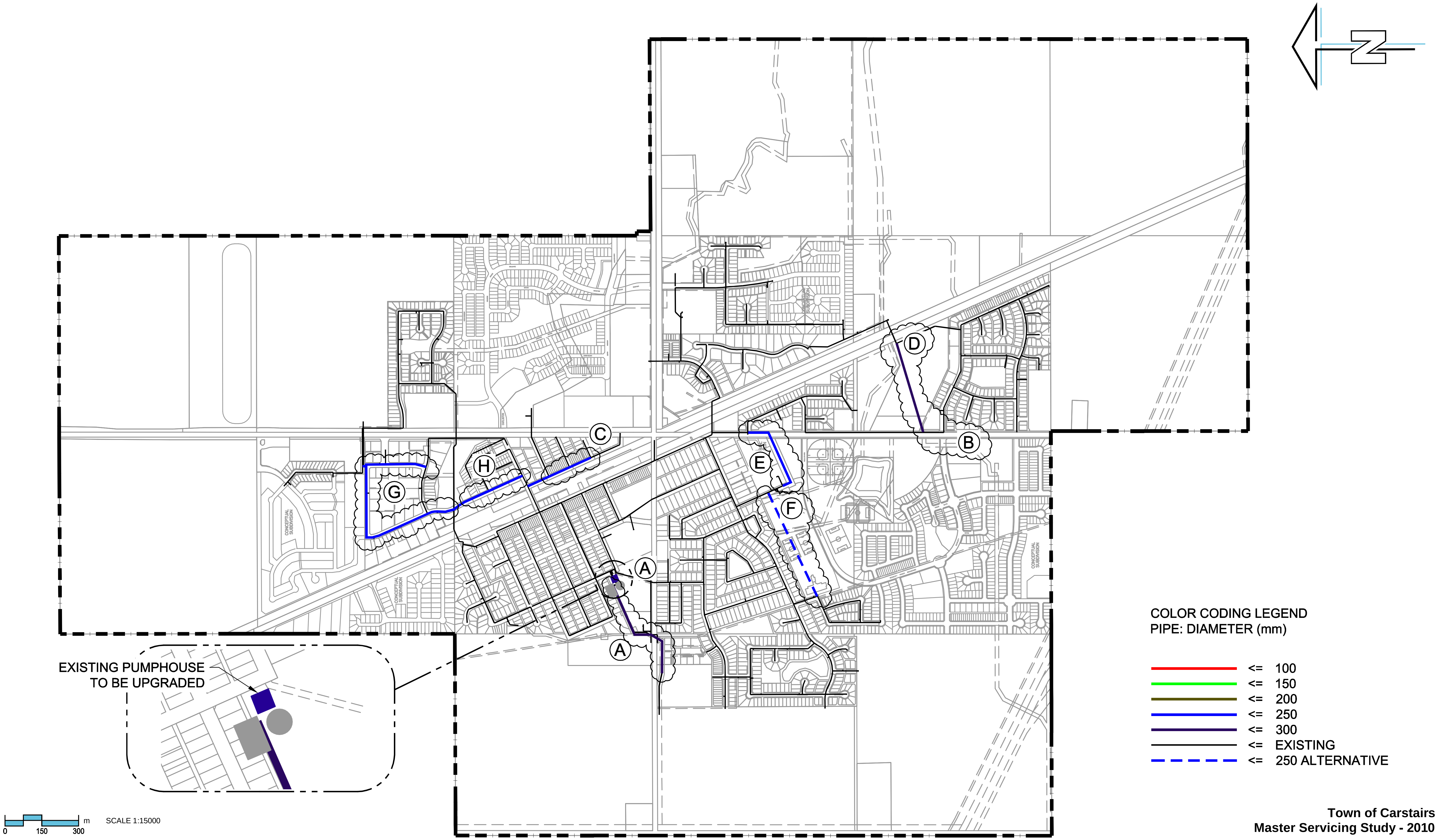
3.6.4 Suggested Improvements to the Existing Water Distribution System

The existing water distribution system is deficient in that there is insufficient fire flow in the Scottsdale community and various locations in the commercial/ industrial/ institutional areas.

To address this deficiency, AECOM simulated the water system with the following suggested improvements to the existing water distribution system:

- Upsize the 150 mm and 200 mm pipes in the north industrial area to 250 mm (north of and surrounding Stem Park)
- Connect the 250 mm water main along secondary Highway 580 at Meadow Park location to the 200 mm pipe ending in Lackner Way near the Community Hall by looping it with a 250 mm pipe
- Connect the 250 mm and 150 mm pipe ends at the Scottsdale Park with a 150 mm pipe
- If the industrial area along Highway 2A between Centre Street and Gough Road is to be serviced off the 150 mm water main along 9th Avenue, then upsize it with a 250 mm pipe
- Currently, the Golf Courses' only service is for irrigation of the southern half of the golf course. Fire protection is by means of a private storage system and domestic facilities are serviced by a private well. . If this area is to be developed, the upsizing or looping capabilities from the towns system must be considered.

These network improvements are illustrated in **Figure 3.2**



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Town of Carstairs
Master Servicing Study - 2010

Improvements to Existing Water System
Figure - 3.2

3.6.5 Future Water Distribution System

The Town's water distribution system should be designed with the capacity of delivering peak demand flow and fire flow for the existing and future scenarios. The future scenario is set at the situation that the Town is fully developed within the new annexation boundary. The following criteria were used to develop the future water distribution system:

- Average daily flow of 0.20 l/s/ha for undeveloped land not classified as commercial or industrial
- Average daily flow of 0.12 l/s/ha for commercial and industrial land
- Golf Course point use of 0.5 l/s average daily demand
- Hugh Sutherland School & Carstairs Elementary School point use of 0.30 l/s
- Bulk water point use of 2.6 l/s average daily demand flow
- Composite water consumption rate of 322 L/c/d
- Future water mains that cross residential areas were looped with 200 mm diameter pipes
- 250 mm diameter water mains in commercial/industrial/institutional areas
- Mainline looping with a 250 mm pipe to the north and 300 mm pipe to the south and west

Figure 3.3 shows the layout of the water mains for this future water distribution system. The modeling results are in the Appendix 4 and are summarised in the following table.

Table 3.11 Future Water Distribution System Summary Results

Modelling Scenario	Results
Peak Hourly Demand	• The water distribution system meets the demand requirement as the water pressure in the system range from 55 to 100 psi
Maximum Daily Demand plus Fire Flow (75 L/s) for Residential Areas	• The water distribution system is able to provide the minimum fire flow in the residential areas of the Town
Maximum Daily Demand plus Fire Flow (233 L/s) for Commercial/ Industrial/ Institutional Areas	• The water distribution system is able to provide the minimum required fire flow in the commercial/industrial/institutional areas of the Town

3.7 Pumping Facilities

The existing water pump station currently houses five water pumps. Four distribution pumps are for maintaining pressure during normal demand periods and one fire pump is equipped with a diesel engine driver. The pump data for pumps P-2 and P-3 were derived from pump curves provided by the Town while the pump curves for pump P-4 and P-5 (jockey pump) were obtained from their respective manufacturers. The following table gives details of the pumps:

Table 3.12 Existing Pump Data

Pump	Manufacturer	Flow (L/s)	Diameter (in)	Pump Head (m H_2O)	Power (hp)
P-2	Crane Deming	16	14	58	20
P-3	Crane Deming	16	14	58	20
P-4	Crane Deming	36	$8^1/_2$	58	40
P-5 (Jockey Pump)	Berkeley	3.79	6	50	7.5
Fire Pump	Darling Brother Ltd	86	$15^5/_8$	58	78

A further detailed study of the distribution network would be required to determine the combined delivery capacity of all five pumps operating together. However, a simple examination based on adding the pump capacities together for pumps P2, P3, P4 and P5 indicates a combined pumping capacity of 72 L/s. In reality, running pumps in parallel yields a performance much less than their combined individual totals. The estimated peak hourly demand in the year 2011 is 72 L/s. Therefore, the pumping capacity of the system is probably already undersized and in need of upgrading.

AENV requires redundancy in pumping. When peak hour demands exceed the capability of the diesel fire pump, additional pumping capability is required. Table 3.13 illustrates, with the forecast population growth, when the existing pumps need to be upgraded.

Table 3.13 Impact of Population Growth on Peak Hour Demand

Year	Population	Peak Hour Demand (l/s)	MDD (l/s)	Fire Pump Demand (l/s)	Fire Event Demand (l/s)	Available Storage for Fire Fighting (m^3)	Time to 0 m3 (hrs)	Remaining Capacity in System after 3 hrs (m^3)
2009	3,647	62	23.3	75.0	98.3	2,658.8	7.5	1,598
2014*	5,047	86	33.8	75.0	108.8	2,658.8	6.7	2,753
2021**	7,843	127	52.6	233.0	285.6	5,658.8	5.5	2,574
2031	11,609	183	77.9	233.0	310.9	5,658.8	5.1	2,301
2041	17,184	267	115.3	233.0	348.3	5,658.8	4.5	1,897

**At population of 5047, (2014) peak hour demand exceeds fire pump capability. **At population of 7843, (2021) a second feed line is added to the second reservoir reducing storage requirement significantly*

At a population of 5047 (projected to be in 2014) the peak hour demand equals the capability of the existing fire pump. Therefore the upgrading of the pumps should be scheduled to happen before this population is reached. The upgrades should ensure that the Peak Hour demands, and the Fire Protection requirements are met in line with the towns development. A full study is required of the pumping system to evaluate the size and specification required for the pump upgrades.

There is a remote-control system in the pump house. The *2005 MSS* recommended the installation of a supervisory control and data acquisition (SCADA) system for the Town's distribution system which will monitor and control the operations and conditions of the water and wastewater systems. It is recommended the SCADA system to monitor the town's water and wastewater systems be installed.

3.8 Recommendations

To provide adequate fire protection to the Scottsdale community and the institutional, commercial and industrial areas, the Town's existing water distribution network, pump house and storage capacity needs to be upgraded. All these upgrades can be scheduled based on the Town's population projections and future land use plan. Table 3.14 summarizes the recommendations and provides a schedule for the installation of the proposed upgrades. To reduce the risk associated with a single line supply and the constraint of the Olds Reservoir delivery capacity, the Town should request from the Commission for Water a back-up agreement outlining the time frame within which service disruptions will be remedied.

Table 3.14. Water System Improvement Schedule

Item Schedule	Details
Year 2011 - 2015 (4,178 to 5,375 people)	• 2011 – Full study of existing pump system, to plan pump upgrades for future growth, including immediate requirements • 2011 – Pre-design and land acquisition for new reservoir & pump station • 2013 – Install pumps to meet peak hour demand • 2014 - Construct 3,000m^3 reservoir with direct supply from existing source • 2012 – Referring to Figure 3.2 – Complete upgrades of existing water mains at points A & B to D • 2015 – Referring to Figure 3.2 – Complete upgrades of existing water mains at point C
Year 2016– 2021 (5,724 to 7,843 people)	• Referring to Figure 3.2 – Complete upgrades of existing water mains at points E & F • Referring to Figure 3.2 – Complete upgrades of existing water mains at point G • 2021 - Construct a second MVRWSC feeder line to new reservoir located in SE area of town
Year 2022 – 2041 (8,157 to 17,184 people)	• 2035 – Construction of Phase 2 of reservoir • 2025 - Referring to Figure 3.2 – Complete upgrades of existing water mains at point H • Design and build a SCADA system for the Town • Review and update the Town's water network • Further pump upgrades to cater for growing peak hour demand based on 2011 study

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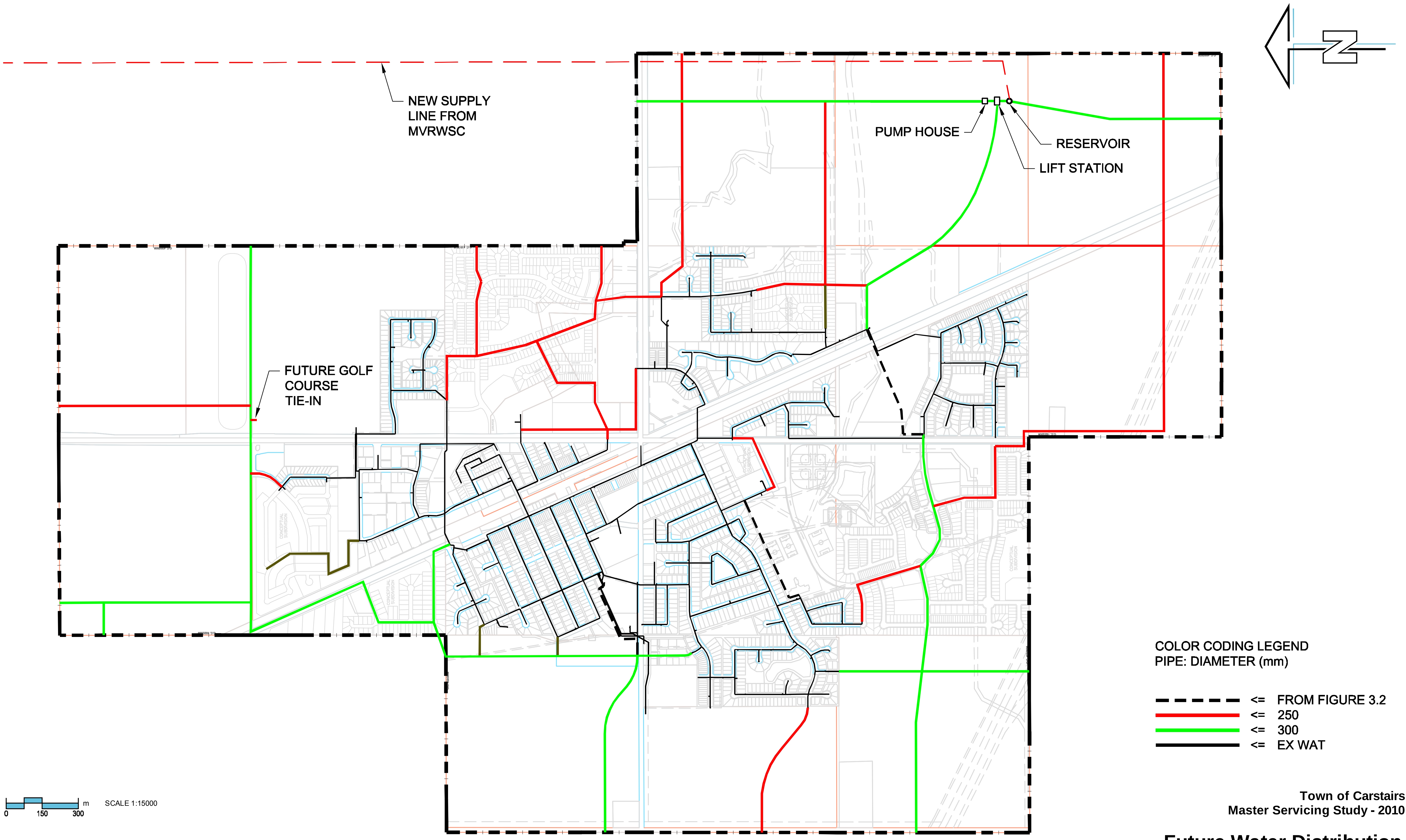

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Future Water Distribution System Network & Storage Figure - 3.3

4. Sanitary Sewer System

4.1 Introduction

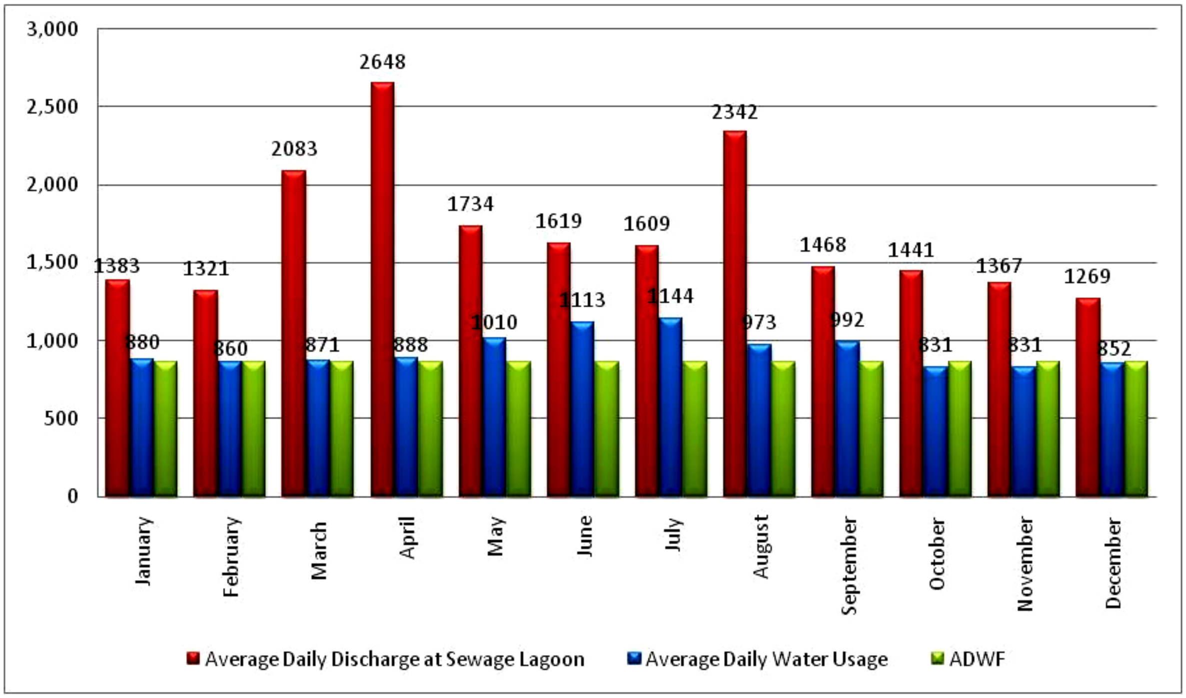
This study on the sanitary sewerage system estimates the inflow/ infiltration (I/I) rate and average dry weather flows (ADWF) based on the daily sanitary sewage flow at the lagoon site and the water supply provided by the Town. This study uses this revised I/I to replace the current Alberta Environment (AENV) I/I requirement of 0.28 L/s/ha plus 0.4 L/s per sag location. Then these I/I and ADWF are used in analysis of the collection system.

The study results will allow the Town to understand the capacity situation of the existing system. This information will be used to estimate the time and locations that upgrades to the collection system. Furthermore, a proposed sanitary trunk system is provided for the Town's future development area. Finally, this study provides a review of the existing lagoon treatment capacity against existing wastewater flow generation rates and confirm if additional treatment volume will be needed.

4.2 Evaluation of Inflow/infiltration (I/I) rate

The Town provided year 2009 sanitary flow metering records at the lagoon site as well as the water consumption quantity from the water pump house. Table 4.1 (on the following page) summarizes these monthly numbers, calculated daily flows, and I/I tributary area. This study assumes that 80% of water used was collected by the sanitary sewerage system. The average daily I/I was calculated as the difference between the lagoon daily discharge flow and the estimated value of 80% of the daily water consumption ending up in the lagoon. A water supply and sewage discharge comparison chart is shown in **Chart 4-1**.

Chart 4-1 Water Supply and Sewage Discharge Comparison Chart



The table below shows that the lowest I/I flows occur in January, February and December (672, 629 and 522 m^3 respectively). The low values were probably due to the cold winter weather, when ground was frozen and I/I rates were minimal. The peak value of 2,018 m^3 occurred in April and that is presumed to be due to a high I/I contribution when the ground was thawing.

Using the maximum I/I flow of 2,018 m^3 being produced by the present contributory area of 252 ha, the I/I rate is calculated as 0.093 l/s/ha. Considering the limited data available, and the cursory level of analysis, a safety factor of 2.0 is used. Thus, the determined I/I rate is 0.186 L/s/ha, rounded up to 0.2 L/s/ha, which is about 71% of the 0.28 L/s/ha (a general reference in Alberta Environment guidelines).

Table 4.1 Water Consumption Quantities and Sewage Flows in Year 2009

	Water Supply Data (m^3)			**Lagoon Data**		
	Total Supply m^3	**Ave. Day Bulk Water Usage m^3/day**	**Avg. Daily Use m^3 / day**	**Avg. Daily Discharge m^3 / day**	**Average Daily I/I m^3 / day**	**Tributary Area Ha**
	A	**B**	**C= (A/days in month) - B**	**D**	**E = D – (0.8xC)**	**F**
January	27505	215	880	1376	672	252
February	24359	281	860	1317	629	
March	27330	338	871	1790	1093	
April	26813	179	888	2728	2018	
May	31845	547	1010	1741	934	
June	36604	3212	1113	1629	739	
July	36857	1391	1144	1638	723	
August	31275	1125	973	2357	1578	
September	31170	1398	992	1501	707	
October	26220	454	831	1440	775	
November	25216	299	831	1501	837	
December	26677	280	852	1203	522	

In addition the above data was used to calculate the average annual wastewater flows of 486 l/c/d, that included domestic flow plus inflow and infiltration. The average annual wastewater volume is used to size the wastewater treatment system, whereas the I/I and estimated domestic flow is used to size the collection system.

4.3 Sanitary Trunk Main System Modeling

The sanitary trunk main system was modeled utilizing the most current software SewerGEMS Sanitary V8i , by Bentley Inc.

To calculate the existing sanitary sewer flows, the following parameters and calculation methods were used:

- Average dry weather flow rate is 257.6 L/capita/day, based on 80% of average daily water demand , and servicing a population of 3,467
- The peak factor is calculated using Harmon's Peaking Factor, $Pf=1+14/(4+P^{0.5})$ where P is population in thousands
- I/I = 0.2 L/s/ha as discussed in Section 4.2
- Manning's friction coefficient n=0.013
- The downstream flow of the trunk sewer is the total flow of the upstream sewers

4.3.1 Existing Trunk Main System Review

The model includes all existing sanitary sewer trunk mains equal to or greater than 300 mm in diameter. The modeling results show that the existing sanitary sewerage system can fulfill the Town's sanitary service requirements. It was also determined that most of the system piping has some extra capacity for future development (See Appendix 5 for Model Results) and **Figure 4.1**

4.3.2 Future scenario servicing analysis

The future development areas include the area within the Town's existing boundary. It is difficult to predict the development sequence of the future development areas. However, the topographical information (refer to Figure 2.1) indicates that the existing gravity mains can be extended to service most future development areas. Some of the future development areas will require lift stations to pump wastewater to the existing wastewater trunks.

The model includes proposed sanitary trunk mains equal to or greater than 300 mm in diameter.

Two scenarios for servicing future development were examined, and these included the following;

1. Servicing Needs when the town's population reaches the 2041 projected figure of 17,184
2. Servicing Needs when the town's population consumes all available land within the Town – estimated at 23,170

For the purposes of this study the available land has been assumed to be sixteen quarter sections. It has been presumed that the quarter section that is currently primarily occupied by the golf course will not be developed at any stage.

4.3.2.1 Proposed Trunk Main System – Population of Town at 2041 figure

For modeling the proposed Trunk Main System when the town's population reaches the projected figure of 17,184 in 2041, the following parameters were used and assumptions made:

- As discussed in Section 4.3.1 the existing sanitary system can deal with the existing town population
- The population density for newly developed residential areas will be 54 people per hectare (20 dwelling units per hectare and 2.7 persons per unit)
- The population density in the existing developed town is 13.7 people / ha.
- The average wastewater generated by residential dwellings is 257 l/c/d.
- The I/I rate is 0.2 l/s/ha
- The estimated land consumption by 2041 is approximately 12.9 quarter sections (refer to Figure 4.3 to see what land is estimated as being undeveloped)
- The golf course is not to be developed, and thus the golf course acreage is not included in the total land consumption

NR1 and NR2 (Refer to Figure 4.3)

It is proposed to service these areas with a 375 mm diameter pipe. With the town's population at the projected figure of 17,184 in 2041, it is anticipated that only section NR2 will be developed. The flow will be taken to a lift station at point C (as shown in Figure 4.3) and pumped to the lift station being installed in the southeast corner of the Carlinton subdivision.

WR2, WR3 and WR4

It is proposed to service these areas with a 375 mm diameter pipe. With the town's population at the projected figure of 17,184 in 2041, it is anticipated that only section WR3 will be developed (collection point M on Figure 4.3).

The bulk of the sanitary waste from WR4 will be directed southeast through the southern section of the West Bay (WB) subdivision, ultimately ending up at the lift station at point Q. In the short term however, installation of a small lift station at point N, with a forced main up to point 10 will eliminate the need for installing infrastructure in subdivision SR2 and the lift station at point Q until such time as these areas are developed.

SR2

It is proposed to service this area with a 375 mm diameter pipe. The southern portion of the flow from the WB subdivision will also be directed through this sanitary main, via junctions N & O on Figure 4.3, ultimately ending up at the lift station at point Q. With the population of the town at 17,184 in 2041, it is not anticipated that this quarter section will contribute to the flow, so to eliminate the need to install sanitary systems in the ground at this location too far in advance of development, as stated above a lift station at point N will be installed.

EIN and EIS

The EIN section which will be comprised of mostly industrial and commercial lands can be serviced by a 375 mm gravity main feeding into the main trunk that ultimately feeds the lagoon.

The EIS section which will be comprised mostly of industrial and commercial lands can be serviced by a 375 mm gravity main feeding down to the lift station at point Q, which will then pump the waste to the main trunk at point 17 on Figure 4.3.

ER1, ER2 & ER3

Due to the topography, the Eastgate Residential (ER) areas will need to be serviced with the aid of lift stations to bring the waste to the main trunk feeding the treatment lagoon. The west portion of the eastern residential land (ER3) can be serviced by the proposed 450 mm sanitary trunk crossing the quarter in a southerly direction through the Eastgate subdivision. A portion of the land near the existing pond may require a small lift station to provide sanitary service.

The land northeast of the east residential land (ER1) and southeast residential land of this east residential land (ER2) can be serviced by 250 mm or smaller gravity pipes which will connect to the trunk main to the lagoon. Due to the low elevation at the pond location, a lift station is required to service the ER1 area~~.~~

Trunk Main to the Lagoon

The critical piece of infrastructure is the sanitary main running along the middle ditch to the lagoon. All of the town's waste flows through this pipe to the treatment area. The sanitary trunk main, with the increased population and population density, will be overloaded. The model applied suggests the following modifications should be made before the town's population reaches 17,184 (refer to **Figure 4.3)**:

- Between points 10 & 11 – needs 375 mm – proposed upgrade is to 525 mm – recommendation – upgrade to 525 mm
- Between points 11 & 12 – needs 450 mm – recommend to upgrade with 525 mm twin
- Between points 12 & 13 – needs 525 mm – recommend to upgrade existing 450 mm with 525 mm twin
- Between points 13 & 15 – needs 600 mm - recommend to upgrade existing 450 mm with 525 mm twin

- Between points 15 & 16 – needs 675 mm - recommend to upgrade existing 450 mm with 525 mm twin (equivalent to > 675 mm)
- Between points 16 & 17 – needs 675 mm - recommend an upgrade of the existing 450 mm with 600 mm twin (equivalent to > 750 mm)
- Between points 17 & Lagoon – needs 750 mm - recommend an upgrade of the existing 450 mm with 600 mm twin (equivalent to > 750 mm)

(see Appendix 6 for model results)

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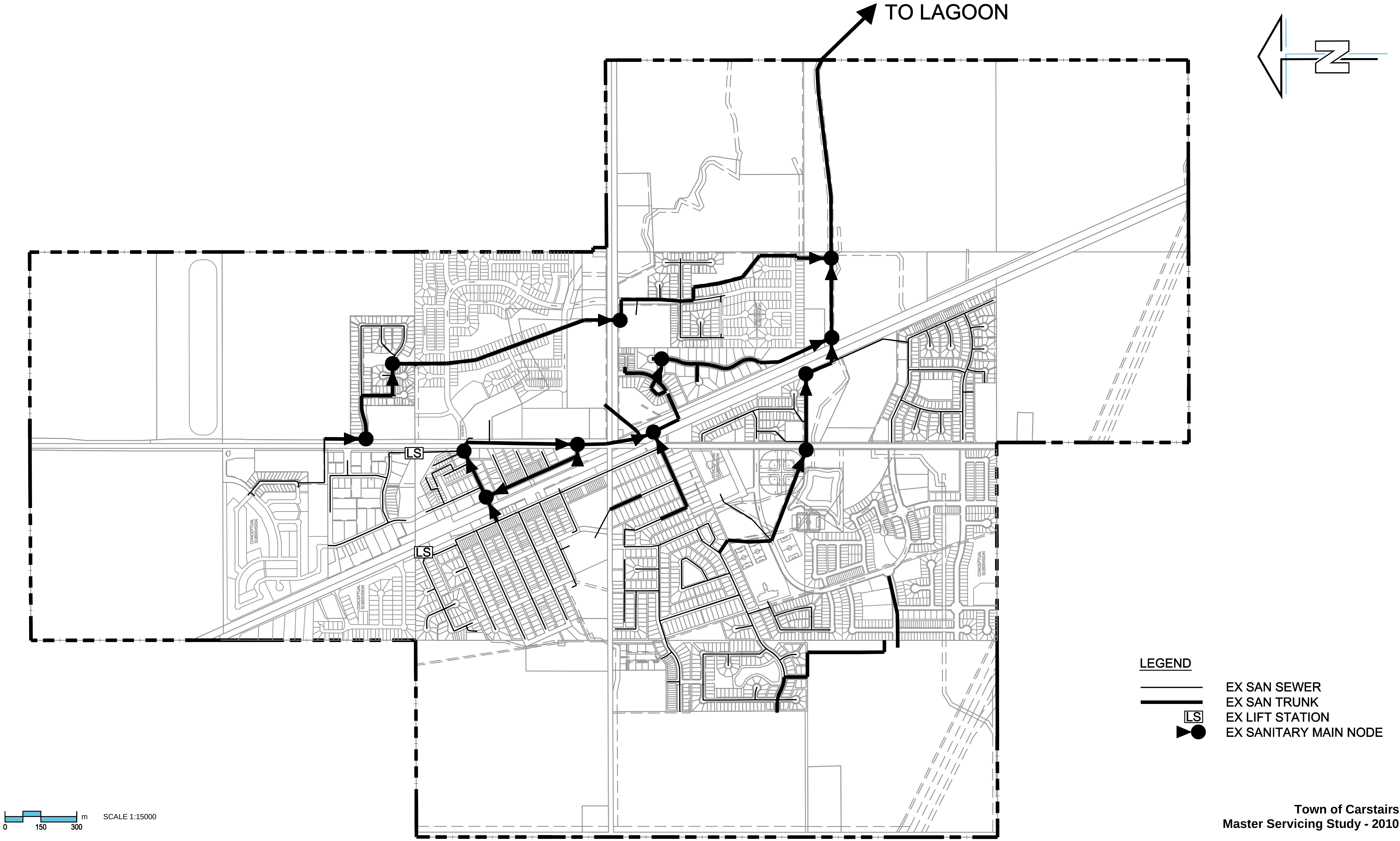

Town of Carstairs
Master Servicing Study - 2010

AECOM

Existing Sanitary Trunk Mains
Figure - 4.1

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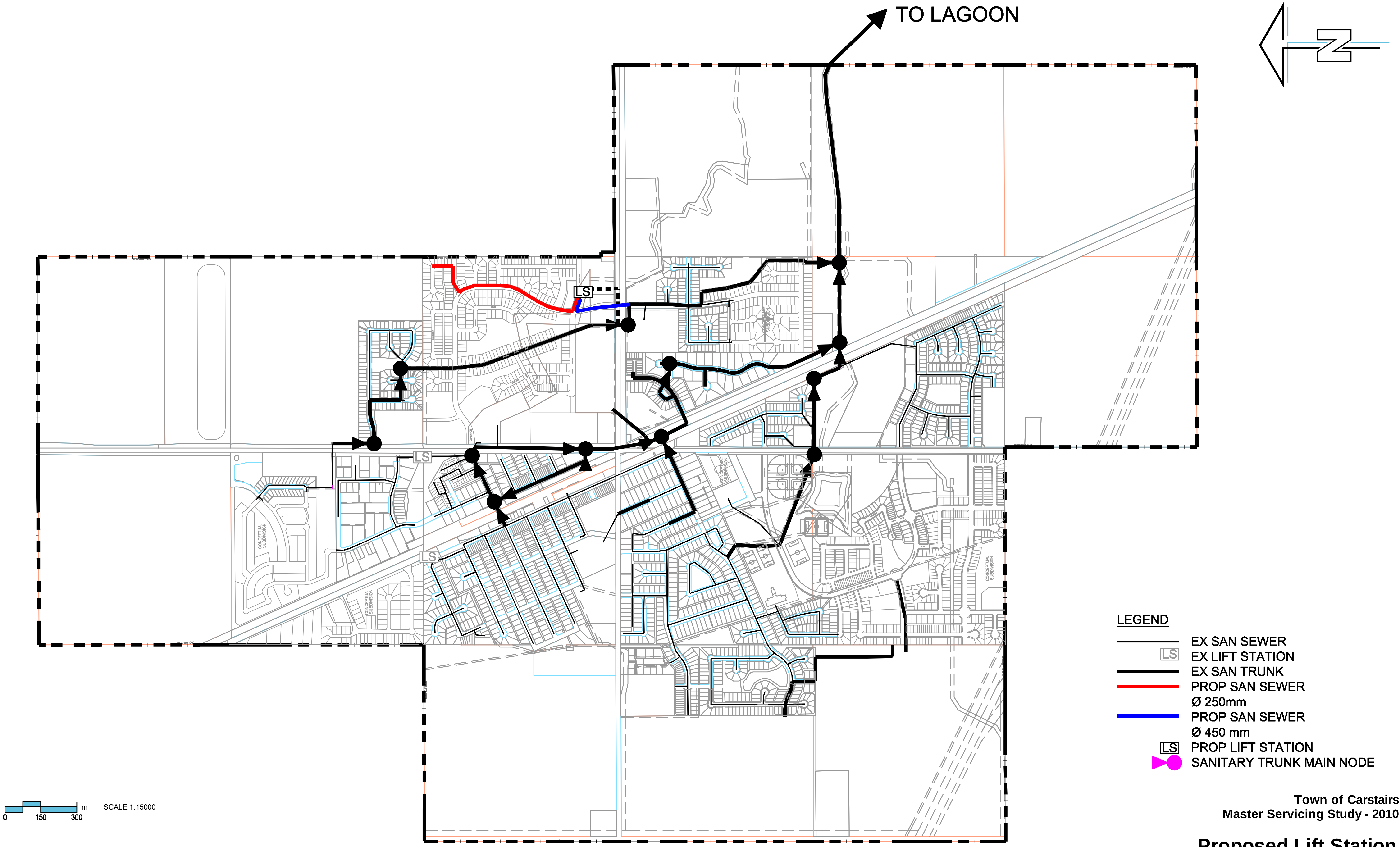
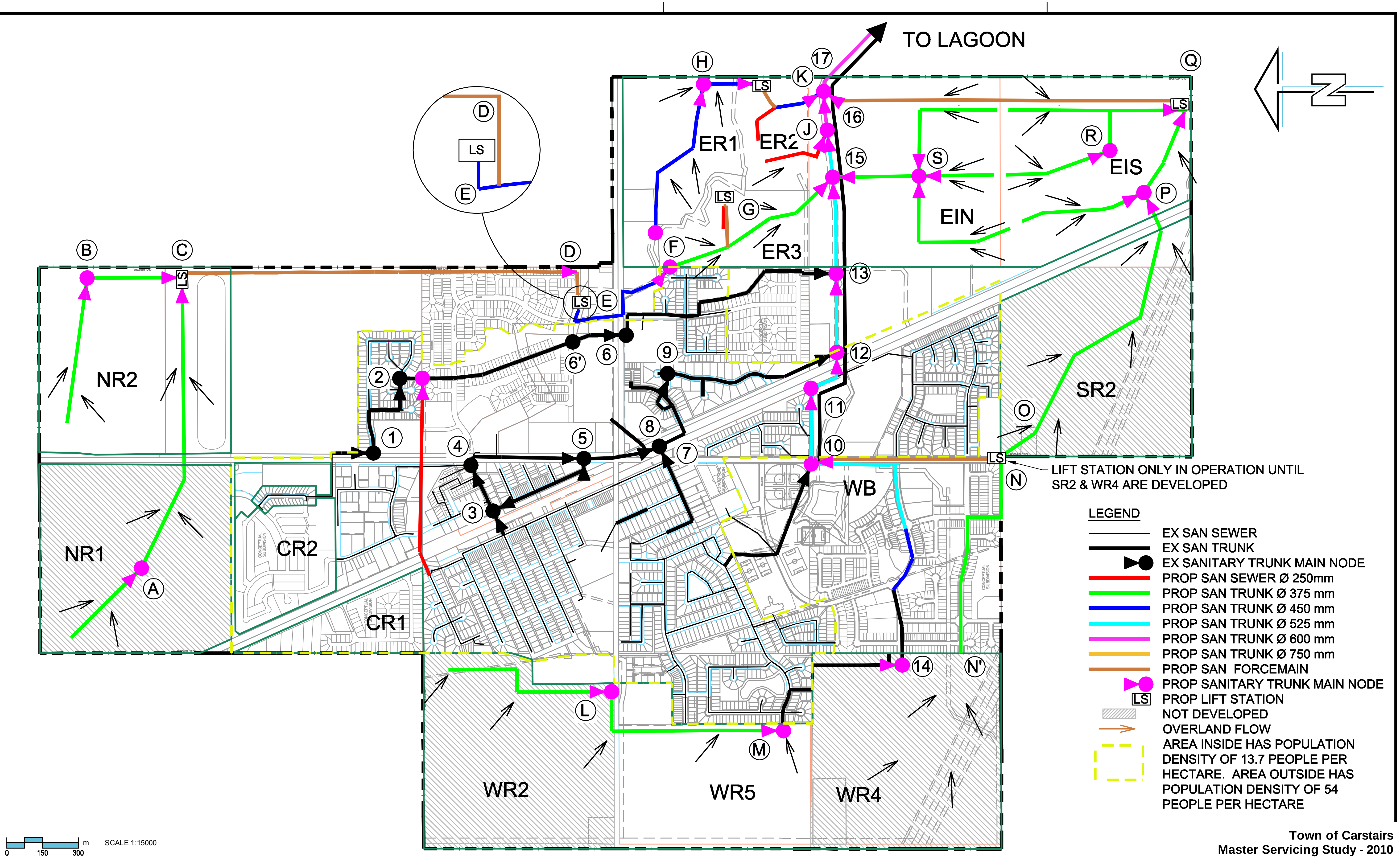


Town of Carstairs
Master Servicing Study - 2010

Proposed Lift Station
Carlinton Area
Figure - 4.2

AECOM



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AECOM

Town of Carstairs
Master Servicing Study - 2010

Proposed Sanitary Trunk Mains
For 2041 Population
Figure - 4.3

4.3.2.2 Proposed Trunk Main System – Full Land Consumption

To ensure that the available land is fully serviced for future development the analysis was carried out for the population density of 54 people / ha at full build-out for all new residential areas, and 13.7 people / ha in the existing developed town. The critical piece of sanitary sewerage infrastructure required to service the population is the trunk main feeding to the lagoon from points 10 – 17, as shown in **Figure 4.4** . The following adjustments from the analysis undertaken in Section 4.3.2.1 have been made for the full land consumption scenario.

NR1 and NR2

It is proposed to service these areas with a 375 mm diameter pipe. At build-out all of these areas are included in the study. The flow, as before, will be directed to a lift station at point C, as shown in Figure 4.3, and pumped to the lift station being installed in the South East Corner of the Carlinton subdivision.

WR2, WR3 and WR4

It is proposed to service these areas with a 375 mm diameter pipe. At build-out all of these areas will be included in the study. The additional contribution of WR4 and WR2 is 1.9 quarter sections.

The bulk of the sanitary waste from WR4 will be directed southeast through the southern section of the West Bay (WB) subdivision, ultimately ending up at the lift station at point Q. At full development the lift station installed at point N will no longer be in service.

SR2

It is proposed to service this area with a 375 mm diameter pipe. The southern portion of the flow from the WB subdivision will also be directed through this sanitary main, via junctions N & O as shown on Figure 4.3, ultimately ending up at the lift station at point Q. At full development the lift station installed at point N will no longer be in service.

EIN and EIS

There are no adjustments needed to account for the contribution of this area to the study area at build-out other than to ensure that the contribution of the upstream sections, such as WR4 and SR2 are allowed for in the sizing of the sanitary mains.

ER1, ER2 & ER3

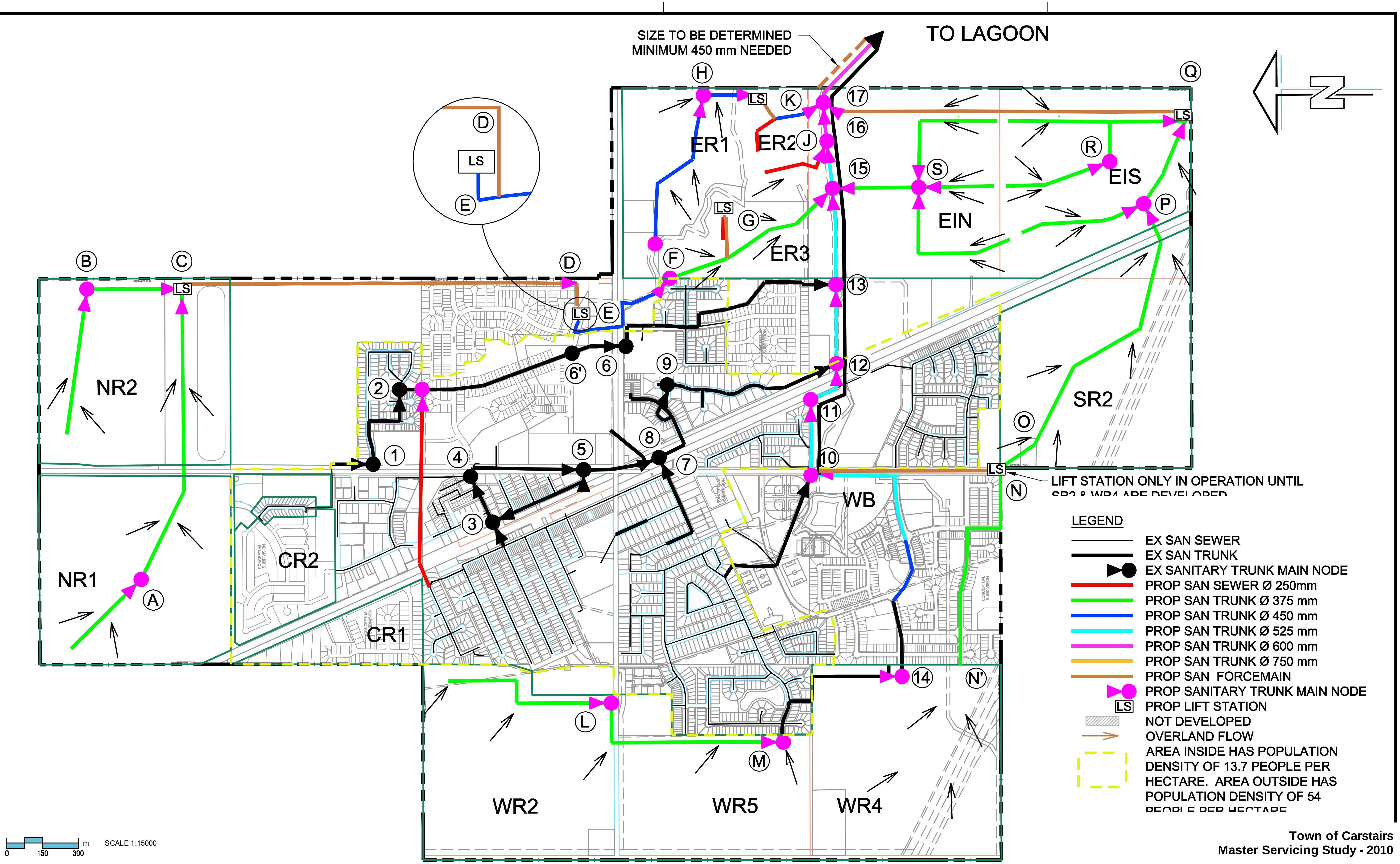
No changes to the contribution made by the Eastgate subdivision, other than to ensure that the upstream section now included in the study (NR1) does not surcharge the sanitary mains in the Eastgate subdivision.

Trunk Main to the Lagoon

With the town at full build-out, the capability of the existing 450 mm trunk main and the proposed additional trunk main to cater for the increased population at full land development, over and above that projected for 2041 has been analysed using the model. The results suggest that the following changes will be required:

- Between points 10 & 11 – needs 375 mm – proposed upgrade for 2041 is 525 mm – no further change needed
- Between points 11 & 12 – needs 525 mm – proposed upgrade for 2041 is 525 mm twin – no further change needed
- Between points 12 & 13 – needs 525 mm – proposed upgrade for 2041 is 525 mm twin – no further change needed

- Between points 13 & 15 – needs 600 mm - proposed upgrade for 2041 is 525 mm twin – no further change needed
- Between points 15 & 16 – needs 675 mm - proposed upgrade for 2041 is 525 mm twin – no further change needed
- Between points 16 & 17 – needs 750 mm – proposed upgrade for 2041 is 600 mm twin – no further change needed
- Between points 17 & Lagoon – needs greater than a 750 mm - proposed upgrade for 2041 is 600 mm twin – which coupled with existing 450 is not enough to be greater than 750mm. Propose a third main upon completion of 2041 development to cater for full development. Either, 450mm which will give capacity equivalent to a pipe of 875 mm diameter or a third main of 525 mm diameter which would give a diameter slightly greater than that of a 900mm pipe. A further analysis needs to be completed at a much later date to determine what the optimum solution would be.



Town of Carstairs
Master Servicing Study - 2010

Proposed Sanitary Trunk Mains
For Build-Out
Figure - 4.4

AECOM

4.4 Sewage treatment facilities

The Town's lagoon treatment facility is located about 3.2 km southwest of the Town. It consists of four anaerobic lagoon cells, one facultative cell, and one storage cell as described below:

- Four anaerobic cells each with 5,400 m^3
- One facultative cell with 110,400 m^3
- One storage cell with 610,600 m^3

Alberta Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems 2006 requires that minimum design standards for wastewater lagoons are a function of average daily flow as summarized below:

- Anaerobic Cells must have 2 days of storage
- Facultative Cell must have 60 days of storage
- Storage Cells must have 365 days of storage

Based on the records supplied from the Town on the daily flow reading into the lagoon, the average daily flow has been calculated at 486 l/c/d.

Anaerobic Cells

Each anaerobic cell was estimated to have a 5,400 m^3 capacity. As per Alberta Environment guidelines, anaerobic cells should be designed to retain influent flow for a 2-day period based on average daily design flow. From the data in table 4.1 the annualised average daily flow into the waste water treatment system is 486.03 l/c/d.

- 5,400 m^3 * 1000 L/m^3 / (486 L/c/d *2 days) = 5,555 persons

This indicates that the existing anaerobic cells have enough capacity to service the Town, based on the high growth rate population projections until 2015.

Facultative Cell

The facultative cell has a capacity of 110,400 m^3. As per Alberta Environment guidelines, a faculative cell should be designed to retain influent flow for at least 60 days based on average daily design flow. Thus, the maximum population that can be serviced by the existing facultative cells can be calculated as:

- 110,400 m^3 *1,000 L/m^3/ (486 L/c/d * 60 days) = 3,786 persons

The population projections indicate that by the end of 2010 the population of Carstairs will be 3,796 people. Therefore an immediate upgrade of the facultative cell is required.

Storage Cell

The storage cell has a capacity of 610,600 m^3. The cell must be sized to allow for retention of influent wastewater for a minimum period of 365 days based on average daily design flows. Thus, the maximum population that can be serviced by the existing facultative cells can be calculated as:

- 610,600 m^3 *1000 L/m^3/ (486 L/c/d * 365 days) = 3,442 persons

The year 2009 population is estimated at 3,467. Therefore, the storage cell capacity has probably already been exceeded, and an immediate upgrade is required.

Based on the above calculation the lagoon requires upgrading in the immediate future. The design criteria are laid out as follows:

Population 2021	7,842 people
Population 2031	11,608 people
Average Annual Water use per capita	486 l/c/d
Anaerobic Cells must have	2 days of storage
Facultative Cell must have	60 days of storage
Storage Cells must have	365 days of storage

The waste water treatment storage requirements are as follows for the 10 and 20 year design periods.

Table 4.2 Years 2021 and 2031 Conceptual Design WWT Storage Requirements

Conceptual Design	Year 2021 (m^3)	Year 2031 (m^3)
Anaerobic - 4 cells each with	7,622	11,283
Facultative	228,673	338,489
Storage Cells	1,391,092	2,059,143

If the existing facility can be utilized to current estimated capacity, the additional storage requirements can be estimated as follows:

Table 4.3 Years 2021 and 2031 Additional Storage Required

	Year 2021 (m^3)	Year 2031 (m^3)
Anaerobic - 4 cells each with	2,222	5,883
Facultative	118,273	228,089
Storage Cells	780,492	1,448,543

It should be noted that the existing facility would need to remain in operation during the expansion. Therefore, new cells will need to be constructed to add additional capacity with a minimum additional two anaerobic cells, a new facultative cell, and one or two storage cells. The concept of the expansion is beyond the scope of the MSS.

Alternative Solutions

The annual average inflow figure of 486 L/c/d is abnormally high for a town of this size. The figure would be expected to be in the range of 1 to 1.2 times the water demand. The water demand is estimated as 322 L/c/d, thus an expected figure would be in the range 322 to 385 L/c/d. The current annual inflow rate is 125% - 150% above the expected range. A number of factors contributing to this high level of inflow into the waste water treatment system are:

- The inflow from the existing Storm ponds at Scarlett Ranch
- The high number of sump pumps feeding directly into the sanitary mains

These additional sources of inflow into the sanitary system could be addressed with shorter term measures such as:

- Raising the manhole levels in the vicinity of the Scarlett Ranch storm ponds
- Enacting a retrospective by-law to outlaw the feeding of sump pumps directly into the sanitary mains.

If these measures are even moderately successful and reduced the inflow to the upper end of the expected range, i.e. 385 L/c/d, the impact on the existing treatment plant would be to increase the capability of the cells to accommodate the following populations.

Cell	Population	Expected Year to Achieve Population
Anaerobic	7,012	2019
Faculative	4,779	2013
Storage	4,345	2012

If these measures are even more successful and reduced the inflow to the middle of the expected range, i.e. 355 L/c/d, the impact on the existing treatment plant would be to increase the capability of the cells to accommodate the following populations.

Cell	Population	Expected Year to Achieve Population
Anaerobic	7,605	2021
Faculative	5,183	2015
Storage	4,712	2013

5. Stormwater System

5.1 Introduction

The intent of this section is to provide an assessment of the stormwater requirements as part of the Master Servicing Study (MSS). The MSS provides a conceptual plan to control surface flow quantity and quality within the Carstairs Town area. The study outlines the methodology used, the results obtained for the stormwater assessment and associated stormwater conveyance system, and the water quality storage analysis.

The main objectives of the stormwater management study are:

- Revision and update of previous stormwater management studies (Town of Carstairs Master Drainage Plan, MDP, UMA 2001; and Town of Carstairs Servicing Study, CSS, Stantec 2005)
- Hydrological modelling for estimation of existing overland flows
- Evaluation of proposed water quality pond volume and outflow quality with long-term continuous simulation
- To provide a conceptual analysis for future stormwater management options, including unit area release rate (UARR) for each subbasin.

5.2 Design Criteria

5.2.1 Methodology

Based on the study area topography and the stormwater runoff direction, the study area was divided into three subbasins as was stated in the 2001 MDP. The main three subbasins were further divided into subcatchments. SWMHYMO and QUALHYMO computer models of the individual subbasins were developed to determine the runoff flow, water quality requirement and unit area release rate. Rainfall data for the model was obtained from the City of Calgary guidelines and AES historical records for Calgary area.

5.2.2 Single Event Simulation Model

Hydrologic analysis was carried out in accordance with the *City of Calgary Stormwater Management and Design Manual*, and with the *Alberta Environment Protection Stormwater Management Design Guidelines*. Single event analysis of rainfall runoff was carried out with the SWMHYMO computer model.

The 1:100 year 24-hour design storm (5 minute rainfall increments) with Chicago distribution was derived based on the 1998 IDF data supplied by the Atmospheric Environment Services (AES) for the Calgary area. The Adjusted A, B and C parameters that were used for deriving the Chicago storm rainfall distribution were taken from the *City of Calgary Stormwater Management and Design Manual 2000* (**Table 1**).

Table 5.1 IDF Parameters for Design Storms

Storm Return Period	A	B	C
1 in 100 Year Storm	663.1	1.87	0.712

5.2.3 Continuous Simulation Model

The operation of detention storage facilities is often influenced by the soil conditions of their contributing drainage areas. This varies from year to year depending on precipitation and wet/dry cycles. As a supplemental procedure to single event analysis, runoff from a catchment can be computed by simulating historic rainfall as a continuous event and taking into account evaporation and the recovery of infiltration. Continuous simulation also accommodates the computation of long term runoff volumes from a catchment

Continuous simulation was performed for this study using historic precipitation data from January 1, 1960 to December 31, 1997, which is provided by AES for the Calgary airport. Precipitation in the form of snowfall was considered, so the snowmelt was included in the analysis. Water quality modeling for sediment removal was also performed in the analysis.

The continuous simulation analyses were carried out with the QUALHYMO computer model. QUALHYMO can be used as a general tool for simulating rainfall runoff; however, it is most suited to analyses in basins where the land surface is developing from a rural or undeveloped state to an urban land use.

5.2.4 Runoff Computation

As recommended by SWMHYMO User's manual, CALIB STANDHYD command was used to simulate the runoff from urban watersheds with impervious ratios larger than 0.2. And CALIB NASHYD was used to simulate the runoff from rural watersheds with impervious ratios smaller than 0.2. These commands use two parallel standard instantaneous unit hydrographs IUH to simulate the surface runoff hydrographs.

With QUALHYMO model runoff may be computed using either the Nash or Williams IUH. For this project, the Nash IUH was used to compute runoff from the study area. The SWMHYMO and QUALYHMO model parameters used for the runoff computations are provided in **Appendices 2 and 3**, along with model outputs.

To model runoff with QUALHYMO, appropriate time to peak t_p is required. The kinematic wave equation is commonly used to compute the time of concentration t_c for sheet flow.

$$\mathbf{t_c = \frac{K\,n^{0.6}\,L^{0.6}}{I^{0.4}\,S^{0.3}}}$$

Where:

t_c = Time of Concentration (min)
n = Roughness coefficient
L = Overland Flow Length (m)
I = Rainfall intensity (mm/hr)
s = Catchment Slope (m/m)
K = Empirical coefficient equal to 6.92

Once t_c is obtained, the unit hydrograph time to peak, $t_p = (t_c \times 0.6)$ is used in QUALHYMO to generate the runoff hydrograph.

The QUALHYMO model uses parameters that describe the soil moisture conditions; specifically SMAX which is the maximum soil moisture holding capacity during dry times, and SMIN which is the minimum soil moisture holding capacity during wet times. Values associated with SMAX and SMIN are important for computing runoff volumes. For detailed description of SMAX and SMIN calculations refer to the QUALHYMO Technical Reference Manual (March, 1990). For SMAX and SMIN values refer to **Appendix 3.**

5.2.5 Storage Routing

Storage routing was performed by both models to simulate the required quality detention storage for the subbasin A that covers the existing development of the Carstairs Town. Table 5.2 summarizes the storage-area-discharge rating used in the models.

Table 5.2 Rating Data for Pond 1 Routing

Pond Depth (m)	Pond Volume (m)	Active Pond Volume (m^3)	Water Surface Area (m^3)	Weir CSCW (2.1 m Length) (m^2)	Weir Discharge (m)
	0	0	14,700		0.000
0.4	6,106	0	15,836		0.000
0.8	12,673	0	17,004		0.000
1.2	19,714	0	18,204		0.000
1.6	27,241	0	19,436		0.000
2	35,267	0	20,700		0.000
2.4	43,805	0	21,996		0.000
2.8	52,868	0	23,324		0.000
3 NWL	57,600	0	24,000		0.000
3.4	67,474	9,874	25,376	1.839	0.940
3.8	77,905	20,305	26,784	1.869	2.594
4.2	88,906	31,306	28,224	1.898	4.641
4.6	100,489	42,889	29,696	1.927	6.943
4.8	106,502	48,902	30,444	1.942	8.160
5 HWL	112,667	55,067	31,200	1.957	9.408
5.3 Free board			32,349		

5.2.6 Sediment Removal Analysis

Water quality modeling for sediment removal was performed by QUALHYMO. Table 5.3 and 5.4 summarize the build-up and wash-off parameters that were used for this study by the model. Table 5.5 illustrates the sediment particle size distribution and settling velocities.

Table 5.3 Pollutant Build-up Parameters

Parameter	Impervious Areas	Pervious Areas
Build-up Method	Power Linear	Power Linear
Equivalent Initial Accumulation Period	30 Days	30 Days
Maximum Accumulation	0.2 kg/m^2	0.2 kg/m^2
Build-up	0.00055 kg/m^2 per 1.0 Day	0.00055 kg/m^2 per 1.0 Day

Table 5.4 Pollutant Washoff Parameters

Parameter	Impervious Areas	Pervious Areas
Washoff Method	Build-up/Washoff	Build-up/Washoff
Washoff Coefficient	6,000 per m^3	3,000 per m^3
Washoff Exponent	1.2	1.2

Table 5.5 Sediment Settling Velocity Data

Sediment Fraction	Particle Size (micron)	Size Classification	Size Fraction (%)	Settling Velocity (m/s)
1	≤5	fine silt	2.8	0.0000007
2	5-10	medium silt	1.2	0.0000025
3	10-20	medium silt	1.2	0.000008
4	20-75	coarse silt	5.8	0.000025
5	≥75	fine sand	89	0.0005
Total			**100**	

5.3 The Stormwater System

5.3.1 Existing Drainage System

The study area covers the whole Carstairs town's recent annexation and its contributing area as shown in **Figure 5. 1.** The catchment area comprises of three subbasins that discharge to Sheep Coulee and Carstairs creek. Both streams extend south east and eventually connect to the Rosebud River. The study area accounts for approximately 2274 hectares. Natural grades vary and run as steep as 1%. Land cover is mainly comprised of paved area and grass.

Subbasin A covers the majority of the town with an area of 1164 ha of developed and agricultural lands. The subbasin drains south east to the two existing ditches (north ditch and middle ditch). These ditches collect stormwater mostly from residential and open areas by curb and gutter, swales, pipe systems and culverts; and ultimately discharge to the existing pond east of The Havenfields community which in turn outflows east to Sheep coulee. Existing ponds were developed in the Town's subdivisions as needed to meet the 2001 MDP unit area release rate of 9 L/s/ha and kept discharging to the existing two ditches.

Subbasin B consists mostly of agricultural land and it covers part of the Town's golf course. The subbasin discharges north east away from the annexed Town area. An existing pond that is located north east of the golf course manages the town's subcatchment stormwater of subbasin B and outflows to Sheep Coulee as well.

Carstairs Subbasin that is located in the southern part of the Town consists of agricultural land and the Town's undeveloped lands with an area of 996 ha. The subbasin captures its runoff by south shallow ditch through overland sheet-flow and culverts. There is not any existing pond in this subbasin and the whole runoff flows south to Carstairs Creek.

5.3.2 Drainage Boundaries and Runoff

As previously discussed, the study area is divided into 21 subcatchments boundaries. The boundaries were determined by the existing grading plan (2001 MDP) and the town's future conceptual design. The proposed subcatchments are listed below and are shown on **Figure 5.1.**

All of the subcatchments area runoff hydrographs resulting from 1:100 year return period single event design rainfall of 24 hour duration were simulated, added together and routed through the existing underground and surface stormwater systems, as shown in **Figure 5.1**. For more details about the existing stormwater system, refer to 2001 MDP.

B SIZE 11" x 17" (279.4mm x 431.8mm)

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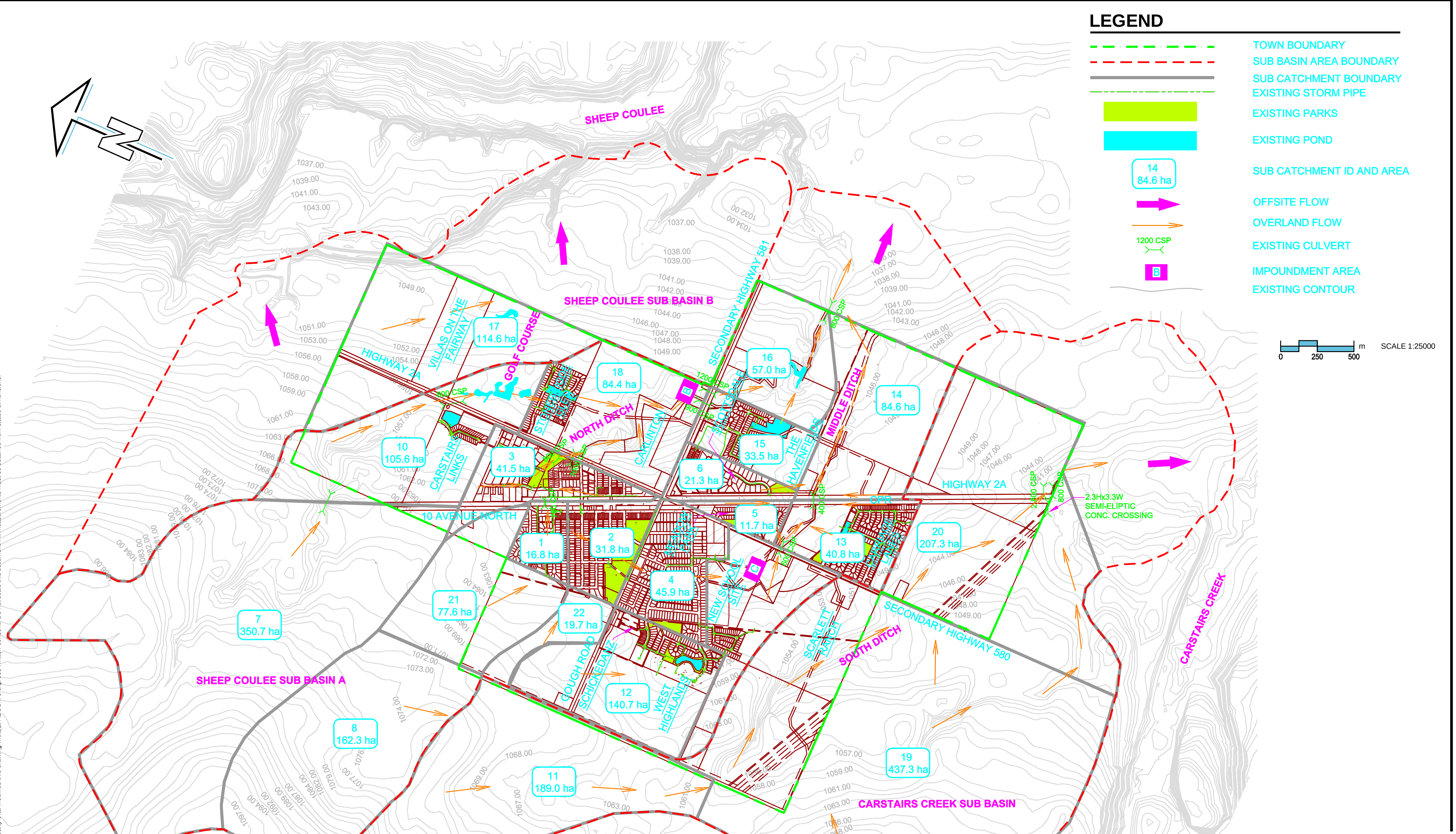
ISS/REV: A



Town of Carstairs
Master Servicing Study - 2010

Existing Town Drainage
Figure - 5.1

Table 5.6 Subcatchment Runoff and UARR

Subcatchemnt ID	Area (Ha)	Cumulative Area (Ha)	1:100 Runoff (m^3)/s	UARR (L/s/Ha)
SHEEP COULEE SUB BASIN A				
7	350.7	350.7	3.875	11.0
10	105.6	456.3	5.138	11.3
21	77.6	533.9	1.255	16.2
1	16.8	550.7	1.804	19.1
3	41.5	77.6	1.711	12.6
18	84.4	94.4	7.904	11.7
15	33.5	135.9	5.118	7.2
16	57.0	767.1	5.352	7.0
22	19.7	19.7	0.336	17.1
2	31.8	51.5	2.554	49.6
4	45.9	97.4	4.508	46.3
12	140.7	238.1	4.744	19.9
5	11.7	249.8		
13	40.8	290.6	4.326	14.9
6	21.3	311.9	4.729	15.2
14	84.6	396.5	5.734	14.5
Sub-Total		**1163.6**	**9.440**	**8.1**
CARSTAIRS CREEK SUB BASIN				
8	162.3	162.3	2.074	12.8
11	189.0	351.3	4.179	11.9
19	437.3	788.6	8.552	10.8
20	207.3	995.9	10.985	11.0
SHEEP COULEE SUB BASIN B				
17	114.6	114.6	1.700	14.8
Total		**2274.1**		

5.3.3 Unit Area Release Rate (UARR)

Based on the existing runoff discharge of each basin, the allowable unit area release rate was calculated. The 1:100 runoffs were divided by the area and are listed for each subcatchment in **Table 5-6**. The UARR of each subbasin is listed below in **Table 5-7**. The future development must comply with these release rates when calculating the storage volume. **Table 5-6** indicates that the stormwater conveyance system between subcatchments can handle a higher release rate than the overall release rate of 8 L/s/ha for subbasin A. Thus the UARR of 9 L/s/ha set in the 2001 MDP that has been used in sizing storage ponds will not undermine the existing stormwater system, as long as the subbasin release rate to water course, in total, meets the values listed in **Table 5.7**.

Table 5.7 Subbasins Unit Area Release Rates

	Sheep coulee Subbasin A	Sheep coulee Subbasin B	Carstairs Creek Subbasin
1 in 100 Year Storm UARR (L/s/ha)	8	15	9

5.4 Stormwater Management Plan

5.4.1 Existing and Future Development

As it was summarized in the 2001 MDP, the existing stormwater system capacity may not meet the current minor flow at two locations. This is due to either culvert constraints or storage volume inadequacy. The two locations are impoundment B and C (**Figure 5.1**).

Ponding at impoundment B is caused by a natural depression that allows stormwater to accumulate upstream of the two 1200 and 900 mm CSP Secondary Highway 581 culverts. This extra runoff flow can be attenuated through the proposed Carlinton storage pond and the impoundment area to avoid future ponding in the area.

Impoundment C is a natural depression area where the invert of the 600 mm CSP outlet is higher than the bottom of the impoundment. Therefore, stormwater ponds in the area and the storage functions as an evaporation pond. The proposed Scarlett Ranch pond west of the Secondary Highway 580 lies within the impoundment area and can provide a proper storage with controlled release rate to predevelopment flow. **Figure 5.2** illustrates the future conceptual development that will help solve the existing ponding issues and accommodate the future expansion of the Town.

The future development as it was mentioned before should limit the runoff release to predevelopment rate by constructing storage facilities within the development area.

5.4.2 Water Quality

The future stormwater storage facilities should meet the quantity and quality requirements per Alberta Environment Protection Stormwater Management Design Guidelines. The existing old development of the Town lacks any stormwater quality measures. Therefore a water quality boundary was developed (**Figure 5.2**) and it covers the areas that require water quality improvement. The purpose of this boundary is to determine the minimum active storage requirement to accommodate the first 25 mm rainfall (first flush). The water quality pond will handle the combined North and Middle ditches outflow where they meet near the east boundary of the town. The proposed pond location can also serve the future development of the surrounding section east of The Havenfields community.

Table 5.8 **5-8** summarizes the results of the 1:100 storage volume and area requirements for the proposed pond. The higher result of the two analysis methods (single event vs. continuous) was used (109,557 m^3) for sizing the water quality pond. The pond side slope is 1 to 5 and length to width ratio is 3.

Table 5.8 Storage Facility Requirements

Storage Facility	Contributing Area (ha)	1:100 Total Volume (m^3)		1:100 Active volume (m^3)	Area at HWL (m^2)	Maximum Inflow (m^3/s)	Maximum Outflow (m^3/s)
		XP-SWMM	QHM				
1	1,163	103,500	109,557	56,957	31,200	9.675	9.410

ISS/REV: A
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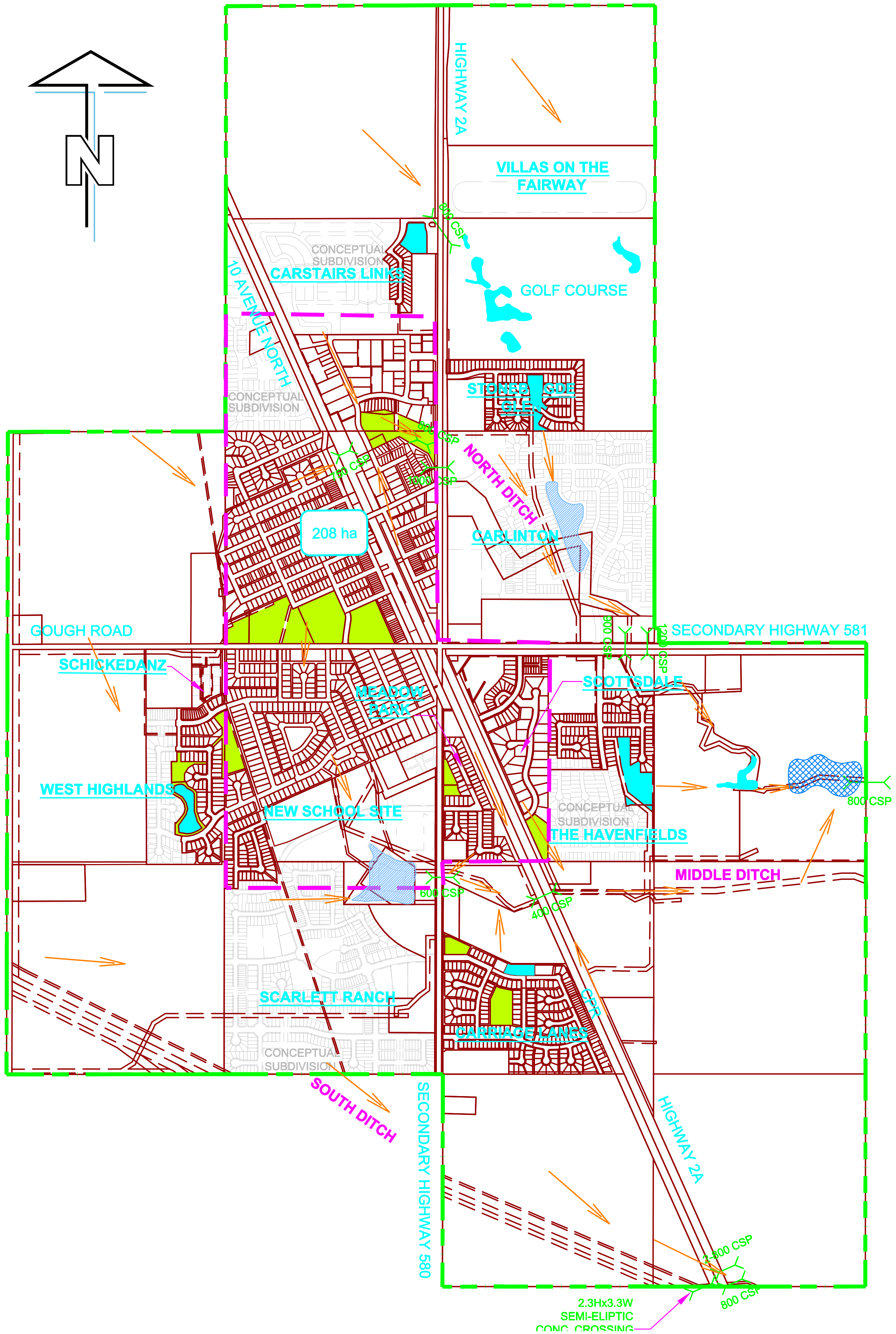

LEGEND

▬ ▬ ▬	TOWN BOUNDARY
▬ ▬ ▬	WATER QUALITY AREA BOUNDARY
🟩	EXISTING PARKS
🟦	EXISTING POND
▨	FUTURE POND
▩	PROPOSED WATER QUALITY POND
▥	CONCEPTUAL FUTURE SUBDIVISION
▥	EXISTING SUBDIVISION
→	OVERLAND FLOW
1200 CSP ≻—≺	EXISTING CULVERT

0 200 400 m SCALE 1:20000

AECOM

Town of Carstairs
Master Servicing Study - 2010

Future Town Drainage
Figure - 5.2

Table 5.9 summarizes the results of the water quality pond sediment simulation for the various size fractions, as determined by QUALHYMO model. The data shows that the Alberta Environment objective of 85% removal of particle sizes greater than 75 microns is exceeded in the pond.

Table 5.9 Sediment Simulation Results

Particle Size (micron)	Sediment Removed Storage Facility -1
≤5	0.32
5-10	0.47
10-20	0.58
20-75	0.67
≥75	0.94
Total	**0.89**

5.5 Stormwater Summary

- SWIMHYMP Parameters of the 2001 MDP were used in this study as no changes in the stormwater system occurred since 2001.
- The Adjusted A, B and C parameters that were used for deriving the Chicago storm rainfall distribution were taken from the City of Calgary Stormwater Management and Design Manual 2000. These Parameters are an update of those mentioned in the 2001 MDP.
- Future subdivision ponds must control the release rate to the allowable UARR per **Table 5.7**.
- The total estimated required storage of the proposed water quality pond is about 109,557 m^3 for the 1:100 design storm event. The proposed pond characteristics according to **Table 5-2** meet the required storage.
- Stormwater will be treated, before leaving the Town, for TSS that could potentially accumulate in the study area.
- Best Management Practices BMB, such as the use of Bio-swales, and LID features, shall be utilized during the development of the Town.

6. Capital Analysis

The following is the order of magnitude capital costs for upgrading the towns infrastructure as recommended in this report.

Table 6.1 Water – Storage, Supply And Pumping

Item	Final Cost Estimate ($CND)
Install 3000 m^3 Reservoir (Refer to Fig 3.3)	$1,740,000
Upgrade Existing Pumphouse (Refer to Fig 3.2)	$470,000
New pumphouse with new fire pump for industrial & commercial (Refer to Fig 3.3)	$1,570,000
Re-do Domestic Pumps (Refer to Fig 3.2)	$1,420,000
Sub-Total	$5,200,000

Table 6.2 Water – Distribution Network Upgrades to Existing

Item (Refer to Fig 3.2)	Final Cost Estimate ($CND)
Upgrade A - Install 300mm main	$170,000
Upgrade B - D - Install 300mm main	$200,000
Upgrade C - Upgrade to 250mm main*	$80,000
Upgrade E - Install 250mm main	$170,000
Upgrade F - Install 250mm main	$380,000
Upgrade G - Upgrade to 250mm main*	$1,520,000
Upgrade H - Upgrade to 250mm main*	$70,000
Sub-Total	$2,569,995
*	

The replacement cost for the existing pipe has been deducted from the cost of installing new pipe, presumes hydrants can be re-used

Table 6.3 Waste Water Trunk Pipelines

Item (Refer to Fig 4.3)	Final Cost Estimate ($CND)
Install Link from CR 1 & CR 2 to Carlinton	$360,000
Install Twinning Main to Lagoon to service population projected for 2041	
Points 10 – 11 - 525 mm pipe	$200,000
Points 11 – 12 - 525 mm pipe	$100,000
Points 12 -13 – 525 mm pipe	$270,000
Points 13 – 15 – 525 mm pipe	$270,000
Points 17 – Lagoon – 600 mm pipe	$1,680,000
Sub Total Trunk Mains	***$2,880,000***
Install Lift Station to Service EIS (Point Q)	$1,890,000
Water Tight and Raise Manholes at Scarlett Ranch	$30,000
Sub Total Manhole & Lift Stations	***$1,920,000***

Table 6.4 Waste Water Treatment Systems Upgrade

Item	Final Cost Estimate ($CND)
Upgrade Anaerobic Cells 20 yr design	$370,000
Upgrade Faculative Cell	$4,160,000
Upgrade Storage Cell	$13,080,000
Associated Piping and Manholes	$410,000
Sub Total	$18,020,000

Table 6.5 Stormwater Quality Upgrades

Item	Final Cost Estimate ($CND)
Excavation	$770,000
Liner & Landscaping	$850,000
Sub-Total	$1,620,000

7. Sustainability Check List

7.1 Economic Sustainability Checklist

With growth and development there are increasing demands for municipal services that often exceed the fiscal resources available to municipalities. In most Canadian provinces, municipal governments must rely heavily on property taxation (residential and non-residential), development charges and user fees.

Economic sustainability, simply put, requires that economic benefits exceed or at least balance costs. It is more easily measurable than ecological or social sustainability, because its elements can usually be defined in monetary terms. However, it is at least as difficult to predict and is affected by as many variables. Economic sustainability and development is influenced by market, physical, regulatory, financial and political issues.

Economic sustainability includes policies and programs for attracting investment and employment and promoting local entrepreneurship.

The following checklist is to be used during the conceptualization stage of the project and shall serve as a check that economic sustainability issues affecting the citizens of Carstairs have been addressed:

1. Shall the project lead to and/or provide access to the creation of jobs and training opportunities that shall enable the citizens of Carstairs to be productive and utilize their skills and abilities?
2. Shall the project t lead to the citizens of Carstairs getting sufficient income to support themselves and their families?
3. Shall the project support Carstairs' existing businesses and services?
4. Shall the project lead to the provision of affordable housing?
5. Shall the project have any features that will reduce Carstairs' long-term community cost of operating and maintaining public services and infrastructure?
6. Shall the project encourage innovation and diversification of Carstairs' economy?
7. Shall the project maintain/enhance/create opportunities to export goods and services and import activities that improve Carstairs' economy?
8. Shall the project maintain/enhance/create a sustainable tax/assessment base?
9. Shall the project maintain/enhance/create support and encouragement for Carstairs' economic development?

7.2 Social Sustainability Checklist

For a community to function and be sustainable, the basic needs of its residents must be met. A socially sustainable community must have the ability to maintain and build its own resources and have the resiliency to prevent and/or address problems in the future.

There are two types/levels of resources in the community that are available to build social sustainability (and, indeed, economic and environmental sustainability), namely:

Individual or human capacity: This refers to the attributes and resources that individuals can contribute to their well being and to the well being of the community as a whole. Such resources include education, skills, health, values and leadership.

Social or community capacity: This is defined as the relationships, networks and norms that facilitate collective action taken to improve upon quality of life and to ensure that such improvements are sustainable.

To be effective and sustainable, both these individual and community resources need to be developed and used within the context of the following four guiding principles:

Equity: When individuals have access to sufficient resources to participate fully in their community and have opportunities for personal development and advancement and there is a fair distribution of resources among communities to facilitate full participation and collaboration.

Inequities can be minimized by recognizing that individuals and groups require different levels of support in order to flourish, and that some individuals and groups are capable of contributing more than others to address disparities and promote fairness of distribution. Lower levels of disparities in societies result in longer life expectancies, less crime, stronger patterns of civic engagement and more robust economic vitality

Social inclusion and interaction: Both the right and the opportunity to participate in and enjoy all aspects of community life and interact with other community members; where the environment enables individuals to celebrate their diversity and react and act on their responsibilities.

Social exclusion limits the levels of involvement and impedes optimal healthy development of individuals and the community as a whole.

Security: Individuals and communities need to have the confidence that they live in safe, supportive and healthy environments in order to contribute to their own well being or engage fully in community life.

Adaptability: Resilience for both individuals and communities and the ability to respond appropriately and creatively to change. Adaptability is a process of building upon what already exists, and learning from and building upon experiences from both within and outside the community.

To comprehensively cover off social sustainability, it needs to be examined under the following three headings to ensure that the relevant social sustainability issues affecting the citizens of Carstairs have been addressed:

Basic Needs Checklist:

1. Shall the project provide, improve and/or develop infrastructure that ensures equitable access to local (community centered) services, amenities and recreational, artistic and leisure opportunities to the community including those members without private transportation. Members of the community also include low income persons, persons with disabilities and seniors.
2. Shall the project lead to the production and/or access to affordable locally produced nutritious foods?
3. Shall the project respond to the needs and interests of a diverse population regardless of culture, income, age or physical ability?
4. Shall the project lead to the creation and/or improvement of privacy, safety and tranquility of new/existing communities and workplaces?

Individual or Human Capacity Checklist:

1. Shall the project maintain/enhance/create opportunities for public creativity/artistic expression and heritage preservation?
2. Shall the project maintain/enhance/create appropriate, affordable recreation, leisure and cultural facilities and programs?

3. Shall the project maintain/enhance/create a wide range of opportunities for individuals to contribute to the health and well-being of the community?
4. Shall the project encourage physical activities through appropriate planning and design?
5. Shall the project encourage residents to become and remain physically active?

Individual or Human Capacity Checklist:

1. Shall the project maintain/enhance/create the community's identity that is reflective of the community's diversity?
2. Shall the project contribute to a varied social composition throughout the community?
3. Shall the project create opportunities for the community to be involved in the planning and decision making through public consultation and are community members affected by the decisions included in the decision making process?
4. Shall the project maintain/enhance/create opportunities and places for social interaction throughout the community?
5. Shall the project contribute to a varied social composition throughout the community?
6. Shall the project maintain/enhance/create support and encouragement for community organizations and networks?
7. Is the project appropriate/accessible to community members from varied social, cultural or economic backgrounds?

7.3 Physical/Environmental Sustainability

Regarding the physical/environmental sustainability, the following of *LEED Canada for Neighbourhood Development (ND) is recommended*. LEED ND is an implementation and rating tool that integrates smart growth, sustainable infrastructure, transportation, public health and ecological site development. LEED ND will allow The Town of Carstairs and developers to work closer together to develop communities based on a set of best practices that will guide developers and help them clearly see the kind of developments the Town of Carstairs prefers to see developed.

8. References

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A.C. Rowney & C.R. Macrae, “QUALHYMO Technical Reference Manual”, March 1990.

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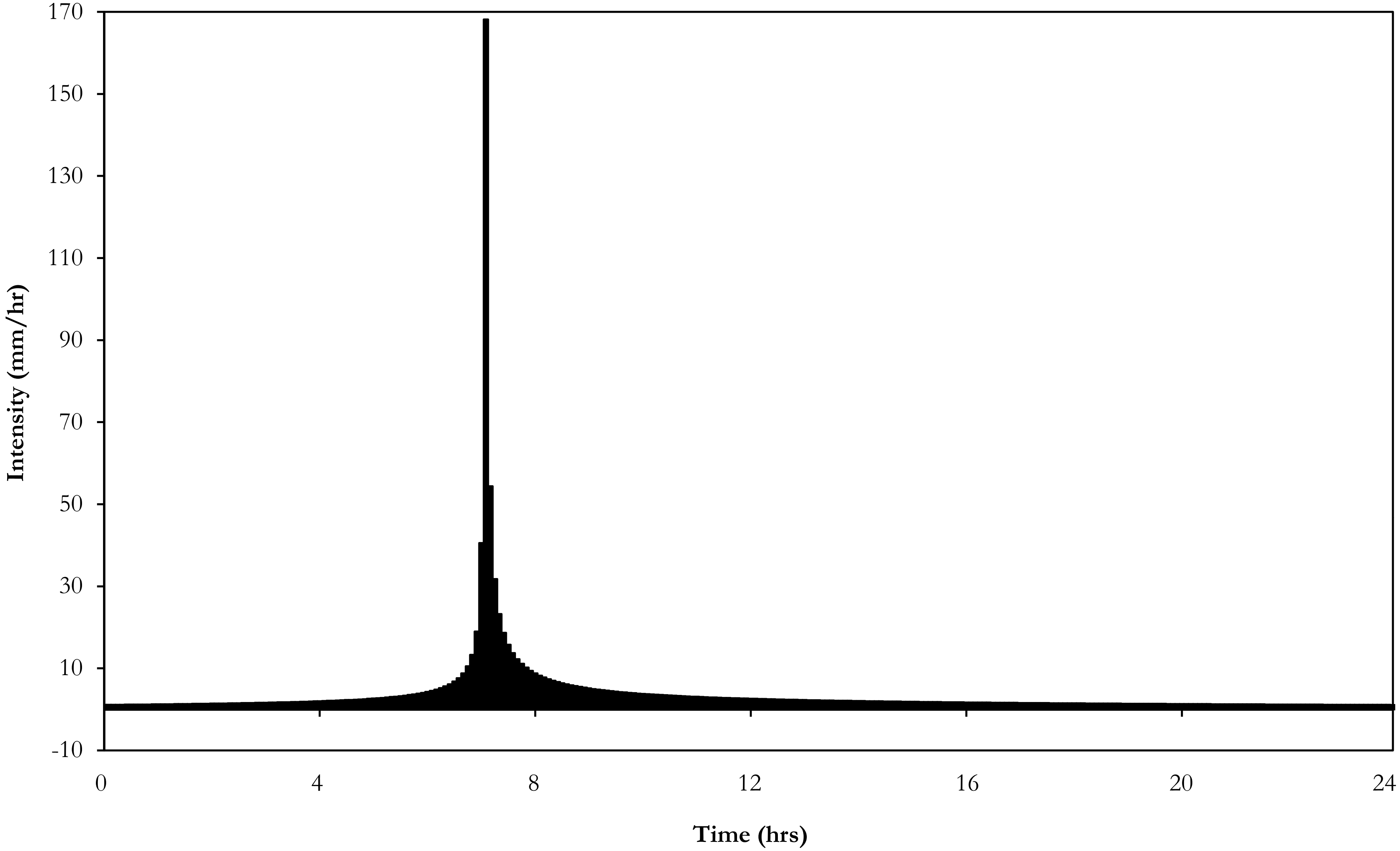
Appendix 1

IDF Curve

- 1:100 City of Calgary Hyetograph

City of Calgary 1:100 year 24-Hour Hyetograph



Appendix 2

SWMHYMO

- Input and Output File

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*#  Company     : AECOM
*#  License #   : 3920701
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                                    [  12.00 , 13.00  ]
                                    [ -1     , -1     ]
                          IDovf=[ 4  ], NHYDovf=[  "OV581" ]
*%-----------------|-----------------------------------------------------------|
*SUBCATCHMENT 15
*
CALIB NASHYD        ID=[ 1 ], NHYD=[   "SUB15"   ], DT=[ 1  ]min, AREA=[  33.5  ](ha),
                    DWF=[ 0 ](cms),  CN/C=[ 65  ], IA=[ 1.5  ](mm),
                    N=[ 3  ], TP=[ 0.98  ]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-----------------------------------------------------------|
ADD HYD             IDsum=[ 2 ], NHYD=[  "OUT15"    ], IDs to add=[ 1+3 ]
*%-----------------|-----------------------------------------------------------
ROUTE CHANNEL       IDout=[ 4 ], NHYD=[   "NDITCH"   ], IDin=[ 2  ],
                    RDT=[  1  ](min),
                    CHLGTH=[    1300    ](m),  CHSLOPE=[ 0.93  ](%),
                                        FPSLOPE=[ 0.93  ](%),
                    SECNUM=[ 1.0  ],       NSEG=[  3  ]
                    ( SEGROUGH, SEGDIST (m))=[  0.05,33 - 0.05,38 - 0.05,76   ] NSEG times
                    ( DISTANCE (m), ELEVATION (m))=[ 0.0  ,  1040.68 ]
                                                   [ 20.0 ,  1039.54 ]
                                                   [ 33.0 ,  1037.61 ]
                                                   [ 38.00 , 1037.61 ]
                                                   [ 53.00 , 1038.01 ]
                                                   [ 76.00 , 1042.40 ]
*%-----------------|----------------------------------------------------------|
*SUBCATCHMENT 16
*
CALIB NASHYD        ID=[ 1 ], NHYD=[   "SUB16"   ], DT=[ 1  ]min, AREA=[  57.0  ](ha),
```

```
                    DWF=[ 0 ](cms),  CN/C=[ 65  ], IA=[ 1.5  ](mm),
                    N=[ 3  ], TP=[ 1.2  ]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-----------------------------------------------------------|
ADD HYD             IDsum=[ 2 ], NHYD=[  "OUT15"    ], IDs to add=[ 1+4 ]
*%-----------------|-----------------------------------------------------------
*************************************************************************************
*************************************************************************************
*SUBCATCHMENT 22
*
CALIB NASHYD        ID=[ 3 ], NHYD=[   "SUB22"   ], DT=[ 1  ]min, AREA=[  19.7  ](ha),
                    DWF=[ 0 ](cms),  CN/C=[ 65  ], IA=[ 1.5  ](mm),
                    N=[ 3  ], TP=[ 1.20  ]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-----------------------------------------------------------|
*SUBCATCHMENT 02
*
CALIB STANDHYD      ID=[ 4 ], NHYD=[   "SUB02"   ], DT=[ 1  ](min), AREA=[  31.8  ](ha),
                    XIMP=[ 0.35  ], TIMP=[ 0.35  ], DWF=[ 0  ](cms), LOSS=[2],
                    SCS curve number CN=[ 75  ],
                    Pervious   surfaces: IAper=[ 3.2  ](mm), SLPP=[  0.4 ](%),
                                         LGP=[ 300  ](m), MNP=[ 0.250  ], SCP=[ 0 ](min),
                    Impervious surfaces: IAimp=[ 0.6  ](mm), SLPI=[ 0.4  ](%),
                                         LGI=[ 500  ](m), MNI=[ 0.015  ], SCI=[ 0 ](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|-----------------------------------------------------------|
ADD HYD             IDsum=[ 5 ], NHYD=[  "22+02"    ], IDs to add=[ 3+4 ]
*%-----------------|-----------------------------------------------------------
*600MM CONCRETE OUTLET SOUTH OF BALL PARK, PONDING IN THE PARK
ROUTE RESERVOIR     IDout=[ 6 ],   NHYD=[   "BALLP"   ],  IDin=[ 5  ],
                    RDT=[  1  ](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0  ,  0.0   ]
                                    [  0.014 , 0.024  ]
                                    [  0.248 , 0.292  ]
                                    [  0.429 , 0.360  ]
                                    [  0.606 , 0.696  ]
                                    [  0.743 , 1.272  ]
                                    [  1.235 , 1.280  ]
                                    [  3.500 , 1.280  ]
                                    [  5.500 , 1.280  ]
                                    [ -1     , -1     ]
                          IDovf=[ 7  ], NHYDovf=[  "OVBALL" ]
*%-----------------|-----------------------------------------------------------|
*SUBCATCHMENT 04
*
CALIB STANDHYD      ID=[ 3 ], NHYD=[   "SUB04"   ], DT=[ 1  ](min), AREA=[  45.9  ](ha),
                    XIMP=[ 0.40  ], TIMP=[ 0.40  ], DWF=[ 0  ](cms), LOSS=[2],
                    SCS curve number CN=[ 75  ],
                    Pervious   surfaces: IAper=[ 3.2  ](mm), SLPP=[  0.4 ](%),
                                         LGP=[ 15  ](m), MNP=[ 0.250  ], SCP=[ 0 ](min),
                    Impervious surfaces: IAimp=[ 0.6  ](mm), SLPI=[ 0.4  ](%),
                                         LGI=[ 700  ](m), MNI=[ 0.015  ], SCI=[ 0 ](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|-----------------------------------------------------------|
ADD HYD             IDsum=[ 4 ], NHYD=[  "BAL04"    ], IDs to add=[ 3+6 ]
*%-----------------|-----------------------------------------------------------
*SUBCATCHMENT 12
*
CALIB NASHYD        ID=[ 5 ], NHYD=[   "SUB12"   ], DT=[ 1  ]min, AREA=[  140.7  ](ha),
                    DWF=[ 0 ](cms),  CN/C=[ 65  ], IA=[ 1.5  ](mm),
                    N=[ 3  ], TP=[ 1.80  ]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-----------------------------------------------------------|
ADD HYD             IDsum=[ 6 ], NHYD=[  "04+12"    ], IDs to add=[ 4+5 ]
*%-----------------|-----------------------------------------------------------
*PONDING BY RODEO GROUND, 600MM CSP CROSSING
ROUTE RESERVOIR     IDout=[ 7 ],   NHYD=[   "RODEO"   ],  IDin=[ 6  ],
                    RDT=[  1  ](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [   0.0  ,  0.0   ]
                                    [  0.014 , 0.215  ]
                                    [  0.350 , 1.417  ]
                                    [  0.429 , 1.719  ]
```

```
                                    [  0.800 , 1.800  ]
                                    [  2.800 , 1.800  ]
                                    [  5.200 , 1.800  ]
                                    [  8.000 , 1.800  ]
                                    [ -1     , -1     ]
                          IDovf=[ 8  ], NHYDovf=[  "OVRODE" ]
*%-----------------|-----------------------------------------------------------|
*SUBCATCHMENT 05
*
CALIB STANDHYD      ID=[ 3 ], NHYD=[   "SUB05"   ], DT=[ 1  ](min), AREA=[  11.7  ](ha),
                    XIMP=[ 0.30  ], TIMP=[ 0.30  ], DWF=[ 0  ](cms), LOSS=[2],
                    SCS curve number CN=[ 75  ],
                    Pervious   surfaces: IAper=[ 3.2  ](mm), SLPP=[  2.0 ](%),
                                         LGP=[ 15  ](m), MNP=[ 0.250  ], SCP=[ 0 ](min),
                    Impervious surfaces: IAimp=[ 0.6  ](mm), SLPI=[ 1.6  ](%),
                                         LGI=[ 200  ](m), MNI=[ 0.015  ], SCI=[ 0 ](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|-----------------------------------------------------------|
*SUBCATCHMENT 13
*
CALIB NASHYD        ID=[ 4 ], NHYD=[   "SUB13"   ], DT=[ 1  ]min, AREA=[  40.8  ](ha),
                    DWF=[ 0 ](cms),  CN/C=[ 65  ], IA=[ 1.5  ](mm),
                    N=[ 3  ], TP=[ 1.50  ]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-----------------------------------------------------------|
ADD HYD             IDsum=[ 5 ], NHYD=[  "O0513"    ], IDs to add=[ 3+4+7 ]
*%-----------------|----------------------------------------------------------
*SUBCATCHMENT 06
*
CALIB STANDHYD      ID=[ 6 ], NHYD=[   "SUB06"   ], DT=[ 1  ](min), AREA=[  21.3  ](ha),
                    XIMP=[ 0.40  ], TIMP=[ 0.40  ], DWF=[ 0  ](cms), LOSS=[2],
                    SCS curve number CN=[ 75  ],
                    Pervious   surfaces: IAper=[ 3.2  ](mm), SLPP=[  2.0 ](%),
                                         LGP=[ 15  ](m), MNP=[ 0.250  ], SCP=[ 0 ](min),
                    Impervious surfaces: IAimp=[ 0.6  ](mm), SLPI=[ 0.4  ](%),
                                         LGI=[ 800  ](m), MNI=[ 0.015  ], SCI=[ 0 ](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|-----------------------------------------------------------|
ADD HYD             IDsum=[ 7 ], NHYD=[  "A06"    ], IDs to add=[ 6+5 ]
*%-----------------|----------------------------------------------------------
*SUBCATCHMENT 14
*
CALIB NASHYD        ID=[ 8 ], NHYD=[   "SUB14"   ], DT=[ 1  ]min, AREA=[  84.6  ](ha),
                    DWF=[ 0 ](cms),  CN/C=[ 65  ], IA=[ 1.5  ](mm),
                    N=[ 3  ], TP=[ 1.7  ]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|---------------------------------------------------------
ADD HYD             IDsum=[ 4 ], NHYD=[  "SDITCH"    ], IDs to add=[ 7+8 ]
*%-----------------|---------------------------------------------------------
ADD HYD             IDsum=[ 5 ], NHYD=[  "N+SDITCH"    ], IDs to add=[ 4+2 ]
*%-----------------|----------------------------------------------------------
ROUTE RESERVOIR     IDout=[ 6 ],   NHYD=[   "Pond01"   ],  IDin=[ 5  ],
                    RDT=[  1  ](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [  0.0   ,  0.0   ]
                                    [  0.0   , 0.6106 ]
                                    [  0.0   , 1.2673 ]
                                    [  0.0   , 1.9714 ]
                                    [  0.0   , 2.7241 ]
                                    [  0.0   , 3.5267 ]
                                    [  0.0   , 4.3805 ]
                                    [  0.0   , 5.2868 ]
                                    [  0.0   , 5.7600 ]
                                    [  0.94  , 6.7474 ]
                                    [  2.59  , 7.7905 ]
                                    [  4.64  , 8.8906 ]
                                    [  6.94  , 10.0489]
                                    [  8.16  , 10.6502]
                                    [  9.41  , 11.2667]
                                    [ -1     , -1     ]
                          IDovf=[ 7  ], NHYDovf=[  "OVer01" ]
*%-----------------|-----------------------------------------------------------|
*************************************************************************************
*************************************************************************************
*SUBCATCHMENT 08
```

```
*
CALIB NASHYD        ID=[ 1 ], NHYD=[   "SUB08"   ], DT=[ 1  ]min, AREA=[  162.3  ](ha),
                    DWF=[ 0 ](cms),  CN/C=[ 65  ], IA=[ 1.5  ](mm),
                    N=[ 3  ], TP=[ 1.85  ]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-----------------------------------------------------------|
*SUBCATCHMENT 11
*
CALIB NASHYD        ID=[ 2 ], NHYD=[   "SUB11"   ], DT=[ 1  ]min, AREA=[  189  ](ha),
                    DWF=[ 0 ](cms),  CN/C=[ 65  ], IA=[ 1.5  ](mm),
                    N=[ 3  ], TP=[ 2.22  ]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-----------------------------------------------------------|
ADD HYD             IDsum=[ 3 ], NHYD=[  "11+08"    ], IDs to add=[ 1+2 ]
*%-----------------|-----------------------------------------------------------
*SUBCATCHMENT 19
*
CALIB NASHYD        ID=[ 4 ], NHYD=[   "SUB19"   ], DT=[ 1  ]min, AREA=[  437.3  ](ha),
                    DWF=[ 0 ](cms),  CN/C=[ 65  ], IA=[ 1.5  ](mm),
                    N=[ 3  ], TP=[ 2.57  ]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-----------------------------------------------------------|
ADD HYD             IDsum=[ 5 ], NHYD=[  "11+19"    ], IDs to add=[ 4+3 ]
*%-----------------|-----------------------------------------------------------
*SUBCATCHMENT 20
*
CALIB NASHYD        ID=[ 6 ], NHYD=[   "SUB20"   ], DT=[ 1  ]min, AREA=[  207.3  ](ha),
                    DWF=[ 0 ](cms),  CN/C=[ 65  ], IA=[ 1.5  ](mm),
                    N=[ 3  ], TP=[ 2.08  ]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%----------------|-----------------------------------------------------------|
ADD HYD             IDsum=[ 7 ], NHYD=[  "20+19"    ], IDs to add=[ 6+5 ]
*%-----------------|-----------------------------------------------------------
*************************************************************************************
*************************************************************************************
*SUBCATCHMENT 17
*
CALIB NASHYD        ID=[ 1 ], NHYD=[   "SUB17"   ], DT=[ 1  ]min, AREA=[  114.6  ](ha),
                    DWF=[ 0 ](cms),  CN/C=[ 65  ], IA=[ 1.5  ](mm),
                    N=[ 3  ], TP=[ 1.48  ]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-----------------------------------------------------------|
FINISH
```

SWMHYMO OUTPUT

```
==============================================================================

 SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    888  =========
 S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  8   8 =========
 SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  8   8 Ver.  4.0
     S   W W   M   M  H   H    Y    M   M  O   O      9999   888  Sept 1998
 SSSSS   W W   M   M  H   H    Y    M   M   OOO          9  8   8 =========
                                                     9   9  8   8 # 3920701
      StormWater Management HYdrologic Model          999    888  =========

 ***************************************************************************
 *************************** SWMHYMO-98  Ver/4.0 ***************************
 *******  A single event and continuous hydrologic simulation model  *******
 *******     based on the principles of HYMO and its successors      *******
 *******                 OTTHYMO-83 and OTTHYMO-89.                  *******
 ***************************************************************************
 ******* Distributed by:  J.F. Sabourin and Associates Inc.          *******
 *******                  Ottawa,  Ontario: (613) 727-5199           *******
 *******                  Gatineau, Quebec: (819) 243-6858           *******
 *******                  E-Mail: swmhymo@jfsa.Com                   *******
 ***************************************************************************

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++ Licensed user: Reid Crowther & Partners Ltd                 +++++++
 +++++++                Edmonton              SERIAL#:3920701        +++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ***************************************************************************
 *******           ++++++ PROGRAM ARRAY DIMENSIONS ++++++            *******
 *******           Maximum value for ID numbers  :     10            *******
 *******           Max. number of rainfall points:  15000            *******
 *******           Max. number of flow points    :  15000            *******
 ***************************************************************************


 ********************   D E T A I L E D   O U T P U T   ********************
 ***************************************************************************
 *       DATE: 2010-06-18     TIME: 18:37:06     RUN COUNTER: 000794       *
 ***************************************************************************
 * Input   filename: H:\data\CARSTA~1\CARSTA~1.DAT                         *
 * Output  filename: H:\data\CARSTA~1\CARSTA~1.out                         *
 * Summary filename: H:\data\CARSTA~1\CARSTA~1.sum                         *
 * User comments:                                                          *
 * 1:______________________________________________________________________*
 * 2:______________________________________________________________________*
 * 3:______________________________________________________________________*
 ***************************************************************************

--------------------------------------------------------------------------------
001:0001------------------------------------------------------------------------
*#******************************************************************************
*#  Project Name: [Carstairs Master Servicing Study]    Project Number: [ 601487
*#  Date        : 06-11-2010
*#  Modeller    : [ Abdelqader A. ]
*#  Company     : AECOM
*#  License #   : 3920701
*#******************************************************************************
--------------------
| START            |  Project  dir.: H:\data\CARSTA~1\
--------------------  Rainfall dir.: H:\data\CARSTA~1\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
--------------------------------------------------------------------------------
001:0002------------------------------------------------------------------------
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 663.100
| Ptotal= 89.67 mm |                          B=   1.870
--------------------                          C=    .712
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 24.00 hrs
                        Storm time step    =  5.00 min
```

```
          Time to peak ratio =   .30

TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
 .08   1.094 |  6.08   4.259 | 12.08   2.597 | 18.08   1.467
 .17   1.103 |  6.17   4.519 | 12.17   2.566 | 18.17   1.460
 .25   1.113 |  6.25   4.821 | 12.25   2.536 | 18.25   1.452
 .33   1.122 |  6.33   5.176 | 12.33   2.506 | 18.33   1.444
 .42   1.132 |  6.42   5.601 | 12.42   2.478 | 18.42   1.436
 .50   1.143 |  6.50   6.120 | 12.50   2.450 | 18.50   1.429
 .58   1.153 |  6.58   6.773 | 12.58   2.423 | 18.58   1.421
 .67   1.163 |  6.67   7.624 | 12.67   2.396 | 18.67   1.414
 .75   1.174 |  6.75   8.785 | 12.75   2.371 | 18.75   1.407
 .83   1.185 |  6.83  10.488 | 12.83   2.346 | 18.83   1.399
 .92   1.197 |  6.92  13.283 | 12.92   2.321 | 18.92   1.392
1.00   1.208 |  7.00  18.961 | 13.00   2.297 | 19.00   1.385
1.08   1.220 |  7.08  40.516 | 13.08   2.274 | 19.08   1.378
1.17   1.232 |  7.17 168.138 | 13.17   2.252 | 19.17   1.372
1.25   1.245 |  7.25  54.372 | 13.25   2.229 | 19.25   1.365
1.33   1.257 |  7.33  31.748 | 13.33   2.208 | 19.33   1.358
1.42   1.270 |  7.42  23.236 | 13.42   2.187 | 19.42   1.352
1.50   1.284 |  7.50  18.660 | 13.50   2.166 | 19.50   1.345
1.58   1.297 |  7.58  15.763 | 13.58   2.146 | 19.58   1.339
1.67   1.311 |  7.67  13.746 | 13.67   2.126 | 19.67   1.332
1.75   1.326 |  7.75  12.251 | 13.75   2.107 | 19.75   1.326
1.83   1.341 |  7.83  11.093 | 13.83   2.088 | 19.83   1.320
1.92   1.356 |  7.92  10.166 | 13.92   2.069 | 19.92   1.313
2.00   1.372 |  8.00   9.405 | 14.00   2.051 | 20.00   1.307
2.08   1.388 |  8.08   8.768 | 14.08   2.034 | 20.08   1.301
2.17   1.404 |  8.17   8.225 | 14.17   2.016 | 20.17   1.295
2.25   1.421 |  8.25   7.756 | 14.25   1.999 | 20.25   1.289
2.33   1.439 |  8.33   7.346 | 14.33   1.983 | 20.33   1.284
2.42   1.457 |  8.42   6.985 | 14.42   1.966 | 20.42   1.278
2.50   1.476 |  8.50   6.664 | 14.50   1.950 | 20.50   1.272
2.58   1.495 |  8.58   6.376 | 14.58   1.935 | 20.58   1.266
2.67   1.515 |  8.67   6.116 | 14.67   1.919 | 20.67   1.261
2.75   1.535 |  8.75   5.880 | 14.75   1.904 | 20.75   1.255
2.83   1.556 |  8.83   5.665 | 14.83   1.889 | 20.83   1.250
2.92   1.578 |  8.92   5.468 | 14.92   1.875 | 20.92   1.244
3.00   1.601 |  9.00   5.287 | 15.00   1.860 | 21.00   1.239
3.08   1.624 |  9.08   5.119 | 15.08   1.846 | 21.08   1.234
3.17   1.648 |  9.17   4.964 | 15.17   1.833 | 21.17   1.229
3.25   1.674 |  9.25   4.819 | 15.25   1.819 | 21.25   1.223
3.33   1.700 |  9.33   4.684 | 15.33   1.806 | 21.33   1.218
3.42   1.727 |  9.42   4.558 | 15.42   1.793 | 21.42   1.213
3.50   1.755 |  9.50   4.440 | 15.50   1.780 | 21.50   1.208
3.58   1.784 |  9.58   4.329 | 15.58   1.767 | 21.58   1.203
3.67   1.815 |  9.67   4.224 | 15.67   1.755 | 21.67   1.198
3.75   1.846 |  9.75   4.125 | 15.75   1.743 | 21.75   1.193
3.83   1.880 |  9.83   4.032 | 15.83   1.731 | 21.83   1.188
3.92   1.914 |  9.92   3.943 | 15.92   1.719 | 21.92   1.184
4.00   1.950 | 10.00   3.859 | 16.00   1.707 | 22.00   1.179
4.08   1.988 | 10.08   3.780 | 16.08   1.696 | 22.08   1.174
4.17   2.028 | 10.17   3.704 | 16.17   1.685 | 22.17   1.170
4.25   2.070 | 10.25   3.631 | 16.25   1.673 | 22.25   1.165
4.33   2.113 | 10.33   3.562 | 16.33   1.663 | 22.33   1.160
4.42   2.159 | 10.42   3.496 | 16.42   1.652 | 22.42   1.156
4.50   2.208 | 10.50   3.433 | 16.50   1.641 | 22.50   1.151
4.58   2.259 | 10.58   3.373 | 16.58   1.631 | 22.58   1.147
4.67   2.313 | 10.67   3.315 | 16.67   1.621 | 22.67   1.143
4.75   2.371 | 10.75   3.259 | 16.75   1.611 | 22.75   1.138
4.83   2.432 | 10.83   3.206 | 16.83   1.601 | 22.83   1.134
4.92   2.497 | 10.92   3.154 | 16.92   1.591 | 22.92   1.130
5.00   2.566 | 11.00   3.105 | 17.00   1.581 | 23.00   1.125
5.08   2.640 | 11.08   3.057 | 17.08   1.572 | 23.08   1.121
5.17   2.719 | 11.17   3.011 | 17.17   1.562 | 23.17   1.117
5.25   2.805 | 11.25   2.967 | 17.25   1.553 | 23.25   1.113
5.33   2.897 | 11.33   2.924 | 17.33   1.544 | 23.33   1.109
5.42   2.997 | 11.42   2.883 | 17.42   1.535 | 23.42   1.105
5.50   3.105 | 11.50   2.843 | 17.50   1.526 | 23.50   1.101
5.58   3.224 | 11.58   2.805 | 17.58   1.517 | 23.58   1.097
5.67   3.354 | 11.67   2.767 | 17.67   1.509 | 23.67   1.093
5.75   3.497 | 11.75   2.731 | 17.75   1.500 | 23.75   1.089
5.83   3.656 | 11.83   2.696 | 17.83   1.492 | 23.83   1.085
5.92   3.833 | 11.92   2.662 | 17.92   1.484 | 23.92   1.081
6.00   4.033 | 12.00   2.629 | 18.00   1.476 | 24.00   1.077
```

```
--------------------------------------------------------------------------------
001:0003------------------------------------------------------------------------
*SUBCATCHMENT 07
*
----------------------
| CALIB NASHYD       |   Area    (ha)=  350.70   Curve Number   (CN)=65.00
| 01:SUB07  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   2.300

     Unit Hyd Qpeak  (cms)=    5.824

     PEAK FLOW       (cms)=    3.875 (i)
     TIME TO PEAK    (hrs)=   10.233
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0004------------------------------------------------------------------------
*SUBCATCHMENT 10
*
----------------------
| CALIB NASHYD       |   Area    (ha)=  105.60   Curve Number   (CN)=65.00
| 02:SUB10  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   2.000

     Unit Hyd Qpeak  (cms)=    2.017

     PEAK FLOW       (cms)=    1.281 (i)
     TIME TO PEAK    (hrs)=    9.817
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0005------------------------------------------------------------------------
--------------------
| ADD HYD (07+10 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------             (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:SUB07    350.70    3.875   10.23  34.56    .000
                +ID2 02:SUB10    105.60    1.281    9.82  34.56    .000
                 ===================================================
                 SUM 03:07+10    456.30    5.138   10.12  34.56    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0006------------------------------------------------------------------------
*SUBCATCHMENT 21
*
----------------------
| CALIB NASHYD       |   Area    (ha)=   77.60   Curve Number   (CN)=65.00
| 04:SUB21  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   1.300

     Unit Hyd Qpeak  (cms)=    2.280

     PEAK FLOW       (cms)=    1.255 (i)
     TIME TO PEAK    (hrs)=    8.850
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0007------------------------------------------------------------------------
*SUBCATCHMENT 01
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=   16.80
```

```
| 01:SUB01  DT= 1.00 |   Total Imp(%)=   40.00   Dir. Conn.(%)=   40.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       6.72        10.08
     Dep. Storage     (mm)=        .60         3.20
     Average Slope     (%)=        .40          .40
     Length            (m)=     450.00        50.00
     Mannings n           =       .015         .250

     Max.eff.Inten.(mm/hr)=     125.48        24.56
                over (min)        8.00        31.00
     Storage Coeff.  (min)=       8.25 (ii)   31.18 (ii)
     Unit Hyd. Tpeak (min)=       8.00        31.00
     Unit Hyd. peak  (cms)=        .14          .04
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.52          .42          1.650 (iii)
     TIME TO PEAK    (hrs)=       7.27         7.68          7.267
     RUNOFF VOLUME    (mm)=      89.05        43.65         61.840
     TOTAL RAINFALL   (mm)=      89.67        89.67         89.667
     RUNOFF COEFFICIENT   =        .99          .49           .690

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0008------------------------------------------------------------------------
--------------------
| ADD HYD (21+01 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------               (ha)     (cms)   (hrs)   (mm)   (cms)
                ID1 01:SUB01     16.80    1.650    7.27  61.84    .000
               +ID2 04:SUB21     77.60    1.255    8.85  34.56    .000
                =======================================================
                SUM 02:21+01     94.40    1.804    7.27  39.41    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0009------------------------------------------------------------------------
*SUBCATCHMENT 03
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=   41.50
| 01:SUB03  DT= 1.00 |   Total Imp(%)=   40.00   Dir. Conn.(%)=   40.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      16.60        24.90
     Dep. Storage     (mm)=        .60         3.20
     Average Slope     (%)=        .40         2.00
     Length            (m)=     800.00        15.00
     Mannings n           =       .015         .250

     Max.eff.Inten.(mm/hr)=      94.93        32.86
                over (min)       13.00        19.00
     Storage Coeff.  (min)=      13.03 (ii)   19.14 (ii)
     Unit Hyd. Tpeak (min)=      13.00        19.00
     Unit Hyd. peak  (cms)=        .09          .06
                                                          *TOTALS*
     PEAK FLOW       (cms)=       2.86         1.41          3.979 (iii)
     TIME TO PEAK    (hrs)=       7.35         7.47          7.367
     RUNOFF VOLUME    (mm)=      89.04        43.67         61.840
     TOTAL RAINFALL   (mm)=      89.67        89.67         89.667
     RUNOFF COEFFICIENT   =        .99          .49           .690

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0010------------------------------------------------------------------------
--------------------
| ADD HYD (03+01 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
```

```
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:SUB03     41.50    3.979    7.37  61.84    .000
                +ID2 02:21+01     94.40    1.804    7.27  39.41    .000
                 ======================================================
                 SUM 04:03+01    135.90    5.572    7.37  46.26    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0011------------------------------------------------------------------------
*WEST OF SECONDARY HIGHWAY 580 PONDING, 1000MM CSP CROSSING
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>04:(03+01 )   |
| OUT<01:(WE580 )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |    1.380  .8270E+00
                            .100  .7100E-01   |    1.820  .1693E+01
                            .300  .1650E+00   |    2.060  .2486E+01
                            .670  .2850E+00   |    2.170  .2955E+01
                            .970  .4340E+00   |    3.500  .3000E+01
                           1.190  .6130E+00   |    5.800  .3000E+01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >04: (03+01 )     135.90     5.572     7.367     46.262
     OUTFLOW<01: (WE580 )     135.90     1.711     9.683     46.262
    OVERFLOW<02: (OV580 )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   30.714
                   TIME SHIFT OF PEAK FLOW         (min)=   139.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1479E+01

--------------------------------------------------------------------------------
001:0012------------------------------------------------------------------------
--------------------
| ADD HYD (OUT10 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:WE580    135.90    1.711    9.68  46.26    .000
                +ID2 03:07+10    456.30    5.138   10.12  34.56    .000
                 ======================================================
                 SUM 04:OUT10    592.20    6.841   10.08  37.24    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0013------------------------------------------------------------------------
--------------------
| ROUTE CHANNEL    |     Routing time step (min) =  1.00
|  IN> 04:OUT10    |     Number of SEGMENTS =  2
| OUT< 05:NDITCH   |     Slopes (%), CHANNEL=1.38   FLOODPLAIN=1.38
--------------------                 LENGTH =  700.00    (m)

               <------ DATA FOR SECTION (   1.0) ------>
               Distance      Elevation       Manning
                    .00       1053.04         .0500
                   6.00       1051.38     .0500 / .0500
                  12.40       1053.87         .0500

   <---------------------------- TRAVEL TIME TABLE --------------------------->
    DEPTH    ELEV   X-VOLUME  S-VOLUME  FLOW RATE  VELOCITY  TRAV.TIME   D x V
      (m)      (m)   (cu.m.)   (cu.m.)      (cms)     (m/s)     (min)   (m2/s)
     .087 1051.467  .165E+02  .747E-01       .007      .282     41.41     .025
     .175 1051.555  .661E+02  .598E+00       .042      .447     26.09     .078
     .262 1051.642  .149E+03  .202E+01       .124      .586     19.91     .154
     .349 1051.729  .264E+03  .478E+01       .268      .710     16.43     .248
     .437 1051.817  .413E+03  .934E+01       .486      .824     14.16     .360
     .524 1051.904  .595E+03  .161E+02       .790      .930     12.54     .488
     .612 1051.992  .810E+03  .256E+02      1.192     1.031     11.32     .630
     .699 1052.079  .106E+04  .382E+02      1.702     1.127     10.35     .788
```

```
      .786 1052.166  .134E+04  .545E+02      2.330     1.219      9.57     .958
      .874 1052.254  .165E+04  .747E+02      3.086     1.308      8.92    1.142
      .961 1052.341  .200E+04  .994E+02      3.979     1.393      8.37    1.339
     1.048 1052.428  .238E+04  .129E+03      5.019     1.477      7.90    1.548
     1.136 1052.516  .279E+04  .164E+03      6.213     1.558      7.49    1.769
     1.223 1052.603  .324E+04  .205E+03      7.570     1.637      7.13    2.002
     1.310 1052.690  .372E+04  .252E+03      9.100     1.714      6.81    2.246
     1.398 1052.778  .423E+04  .306E+03     10.808     1.789      6.52    2.501
     1.485 1052.865  .477E+04  .367E+03     12.705     1.863      6.26    2.766
     1.573 1052.953  .535E+04  .436E+03     14.797     1.935      6.03    3.043
     1.660 1053.040  .596E+04  .512E+03     17.092     2.006      5.82    3.330

 X-VOLUME= Total X-Section volume over given CHANNEL LENGTH at specified DEPTH.
 S-VOLUME= Volume that can be stored in channel at specified ELEVATION.

                                     <---- hydrograph ---->   <-pipe / channel->
                               AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                               (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 4:OUT10      592.20    6.841   10.08 37.244     1.176     1.593
   OUTFLOW: ID= 5:NDITCH     592.20    6.834   10.18 37.244     1.174     1.591


--------------------------------------------------------------------------------
001:0014------------------------------------------------------------------------
*SUBCATCHMENT 18
*
----------------------
| CALIB NASHYD       |   Area    (ha)=   84.40   Curve Number   (CN)=65.00
| 01:SUB18  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   1.700

     Unit Hyd Qpeak  (cms)=    1.896

     PEAK FLOW       (cms)=    1.141 (i)
     TIME TO PEAK    (hrs)=    9.400
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0015------------------------------------------------------------------------
--------------------
| ADD HYD (CH+18 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:SUB18     84.40    1.141    9.40  34.56    .000
                +ID2 05:NDITCH   592.20    6.834   10.18  37.24    .000
                 ===================================================
                 SUM 02:CH+18    676.60    7.904   10.00  36.91    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0016------------------------------------------------------------------------
*NORTH OF SECONDARY HIGHWAY 581 PONDING, 900MM STEEL AND 1200MM CSP CROSSINGS
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(CH+18 )   |
| OUT<03:(NO581 )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |    4.357  .5940E+01
                            .079  .3000E-01   |    5.348  .7621E+01
                            .392  .2010E+00   |    6.400  .1172E+02
                            .550  .2178E+01   |    7.500  .1300E+02
                           1.964  .3235E+01   |   10.900  .1300E+02
                           3.761  .4483E+01   |   12.000  .1300E+02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (CH+18 )     676.60     7.904    10.000     36.909
     OUTFLOW<03: (NO581 )     676.60     4.979    13.450     36.909
    OVERFLOW<04: (OV581 )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
```

```
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   62.990
                   TIME SHIFT OF PEAK FLOW         (min)=   207.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.6995E+01

--------------------------------------------------------------------------------
001:0017------------------------------------------------------------------------
*SUBCATCHMENT 15
*
----------------------
| CALIB NASHYD       |   Area    (ha)=   33.50   Curve Number   (CN)=65.00
| 01:SUB15  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .980

     Unit Hyd Qpeak  (cms)=    1.306

     PEAK FLOW       (cms)=     .654 (i)
     TIME TO PEAK    (hrs)=    8.417
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0018------------------------------------------------------------------------
--------------------
| ADD HYD (OUT15 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                ID1 01:SUB15     33.50      .654    8.42  34.56    .000
               +ID2 03:NO581    676.60     4.979   13.45  36.91    .000
                =======================================================
                SUM 02:OUT15    710.10     5.118   13.35  36.80    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0019------------------------------------------------------------------------
--------------------
| ROUTE CHANNEL    |     Routing time step (min) =  1.00
|  IN> 02:OUT15    |     Number of SEGMENTS =  3
| OUT< 04:NDITCH   |     Slopes (%), CHANNEL= .93   FLOODPLAIN= .93
--------------------                 LENGTH = 1300.00    (m)

               <------ DATA FOR SECTION (   1.0) ------>
               Distance      Elevation       Manning
                   .00        1040.68         .0500
                 20.00        1039.54         .0500
                 33.00        1037.61     .0500 / .0500
                 38.00        1037.61     .0500 / .0500
                 53.00        1038.01         .0500
                 76.00        1042.40         .0500

   <---------------------------- TRAVEL TIME TABLE --------------------------->
    DEPTH    ELEV   X-VOLUME  S-VOLUME  FLOW RATE  VELOCITY  TRAV.TIME   D x V
      (m)      (m)  (cu.m.)   (cu.m.)      (cms)     (m/s)     (min)   (m2/s)
     .162 1037.771  .180E+04  .120E+02       .670      .484     44.79     .078
     .323 1037.933  .510E+04  .682E+02      2.787      .710     30.51     .229
     .485 1038.095  .975E+04  .196E+03      6.991      .932     23.25     .452
     .646 1038.256  .149E+05  .399E+03     13.337     1.161     18.67     .750
     .808 1038.418  .205E+05  .686E+03     21.513     1.363     15.90    1.101
     .969 1038.579  .265E+05  .106E+04     31.493     1.544     14.03    1.496
    1.131 1038.741  .329E+05  .154E+04     43.282     1.709     12.68    1.933
    1.292 1038.902  .397E+05  .212E+04     56.901     1.862     11.64    2.406
    1.454 1039.064  .469E+05  .282E+04     72.380     2.004     10.81    2.915
    1.616 1039.226  .546E+05  .365E+04     89.759     2.139     10.13    3.455
    1.777 1039.387  .626E+05  .460E+04    109.080     2.266      9.56    4.026
    1.939 1039.549  .710E+05  .569E+04    130.277     2.385      9.09    4.623
    2.100 1039.710  .801E+05  .695E+04    151.936     2.467      8.78    5.181
    2.262 1039.872  .899E+05  .841E+04    176.314     2.550      8.50    5.768
    2.423 1040.033  .100E+06  .101E+05    203.442     2.632      8.23    6.379
    2.585 1040.195  .112E+06  .120E+05    233.398     2.713      7.99    7.013
    2.746 1040.356  .124E+06  .141E+05    266.279     2.792      7.76    7.669
```

```
    2.908 1040.518  .137E+06  .165E+05    302.196     2.870      7.55    8.347
    3.070 1040.680  .151E+06  .191E+05    341.263     2.947      7.35    9.045

 X-VOLUME= Total X-Section volume over given CHANNEL LENGTH at specified DEPTH.
 S-VOLUME= Volume that can be stored in channel at specified ELEVATION.

                                   <---- hydrograph ---->   <-pipe / channel->
                             AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                             (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 2:OUT15     710.10    5.118   13.35 36.798      .413      .818
   OUTFLOW: ID= 4:NDITCH    710.10    5.105   13.65 36.798      .411      .816


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001:0020------------------------------------------------------------------------
*SUBCATCHMENT 16
*
----------------------
| CALIB NASHYD       |   Area    (ha)=   57.00   Curve Number   (CN)=65.00
| 01:SUB16  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   1.200

     Unit Hyd Qpeak  (cms)=    1.814

     PEAK FLOW       (cms)=     .973 (i)
     TIME TO PEAK    (hrs)=    8.717
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0021------------------------------------------------------------------------
--------------------
| ADD HYD (OUT15 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:SUB16     57.00     .973    8.72  34.56    .000
                +ID2 04:NDITCH   710.10    5.105   13.65  36.80    .000
                 ==================================================
                 SUM 02:OUT15    767.10    5.352   13.38  36.63    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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001:0022------------------------------------------------------------------------
*********************************************************************************
*********************************************************************************
*SUBCATCHMENT 22
*
----------------------
| CALIB NASHYD       |   Area    (ha)=   19.70   Curve Number   (CN)=65.00
| 03:SUB22  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   1.200

     Unit Hyd Qpeak  (cms)=     .627

     PEAK FLOW       (cms)=     .336 (i)
     TIME TO PEAK    (hrs)=    8.717
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0023------------------------------------------------------------------------
*SUBCATCHMENT 02
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=   31.80
| 04:SUB02  DT= 1.00 |   Total Imp(%)=   35.00   Dir. Conn.(%)=   35.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      11.13        20.67
     Dep. Storage     (mm)=        .60         3.20
```

```
     Average Slope     (%)=        .40          .40
     Length            (m)=     500.00       300.00
     Mannings n           =       .015         .250

     Max.eff.Inten.(mm/hr)=     117.58        70.05
                over (min)        9.00        53.00
     Storage Coeff.  (min)=       9.02 (ii)   53.20 (ii)
     Unit Hyd. Tpeak (min)=       9.00        53.00
     Unit Hyd. peak  (cms)=        .13          .02
                                                           *TOTALS*
     PEAK FLOW       (cms)=       2.38          .60          2.506 (iii)
     TIME TO PEAK    (hrs)=       7.28         8.08          7.283
     RUNOFF VOLUME    (mm)=      89.04        43.63         59.571
     TOTAL RAINFALL   (mm)=      89.67        89.67         89.667
     RUNOFF COEFFICIENT   =        .99          .49           .664

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.

     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0024------------------------------------------------------------------------
--------------------
| ADD HYD (22+02 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 03:SUB22     19.70      .336    8.72  34.56    .000
                +ID2 04:SUB02     31.80     2.506    7.28  59.57    .000
                 ======================================================
                 SUM 05:22+02     51.50     2.554    7.28  50.00    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0025------------------------------------------------------------------------
*600MM CONCRETE OUTLET SOUTH OF BALL PARK, PONDING IN THE PARK
--------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(22+02 )   |
| OUT<06:(BALLP )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .743  .1272E+01
                            .014  .2400E-01   |    1.235  .1280E+01
                            .248  .2920E+00   |    3.500  .1280E+01
                            .429  .3600E+00   |    5.500  .1280E+01
                            .606  .6960E+00   |     .000  .0000E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >05: (22+02 )      51.50     2.554     7.283     50.003
     OUTFLOW<06: (BALLP )      51.50      .623    10.033     50.002
    OVERFLOW<07: (OVBALL)        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   24.380
                   TIME SHIFT OF PEAK FLOW         (min)=   165.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.7662E+00

--------------------------------------------------------------------------------
001:0026------------------------------------------------------------------------
*SUBCATCHMENT 04
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=   45.90
| 03:SUB04  DT= 1.00 |   Total Imp(%)=   40.00   Dir. Conn.(%)=   40.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      18.36        27.54
     Dep. Storage     (mm)=        .60         3.20
```

```
     Average Slope     (%)=        .40          .40
     Length            (m)=     700.00        15.00
     Mannings n           =       .015         .250

     Max.eff.Inten.(mm/hr)=      99.47        30.12
                over (min)       12.00        22.00
     Storage Coeff.  (min)=      11.80 (ii)   22.06 (ii)
     Unit Hyd. Tpeak (min)=      12.00        22.00
     Unit Hyd. peak  (cms)=        .10          .05
                                                            *TOTALS*
     PEAK FLOW       (cms)=       3.35         1.42           4.252 (iii)
     TIME TO PEAK    (hrs)=       7.33         7.52           7.350
     RUNOFF VOLUME    (mm)=      89.04        43.67          61.839
     TOTAL RAINFALL   (mm)=      89.67        89.67          89.667
     RUNOFF COEFFICIENT   =        .99          .49            .690

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0027------------------------------------------------------------------------
--------------------
| ADD HYD (BAL04 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 03:SUB04     45.90    4.252    7.35  61.84    .000
                +ID2 06:BALLP     51.50     .623   10.03  50.00    .000
                 ======================================================
                 SUM 04:BAL04     97.40    4.508    7.37  55.58    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0028------------------------------------------------------------------------
*SUBCATCHMENT 12
*
----------------------
| CALIB NASHYD       |   Area    (ha)=  140.70   Curve Number   (CN)=65.00
| 05:SUB12  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   1.800

     Unit Hyd Qpeak  (cms)=    2.986

     PEAK FLOW       (cms)=    1.831 (i)
     TIME TO PEAK    (hrs)=    9.533
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0029------------------------------------------------------------------------
--------------------
| ADD HYD (04+12 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 04:BAL04     97.40    4.508    7.37  55.58    .000
                +ID2 05:SUB12    140.70    1.831    9.53  34.56    .000
                 ======================================================
                 SUM 06:04+12    238.10    4.744    7.40  43.16    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0030------------------------------------------------------------------------
*PONDING BY RODEO GROUND, 600MM CSP CROSSING
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>06:(04+12 )   |
| OUT<07:(RODEO )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .800  .1800E+01
                            .014  .2150E+00   |    2.800  .1800E+01
```

```
                            .350  .1417E+01   |    5.200  .1800E+01
                            .429  .1719E+01   |    8.000  .1800E+01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >06: (04+12 )     238.10     4.744     7.400     43.158
     OUTFLOW<07: (RODEO )     238.10     3.595     9.067     43.147
    OVERFLOW<08: (OVRODE)        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   75.790
                   TIME SHIFT OF PEAK FLOW         (min)=   100.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1802E+01

--------------------------------------------------------------------------------
001:0031------------------------------------------------------------------------
*SUBCATCHMENT 05
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=   11.70
| 03:SUB05  DT= 1.00 |   Total Imp(%)=   30.00   Dir. Conn.(%)=   30.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.51         8.19
     Dep. Storage     (mm)=        .60         3.20
     Average Slope     (%)=       1.60         2.00
     Length            (m)=     200.00        15.00
     Mannings n           =       .015         .250

     Max.eff.Inten.(mm/hr)=     168.14        53.92
                over (min)       3.00         8.00
     Storage Coeff.  (min)=       2.98 (ii)    7.99 (ii)
     Unit Hyd. Tpeak (min)=       3.00         8.00
     Unit Hyd. peak  (cms)=        .38          .14
                                                            *TOTALS*
     PEAK FLOW       (cms)=       1.30          .78          1.765 (iii)
     TIME TO PEAK    (hrs)=       7.18         7.27          7.183
     RUNOFF VOLUME    (mm)=      89.06        43.68         57.302
     TOTAL RAINFALL   (mm)=      89.67        89.67         89.667
     RUNOFF COEFFICIENT   =        .99          .49           .639

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0032------------------------------------------------------------------------
*SUBCATCHMENT 13
*
----------------------
| CALIB NASHYD       |   Area    (ha)=   40.80   Curve Number   (CN)=65.00
| 04:SUB13  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   1.500

     Unit Hyd Qpeak  (cms)=    1.039

     PEAK FLOW       (cms)=     .600 (i)
     TIME TO PEAK    (hrs)=    9.133
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0033------------------------------------------------------------------------
--------------------
| ADD HYD (O0513 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 03:SUB05     11.70    1.765    7.18  57.30    .000
```

```
                +ID2 04:SUB13     40.80     .600    9.13  34.56    .000
                +ID3 07:RODEO    238.10    3.595    9.07  43.15    .000
                 ====================================================
                 SUM 05:O0513    290.60    4.326    9.03  42.51    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0034------------------------------------------------------------------------
*SUBCATCHMENT 06
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=   21.30
| 06:SUB06  DT= 1.00 |   Total Imp(%)=   40.00   Dir. Conn.(%)=   40.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       8.52        12.78
     Dep. Storage     (mm)=        .60         3.20
     Average Slope     (%)=        .40         2.00
     Length            (m)=     800.00        15.00
     Mannings n           =       .015         .250

     Max.eff.Inten.(mm/hr)=      94.93        32.86
                over (min)       13.00        19.00
     Storage Coeff.  (min)=      13.03 (ii)   19.14 (ii)
     Unit Hyd. Tpeak (min)=      13.00        19.00
     Unit Hyd. peak  (cms)=        .09          .06
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.47          .72          2.042 (iii)
     TIME TO PEAK    (hrs)=       7.35         7.47          7.367
     RUNOFF VOLUME    (mm)=      89.04        43.67         61.840
     TOTAL RAINFALL   (mm)=      89.67        89.67         89.667
     RUNOFF COEFFICIENT   =        .99          .49           .690

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0035------------------------------------------------------------------------
--------------------
| ADD HYD (A06   ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 06:SUB06     21.30    2.042    7.37  61.84    .000
                +ID2 05:O0513    290.60    4.326    9.03  42.51    .000
                 ====================================================
                 SUM 07:A06      311.90    4.729    8.30  43.83    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0036------------------------------------------------------------------------
*SUBCATCHMENT 14
*
----------------------
| CALIB NASHYD       |   Area    (ha)=   84.60   Curve Number   (CN)=65.00
| 08:SUB14  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   1.700

     Unit Hyd Qpeak  (cms)=    1.901

     PEAK FLOW       (cms)=    1.144 (i)
     TIME TO PEAK    (hrs)=    9.400
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0037------------------------------------------------------------------------
--------------------
| ADD HYD (SDITCH) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
```

```
                 ID1 07:A06      311.90    4.729    8.30  43.83    .000
                +ID2 08:SUB14     84.60    1.144    9.40  34.56    .000
                 ====================================================
                 SUM 04:SDITCH   396.50    5.734    9.03  41.85    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0038------------------------------------------------------------------------
--------------------
| ADD HYD (N+SDIT) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 04:SDITCH   396.50    5.734    9.03  41.85    .000
                +ID2 02:OUT15    767.10    5.352   13.38  36.63    .000
                 ====================================================
                 SUM 05:N+SDIT  1163.60    9.440   10.53  38.41    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0039------------------------------------------------------------------------
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(N+SDIT)   |
| OUT<06:(Pond01)   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)    |   (cms)    (ha.m.)
                           .000  .0000E+00    |     .000  .5760E+01
                           .000  .6106E+00    |     .940  .6747E+01
                           .000  .1267E+01    |    2.590  .7791E+01
                           .000  .1971E+01    |    4.640  .8891E+01
                           .000  .2724E+01    |    6.940  .1005E+02
                           .000  .3527E+01    |    8.160  .1065E+02
                           .000  .4380E+01    |    9.410  .1127E+02
                           .000  .5287E+01    |     .000  .0000E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >05: (N+SDIT)    1163.60     9.440    10.533     38.409
     OUTFLOW<06: (Pond01)    1163.60     7.543    13.967     33.462
    OVERFLOW<07: (OVer01)        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   79.905
                   TIME SHIFT OF PEAK FLOW         (min)=   206.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1035E+02

      *** WARNING: Outflow volume is less than inflow volume.
--------------------------------------------------------------------------------
001:0040------------------------------------------------------------------------
********************************************************************************
********************************************************************************
*SUBCATCHMENT 08
*
----------------------
| CALIB NASHYD       |   Area    (ha)=  162.30   Curve Number   (CN)=65.00
| 01:SUB08  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   1.850

     Unit Hyd Qpeak  (cms)=    3.351

     PEAK FLOW       (cms)=    2.074 (i)
     TIME TO PEAK    (hrs)=    9.617
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0041------------------------------------------------------------------------
*SUBCATCHMENT 11
```

```
*
----------------------
| CALIB NASHYD       |   Area    (ha)=  189.00   Curve Number   (CN)=65.00
| 02:SUB11  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   2.220

     Unit Hyd Qpeak  (cms)=    3.252

     PEAK FLOW       (cms)=    2.138 (i)
     TIME TO PEAK    (hrs)=   10.117
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0042-----------------------------------------------------------------------
--------------------
| ADD HYD (11+08 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:SUB08    162.30    2.074    9.62  34.56    .000
                +ID2 02:SUB11    189.00    2.138   10.12  34.56    .000
                 ====================================================
                 SUM 03:11+08    351.30    4.179    9.85  34.56    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0043-----------------------------------------------------------------------
*SUBCATCHMENT 19
*
----------------------
| CALIB NASHYD       |   Area    (ha)=  437.30   Curve Number   (CN)=65.00
| 04:SUB19  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   2.570

     Unit Hyd Qpeak  (cms)=    6.499

     PEAK FLOW       (cms)=    4.486 (i)
     TIME TO PEAK    (hrs)=   10.617
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0044-----------------------------------------------------------------------
--------------------
| ADD HYD (11+19 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 04:SUB19    437.30    4.486   10.62  34.56    .000
                +ID2 03:11+08    351.30    4.179    9.85  34.56    .000
                 ====================================================
                 SUM 05:11+19    788.60    8.552   10.22  34.56    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0045-----------------------------------------------------------------------
*SUBCATCHMENT 20
*
----------------------
| CALIB NASHYD       |   Area    (ha)=  207.30   Curve Number   (CN)=65.00
| 06:SUB20  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   2.080

     Unit Hyd Qpeak  (cms)=    3.807

     PEAK FLOW       (cms)=    2.449 (i)
     TIME TO PEAK    (hrs)=    9.933
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385
```

```
     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0046------------------------------------------------------------------------
--------------------
| ADD HYD (20+19 ) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.    DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 06:SUB20    207.30    2.449    9.93  34.56    .000
                +ID2 05:11+19    788.60    8.552   10.22  34.56    .000
                 ==================================================
                 SUM 07:20+19    995.90   10.985   10.15  34.56    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0047------------------------------------------------------------------------
*********************************************************************************
*********************************************************************************
*SUBCATCHMENT 17
*
----------------------
| CALIB NASHYD       |   Area    (ha)=  114.60   Curve Number   (CN)=65.00
| 01:SUB17  DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=   1.480

     Unit Hyd Qpeak  (cms)=    2.958

     PEAK FLOW       (cms)=    1.700 (i)
     TIME TO PEAK    (hrs)=    9.100
     RUNOFF VOLUME    (mm)=   34.558
     TOTAL RAINFALL   (mm)=   89.667
     RUNOFF COEFFICIENT   =     .385

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0048------------------------------------------------------------------------
      FINISH
--------------------------------------------------------------------------------
********************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0039 ROUTE RESERVOIR
      *** WARNING: Outflow volume is less than inflow volume.
   Simulation ended on 2010-06-18     at 18:37:13
================================================================================
```

Appendix 3

QUALHYMO

- **Input and Output File**

QUALHYMO INPUT

```
*
*
*  *****************           QUALHYMO            *********************
*
*
*               ====                                       ====
*               ====     File: Carstairs MSS               ====
*               ====     Rain File:97precip.pre            ====
*               ====     Snowmelt File:97temp.tmp          ====
*               ====     Evaporation File:EG_CAL_10S.TXT   ====
************************************************************************
*
*
*
*
START                START DATE OF SIMULATION         59  12 31
                     END DATE OF SIMULATION           98  01 01
                     RAINFALL WILL BE READ ON DEVICE  IRAIN  9
                     PRECIP IS IN AES HOURLY FORMAT   IPFORM 1
                     FLOW FILE WILL BE READ ON DEVICE IFLOW 10
                     TEMPERATURE FILE AES FORMAT      ITFORM 1
                     SET SURF EVAPORATION FLAG ON     ICASE  2
                                                      CPAN   1
                     SET LAKE EVAPORATINO FLAG ON  EVAPCASE  2
                                                        PPAN 1
                     SET POLLUTANT FLAG OFF           IFDECA 0
                     SIMULATE SEDIMENT                IFSEDT 1
                       SETTLING VELOCITIES  IN M PER SEC ARE
                     0.0000007 0.0000025 0.000008 0.000025 0.0005
                       FOR SIZE FRACTIONS
                     0.028     0.012     0.012    0.058    0.89
*
*             ESTABLISH SEDIMENT BUILD-UP AND WASH-OFF PARAMETERS
*
POLLUTANT SERIES    JCASE=3 (SEDIMENT, IMPERVIOUS AREA)
                     WASHOFF METHOD IS 2 (BUILDUP WASHOFF)
                     WASHOFF RATE PCO = 6000 PEX = 1.2
                     BUILDUP METHOD IS 1 (POWER LINEAR)
                     EQUIVALENT INITIAL ACCUMULATION=30 DAYS
                     OF BUILDUP MAXIMUM ACCUMULATION IS 0.2 KG PER SQ M
                     BUILDUP IS 0.00055 KG PER SQ M PER 1 DAY
*
POLLUTANT SERIES    JCASE=4 (SEDIMENT, PERVIOUS AREA)
                     WASHOFF METHOD IS 2 (BUILDUP WASHOFF)
                     WASHOFF RATE PCO = 3000 PEX = 1.2
                     BUILDUP METHOD IS 1 (POWER LINEAR)
                     EQUIVALENT INITIAL ACCUMULATION=30 DAYS
                     OF BUILDUP MAXIMUM ACCUMULATION IS 0.2 KG PER SQ M
                     BUILDUP IS 0.00055 KG PER SQ M PER 1 DAY
*
*===============================================================================
*
*
*
*  #########                                                    #########
*  #########     CATCHMENT 1                                    #########
*  #########                                                    #########
*  #########                                                    #########
*
GENERATE             ID=1 ISER=201 DT=1.0 HR  DA=1163.6 HA
                                   AB=0       FRIMP=0.07
                     IMPERVIOUS AREA        ============================
                      NASH UNIT HYD   AA=1      N=2     TP=2.6 HRS
                                      ABSIMP=0.6 MM     RIMP=0.95 CETIMP=1
                     PERVIOUS AREA    =================================
                      NASH UNIT HYD   AA=1      N=2     TP=2.6 HRS
                                      SMIN=50   SMAX=227    SK=0.04
                                      APIK=0.9  API=44 ABSPER=1.5 MM CETPER=1
                     BASE FLOW  DATA
                     NUMBER OF GROUNDWATER RESERVOIRS NSVOL=0
                     MINIMUM BASE FLOW                BASMIN=0.0
                     BASE FLOW DEPLETION FACTOR       BFACR=1.0
                     STARTING SOIL MOISTURE           SVOL=6.5 MM
                     SOIL MOISTURE AT WILTING PT      SWILT=0.1 MM
```

```
                    SOIL MOISTURE AT FIELD CAPACITY  SFIELD=250 MM
                    BASE RECESSION CONSTANT          SLOSKA=0.0057
                    BASE FLOW REDUCTION FACTOR       SLOSKB=0.000
                    BASE FLOW ET CORRECTION FACTOR   CET=5
                    SNOW ROUTINE          =============================
                                    ISNOW=1 ANNUAL COEFFICIENT METHOD
                                    BASET= -1
                                    SNOWFAC = 0.5 MM/DEG/HOUR
                                    PACDEP = 0.0 MM
                                    ALPHAA = 2.5
                                    XLK = 5
                                    BCOEF = 1
                                    XNCOEF = 1
                                    KFLAG = 0 NO SNOW REMOVAL
*
*========================================================================
*CATCHMENT DISCHARGE data series.
*
*MAXMIN               DISCHARGE IDQ=1  annual MAX SERIES IOPT=3
*                     START DATE OF ANALYSIS         1960
*                     END DATE OF ANALYSIS           1997
*
*
*========================================================================
*
*PRINT SERIES TOTALS  ID=1 FROM 1960 TO 1997
*
*========================================================================*
* ROUTE FLOWS THROUGH DRY POND 1
*
*
POND                PRINT LAKE OUTFLOW IDOUT=2
                    ISER=-501   IDH=1
                    DETENTION TIME IS                    TDET=0 HRS
                    NUMBER OF CSTRS IS                   NELS=1
                    FLOW ROUTING TIME STEP IS            RTINC=1.00 HRS
                    BASEFLOW                             QBAS=0.0 CMS
                    EVAPORATION                          CPAN=1
                    DRY WEATHER FLAG                     IFQBY=0
                    APPROACH FLOW CURVE ****************************
                     NPTQQ = 0
                    CONTINUOUS FLOW CURVE **************************
                     NPTSQ(ONE) = 0
                    OPERATED OUTFLOW CURVE *************************
                     ISIG=1 NPTSQ(TWO)=7
                     STAGE(m) OUTFLOW(cms)
                       3.00       0.0   (NWL)
                       3.40       0.94
                       3.80       2.59
                       4.20       4.64
                       4.60       6.94
                       4.80       8.16
                       5.00       9.41
                     OVERFLOW CURVE *************************************
                     ISIG=1 NPTSQV=0
                    RATING CURVE DATA **********************************
                     STAGE VOLUME CURVE ********************************
                      ISIG=1 NPTSV=15
                      STAGE(m) VOLUME(cubic m)
                       0.00        0
                       0.40       6106
                       0.80       12673
                       1.20       19714
                       1.60       27241
                       2.00       35267
                       2.40       43805
                       2.80       52868
                       3.00       57600
                       3.40       67474
                       3.80       77905
                       4.20       88906
                       4.60       100489
                       4.80       106502
                       5.00       112667
                    POND AREA CURVE **********************************
                      NPTSA=15
```

```
                      STAGE (m) AREA (square m)
                       0.00       14700
                       0.40       15836
                       0.80       17004
                       1.20       18204
                       1.60       19436
                       2.00       20700
                       2.40       21996
                       2.80       23324
                       3.00       24000
                       3.40       25376
                       3.80       26784
                       4.20       28224
                       4.60       29696
                       4.80       30444
                       5.00       31200
                    OTHER REQUIRED VARIABLES
                    STARTING STAGE                           SBEGIN=03.00
                    MULTIPLICATION FACTOR FOR POLLUTANTS     FEMULT=1
                    MULTIPLICATION FACTOR FOR SEDIMENT       SEMULT=1
*
*==================================================================================
*
CALC POND STATS        FROM 1960  01 01
                       TO   1997  12 31
*
*
*===============================================================================
FINISH
```

QUALHYMO OUTPUT

```
*
*
*  *****************           QUALHYMO            *********************
*
*
*               ====                                      ====
*               ====     File: Carstairs MSS              ====
*               ====     Rain File:97precip.pre           ====
*               ====     Snowmelt File:97temp.tmp         ====
*               ====     Evaporation File:EG_CAL_10S.TXT   ====
************************************************************************
*
*
*
*
START               START DATE OF SIMULATION         59  12 31
                    END DATE OF SIMULATION           98  01 01
                    RAINFALL WILL BE READ ON DEVICE  IRAIN  9
                    PRECIP IS IN AES HOURLY FORMAT   IPFORM 1
                    FLOW FILE WILL BE READ ON DEVICE IFLOW 10
                    TEMPERATURE FILE AES FORMAT      ITFORM 1
                    SET SURF EVAPORATION FLAG ON     ICASE  2
                                                     CPAN   1
                    SET LAKE EVAPORATINO FLAG ON  EVAPCASE  2
                                                       PPAN 1
                    SET POLLUTANT FLAG OFF           IFDECA 0
                    SIMULATE SEDIMENT                IFSEDT 1
                      SETTLING VELOCITIES  IN M PER SEC ARE
                    0.0000007 0.0000025 0.000008 0.000025 0.0005
                      FOR SIZE FRACTIONS
                    0.028     0.012     0.012    0.058    0.89
 - PRECIP IS HOURLY, READ IN AES CONDENSED FORMAT
   FLOW RECORDS WILL BE SOUGHT ON DEVICE      10

*
*             ESTABLISH SEDIMENT BUILD-UP AND WASH-OFF PARAMETERS
*
POLLUTANT SERIES    JCASE=3 (SEDIMENT, IMPERVIOUS AREA)
                    WASHOFF METHOD IS 2 (BUILDUP WASHOFF)
                    WASHOFF RATE PCO = 6000 PEX = 1.2
                    BUILDUP METHOD IS 1 (POWER LINEAR)
                    EQUIVALENT INITIAL ACCUMULATION=30 DAYS
                    OF BUILDUP MAXIMUM ACCUMULATION IS 0.2 KG PER SQ M
                    BUILDUP IS 0.00055 KG PER SQ M PER 1 DAY
*
POLLUTANT SERIES    JCASE=4 (SEDIMENT, PERVIOUS AREA)
                    WASHOFF METHOD IS 2 (BUILDUP WASHOFF)
                    WASHOFF RATE PCO = 3000 PEX = 1.2
                    BUILDUP METHOD IS 1 (POWER LINEAR)
                    EQUIVALENT INITIAL ACCUMULATION=30 DAYS
                    OF BUILDUP MAXIMUM ACCUMULATION IS 0.2 KG PER SQ M
                    BUILDUP IS 0.00055 KG PER SQ M PER 1 DAY
*
*==============================================================================
*
*
*
*  #########                                                     #########
*  #########     CATCHMENT 1                                     #########
*  #########                                                     #########
*  #########                                                     #########
*
GENERATE            ID=1 ISER=201 DT=1.0 HR  DA=1163.6 HA
                                  AB=0        FRIMP=0.07
                    IMPERVIOUS AREA        ============================
                     NASH UNIT HYD   AA=1      N=2     TP=2.6 HRS
                                     ABSIMP=0.6 MM     RIMP=0.95 CETIMP=1
                    PERVIOUS AREA    ================================
                     NASH UNIT HYD   AA=1      N=2     TP=2.6 HRS
                                     SMIN=50   SMAX=227    SK=0.04
                                     APIK=0.9  API=44 ABSPER=1.5 MM CETPER=1
                    BASE FLOW  DATA
```

```
                    NUMBER OF GROUNDWATER RESERVOIRS NSVOL=0
                    MINIMUM BASE FLOW                BASMIN=0.0
                    BASE FLOW DEPLETION FACTOR       BFACR=1.0
                    STARTING SOIL MOISTURE           SVOL=6.5 MM
                    SOIL MOISTURE AT WILTING PT      SWILT=0.1 MM
                    SOIL MOISTURE AT FIELD CAPACITY  SFIELD=250 MM
                    BASE RECESSION CONSTANT          SLOSKA=0.0057
                    BASE FLOW REDUCTION FACTOR       SLOSKB=0.000
                    BASE FLOW ET CORRECTION FACTOR   CET=5
                    SNOW ROUTINE           =============================
                                    ISNOW=1 ANNUAL COEFFICIENT METHOD
                                    BASET= -1
                                    SNOWFAC = 0.5 MM/DEG/HOUR
                                    PACDEP = 0.0 MM
                                    ALPHAA = 2.5
                                    XLK = 5
                                    BCOEF = 1
                                    XNCOEF = 1
                                    KFLAG = 0 NO SNOW REMOVAL

====== IMPERVIOUS AREA UNIT HYDROGRAPH DATA ======

 - SHAPE CONSTANT, N =  2.000          - UNIT PEAK,QP =  0.0320 CMS
 - THE UH YIELDS   0.9680 MM VOL SO MULT BY   1.0331 WILL ENSURE A 1 MM UH.

======= PERVIOUS AREA UNIT HYDROGRAPH DATA =======

 - SHAPE CONSTANT, N =  2.000          - UNIT PEAK,QP =  0.4253 CMS
 - THE UH YIELDS   0.9680 MM VOL SO MULT BY   1.0331 WILL ENSURE A 1 MM UH.

API REDUCTION FACTOR IS  0.996E+00 PER TIME STEP OR  0.900E+00 PER DAY

  GW CET =    5.000000
 TEMP RECORD ON REQUESTED START DATE FOUND 1959  12 31


     W A T E R   M A S S   B A L A N C E
     A-TOTAL RAINFALL               =    14310.64 MM
     B-TOTAL RUNOFF IMPRV+PERV      =     1895.40 MM
     C-ALL INITIAL ABSTRACTIONS     =     2955.38 MM
     D-TOTAL INFILTERED WATER       =     9250.13 MM
     TOTAL GROUNDWATER ACCRETION    =     5838.32 MM
     E-TOTAL BASE FLOW              =        0.00 MM
     F-CHANGE IN GROUNDWATER STORAGE=       -6.50 MM
     G-EVAPORATION FROM SOIL WATER  =     3418.34 MM
     H-LOSS TO DEEP GROUNDWATER     =     5838.32 MM
     I-CHANGE IN SNOW PACK STORAGE  =        0.00 MM
     G-NET IMPORTED SNOW            =        0.00 MM

     SURFACE WATER BALANCE = A - B - C - D       =     209.74 MM
     SUBSURFACE WATER BALANCE= D - E - F - G - H =      -0.02 MM
     TOTAL BALANCE  = A - B - C - E - F - G - H  =     209.71 MM

 RAINFALL AND DIRECT  RUNOFF TOTALS OVER THE SIMULATION TIME SPAN ==========
   RAINFALL  PERVIOUS  IMPERVIOUS   TOTAL
              RUNOFF     RUNOFF     RUNOFF
     (MM)      (MM)       (MM)       (MM)
  14310.638   1138.692  11948.772   1895.395
*
*========================================================================
*CATCHMENT DISCHARGE data series.
*
*MAXMIN               DISCHARGE IDQ=1  annual MAX SERIES IOPT=3
*                     START DATE OF ANALYSIS         1960
*                     END DATE OF ANALYSIS           1997
*
*
*========================================================================
*
*PRINT SERIES TOTALS  ID=1 FROM 1960 TO 1997
*
*========================================================================*
* ROUTE FLOWS THROUGH DRY POND 1
*
*
POND                PRINT LAKE OUTFLOW IDOUT=2
```

```
                  ISER=-501   IDH=1
                  DETENTION TIME IS                     TDET=0 HRS
                  NUMBER OF CSTRS IS                    NELS=1
                  FLOW ROUTING TIME STEP IS             RTINC=1.00 HRS
                  BASEFLOW                              QBAS=0.0 CMS
                  EVAPORATION                           CPAN=1
                  DRY WEATHER FLAG                      IFQBY=0
                  APPROACH FLOW CURVE ****************************
                   NPTQQ = 0
                  CONTINUOUS FLOW CURVE **************************
                   NPTSQ(ONE) = 0
                  OPERATED OUTFLOW CURVE *************************
                   ISIG=1 NPTSQ(TWO)=7
                   STAGE(m) OUTFLOW(cms)
                     3.00       0.0   (NWL)
                     3.40       0.94
                     3.80       2.59
                     4.20       4.64
                     4.60       6.94
                     4.80       8.16
                     5.00       9.41
                   OVERFLOW CURVE ************************************
                   ISIG=1 NPTSQV=0
                  RATING CURVE DATA **********************************
                   STAGE VOLUME CURVE ********************************
                    ISIG=1 NPTSV=15
                    STAGE(m) VOLUME(cubic m)
                     0.00        0
                     0.40       6106
                     0.80       12673
                     1.20       19714
                     1.60       27241
                     2.00       35267
                     2.40       43805
                     2.80       52868
                     3.00       57600
                     3.40       67474
                     3.80       77905
                     4.20       88906
                     4.60       100489
                     4.80       106502
                     5.00       112667
                  POND AREA CURVE ***********************************
                    NPTSA=15
                    STAGE (m) AREA (square m)
                     0.00       14700
                     0.40       15836
                     0.80       17004
                     1.20       18204
                     1.60       19436
                     2.00       20700
                     2.40       21996
                     2.80       23324
                     3.00       24000
                     3.40       25376
                     3.80       26784
                     4.20       28224
                     4.60       29696
                     4.80       30444
                     5.00       31200
                  OTHER REQUIRED VARIABLES
                  STARTING STAGE                            SBEGIN=03.00
                  MULTIPLICATION FACTOR FOR POLLUTANTS     FEMULT=1
                  MULTIPLICATION FACTOR FOR SEDIMENT       SEMULT=1

   ====== BASIC PARAMETER INPUT CHECKS ======
 APPROACH FLOW NPTQQ -      0
 CONTINUOUS OUTFLOW NPTSQ1 -      0
 OPERATED OUTFLOW NPTSQ2 -      7
 OVERFLOW NPTSQV -      0
 STAGE VOLUME NPTSV -     15
 STAGE AREA NPTSA -     15
 DETENTION TIME -   0.0000000E+00
 BASE FLOW -   0.0000000E+00
 STARTING STAGE IN POND IS               0.300E+01 M
 MULTIPLICATION FACTOR FOR POLLUTANT IS  0.100E+01
```

```
MULTIPLICATION FACTOR FOR SEDIMENT IS   0.100E+01
TIME STEP OF INPUT FILE IS     1.000 HOURS
CALCULATION STEP SELECTED IS    1.0000 HOURS

  ============ COMBINED OUTFLOW CURVES ============
                --- TOTAL ----         ---- TOTAL ----
                 CONTINUOUS               OPERATED
               OUTFLOW  CURVE           OUTFLOW  CURVE
 STAGE         ST. IND.      FLOW        ST. IND.     FLOW
               COEFF.                    COEFF.
  (M)          (CMS)        (CMS)        (CMS)      (CMS)

 0.000000E+00 0.000000E+00 0.000000E+00 0.000000E+00 0.000000E+00
 0.400000E+00 0.169611E+01 0.000000E+00 0.169611E+01 0.000000E+00
 0.800000E+00 0.352028E+01 0.000000E+00 0.352028E+01 0.000000E+00
 0.120000E+01 0.547611E+01 0.000000E+00 0.547611E+01 0.000000E+00
 0.160000E+01 0.756694E+01 0.000000E+00 0.756694E+01 0.000000E+00
 0.200000E+01 0.979639E+01 0.000000E+00 0.979639E+01 0.000000E+00
 0.240000E+01 0.121681E+02 0.000000E+00 0.121681E+02 0.000000E+00
 0.280000E+01 0.146856E+02 0.000000E+00 0.146856E+02 0.000000E+00
 0.300000E+01 0.160000E+02 0.000000E+00 0.160000E+02 0.000000E+00
 0.340000E+01 0.187428E+02 0.000000E+00 0.192128E+02 0.940000E+00
 0.380000E+01 0.216403E+02 0.000000E+00 0.229353E+02 0.259000E+01
 0.420000E+01 0.246961E+02 0.000000E+00 0.270161E+02 0.464000E+01
 0.460000E+01 0.279136E+02 0.000000E+00 0.313836E+02 0.694000E+01
 0.480000E+01 0.295839E+02 0.000000E+00 0.336639E+02 0.816000E+01
 0.500000E+01 0.312964E+02 0.000000E+00 0.360014E+02 0.941000E+01

AN INITIAL STAGE OF        0.300000E+01 M.,
AN AREA OF                 0.576000E+05 SQ.M.
A VOLUME OF                0.240000E+05 CU.M.
A THROUGHFLOW RATE OF      0.000000E+00 CU.M./SEC.
AND AN S.I. VALUE OF       0.160000E+02 CU.M./SEC.
ARE ASSUMED.

================ CONTINUITY CHECK =================
INFLOW            0.231E+08
OUTFLOW           0.223E+08
LOSSES            0.823E+06
VOLUME CHANGE    -0.781E-02
CONTINUITY ERROR    0.00% OF AVERAGE THROUGHFLOW
===================================================

========== GLOBAL MASS BEHAVIOR ==========

INITIAL VOLUME IN POND:             0.576E+05 M**3

TOTAL VOLUME OF APPROACH FLOW:      0.231E+08 M**3
TOTAL VOLUME BYPASSING:             0.000E+00 M**3
TOTAL VOLUME INTO POND:             0.231E+08 M**3


TOTAL VOLUME OF DEPARTING FLOW:     0.223E+08 M**3
TOTAL VOLUME BYPASSING:             0.000E+00 M**3
TOTAL VOLUME OUT OF POND:           0.223E+08 M**3


SEDIMENT FRACTION 1
TOTAL QUANTITY INTO POND IS:     0.220E+07
TOTAL QUANTITY OUT OF POND IS:   0.150E+07
TOTAL QUANTITY LEFT IN POND IS:  0.369E+03
TOTAL QUANTITY REMOVED IS:       0.694E+06
FRACTION OF QUANTITY REMOVED IS: 0.316E+00


SEDIMENT FRACTION 2
TOTAL QUANTITY INTO POND IS:     0.941E+06
TOTAL QUANTITY OUT OF POND IS:   0.495E+06
TOTAL QUANTITY LEFT IN POND IS:  0.543E+02
TOTAL QUANTITY REMOVED IS:       0.446E+06
FRACTION OF QUANTITY REMOVED IS: 0.474E+00


SEDIMENT FRACTION 3
TOTAL QUANTITY INTO POND IS:     0.941E+06
TOTAL QUANTITY OUT OF POND IS:   0.398E+06
```

```
 TOTAL QUANTITY LEFT IN POND IS:  0.389E+01
 TOTAL QUANTITY REMOVED IS:       0.543E+06
 FRACTION OF QUANTITY REMOVED IS: 0.577E+00


 SEDIMENT FRACTION 4
 TOTAL QUANTITY INTO POND IS:     0.455E+07
 TOTAL QUANTITY OUT OF POND IS:   0.153E+07
 TOTAL QUANTITY LEFT IN POND IS:  0.649E-02
 TOTAL QUANTITY REMOVED IS:       0.302E+07
 FRACTION OF QUANTITY REMOVED IS: 0.665E+00


 SEDIMENT FRACTION 5
 TOTAL QUANTITY INTO POND IS:     0.698E+08
 TOTAL QUANTITY OUT OF POND IS:   0.444E+07
 TOTAL QUANTITY LEFT IN POND IS:  0.000E+00
 TOTAL QUANTITY REMOVED IS:       0.653E+08
 FRACTION OF QUANTITY REMOVED IS: 0.936E+00

 TOTAL SEDIMENT
 TOTAL QUANTITY INTO POND IS:     0.784E+08
 TOTAL QUANTITY OUT OF POND IS:   0.836E+07
 TOTAL QUANTITY LEFT IN POND IS:  0.427E+03
 TOTAL QUANTITY REMOVED IS:       0.701E+08
 FRACTION OF QUANTITY REMOVED IS: 0.893E+00

 ========= VOLUME USE OVER 0.3332E+06 HRS,==========
     STAGE        VOLUME              ATTAINED
      (M)         (CU.M.)      (HOURS)   (% OF TIME)

 0.000000E+00 0.0000E+00 0.3332E+06     100.00
 0.250000E+00 0.3816E+04 0.3332E+06     100.00

 0.500000E+00 0.7748E+04 0.3332E+06     100.00
 0.750000E+00 0.1185E+05 0.3332E+06     100.00
 0.100000E+01 0.1619E+05 0.3332E+06     100.00
 0.125000E+01 0.2065E+05 0.3332E+06     100.00
 0.150000E+01 0.2536E+05 0.3332E+06     100.00
 0.175000E+01 0.3025E+05 0.3332E+06     100.00
 0.200000E+01 0.3527E+05 0.3332E+06     100.00
 0.225000E+01 0.4060E+05 0.3332E+06     100.00
 0.250000E+01 0.4607E+05 0.3332E+06     100.00
 0.275000E+01 0.5174E+05 0.3330E+06      99.95
 0.300000E+01 0.5760E+05 0.1603E+06      48.11
 0.325000E+01 0.6377E+05 0.2150E+04       0.65
 0.350000E+01 0.7008E+05 0.6470E+03       0.19
 0.375000E+01 0.7660E+05 0.2230E+03       0.07
 0.400000E+01 0.8341E+05 0.8000E+02       0.02
 0.425000E+01 0.9035E+05 0.2200E+02       0.01
 0.450000E+01 0.9759E+05 0.8000E+01       0.00
 0.475000E+01 0.1050E+06 0.5000E+01       0.00
 0.500000E+01 0.1127E+06 0.0000E+00       0.00
 0.525000E+01 0.1183E+06 0.0000E+00       0.00
*
*===============================================================================
*
CALC POND STATS        FROM 1960  01 01
                       TO   1997  12 31
 ============ MONTHLY MAXIMUMS =========
   DATE    INFLOW     OUTFLOW     STAGE     VOLUME
           (CMS)       (CMS)       (M)       (M**3)
 1960  1  0.634E+00  0.478E+00  0.320E+01  0.626E+05
 1960  2  0.509E+00  0.390E+00  0.317E+01  0.617E+05
 1960  3  0.478E+00  0.369E+00  0.316E+01  0.615E+05
 1960  4  0.854E+00  0.638E+00  0.327E+01  0.643E+05
 1960  5  0.101E+01  0.797E+00  0.334E+01  0.660E+05
 1960  6  0.547E+00  0.409E+00  0.317E+01  0.619E+05
 1960  7  0.960E+00  0.713E+00  0.330E+01  0.651E+05
 1960  8  0.360E+00  0.270E+00  0.311E+01  0.604E+05
 1960  9  0.995E-01  0.664E-01  0.303E+01  0.583E+05
 1960 10  0.000E+00  0.000E+00  0.297E+01  0.569E+05
 1960 11  0.144E+00  0.102E+00  0.304E+01  0.587E+05
 1960 12  0.677E+00  0.492E+00  0.321E+01  0.628E+05
 1961  1  0.436E-01  0.326E-01  0.301E+01  0.579E+05
 1961  2  0.737E+00  0.654E+00  0.328E+01  0.645E+05
```

```
1961  3  0.729E-01  0.555E-01  0.302E+01  0.582E+05
1961  4  0.197E+01  0.159E+01  0.356E+01  0.716E+05
1961  5  0.483E+00  0.365E+00  0.316E+01  0.614E+05
1961  6  0.392E+00  0.210E+00  0.309E+01  0.598E+05
1961  7  0.114E+01  0.792E+00  0.334E+01  0.659E+05
1961  8  0.379E+00  0.295E+00  0.313E+01  0.607E+05
1961  9  0.357E+00  0.299E+00  0.313E+01  0.607E+05
1961 10  0.000E+00  0.000E+00  0.296E+01  0.567E+05
1961 11  0.205E+00  0.104E+00  0.304E+01  0.587E+05
1961 12  0.298E+00  0.214E+00  0.309E+01  0.599E+05
1962  1  0.143E+00  0.106E+00  0.304E+01  0.587E+05
1962  2  0.163E+00  0.130E+00  0.306E+01  0.590E+05
1962  3  0.239E+00  0.177E+00  0.308E+01  0.595E+05
1962  4  0.224E+00  0.164E+00  0.307E+01  0.593E+05
1962  5  0.131E+01  0.967E+00  0.341E+01  0.676E+05
1962  6  0.552E+00  0.386E+00  0.316E+01  0.617E+05
1962  7  0.216E+00  0.150E+00  0.306E+01  0.592E+05
1962  8  0.135E+01  0.125E+01  0.348E+01  0.694E+05
1962  9  0.928E-01  0.582E-01  0.302E+01  0.582E+05
1962 10  0.104E+00  0.211E-02  0.300E+01  0.576E+05
1962 11  0.503E-01  0.359E-01  0.302E+01  0.580E+05
1962 12  0.119E+00  0.877E-01  0.304E+01  0.585E+05
1963  1  0.791E+00  0.619E+00  0.326E+01  0.641E+05
1963  2  0.151E+00  0.116E+00  0.305E+01  0.588E+05
1963  3  0.289E+00  0.207E+00  0.309E+01  0.598E+05
1963  4  0.695E+00  0.498E+00  0.321E+01  0.628E+05
1963  5  0.701E+00  0.522E+00  0.322E+01  0.631E+05
1963  6  0.437E+01  0.404E+01  0.408E+01  0.857E+05
1963  7  0.324E+01  0.268E+01  0.382E+01  0.784E+05
1963  8  0.128E+00  0.980E-01  0.304E+01  0.586E+05
1963  9  0.896E+00  0.617E+00  0.326E+01  0.641E+05
1963 10  0.000E+00  0.000E+00  0.294E+01  0.562E+05
1963 11  0.601E+00  0.404E+00  0.317E+01  0.618E+05
1963 12  0.911E+00  0.674E+00  0.329E+01  0.647E+05
1964  1  0.329E-01  0.233E-01  0.301E+01  0.578E+05
1964  2  0.234E-01  0.173E-01  0.301E+01  0.578E+05
1964  3  0.105E+00  0.753E-01  0.303E+01  0.584E+05
1964  4  0.651E+00  0.483E+00  0.321E+01  0.627E+05
1964  5  0.330E+00  0.291E+00  0.312E+01  0.607E+05
1964  6  0.266E+01  0.239E+01  0.375E+01  0.766E+05
1964  7  0.390E+01  0.315E+01  0.391E+01  0.809E+05
1964  8  0.550E-01  0.000E+00  0.293E+01  0.560E+05
1964  9  0.121E+01  0.103E+01  0.342E+01  0.680E+05
1964 10  0.789E-01  0.634E-01  0.303E+01  0.583E+05
1964 11  0.347E+00  0.252E+00  0.311E+01  0.602E+05
1964 12  0.193E+00  0.141E+00  0.306E+01  0.591E+05
1965  1  0.118E+01  0.939E+00  0.340E+01  0.675E+05
1965  2  0.306E+00  0.232E+00  0.310E+01  0.600E+05
1965  3  0.236E+00  0.181E+00  0.308E+01  0.595E+05
1965  4  0.706E+00  0.505E+00  0.321E+01  0.629E+05
1965  5  0.298E+00  0.218E+00  0.309E+01  0.599E+05
1965  6  0.273E+01  0.250E+01  0.378E+01  0.773E+05
1965  7  0.524E+01  0.431E+01  0.413E+01  0.871E+05
1965  8  0.465E+01  0.419E+01  0.411E+01  0.865E+05
1965  9  0.159E+01  0.145E+01  0.352E+01  0.707E+05
1965 10  0.145E+00  0.893E-01  0.304E+01  0.585E+05
1965 11  0.104E+01  0.835E+00  0.336E+01  0.664E+05
1965 12  0.419E-01  0.303E-01  0.301E+01  0.579E+05
1966  1  0.286E+00  0.233E+00  0.310E+01  0.600E+05
1966  2  0.280E+00  0.211E+00  0.309E+01  0.598E+05
1966  3  0.866E-01  0.630E-01  0.303E+01  0.583E+05
1966  4  0.701E+00  0.574E+00  0.324E+01  0.636E+05
1966  5  0.852E+00  0.649E+00  0.328E+01  0.644E+05
1966  6  0.213E+01  0.174E+01  0.359E+01  0.725E+05
1966  7  0.599E+01  0.518E+01  0.429E+01  0.916E+05
1966  8  0.351E+00  0.253E+00  0.311E+01  0.603E+05
1966  9  0.111E+00  0.310E-02  0.300E+01  0.576E+05
1966 10  0.135E+00  0.977E-01  0.304E+01  0.586E+05
1966 11  0.651E+00  0.469E+00  0.320E+01  0.625E+05
1966 12  0.117E+00  0.845E-01  0.304E+01  0.585E+05
1967  1  0.369E+00  0.286E+00  0.312E+01  0.606E+05
1967  2  0.250E+00  0.189E+00  0.308E+01  0.596E+05
1967  3  0.389E+00  0.304E+00  0.313E+01  0.608E+05
1967  4  0.657E+00  0.477E+00  0.320E+01  0.626E+05
1967  5  0.695E+00  0.526E+00  0.322E+01  0.631E+05
1967  6  0.120E+01  0.858E+00  0.337E+01  0.666E+05
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 1967  7  0.446E-01  0.000E+00  0.297E+01  0.570E+05
 1967  8  0.559E+00  0.304E+00  0.313E+01  0.608E+05
 1967  9  0.628E-02  0.000E+00  0.287E+01  0.544E+05
 1967 10  0.316E+00  0.546E-01  0.302E+01  0.582E+05
 1967 11  0.199E+00  0.138E+00  0.306E+01  0.590E+05
 1967 12  0.204E+00  0.147E+00  0.306E+01  0.591E+05
 1968  1  0.133E+00  0.948E-01  0.304E+01  0.586E+05
 1968  2  0.180E+00  0.127E+00  0.305E+01  0.589E+05
 1968  3  0.283E+00  0.201E+00  0.309E+01  0.597E+05
 1968  4  0.102E+01  0.834E+00  0.335E+01  0.664E+05
 1968  5  0.109E+01  0.825E+00  0.335E+01  0.663E+05
 1968  6  0.504E+00  0.376E+00  0.316E+01  0.616E+05
 1968  7  0.272E+01  0.238E+01  0.375E+01  0.766E+05
 1968  8  0.136E+00  0.913E-01  0.304E+01  0.586E+05
 1968  9  0.678E+00  0.576E+00  0.325E+01  0.636E+05
 1968 10  0.787E-01  0.000E+00  0.298E+01  0.571E+05
 1968 11  0.251E+00  0.172E+00  0.307E+01  0.594E+05
 1968 12  0.800E-01  0.622E-01  0.303E+01  0.583E+05
 1969  1  0.928E+00  0.696E+00  0.330E+01  0.649E+05
 1969  2  0.281E+00  0.230E+00  0.310E+01  0.600E+05
 1969  3  0.203E+00  0.165E+00  0.307E+01  0.593E+05
 1969  4  0.231E+01  0.158E+01  0.355E+01  0.715E+05
 1969  5  0.264E+01  0.230E+01  0.373E+01  0.761E+05
 1969  6  0.270E+01  0.246E+01  0.377E+01  0.771E+05
 1969  7  0.196E+01  0.156E+01  0.355E+01  0.714E+05
 1969  8  0.329E+00  0.212E+00  0.309E+01  0.598E+05
 1969  9  0.131E+01  0.110E+01  0.344E+01  0.685E+05
 1969 10  0.206E+00  0.148E+00  0.306E+01  0.592E+05
 1969 11  0.563E-01  0.394E-01  0.302E+01  0.580E+05
 1969 12  0.618E-01  0.484E-01  0.302E+01  0.581E+05
 1970  1  0.173E+00  0.140E+00  0.306E+01  0.591E+05
 1970  2  0.699E-01  0.532E-01  0.302E+01  0.582E+05
 1970  3  0.654E+00  0.480E+00  0.320E+01  0.626E+05
 1970  4  0.742E+00  0.601E+00  0.326E+01  0.639E+05
 1970  5  0.123E+00  0.953E-01  0.304E+01  0.586E+05
 1970  6  0.534E+01  0.511E+01  0.428E+01  0.913E+05
 1970  7  0.909E+00  0.631E+00  0.327E+01  0.642E+05
 1970  8  0.998E-01  0.305E-01  0.301E+01  0.579E+05
 1970  9  0.113E+00  0.579E-01  0.302E+01  0.582E+05
 1970 10  0.173E+00  0.101E+00  0.304E+01  0.587E+05
 1970 11  0.341E+00  0.253E+00  0.311E+01  0.603E+05
 1970 12  0.356E+00  0.273E+00  0.312E+01  0.605E+05
 1971  1  0.263E+00  0.187E+00  0.308E+01  0.596E+05
 1971  2  0.596E+00  0.466E+00  0.320E+01  0.625E+05
 1971  3  0.696E+00  0.530E+00  0.323E+01  0.632E+05
 1971  4  0.448E+00  0.367E+00  0.316E+01  0.615E+05
 1971  5  0.109E+00  0.666E-01  0.303E+01  0.583E+05
 1971  6  0.182E+01  0.166E+01  0.357E+01  0.720E+05
 1971  7  0.741E+00  0.546E+00  0.323E+01  0.633E+05
 1971  8  0.860E+00  0.699E+00  0.330E+01  0.649E+05
 1971  9  0.386E+00  0.273E+00  0.312E+01  0.605E+05
 1971 10  0.217E-01  0.000E+00  0.298E+01  0.572E+05
 1971 11  0.286E-01  0.000E+00  0.299E+01  0.573E+05
 1971 12  0.899E-01  0.718E-01  0.303E+01  0.584E+05
 1972  1  0.107E+01  0.836E+00  0.336E+01  0.664E+05
 1972  2  0.489E+00  0.389E+00  0.317E+01  0.617E+05
 1972  3  0.978E+00  0.767E+00  0.333E+01  0.657E+05
 1972  4  0.711E+00  0.517E+00  0.322E+01  0.630E+05
 1972  5  0.716E+00  0.599E+00  0.326E+01  0.639E+05
 1972  6  0.453E+01  0.408E+01  0.409E+01  0.859E+05
 1972  7  0.146E+01  0.107E+01  0.343E+01  0.683E+05
 1972  8  0.144E+01  0.107E+01  0.343E+01  0.683E+05
 1972  9  0.227E+00  0.207E+00  0.309E+01  0.598E+05
 1972 10  0.172E-01  0.000E+00  0.296E+01  0.567E+05
 1972 11  0.946E-01  0.254E-01  0.301E+01  0.579E+05
 1972 12  0.939E+00  0.703E+00  0.330E+01  0.650E+05
 1973  1  0.662E+00  0.541E+00  0.323E+01  0.633E+05
 1973  2  0.669E+00  0.560E+00  0.324E+01  0.635E+05
 1973  3  0.147E+00  0.106E+00  0.305E+01  0.587E+05
 1973  4  0.422E+00  0.328E+00  0.314E+01  0.610E+05
 1973  5  0.226E+00  0.198E+00  0.308E+01  0.597E+05
 1973  6  0.123E+01  0.116E+01  0.345E+01  0.689E+05
 1973  7  0.430E+00  0.302E+00  0.313E+01  0.608E+05
 1973  8  0.145E+01  0.120E+01  0.346E+01  0.691E+05
 1973  9  0.734E+00  0.637E+00  0.327E+01  0.643E+05
 1973 10  0.314E-01  0.000E+00  0.298E+01  0.571E+05
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 1973 11  0.601E+00  0.474E+00  0.320E+01  0.626E+05
 1973 12  0.797E-01  0.572E-01  0.302E+01  0.582E+05
 1974  1  0.705E+00  0.510E+00  0.322E+01  0.630E+05
 1974  2  0.383E+00  0.298E+00  0.313E+01  0.607E+05
 1974  3  0.151E+00  0.107E+00  0.305E+01  0.587E+05
 1974  4  0.192E+01  0.161E+01  0.356E+01  0.717E+05
 1974  5  0.138E+01  0.116E+01  0.345E+01  0.688E+05
 1974  6  0.311E+00  0.222E+00  0.309E+01  0.599E+05
 1974  7  0.533E+00  0.384E+00  0.316E+01  0.616E+05
 1974  8  0.104E+01  0.909E+00  0.339E+01  0.671E+05
 1974  9  0.100E+01  0.696E+00  0.330E+01  0.649E+05
 1974 10  0.169E+00  0.114E+00  0.305E+01  0.588E+05
 1974 11  0.367E+00  0.241E+00  0.310E+01  0.601E+05
 1974 12  0.105E+00  0.748E-01  0.303E+01  0.584E+05
 1975  1  0.821E-01  0.599E-01  0.303E+01  0.582E+05
 1975  2  0.301E+00  0.237E+00  0.310E+01  0.601E+05
 1975  3  0.634E+00  0.480E+00  0.320E+01  0.626E+05
 1975  4  0.683E+00  0.503E+00  0.321E+01  0.629E+05
 1975  5  0.505E+00  0.451E+00  0.319E+01  0.623E+05
 1975  6  0.430E+00  0.365E+00  0.316E+01  0.614E+05
 1975  7  0.729E+00  0.499E+00  0.321E+01  0.628E+05
 1975  8  0.405E+00  0.311E+00  0.313E+01  0.609E+05
 1975  9  0.595E+00  0.509E+00  0.322E+01  0.629E+05
 1975 10  0.100E+00  0.482E-01  0.302E+01  0.581E+05
 1975 11  0.628E-02  0.000E+00  0.298E+01  0.571E+05
 1975 12  0.433E+00  0.304E+00  0.313E+01  0.608E+05
 1976  1  0.346E+00  0.257E+00  0.311E+01  0.603E+05
 1976  2  0.680E-01  0.493E-01  0.302E+01  0.581E+05
 1976  3  0.394E+00  0.292E+00  0.312E+01  0.607E+05
 1976  4  0.910E-01  0.692E-01  0.303E+01  0.583E+05
 1976  5  0.152E+01  0.138E+01  0.351E+01  0.703E+05
 1976  6  0.128E+01  0.113E+01  0.345E+01  0.687E+05
 1976  7  0.103E+01  0.747E+00  0.332E+01  0.655E+05
 1976  8  0.364E+01  0.317E+01  0.391E+01  0.810E+05
 1976  9  0.328E+00  0.254E+00  0.311E+01  0.603E+05
 1976 10  0.215E-01  0.000E+00  0.300E+01  0.575E+05
 1976 11  0.403E+00  0.346E+00  0.315E+01  0.612E+05
 1976 12  0.117E+00  0.818E-01  0.303E+01  0.585E+05
 1977  1  0.224E+00  0.175E+00  0.307E+01  0.594E+05
 1977  2  0.181E+00  0.129E+00  0.305E+01  0.590E+05
 1977  3  0.128E+00  0.913E-01  0.304E+01  0.586E+05
 1977  4  0.313E-01  0.177E-01  0.301E+01  0.578E+05
 1977  5  0.650E+00  0.497E+00  0.321E+01  0.628E+05
 1977  6  0.323E+00  0.226E+00  0.310E+01  0.600E+05
 1977  7  0.177E+01  0.136E+01  0.350E+01  0.701E+05
 1977  8  0.211E+01  0.167E+01  0.358E+01  0.721E+05
 1977  9  0.114E+01  0.878E+00  0.337E+01  0.668E+05
 1977 10  0.189E-01  0.928E-02  0.300E+01  0.577E+05
 1977 11  0.156E+00  0.125E+00  0.305E+01  0.589E+05
 1977 12  0.390E+00  0.296E+00  0.313E+01  0.607E+05
 1978  1  0.155E+00  0.129E+00  0.306E+01  0.590E+05
 1978  2  0.115E+01  0.910E+00  0.339E+01  0.672E+05
 1978  3  0.742E-01  0.570E-01  0.302E+01  0.582E+05
 1978  4  0.803E+00  0.686E+00  0.329E+01  0.648E+05
 1978  5  0.107E+01  0.889E+00  0.338E+01  0.669E+05
 1978  6  0.864E+00  0.677E+00  0.329E+01  0.647E+05
 1978  7  0.756E+00  0.518E+00  0.322E+01  0.630E+05
 1978  8  0.439E+01  0.421E+01  0.412E+01  0.866E+05
 1978  9  0.302E+01  0.271E+01  0.382E+01  0.786E+05
 1978 10  0.792E-01  0.669E-01  0.303E+01  0.583E+05
 1978 11  0.410E+00  0.306E+00  0.313E+01  0.608E+05
 1978 12  0.246E+00  0.175E+00  0.307E+01  0.594E+05
 1979  1  0.246E+00  0.176E+00  0.308E+01  0.595E+05
 1979  2  0.148E+00  0.105E+00  0.304E+01  0.587E+05
 1979  3  0.103E+00  0.783E-01  0.303E+01  0.584E+05
 1979  4  0.752E+00  0.540E+00  0.323E+01  0.633E+05
 1979  5  0.596E+00  0.453E+00  0.319E+01  0.624E+05
 1979  6  0.188E+01  0.155E+01  0.355E+01  0.713E+05
 1979  7  0.708E+00  0.496E+00  0.321E+01  0.628E+05
 1979  8  0.330E+00  0.244E+00  0.310E+01  0.602E+05
 1979  9  0.315E+00  0.192E+00  0.308E+01  0.596E+05
 1979 10  0.107E+00  0.658E-01  0.303E+01  0.583E+05
 1979 11  0.342E+00  0.252E+00  0.311E+01  0.602E+05
 1979 12  0.435E+00  0.321E+00  0.314E+01  0.610E+05
 1980  1  0.225E+00  0.168E+00  0.307E+01  0.594E+05
 1980  2  0.178E+00  0.133E+00  0.306E+01  0.590E+05
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 1980  3  0.115E+00  0.818E-01  0.303E+01  0.585E+05
 1980  4  0.551E+00  0.410E+00  0.317E+01  0.619E+05
 1980  5  0.231E+01  0.201E+01  0.366E+01  0.742E+05
 1980  6  0.183E+01  0.155E+01  0.355E+01  0.713E+05
 1980  7  0.916E+00  0.683E+00  0.329E+01  0.648E+05
 1980  8  0.179E+00  0.121E+00  0.305E+01  0.589E+05
 1980  9  0.553E+00  0.434E+00  0.318E+01  0.622E+05
 1980 10  0.229E+00  0.210E+00  0.309E+01  0.598E+05
 1980 11  0.268E+00  0.181E+00  0.308E+01  0.595E+05
 1980 12  0.649E+00  0.507E+00  0.322E+01  0.629E+05
 1981  1  0.980E-01  0.703E-01  0.303E+01  0.583E+05
 1981  2  0.176E+00  0.126E+00  0.305E+01  0.589E+05
 1981  3  0.804E+00  0.617E+00  0.326E+01  0.641E+05
 1981  4  0.297E-01  0.945E-03  0.300E+01  0.576E+05
 1981  5  0.281E+01  0.274E+01  0.383E+01  0.787E+05
 1981  6  0.858E+00  0.637E+00  0.327E+01  0.643E+05
 1981  7  0.156E+01  0.128E+01  0.348E+01  0.696E+05
 1981  8  0.634E+00  0.437E+00  0.319E+01  0.622E+05
 1981  9  0.171E+01  0.137E+01  0.351E+01  0.702E+05
 1981 10  0.167E+00  0.126E+00  0.305E+01  0.589E+05
 1981 11  0.598E+00  0.429E+00  0.318E+01  0.621E+05
 1981 12  0.759E-01  0.539E-01  0.302E+01  0.582E+05
 1982  1  0.650E+00  0.482E+00  0.321E+01  0.627E+05
 1982  2  0.339E+00  0.243E+00  0.310E+01  0.602E+05
 1982  3  0.210E+00  0.160E+00  0.307E+01  0.593E+05
 1982  4  0.774E+00  0.580E+00  0.325E+01  0.637E+05
 1982  5  0.744E+00  0.572E+00  0.324E+01  0.636E+05
 1982  6  0.138E+01  0.993E+00  0.341E+01  0.678E+05
 1982  7  0.121E+01  0.925E+00  0.339E+01  0.673E+05
 1982  8  0.241E+00  0.163E+00  0.307E+01  0.593E+05
 1982  9  0.122E+01  0.994E+00  0.341E+01  0.678E+05
 1982 10  0.000E+00  0.000E+00  0.299E+01  0.573E+05
 1982 11  0.156E+00  0.110E+00  0.305E+01  0.588E+05
 1982 12  0.974E-01  0.689E-01  0.303E+01  0.583E+05
 1983  1  0.110E+00  0.777E-01  0.303E+01  0.584E+05
 1983  2  0.663E-01  0.505E-01  0.302E+01  0.581E+05
 1983  3  0.515E+00  0.380E+00  0.316E+01  0.616E+05
 1983  4  0.885E+00  0.674E+00  0.329E+01  0.647E+05
 1983  5  0.475E-01  0.332E-01  0.301E+01  0.579E+05
 1983  6  0.321E+00  0.219E+00  0.309E+01  0.599E+05
 1983  7  0.132E+01  0.114E+01  0.345E+01  0.687E+05
 1983  8  0.188E+01  0.160E+01  0.356E+01  0.716E+05
 1983  9  0.147E+00  0.992E-01  0.304E+01  0.586E+05
 1983 10  0.189E-01  0.000E+00  0.293E+01  0.560E+05
 1983 11  0.192E+00  0.144E+00  0.306E+01  0.591E+05
 1983 12  0.245E+00  0.187E+00  0.308E+01  0.596E+05
 1984  1  0.896E-01  0.640E-01  0.303E+01  0.583E+05
 1984  2  0.371E-01  0.258E-01  0.301E+01  0.579E+05
 1984  3  0.431E+00  0.315E+00  0.313E+01  0.609E+05
 1984  4  0.220E+00  0.169E+00  0.307E+01  0.594E+05
 1984  5  0.488E+00  0.371E+00  0.316E+01  0.615E+05
 1984  6  0.166E+01  0.157E+01  0.355E+01  0.714E+05
 1984  7  0.250E+00  0.194E+00  0.308E+01  0.596E+05
 1984  8  0.304E+00  0.227E+00  0.310E+01  0.600E+05
 1984  9  0.228E+01  0.213E+01  0.369E+01  0.750E+05
 1984 10  0.600E-01  0.171E-01  0.301E+01  0.578E+05
 1984 11  0.689E-01  0.271E-01  0.301E+01  0.579E+05
 1984 12  0.317E-01  0.226E-01  0.301E+01  0.578E+05
 1985  1  0.182E+00  0.132E+00  0.306E+01  0.590E+05
 1985  2  0.133E+00  0.952E-01  0.304E+01  0.586E+05
 1985  3  0.178E+00  0.128E+00  0.305E+01  0.589E+05
 1985  4  0.651E+00  0.486E+00  0.321E+01  0.627E+05
 1985  5  0.491E+00  0.448E+00  0.319E+01  0.623E+05
 1985  6  0.848E+00  0.630E+00  0.327E+01  0.642E+05
 1985  7  0.871E+00  0.684E+00  0.329E+01  0.648E+05
 1985  8  0.119E+01  0.101E+01  0.342E+01  0.679E+05
 1985  9  0.962E+01  0.913E+01  0.496E+01  0.111E+06
 1985 10  0.142E+00  0.855E-01  0.304E+01  0.585E+05
 1985 11  0.146E+00  0.105E+00  0.304E+01  0.587E+05
 1985 12  0.285E+00  0.221E+00  0.309E+01  0.599E+05
 1986  1  0.163E-01  0.114E-01  0.300E+01  0.577E+05
 1986  2  0.530E+00  0.401E+00  0.317E+01  0.618E+05
 1986  3  0.829E-01  0.660E-01  0.303E+01  0.583E+05
 1986  4  0.176E+00  0.111E+00  0.305E+01  0.588E+05
 1986  5  0.988E+00  0.761E+00  0.332E+01  0.656E+05
 1986  6  0.304E+01  0.272E+01  0.383E+01  0.786E+05
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 1986  7  0.224E+01  0.201E+01  0.366E+01  0.742E+05
 1986  8  0.500E+00  0.305E+00  0.313E+01  0.608E+05
 1986  9  0.194E+01  0.155E+01  0.355E+01  0.713E+05
 1986 10  0.105E+00  0.854E-01  0.304E+01  0.585E+05
 1986 11  0.572E+00  0.420E+00  0.318E+01  0.620E+05
 1986 12  0.396E-01  0.282E-01  0.301E+01  0.579E+05
 1987  1  0.399E-01  0.280E-01  0.301E+01  0.579E+05
 1987  2  0.615E-01  0.437E-01  0.302E+01  0.581E+05
 1987  3  0.325E+00  0.233E+00  0.310E+01  0.601E+05
 1987  4  0.333E+00  0.257E+00  0.311E+01  0.603E+05
 1987  5  0.120E+00  0.807E-01  0.303E+01  0.584E+05
 1987  6  0.229E+00  0.104E+00  0.304E+01  0.587E+05
 1987  7  0.218E+01  0.184E+01  0.362E+01  0.732E+05
 1987  8  0.152E+01  0.130E+01  0.349E+01  0.698E+05
 1987  9  0.630E+00  0.495E+00  0.321E+01  0.628E+05
 1987 10  0.251E-01  0.000E+00  0.298E+01  0.572E+05
 1987 11  0.139E+00  0.486E-01  0.302E+01  0.581E+05
 1987 12  0.189E+00  0.130E+00  0.306E+01  0.590E+05
 1988  1  0.175E+00  0.126E+00  0.305E+01  0.589E+05
 1988  2  0.167E+00  0.119E+00  0.305E+01  0.588E+05
 1988  3  0.144E+00  0.102E+00  0.304E+01  0.587E+05
 1988  4  0.000E+00  0.000E+00  0.300E+01  0.576E+05
 1988  5  0.250E+00  0.166E+00  0.307E+01  0.593E+05
 1988  6  0.210E+01  0.174E+01  0.359E+01  0.725E+05
 1988  7  0.160E+01  0.129E+01  0.348E+01  0.697E+05
 1988  8  0.386E+01  0.370E+01  0.402E+01  0.838E+05
 1988  9  0.335E+00  0.239E+00  0.310E+01  0.601E+05
 1988 10  0.000E+00  0.000E+00  0.298E+01  0.570E+05
 1988 11  0.103E+00  0.718E-01  0.303E+01  0.584E+05
 1988 12  0.606E-01  0.525E-01  0.302E+01  0.582E+05
 1989  1  0.801E+00  0.652E+00  0.328E+01  0.645E+05
 1989  2  0.151E+00  0.108E+00  0.305E+01  0.587E+05
 1989  3  0.271E+00  0.202E+00  0.309E+01  0.597E+05
 1989  4  0.269E+00  0.205E+00  0.309E+01  0.598E+05
 1989  5  0.209E+00  0.168E+00  0.307E+01  0.594E+05
 1989  6  0.579E+00  0.423E+00  0.318E+01  0.620E+05
 1989  7  0.124E+01  0.963E+00  0.341E+01  0.676E+05
 1989  8  0.945E+00  0.667E+00  0.328E+01  0.646E+05
 1989  9  0.734E+00  0.581E+00  0.325E+01  0.637E+05
 1989 10  0.455E-01  0.212E-01  0.301E+01  0.578E+05
 1989 11  0.125E+00  0.106E+00  0.305E+01  0.587E+05
 1989 12  0.364E+00  0.259E+00  0.311E+01  0.603E+05
 1990  1  0.193E-01  0.137E-01  0.301E+01  0.577E+05
 1990  2  0.139E+00  0.993E-01  0.304E+01  0.586E+05
 1990  3  0.722E-01  0.553E-01  0.302E+01  0.582E+05
 1990  4  0.343E+00  0.252E+00  0.311E+01  0.602E+05
 1990  5  0.141E+01  0.114E+01  0.345E+01  0.688E+05
 1990  6  0.986E+00  0.844E+00  0.336E+01  0.665E+05
 1990  7  0.834E+00  0.650E+00  0.328E+01  0.644E+05
 1990  8  0.191E+01  0.151E+01  0.354E+01  0.711E+05
 1990  9  0.202E+00  0.114E+00  0.305E+01  0.588E+05
 1990 10  0.162E+00  0.600E-01  0.303E+01  0.582E+05
 1990 11  0.487E+00  0.377E+00  0.316E+01  0.616E+05
 1990 12  0.146E+00  0.119E+00  0.305E+01  0.588E+05
 1991  1  0.794E-01  0.615E-01  0.303E+01  0.582E+05
 1991  2  0.993E-01  0.904E-01  0.304E+01  0.585E+05
 1991  3  0.430E+00  0.320E+00  0.314E+01  0.610E+05
 1991  4  0.537E-01  0.293E-01  0.301E+01  0.579E+05
 1991  5  0.822E+00  0.706E+00  0.330E+01  0.650E+05
 1991  6  0.252E+01  0.222E+01  0.371E+01  0.756E+05
 1991  7  0.256E+00  0.176E+00  0.307E+01  0.594E+05
 1991  8  0.185E+01  0.150E+01  0.353E+01  0.710E+05
 1991  9  0.841E+00  0.565E+00  0.324E+01  0.635E+05
 1991 10  0.220E-01  0.000E+00  0.297E+01  0.568E+05
 1991 11  0.399E+00  0.282E+00  0.312E+01  0.606E+05
 1991 12  0.266E-01  0.185E-01  0.301E+01  0.578E+05
 1992  1  0.443E-01  0.310E-01  0.301E+01  0.579E+05
 1992  2  0.102E+00  0.728E-01  0.303E+01  0.584E+05
 1992  3  0.418E+00  0.351E+00  0.315E+01  0.613E+05
 1992  4  0.259E+00  0.192E+00  0.308E+01  0.596E+05
 1992  5  0.696E+00  0.531E+00  0.323E+01  0.632E+05
 1992  6  0.511E+01  0.490E+01  0.424E+01  0.902E+05
 1992  7  0.191E+01  0.860E+00  0.337E+01  0.666E+05
 1992  8  0.180E+01  0.145E+01  0.352E+01  0.707E+05
 1992  9  0.622E+00  0.525E+00  0.322E+01  0.631E+05
 1992 10  0.239E+00  0.159E+00  0.307E+01  0.593E+05
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1992 11  0.415E+00  0.313E+00  0.313E+01  0.609E+05
1992 12  0.267E+00  0.195E+00  0.308E+01  0.596E+05
1993  1  0.439E+00  0.323E+00  0.314E+01  0.610E+05
1993  2  0.348E+00  0.284E+00  0.312E+01  0.606E+05
1993  3  0.195E+00  0.167E+00  0.307E+01  0.594E+05
1993  4  0.426E-01  0.306E-01  0.301E+01  0.579E+05
1993  5  0.753E+00  0.656E+00  0.328E+01  0.645E+05
1993  6  0.373E+01  0.322E+01  0.392E+01  0.813E+05
1993  7  0.113E+01  0.818E+00  0.335E+01  0.662E+05
1993  8  0.230E+01  0.196E+01  0.365E+01  0.739E+05
1993  9  0.276E+00  0.196E+00  0.308E+01  0.597E+05
1993 10  0.000E+00  0.000E+00  0.296E+01  0.568E+05
1993 11  0.412E+00  0.259E+00  0.311E+01  0.603E+05
1993 12  0.429E-01  0.307E-01  0.301E+01  0.579E+05
1994  1  0.269E+00  0.191E+00  0.308E+01  0.596E+05
1994  2  0.187E+00  0.134E+00  0.306E+01  0.590E+05
1994  3  0.381E+00  0.282E+00  0.312E+01  0.606E+05
1994  4  0.511E+00  0.387E+00  0.316E+01  0.617E+05
1994  5  0.842E+00  0.718E+00  0.331E+01  0.651E+05
1994  6  0.205E+01  0.164E+01  0.357E+01  0.719E+05
1994  7  0.111E+01  0.781E+00  0.333E+01  0.658E+05
1994  8  0.118E+01  0.115E+01  0.345E+01  0.688E+05
1994  9  0.169E+00  0.114E+00  0.305E+01  0.588E+05
1994 10  0.425E+00  0.298E+00  0.313E+01  0.607E+05
1994 11  0.153E+00  0.113E+00  0.305E+01  0.588E+05
1994 12  0.326E-01  0.231E-01  0.301E+01  0.578E+05
1995  1  0.928E-01  0.651E-01  0.303E+01  0.583E+05
1995  2  0.335E-01  0.260E-01  0.301E+01  0.579E+05
1995  3  0.315E+00  0.224E+00  0.310E+01  0.600E+05
1995  4  0.446E+00  0.345E+00  0.315E+01  0.612E+05
1995  5  0.797E+00  0.664E+00  0.328E+01  0.646E+05
1995  6  0.107E+01  0.930E+00  0.340E+01  0.674E+05
1995  7  0.208E+01  0.177E+01  0.360E+01  0.727E+05
1995  8  0.221E+00  0.185E+00  0.308E+01  0.595E+05
1995  9  0.857E+00  0.636E+00  0.327E+01  0.643E+05
1995 10  0.201E+00  0.136E+00  0.306E+01  0.590E+05
1995 11  0.437E+00  0.304E+00  0.313E+01  0.608E+05
1995 12  0.786E+00  0.584E+00  0.325E+01  0.637E+05
1996  1  0.110E+01  0.813E+00  0.335E+01  0.661E+05
1996  2  0.444E+00  0.324E+00  0.314E+01  0.610E+05
1996  3  0.238E+00  0.171E+00  0.307E+01  0.594E+05
1996  4  0.978E+00  0.832E+00  0.335E+01  0.663E+05
1996  5  0.726E+00  0.551E+00  0.323E+01  0.634E+05
1996  6  0.182E+01  0.163E+01  0.357E+01  0.718E+05
1996  7  0.990E+00  0.727E+00  0.331E+01  0.652E+05
1996  8  0.454E+00  0.363E+00  0.315E+01  0.614E+05
1996  9  0.593E+00  0.476E+00  0.320E+01  0.626E+05
1996 10  0.191E+00  0.135E+00  0.306E+01  0.590E+05
1996 11  0.112E+01  0.860E+00  0.337E+01  0.666E+05
1996 12  0.372E+00  0.278E+00  0.312E+01  0.605E+05
1997  1  0.821E+00  0.592E+00  0.325E+01  0.638E+05
1997  2  0.207E-01  0.165E-01  0.301E+01  0.578E+05
1997  3  0.390E+00  0.278E+00  0.312E+01  0.605E+05
1997  4  0.462E+00  0.331E+00  0.314E+01  0.611E+05
1997  5  0.296E+01  0.266E+01  0.381E+01  0.783E+05
1997  6  0.604E+01  0.570E+01  0.438E+01  0.943E+05
1997  7  0.142E+00  0.970E-01  0.304E+01  0.586E+05
1997  8  0.187E+01  0.175E+01  0.360E+01  0.726E+05
1997  9  0.344E+00  0.286E+00  0.312E+01  0.606E+05
1997 10  0.000E+00  0.000E+00  0.295E+01  0.564E+05
1997 11  0.930E-01  0.000E+00  0.298E+01  0.571E+05
1997 12  0.156E+00  0.122E+00  0.305E+01  0.589E+05
============ MONTHLY MINIMUMS ==========
  DATE    INFLOW     OUTFLOW     STAGE     VOLUME
           (CMS)      (CMS)       (M)      (M**3)
1960  1  0.000E+00  0.000E+00  0.300E+01  0.576E+05
1960  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
1960  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
1960  4  0.000E+00  0.000E+00  0.296E+01  0.567E+05
1960  5  0.000E+00  0.000E+00  0.297E+01  0.569E+05
1960  6  0.000E+00  0.000E+00  0.296E+01  0.565E+05
1960  7  0.000E+00  0.000E+00  0.291E+01  0.556E+05
1960  8  0.000E+00  0.000E+00  0.295E+01  0.564E+05
1960  9  0.000E+00  0.000E+00  0.293E+01  0.559E+05
1960 10  0.000E+00  0.000E+00  0.290E+01  0.551E+05
1960 11  0.000E+00  0.000E+00  0.290E+01  0.551E+05
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 1960 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1961  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1961  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1961  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1961  4  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1961  5  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1961  6  0.000E+00  0.000E+00  0.287E+01  0.544E+05
 1961  7  0.000E+00  0.000E+00  0.285E+01  0.541E+05
 1961  8  0.000E+00  0.000E+00  0.290E+01  0.553E+05
 1961  9  0.000E+00  0.000E+00  0.291E+01  0.554E+05
 1961 10  0.000E+00  0.000E+00  0.289E+01  0.551E+05
 1961 11  0.000E+00  0.000E+00  0.289E+01  0.551E+05
 1961 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1962  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1962  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1962  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1962  4  0.000E+00  0.000E+00  0.296E+01  0.568E+05
 1962  5  0.000E+00  0.000E+00  0.294E+01  0.563E+05
 1962  6  0.000E+00  0.000E+00  0.297E+01  0.568E+05
 1962  7  0.000E+00  0.000E+00  0.292E+01  0.556E+05
 1962  8  0.000E+00  0.000E+00  0.293E+01  0.559E+05
 1962  9  0.000E+00  0.000E+00  0.290E+01  0.553E+05
 1962 10  0.000E+00  0.000E+00  0.288E+01  0.547E+05
 1962 11  0.000E+00  0.000E+00  0.296E+01  0.566E+05
 1962 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1963  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1963  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1963  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1963  4  0.000E+00  0.000E+00  0.299E+01  0.573E+05
 1963  5  0.000E+00  0.000E+00  0.291E+01  0.554E+05
 1963  6  0.000E+00  0.000E+00  0.294E+01  0.562E+05
 1963  7  0.000E+00  0.000E+00  0.295E+01  0.565E+05
 1963  8  0.000E+00  0.000E+00  0.292E+01  0.557E+05
 1963  9  0.000E+00  0.000E+00  0.288E+01  0.547E+05
 1963 10  0.000E+00  0.000E+00  0.286E+01  0.544E+05
 1963 11  0.000E+00  0.000E+00  0.286E+01  0.544E+05
 1963 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1964  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1964  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1964  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1964  4  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1964  5  0.000E+00  0.000E+00  0.294E+01  0.563E+05
 1964  6  0.000E+00  0.000E+00  0.294E+01  0.561E+05
 1964  7  0.000E+00  0.000E+00  0.285E+01  0.540E+05
 1964  8  0.000E+00  0.000E+00  0.286E+01  0.543E+05
 1964  9  0.000E+00  0.000E+00  0.289E+01  0.549E+05
 1964 10  0.000E+00  0.000E+00  0.294E+01  0.563E+05
 1964 11  0.000E+00  0.000E+00  0.294E+01  0.563E+05
 1964 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1965  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1965  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1965  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1965  4  0.000E+00  0.000E+00  0.298E+01  0.572E+05
 1965  5  0.000E+00  0.000E+00  0.294E+01  0.562E+05
 1965  6  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1965  7  0.000E+00  0.000E+00  0.296E+01  0.566E+05
 1965  8  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1965  9  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1965 10  0.000E+00  0.000E+00  0.293E+01  0.561E+05
 1965 11  0.000E+00  0.000E+00  0.300E+01  0.575E+05
 1965 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1966  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1966  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1966  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1966  4  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1966  5  0.000E+00  0.000E+00  0.295E+01  0.563E+05
 1966  6  0.000E+00  0.000E+00  0.296E+01  0.566E+05
 1966  7  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1966  8  0.000E+00  0.000E+00  0.293E+01  0.560E+05
 1966  9  0.000E+00  0.000E+00  0.288E+01  0.547E+05
 1966 10  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1966 11  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1966 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1967  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1967  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1967  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
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 1967  4  0.000E+00  0.000E+00  0.299E+01  0.574E+05
 1967  5  0.000E+00  0.000E+00  0.297E+01  0.570E+05
 1967  6  0.000E+00  0.000E+00  0.294E+01  0.562E+05
 1967  7  0.000E+00  0.000E+00  0.284E+01  0.537E+05
 1967  8  0.000E+00  0.000E+00  0.281E+01  0.530E+05
 1967  9  0.000E+00  0.000E+00  0.273E+01  0.512E+05
 1967 10  0.000E+00  0.000E+00  0.272E+01  0.511E+05
 1967 11  0.000E+00  0.000E+00  0.296E+01  0.566E+05
 1967 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1968  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1968  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1968  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1968  4  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1968  5  0.000E+00  0.000E+00  0.293E+01  0.559E+05
 1968  6  0.000E+00  0.000E+00  0.289E+01  0.550E+05
 1968  7  0.000E+00  0.000E+00  0.289E+01  0.550E+05
 1968  8  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1968  9  0.000E+00  0.000E+00  0.296E+01  0.566E+05
 1968 10  0.000E+00  0.000E+00  0.290E+01  0.552E+05
 1968 11  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1968 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1969  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
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 1969  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1969  4  0.000E+00  0.000E+00  0.295E+01  0.565E+05
 1969  5  0.000E+00  0.000E+00  0.293E+01  0.559E+05
 1969  6  0.000E+00  0.000E+00  0.290E+01  0.552E+05
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 1969  9  0.000E+00  0.000E+00  0.297E+01  0.570E+05
 1969 10  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1969 11  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1969 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1970  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1970  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1970  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1970  4  0.000E+00  0.000E+00  0.299E+01  0.573E+05
 1970  5  0.000E+00  0.000E+00  0.295E+01  0.565E+05
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 1970 10  0.000E+00  0.000E+00  0.295E+01  0.564E+05
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 1971  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1971  4  0.000E+00  0.000E+00  0.299E+01  0.573E+05
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 1971 11  0.000E+00  0.000E+00  0.294E+01  0.562E+05
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 1973  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
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 1973 11  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1973 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1974  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
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 1975  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1975  4  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1975  5  0.000E+00  0.000E+00  0.297E+01  0.569E+05
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 1975  8  0.000E+00  0.000E+00  0.297E+01  0.568E+05
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 1975 10  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1975 11  0.000E+00  0.000E+00  0.297E+01  0.570E+05
 1975 12  0.000E+00  0.000E+00  0.298E+01  0.571E+05
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 1976  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1976  4  0.000E+00  0.000E+00  0.297E+01  0.570E+05
 1976  5  0.000E+00  0.000E+00  0.297E+01  0.569E+05
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 1976 10  0.000E+00  0.000E+00  0.294E+01  0.563E+05
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 1977  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
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 1978  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
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 1978  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1978  4  0.000E+00  0.000E+00  0.299E+01  0.575E+05
 1978  5  0.000E+00  0.000E+00  0.297E+01  0.569E+05
 1978  6  0.000E+00  0.000E+00  0.298E+01  0.570E+05
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 1978  8  0.000E+00  0.000E+00  0.296E+01  0.567E+05
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 1978 10  0.000E+00  0.000E+00  0.295E+01  0.563E+05
 1978 11  0.000E+00  0.000E+00  0.298E+01  0.572E+05
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 1979  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1979  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1979  4  0.000E+00  0.000E+00  0.298E+01  0.572E+05
 1979  5  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1979  6  0.000E+00  0.000E+00  0.288E+01  0.547E+05
 1979  7  0.000E+00  0.000E+00  0.292E+01  0.557E+05
 1979  8  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1979  9  0.000E+00  0.000E+00  0.294E+01  0.561E+05
 1979 10  0.000E+00  0.000E+00  0.295E+01  0.564E+05
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```

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 1980  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1980  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1980  4  0.000E+00  0.000E+00  0.296E+01  0.566E+05
 1980  5  0.000E+00  0.000E+00  0.285E+01  0.540E+05
 1980  6  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1980  7  0.000E+00  0.000E+00  0.293E+01  0.560E+05
 1980  8  0.000E+00  0.000E+00  0.297E+01  0.569E+05
 1980  9  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1980 10  0.000E+00  0.000E+00  0.297E+01  0.569E+05
 1980 11  0.000E+00  0.000E+00  0.297E+01  0.569E+05
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 1981  5  0.000E+00  0.000E+00  0.294E+01  0.562E+05
 1981  6  0.000E+00  0.000E+00  0.298E+01  0.572E+05
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 1981  9  0.000E+00  0.000E+00  0.294E+01  0.562E+05
 1981 10  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1981 11  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1981 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1982  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1982  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1982  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1982  4  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1982  5  0.000E+00  0.000E+00  0.297E+01  0.569E+05
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 1982  9  0.000E+00  0.000E+00  0.295E+01  0.565E+05
 1982 10  0.000E+00  0.000E+00  0.292E+01  0.558E+05
 1982 11  0.000E+00  0.000E+00  0.292E+01  0.558E+05
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 1984 10  0.000E+00  0.000E+00  0.294E+01  0.562E+05
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 1987 11  0.000E+00  0.000E+00  0.291E+01  0.555E+05
 1987 12  0.000E+00  0.000E+00  0.299E+01  0.574E+05
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 1988  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1988  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1988  4  0.000E+00  0.000E+00  0.291E+01  0.555E+05
 1988  5  0.000E+00  0.000E+00  0.283E+01  0.535E+05
 1988  6  0.000E+00  0.000E+00  0.293E+01  0.558E+05
 1988  7  0.000E+00  0.000E+00  0.289E+01  0.551E+05
 1988  8  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1988  9  0.000E+00  0.000E+00  0.293E+01  0.559E+05
 1988 10  0.000E+00  0.000E+00  0.291E+01  0.555E+05
 1988 11  0.000E+00  0.000E+00  0.291E+01  0.555E+05
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 1989  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1989  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1989  4  0.000E+00  0.000E+00  0.298E+01  0.572E+05
 1989  5  0.000E+00  0.000E+00  0.295E+01  0.565E+05
 1989  6  0.000E+00  0.000E+00  0.297E+01  0.569E+05
 1989  7  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1989  8  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1989  9  0.000E+00  0.000E+00  0.295E+01  0.565E+05
 1989 10  0.000E+00  0.000E+00  0.294E+01  0.563E+05
 1989 11  0.000E+00  0.000E+00  0.294E+01  0.563E+05
 1989 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1990  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1990  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1990  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1990  4  0.000E+00  0.000E+00  0.298E+01  0.570E+05
 1990  5  0.000E+00  0.000E+00  0.298E+01  0.572E+05
 1990  6  0.000E+00  0.000E+00  0.296E+01  0.566E+05
 1990  7  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1990  8  0.000E+00  0.000E+00  0.294E+01  0.561E+05
 1990  9  0.000E+00  0.000E+00  0.292E+01  0.557E+05
 1990 10  0.000E+00  0.000E+00  0.291E+01  0.554E+05
 1990 11  0.000E+00  0.000E+00  0.293E+01  0.561E+05
 1990 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1991  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1991  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1991  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1991  4  0.000E+00  0.000E+00  0.294E+01  0.561E+05
 1991  5  0.000E+00  0.000E+00  0.297E+01  0.570E+05
 1991  6  0.000E+00  0.000E+00  0.295E+01  0.565E+05
 1991  7  0.000E+00  0.000E+00  0.296E+01  0.566E+05
 1991  8  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1991  9  0.000E+00  0.000E+00  0.294E+01  0.563E+05
 1991 10  0.000E+00  0.000E+00  0.290E+01  0.553E+05
 1991 11  0.000E+00  0.000E+00  0.290E+01  0.553E+05
 1991 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1992  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1992  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1992  3  0.000E+00  0.000E+00  0.299E+01  0.573E+05
 1992  4  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1992  5  0.000E+00  0.000E+00  0.297E+01  0.569E+05
 1992  6  0.000E+00  0.000E+00  0.296E+01  0.566E+05
 1992  7  0.000E+00  0.000E+00  0.298E+01  0.571E+05
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 1992  8  0.000E+00  0.000E+00  0.291E+01  0.554E+05
 1992  9  0.000E+00  0.000E+00  0.295E+01  0.563E+05
 1992 10  0.000E+00  0.000E+00  0.297E+01  0.570E+05
 1992 11  0.000E+00  0.000E+00  0.299E+01  0.573E+05
 1992 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1993  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1993  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1993  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1993  4  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1993  5  0.000E+00  0.000E+00  0.295E+01  0.565E+05
 1993  6  0.000E+00  0.000E+00  0.294E+01  0.562E+05
 1993  7  0.000E+00  0.000E+00  0.298E+01  0.572E+05
 1993  8  0.000E+00  0.000E+00  0.297E+01  0.568E+05
 1993  9  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1993 10  0.000E+00  0.000E+00  0.290E+01  0.552E+05
 1993 11  0.000E+00  0.000E+00  0.290E+01  0.552E+05
 1993 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1994  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1994  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1994  3  0.000E+00  0.000E+00  0.299E+01  0.573E+05
 1994  4  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1994  5  0.000E+00  0.000E+00  0.297E+01  0.568E+05
 1994  6  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1994  7  0.000E+00  0.000E+00  0.294E+01  0.562E+05
 1994  8  0.000E+00  0.000E+00  0.291E+01  0.555E+05
 1994  9  0.000E+00  0.000E+00  0.291E+01  0.556E+05
 1994 10  0.000E+00  0.000E+00  0.291E+01  0.556E+05
 1994 11  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1994 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1995  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1995  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1995  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1995  4  0.000E+00  0.000E+00  0.299E+01  0.573E+05
 1995  5  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1995  6  0.000E+00  0.000E+00  0.294E+01  0.563E+05
 1995  7  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1995  8  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1995  9  0.000E+00  0.000E+00  0.294E+01  0.562E+05
 1995 10  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1995 11  0.000E+00  0.000E+00  0.296E+01  0.567E+05
 1995 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1996  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1996  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1996  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1996  4  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1996  5  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1996  6  0.000E+00  0.000E+00  0.294E+01  0.561E+05
 1996  7  0.000E+00  0.000E+00  0.296E+01  0.568E+05
 1996  8  0.000E+00  0.000E+00  0.285E+01  0.540E+05
 1996  9  0.000E+00  0.000E+00  0.284E+01  0.538E+05
 1996 10  0.000E+00  0.000E+00  0.296E+01  0.568E+05
 1996 11  0.000E+00  0.000E+00  0.299E+01  0.575E+05
 1996 12  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1997  1  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1997  2  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1997  3  0.000E+00  0.560E-06  0.300E+01  0.576E+05
 1997  4  0.000E+00  0.000E+00  0.298E+01  0.572E+05
 1997  5  0.000E+00  0.000E+00  0.293E+01  0.560E+05
 1997  6  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 1997  7  0.000E+00  0.000E+00  0.291E+01  0.555E+05
 1997  8  0.000E+00  0.000E+00  0.296E+01  0.565E+05
 1997  9  0.000E+00  0.000E+00  0.295E+01  0.564E+05
 1997 10  0.000E+00  0.000E+00  0.288E+01  0.548E+05
 1997 11  0.000E+00  0.000E+00  0.288E+01  0.548E+05
 1997 12  0.000E+00  0.000E+00  0.298E+01  0.571E+05
 =========== ANNUAL MAXIMUMS ==========
   DATE    INFLOW     OUTFLOW     STAGE     VOLUME
           (CMS)       (CMS)       (M)       (M**3)
  1960    0.101E+01  0.797E+00  0.334E+01  0.660E+05
  1961    0.197E+01  0.159E+01  0.356E+01  0.716E+05
  1962    0.135E+01  0.125E+01  0.348E+01  0.694E+05
  1963    0.437E+01  0.404E+01  0.408E+01  0.857E+05
  1964    0.390E+01  0.315E+01  0.391E+01  0.809E+05
  1965    0.524E+01  0.431E+01  0.413E+01  0.871E+05
  1966    0.599E+01  0.518E+01  0.429E+01  0.916E+05
  1967    0.120E+01  0.858E+00  0.337E+01  0.666E+05
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  1968    0.272E+01  0.238E+01  0.375E+01  0.766E+05
  1969    0.270E+01  0.246E+01  0.377E+01  0.771E+05
  1970    0.534E+01  0.511E+01  0.428E+01  0.913E+05
  1971    0.182E+01  0.166E+01  0.357E+01  0.720E+05
  1972    0.453E+01  0.408E+01  0.409E+01  0.859E+05
  1973    0.145E+01  0.120E+01  0.346E+01  0.691E+05
  1974    0.192E+01  0.161E+01  0.356E+01  0.717E+05
  1975    0.729E+00  0.509E+00  0.322E+01  0.629E+05
  1976    0.364E+01  0.317E+01  0.391E+01  0.810E+05
  1977    0.211E+01  0.167E+01  0.358E+01  0.721E+05
  1978    0.439E+01  0.421E+01  0.412E+01  0.866E+05
  1979    0.188E+01  0.155E+01  0.355E+01  0.713E+05
  1980    0.231E+01  0.201E+01  0.366E+01  0.742E+05
  1981    0.281E+01  0.274E+01  0.383E+01  0.787E+05
  1982    0.138E+01  0.994E+00  0.341E+01  0.678E+05
  1983    0.188E+01  0.160E+01  0.356E+01  0.716E+05
  1984    0.228E+01  0.213E+01  0.369E+01  0.750E+05
  1985    0.962E+01  0.913E+01  0.496E+01  0.111E+06
  1986    0.304E+01  0.272E+01  0.383E+01  0.786E+05
  1987    0.218E+01  0.184E+01  0.362E+01  0.732E+05
  1988    0.386E+01  0.370E+01  0.402E+01  0.838E+05
  1989    0.124E+01  0.963E+00  0.341E+01  0.676E+05
  1990    0.191E+01  0.151E+01  0.354E+01  0.711E+05
  1991    0.252E+01  0.222E+01  0.371E+01  0.756E+05
  1992    0.511E+01  0.490E+01  0.424E+01  0.902E+05
  1993    0.373E+01  0.322E+01  0.392E+01  0.813E+05
  1994    0.205E+01  0.164E+01  0.357E+01  0.719E+05
  1995    0.208E+01  0.177E+01  0.360E+01  0.727E+05
  1996    0.182E+01  0.163E+01  0.357E+01  0.718E+05
  1997    0.604E+01  0.570E+01  0.438E+01  0.943E+05
 ============ ANNUAL MINIMUMS ===========
   DATE    INFLOW     OUTFLOW     STAGE     VOLUME
           (CMS)       (CMS)       (M)       (M**3)
  1960    0.000E+00  0.000E+00  0.290E+01  0.551E+05
  1961    0.000E+00  0.000E+00  0.285E+01  0.541E+05
  1962    0.000E+00  0.000E+00  0.288E+01  0.547E+05
  1963    0.000E+00  0.000E+00  0.286E+01  0.544E+05
  1964    0.000E+00  0.000E+00  0.285E+01  0.540E+05
  1965    0.000E+00  0.000E+00  0.293E+01  0.561E+05
  1966    0.000E+00  0.000E+00  0.288E+01  0.547E+05
  1967    0.000E+00  0.000E+00  0.272E+01  0.511E+05
  1968    0.000E+00  0.000E+00  0.289E+01  0.550E+05
  1969    0.000E+00  0.000E+00  0.290E+01  0.552E+05
  1970    0.000E+00  0.000E+00  0.287E+01  0.545E+05
  1971    0.000E+00  0.000E+00  0.283E+01  0.537E+05
  1972    0.000E+00  0.000E+00  0.292E+01  0.558E+05
  1973    0.000E+00  0.000E+00  0.287E+01  0.546E+05
  1974    0.000E+00  0.000E+00  0.284E+01  0.539E+05
  1975    0.000E+00  0.000E+00  0.295E+01  0.564E+05
  1976    0.000E+00  0.000E+00  0.291E+01  0.555E+05
  1977    0.000E+00  0.000E+00  0.292E+01  0.556E+05
  1978    0.000E+00  0.000E+00  0.294E+01  0.563E+05
  1979    0.000E+00  0.000E+00  0.288E+01  0.547E+05
  1980    0.000E+00  0.000E+00  0.285E+01  0.540E+05
  1981    0.000E+00  0.000E+00  0.294E+01  0.562E+05
  1982    0.000E+00  0.000E+00  0.291E+01  0.554E+05
  1983    0.000E+00  0.000E+00  0.289E+01  0.549E+05
  1984    0.000E+00  0.000E+00  0.279E+01  0.526E+05
  1985    0.000E+00  0.000E+00  0.287E+01  0.545E+05
  1986    0.000E+00  0.000E+00  0.289E+01  0.549E+05
  1987    0.000E+00  0.000E+00  0.287E+01  0.544E+05
  1988    0.000E+00  0.000E+00  0.283E+01  0.535E+05
  1989    0.000E+00  0.000E+00  0.294E+01  0.563E+05
  1990    0.000E+00  0.000E+00  0.291E+01  0.554E+05
  1991    0.000E+00  0.000E+00  0.290E+01  0.553E+05
  1992    0.000E+00  0.000E+00  0.291E+01  0.554E+05
  1993    0.000E+00  0.000E+00  0.290E+01  0.552E+05
  1994    0.000E+00  0.000E+00  0.291E+01  0.555E+05
  1995    0.000E+00  0.000E+00  0.294E+01  0.562E+05
  1996    0.000E+00  0.000E+00  0.284E+01  0.538E+05
  1997    0.000E+00  0.000E+00  0.288E+01  0.548E+05
*
*
*=============================================================================
FINISH
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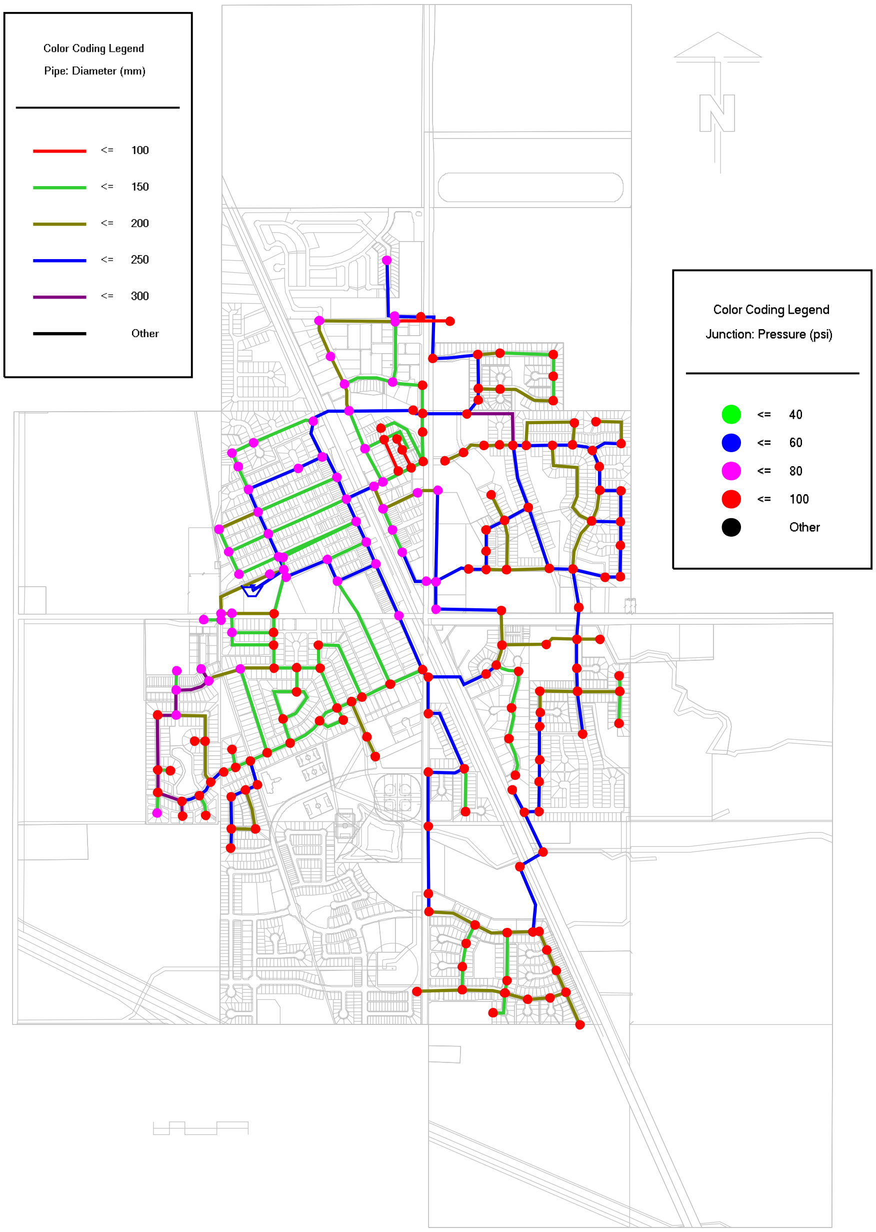
Appendix 4

Water Modelling Results

Scenario: Existing Sys- Peak Hourly Demand

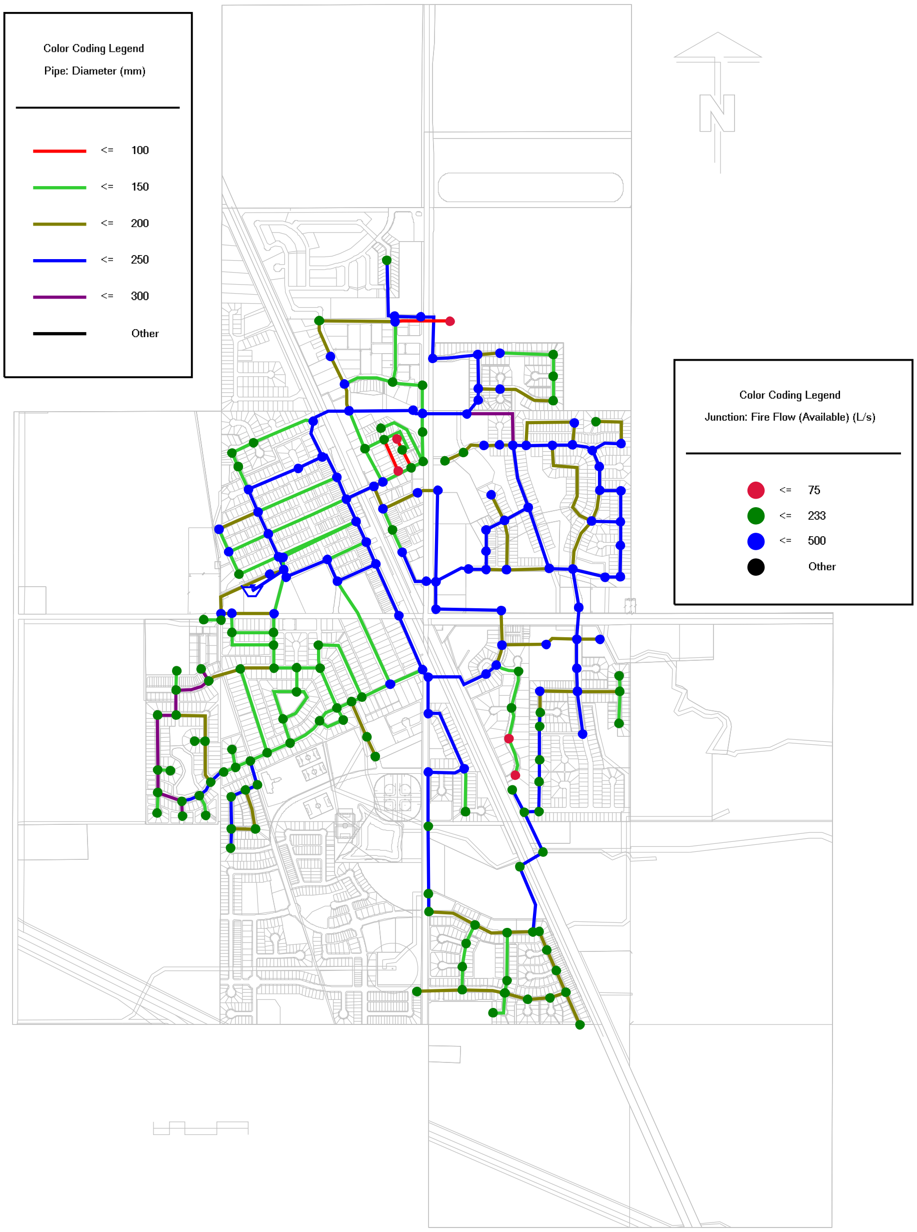


Carstairs Water Model-Rev2.wtg
10/11/15

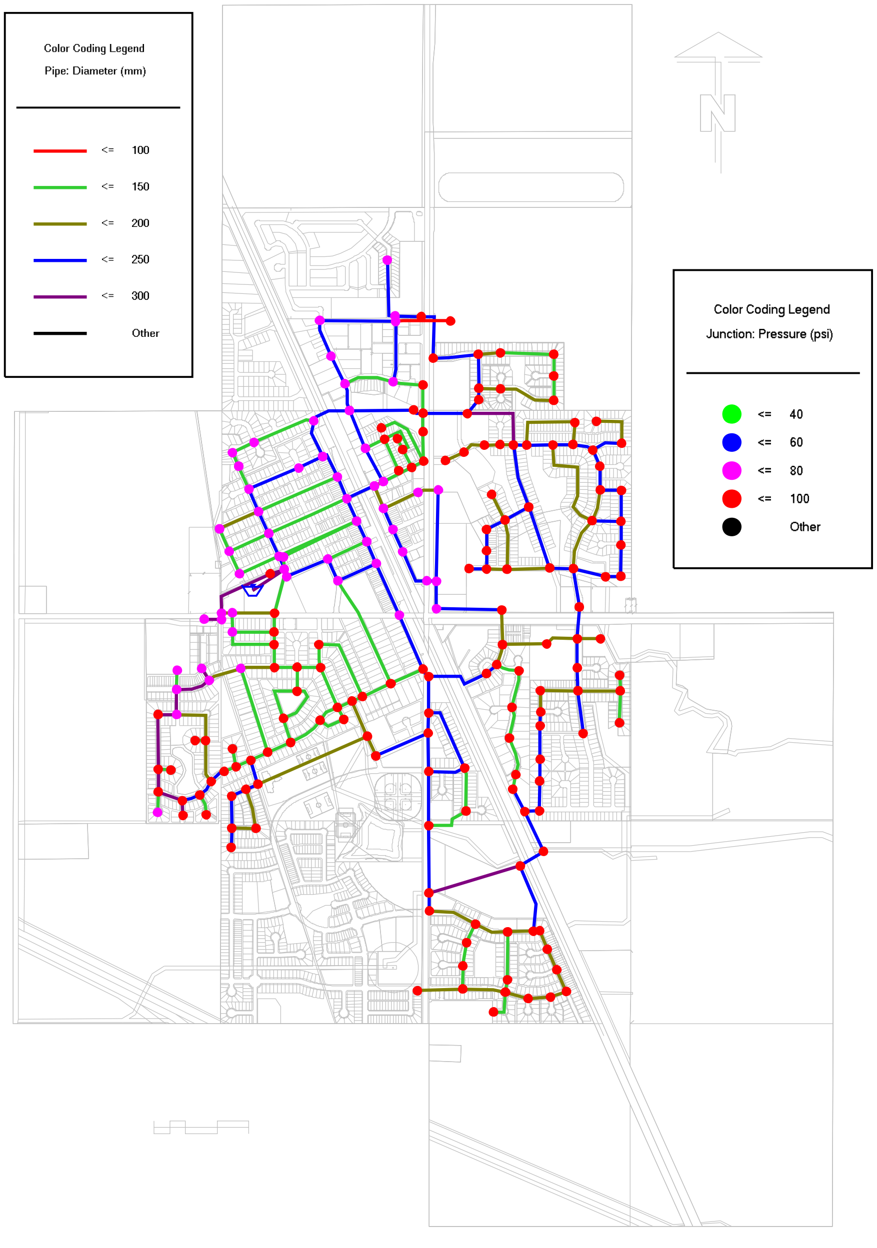
Analyzed By AECOM

Bentley WaterGEMS V8i (SELECTseries 1)
[08.11.01.32]

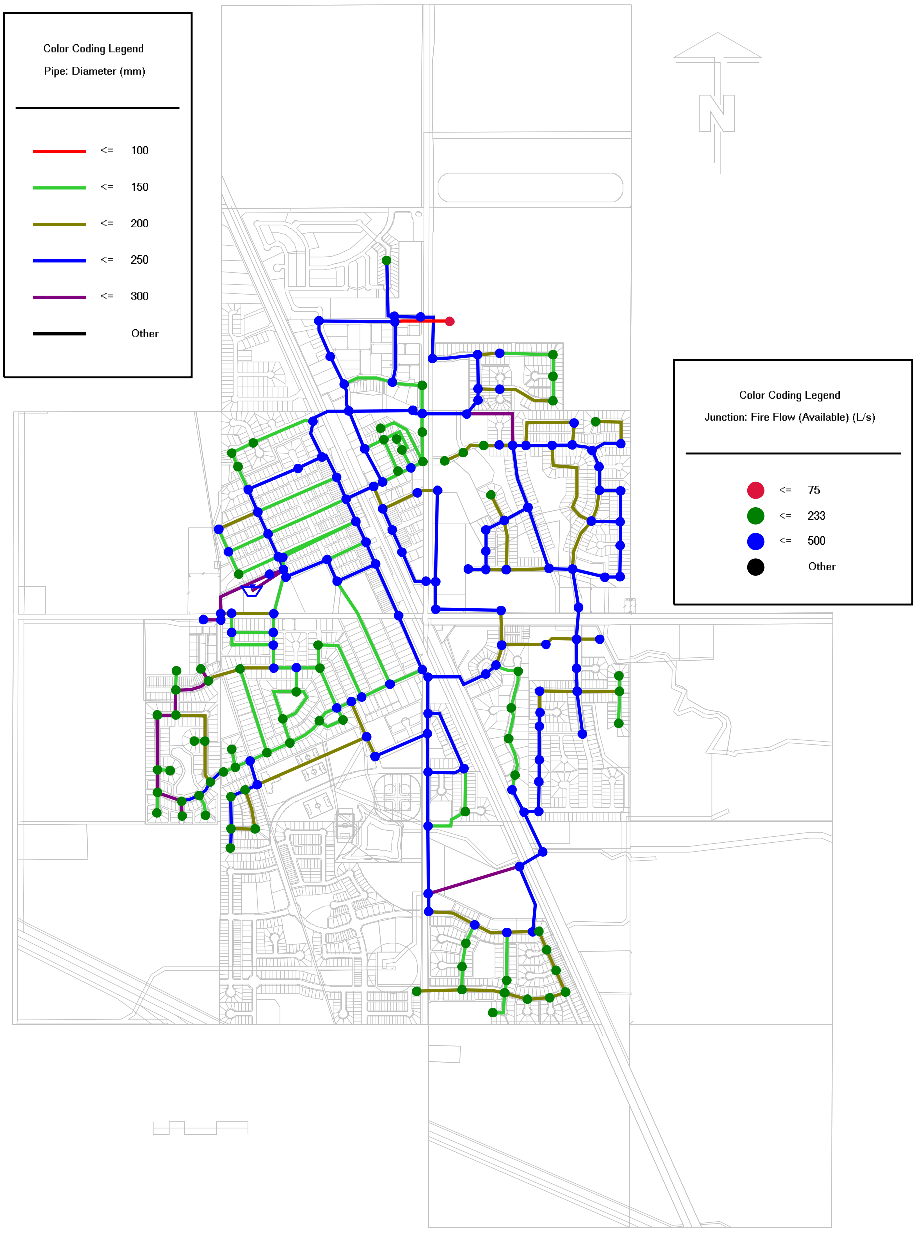
Scenario: Existing Sys- Maximum Daily Demand+ Fire Flow



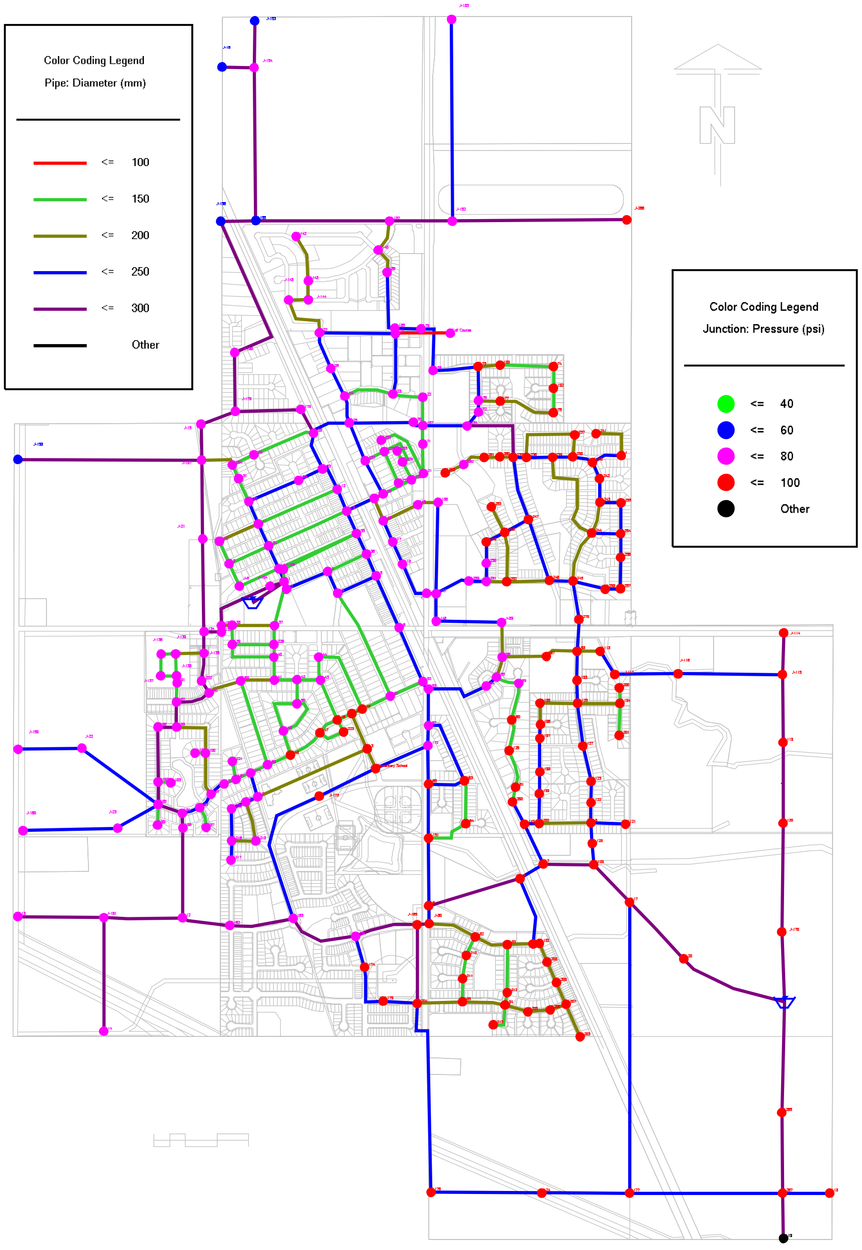
Scenario: Improved Sys-Peak Hourly Demand



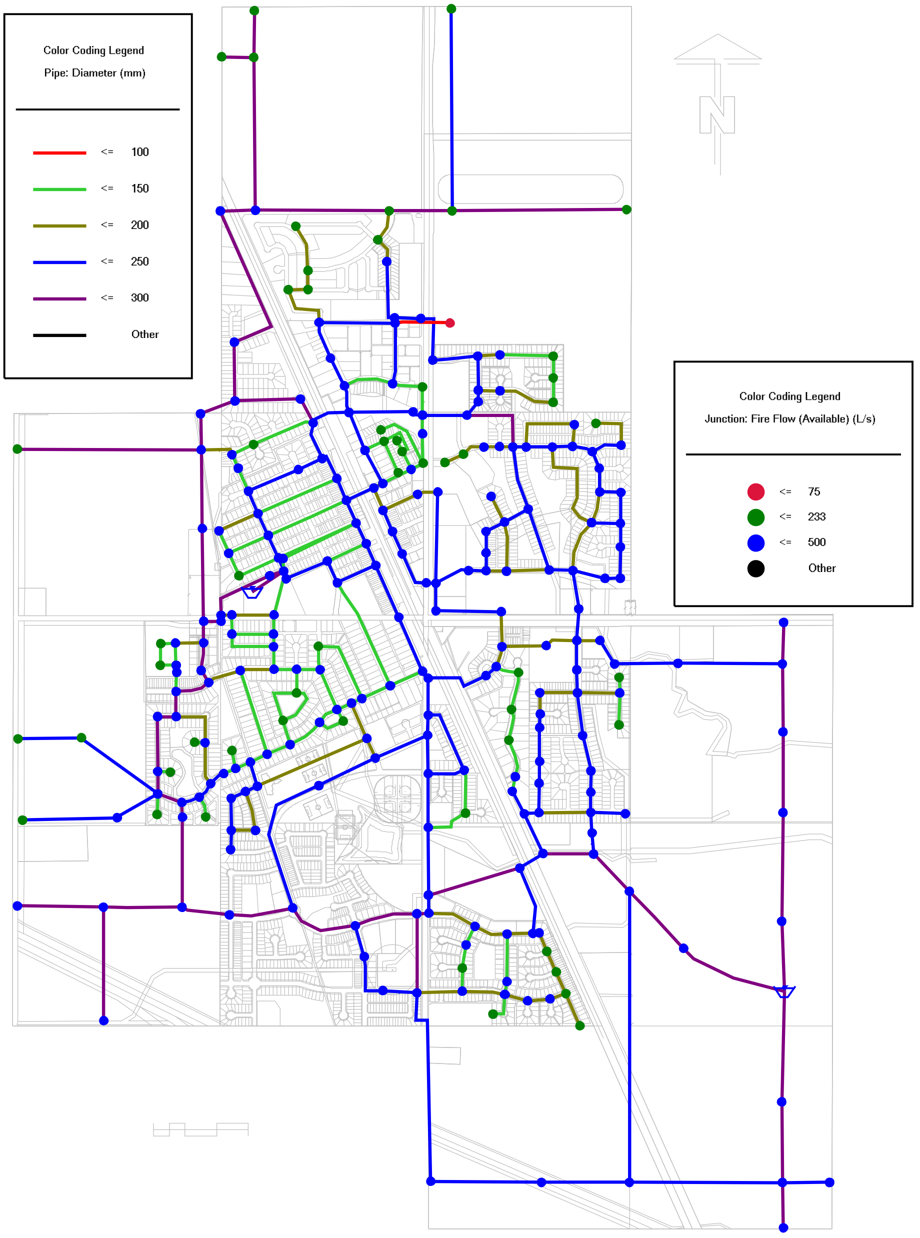
Scenario: Improved Sys-Maximum Daily Demand+ Fire Flow



Scenario: Future Sys- Peak Hourly Demand



Scenario: Future Sys- Maximum Daily Demand+ Fire Flow



Active Scenario: Existing Sys- Peak Hourly Demand

FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-134	1,062.57	0	True	1,114.15	73
J-91	1,061.50	0	True	1,113.51	74
J-27	1,060.77	2	True	1,113.30	75
J-10	1,060.90	0	True	1,113.96	75
J-133	1,061.00	0	True	1,114.15	75
J-146	1,060.14	0	True	1,113.30	75
J-26	1,060.16	0	True	1,113.34	75
J-11	1,060.74	0	True	1,113.94	76
J-5	1,060.51	0	True	1,113.78	76
J-87	1,060.00	1	True	1,113.51	76
J-32	1,060.31	1	True	1,113.86	76
J-36	1,060.16	0	True	1,113.79	76
J-9	1,060.28	1	True	1,114.02	76
J-19	1,059.54	0	True	1,113.30	76
J-39	1,060.29	0	True	1,114.05	76
J-31	1,059.94	1	True	1,113.78	76
J-38	1,060.25	1	True	1,114.14	76
J-34	1,060.13	1	True	1,114.03	77
J-264	1,059.80	0	True	1,113.75	77
J-30	1,059.61	1	True	1,113.69	77
J-105	1,060.00	0	True	1,114.15	77
J-18	1,059.09	1	True	1,113.31	77
J-17	1,059.17	0	True	1,113.40	77
J-35	1,059.54	1	True	1,113.78	77
J-147	1,059.00	0	True	1,113.30	77
J-69	1,059.38	1	True	1,113.75	77
J-16	1,059.02	0	True	1,113.44	77
J-90	1,059.00	1	True	1,113.52	77
J-222	1,059.00	0	True	1,113.52	77
J-13	1,059.17	0	True	1,113.72	77
J-23	1,058.71	2	True	1,113.32	78
J-29	1,058.92	1	True	1,113.60	78
J-86	1,058.50	3	True	1,113.25	78
J-15	1,058.70	0	True	1,113.49	78
J-3	1,059.19	0	True	1,113.99	78
J-8	1,059.24	0	True	1,114.08	78
J-68	1,058.67	1	True	1,113.54	78
J-14	1,058.69	0	True	1,113.60	78
J-33	1,058.75	0	True	1,113.71	78
J-28	1,058.24	2	True	1,113.25	78
J-4	1,058.86	0	True	1,113.89	78
J-7	1,059.15	1	True	1,114.19	78
J-12	1,058.67	1	True	1,113.72	78
J-24	1,058.31	2	True	1,113.38	78
J-185	1,058.00	0	True	1,113.25	78

Active Scenario: Existing Sys- Peak Hourly Demand
FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-106	1,059.00	0	True	1,114.28	78
J-20	1,058.26	0	True	1,113.58	79
J-2	1,058.87	1	True	1,114.28	79
J-6	1,058.21	0	True	1,113.63	79
J-1	1,058.87	10	True	1,114.35	79
J-227	1,058.00	0	True	1,113.51	79
J-186	1,057.76	0	True	1,113.33	79
J-25	1,057.55	1	True	1,113.46	79
J-88	1,057.60	0	True	1,113.51	79
J-99	1,057.40	0	True	1,113.51	80
J-104	1,058.00	0	True	1,114.33	80
J-22	1,056.96	0	True	1,113.34	80
J-70	1,056.90	0	True	1,113.36	80
J-71	1,056.90	0	True	1,113.39	80
J-100	1,057.00	0	True	1,113.51	80
J-231	1,056.80	0	True	1,113.46	80
J-230	1,056.80	0	True	1,113.50	80
J-233	1,056.80	0	True	1,113.50	80
J-233	1,056.80	0	True	1,113.51	80
J-229	1,056.80	0	True	1,113.51	80
J-228	1,056.80	0	True	1,113.51	80
J-79	1,056.50	0	True	1,113.25	81
J-37	1,057.29	0	True	1,114.13	81
J-259	1,056.35	0	True	1,113.26	81
J-40	1,057.00	0	True	1,113.95	81
Golf Course	1,056.00	2	True	1,113.04	81
J-226	1,057.00	0	True	1,114.04	81
J-21	1,056.40	0	True	1,113.46	81
J-81	1,056.40	0	True	1,113.51	81
J-101	1,056.40	0	True	1,113.51	81
J-98	1,056.40	0	True	1,113.51	81
J-53	1,056.26	1	True	1,113.44	81
J-52	1,056.26	0	True	1,113.48	81
J-41	1,056.36	0	True	1,113.59	81
J-44	1,056.28	1	True	1,113.52	81
J-107	1,056.00	0	True	1,113.35	81
J-89	1,055.80	1	True	1,113.30	82
J-94	1,056.00	0	True	1,113.51	82
J-95	1,056.00	0	True	1,113.51	82
J-96	1,056.00	0	True	1,113.51	82
J-102	1,055.80	0	True	1,113.51	82
J-78	1,055.50	0	True	1,113.25	82
J-62	1,055.55	1	True	1,113.41	82
J-103	1,055.60	0	True	1,113.51	82
J-56	1,055.39	1	True	1,113.31	82

Active Scenario: Existing Sys- Peak Hourly Demand

FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-214	1,055.50	0	True	1,113.51	82
J-221	1,055.50	0	True	1,113.51	82
J-67	1,055.46	0	True	1,113.51	82
J-220	1,055.40	0	True	1,113.51	82
J-215	1,055.40	0	True	1,113.51	82
J-2	1,055.40	0	True	1,113.51	82
J-93	1,055.40	0	True	1,113.51	82
J-97	1,055.40	0	True	1,113.51	82
J-216	1,055.20	0	True	1,113.51	83
J-218	1,055.20	0	True	1,113.51	83
J-54	1,055.06	0	True	1,113.37	83
J-251	1,054.92	1	True	1,113.24	83
J-217	1,055.00	0	True	1,113.51	83
J-92	1,055.00	0	True	1,113.51	83
J-50	1,054.88	0	True	1,113.52	83
J-42	1,054.79	1	True	1,113.53	83
J-234	1,054.50	0	True	1,113.25	83
J-51	1,054.57	1	True	1,113.52	84
J-66	1,054.54	1	True	1,113.51	84
J-55	1,054.35	0	True	1,113.36	84
J-250	1,053.99	0	True	1,113.23	84
J-76	1,054.00	0	True	1,113.25	84
J-72	1,054.00	0	True	1,113.25	84
J-43	1,054.22	0	True	1,113.52	84
J-59	1,053.85	0	True	1,113.35	84
J-262	1,053.54	2	True	1,113.17	85
J-49	1,053.85	0	True	1,113.52	85
J-252	1,053.17	1	True	1,113.22	85
J-60	1,053.29	0	True	1,113.35	85
J-202	1,053.00	0	True	1,113.22	85
J-149	1,053.00	0	True	1,113.22	85
J-63	1,053.14	1	True	1,113.37	85
J-75	1,053.00	1	True	1,113.25	86
J-77	1,053.00	1	True	1,113.25	86
J-189	1,053.00	0	True	1,113.25	86
J-73	1,053.00	0	True	1,113.25	86
J-48	1,053.23	1	True	1,113.51	86
J-45	1,053.15	1	True	1,113.52	86
Elementary School	1,053.00	0	True	1,113.52	86
J-3	1,053.00	0	True	1,113.52	86
J-224	1,053.00	0	True	1,113.52	86
J-268	1,052.67	0	True	1,113.22	86
J-47	1,052.88	0	True	1,113.52	86
J-61	1,052.67	0	True	1,113.35	86
J-46	1,052.82	0	True	1,113.52	86

Active Scenario: Existing Sys- Peak Hourly Demand
FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-223	1,052.80	0	True	1,113.52	86
J-192	1,052.50	0	True	1,113.25	86
J-261	1,052.38	3	True	1,113.18	86
J-263	1,052.23	0	True	1,113.17	87
J-199	1,052.20	0	True	1,113.22	87
J-65	1,052.21	1	True	1,113.35	87
J-237	1,052.00	2	True	1,113.20	87
J-253	1,052.00	1	True	1,113.22	87
J-198	1,052.00	0	True	1,113.22	87
J-7	1,052.00	0	True	1,113.23	87
J-5	1,052.00	0	True	1,113.23	87
J-74	1,052.00	0	True	1,113.25	87
J-241	1,051.93	1	True	1,113.19	87
J-57	1,052.00	0	True	1,113.26	87
J-151	1,052.00	0	True	1,113.33	87
J-126	1,052.00	0	True	1,113.35	87
J-1	1,051.50	0	True	1,113.19	88
J-238	1,051.46	0	True	1,113.20	88
J-240	1,051.44	1	True	1,113.20	88
J-207	1,051.24	0	True	1,113.22	88
J-260	1,051.18	1	True	1,113.19	88
J-248	1,051.01	0	True	1,113.22	88
J-196	1,051.00	0	True	1,113.22	88
J-197	1,051.00	0	True	1,113.22	88
J-209	1,050.98	0	True	1,113.22	88
J-206	1,050.61	0	True	1,113.22	89
J-80	1,050.63	0	True	1,113.30	89
J-6	1,050.63	0	True	1,113.31	89
J-64	1,050.68	1	True	1,113.37	89
J-201	1,050.50	0	True	1,113.22	89
J-200	1,050.50	0	True	1,113.22	89
J-194	1,050.50	0	True	1,113.22	89
J-125	1,050.50	0	True	1,113.22	89
J-127	1,050.50	0	True	1,113.22	89
J-193	1,050.50	0	True	1,113.22	89
J-58	1,050.50	0	True	1,113.22	89
J-118	1,050.50	0	True	1,113.22	89
J-195	1,050.50	0	True	1,113.22	89
J-239	1,050.43	2	True	1,113.20	89
J-242	1,050.42	1	True	1,113.20	89
J-210	1,050.41	0	True	1,113.24	89
J-205	1,050.34	0	True	1,113.23	89
J-249	1,050.29	1	True	1,113.22	89
J-235	1,050.26	0	True	1,113.21	89
J-203	1,050.22	0	True	1,113.22	89

Active Scenario: Existing Sys- Peak Hourly Demand
FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-211	1,050.15	0	True	1,113.23	90
J-204	1,050.13	0	True	1,113.23	90
J-246	1,050.03	1	True	1,113.21	90
J-255	1,050.00	1	True	1,113.20	90
J-243	1,049.90	2	True	1,113.20	90
J-82	1,049.90	0	True	1,113.25	90
J-84	1,049.76	0	True	1,113.23	90
J-208	1,049.58	0	True	1,113.22	90
J-213	1,049.56	0	True	1,113.23	90
J-85	1,049.54	0	True	1,113.23	90
J-236	1,049.37	0	True	1,113.20	91
J-83	1,049.37	0	True	1,113.24	91
J-212	1,049.30	0	True	1,113.23	91
J-254	1,049.16	1	True	1,113.20	91
J-244	1,049.00	1	True	1,113.20	91
J-270	1,049.00	0	True	1,113.22	91
J-132	1,048.35	0	True	1,113.23	92
J-131	1,048.33	0	True	1,113.23	92
J-245	1,048.21	2	True	1,113.21	92
J-247	1,047.90	2	True	1,113.21	93
J-256	1,047.00	2	True	1,113.20	94
J-258	1,046.57	0	True	1,113.20	95
J-257	1,046.25	0	True	1,113.20	95

Active Scenario: Existing Sys- Peak Hourly Demand

FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-148	R & Pump House	J-1	250	151	130.0	0.15	97	1.97
P-7	J-1	J-7	250	56	123.0	0.17	39	0.79
P-2	J-1	J-2	250	31	123.0	0.07	34	0.69
P-52	J-40	J-41	150	91	123.0	0.36	12	0.66
P-3	J-2	J-3	250	178	123.0	0.29	28	0.57
P-40	J-7	J-34	250	98	123.0	0.16	27	0.56
P-4	J-3	J-4	250	95	123.0	0.10	22	0.45
P-347	J-40	J-226	150	49	123.0	0.09	-8	0.44
P-14	J-13	J-14	250	120	123.0	0.11	21	0.43
P-41	J-34	J-11	250	96	123.0	0.09	21	0.42
P-31	J-25	J-29	250	157	123.0	0.14	-20	0.42
P-67	J-52	J-53	250	39	123.0	0.03	20	0.41
P-37	J-11	J-32	250	97	123.0	0.08	20	0.41
P-15	J-14	J-15	200	96	123.0	0.11	13	0.40
P-275	J-16	J-186	152	81	123.0	0.11	7	0.37
P-47	J-33	J-29	250	153	123.0	0.11	18	0.36
P-146	J-35	J-106	150	323	110.0	0.50	-6	0.36
P-147	J-106	J-1	150	50	110.0	0.08	-6	0.36
P-348	J-226	J-37	150	76	123.0	0.09	-6	0.36
P-6	J-5	J-6	250	224	123.0	0.15	17	0.35
P-66	J-52	J-6	250	235	123.0	0.16	-17	0.35
P-42	J-7	J-35	150	338	123.0	0.41	6	0.35
P-44	J-3	J-36	150	169	123.0	0.20	6	0.35
P-43	J-35	J-13	250	98	123.0	0.06	17	0.34
P-5	J-4	J-5	250	167	123.0	0.10	16	0.33
P-50	J-38	J-39	150	76	123.0	0.08	6	0.33
P-25	J-24	J-25	200	109	123.0	0.08	-10	0.32
P-17	J-15	J-17	150	91	123.0	0.09	6	0.32
P-360	J-107	J-234	250	176	123.0	0.09	15	0.31
P-39	J-34	J-13	150	339	123.0	0.31	5	0.30
P-18	J-17	J-18	150	97	123.0	0.09	5	0.30
P-87	J-32	J-69	250	214	123.0	0.10	15	0.30
P-341	J-4	J-51	150	460	130.0	0.36	5	0.29
P-48	J-2	J-37	150	168	123.0	0.15	5	0.29
P-70	J-55	J-56	200	83	123.0	0.05	9	0.28
P-34	J-31	J-32	150	99	123.0	0.08	-5	0.27
P-88	J-69	J-33	250	105	123.0	0.04	13	0.27
P-20	J-14	J-20	200	39	123.0	0.02	8	0.26
P-53	J-41	J-42	150	91	123.0	0.06	5	0.26
P-355	J-230	J-21	150	53	123.0	0.04	5	0.26
P-149	J-70	J-107	250	43	123.0	0.02	13	0.26
P-267	J-25	J-70	250	254	123.0	0.09	13	0.26
P-413	J-28	Golf Course	100	222	130.0	0.21	2	0.25
P-354	J-20	J-230	150	126	123.0	0.08	4	0.25

Active Scenario: Existing Sys- Peak Hourly Demand

FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-12	J-11	J-12	150	343	123.0	0.23	4	0.25
P-10	J-9	J-10	150	97	123.0	0.06	4	0.25
P-8	J-7	J-8	150	172	123.0	0.11	4	0.25
P-1	J-147	J-259	250	143	130.0	0.04	12	0.24
P-90	J-107	J-71	150	74	123.0	0.04	-4	0.24
P-91	J-71	J-21	150	117	123.0	0.07	-4	0.24
P-143	J-1	J-104	200	58	123.0	0.02	7	0.24
P-144	J-104	J-105	200	281	100.0	0.17	7	0.24
P-145	J-105	J-38	200	43	123.0	0.02	7	0.24
P-394	J-251	J-259	250	70	130.0	0.02	-11	0.23
P-399	J-30	J-264	150	95	123.0	0.05	-4	0.23
P-400	J-264	J-31	150	60	123.0	0.03	-4	0.23
P-9	J-8	J-9	150	98	123.0	0.05	4	0.23
P-85	J-68	J-41	200	133	123.0	0.05	-7	0.23
P-51	J-39	J-40	150	213	123.0	0.11	4	0.22
P-16	J-15	J-16	200	152	123.0	0.05	7	0.22
P-68	J-53	J-54	250	260	123.0	0.07	11	0.22
P-395	J-235	J-260	200	52	130.0	0.02	7	0.21
P-69	J-54	J-55	250	55	123.0	0.01	10	0.21
P-351	J-227	J-20	150	150	123.0	0.07	-4	0.21
P-71	J-56	J-57	200	176	123.0	0.05	6	0.19
P-72	J-57	J-58	200	131	123.0	0.04	6	0.19
P-250	J-24	J-26	200	122	123.0	0.03	6	0.19
P-28	J-26	J-27	200	151	123.0	0.04	6	0.19
P-32	J-29	J-30	150	257	123.0	0.09	-3	0.18
P-396	J-260	J-261	200	63	130.0	0.01	6	0.18
P-113	J-80	J-82	200	196	123.0	0.05	6	0.18
P-65	J-51	J-52	150	140	123.0	0.05	3	0.18
P-362	J-234	J-235	300	306	130.0	0.04	13	0.18
P-350	J-25	J-227	150	162	123.0	0.05	-3	0.18
P-76	J-53	J-62	250	145	123.0	0.03	8	0.17
P-30	J-28	J-23	150	241	123.0	0.07	-3	0.16
P-77	J-62	J-63	250	285	123.0	0.04	8	0.16
P-380	J-251	J-252	200	81	130.0	0.01	5	0.16
P-123	J-68	J-90	200	136	123.0	0.03	5	0.16
P-24	J-23	J-24	150	201	123.0	0.05	-3	0.15
P-363	J-235	J-236	250	52	130.0	0.01	7	0.15
P-29	J-27	J-28	200	301	123.0	0.05	4	0.14
P-79	J-63	J-65	250	146	123.0	0.02	7	0.13
P-274	J-186	J-147	250	362	130.0	0.03	6	0.13
P-11	J-10	J-11	200	169	123.0	0.02	4	0.12
P-211	J-65	J-151	250	214	123.0	0.02	6	0.12
P-13	J-151	J-6	250	269	123.0	0.03	6	0.12
P-14	J-6	J-80	250	71	123.0	0.01	6	0.12
P-378	J-249	J-250	250	85	130.0	0.01	-6	0.12

Active Scenario: Existing Sys- Peak Hourly Demand
FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-379	J-250	J-251	250	72	130.0	0.01	-6	0.12
P-114	J-82	J-83	200	135	123.0	0.01	3	0.11
P-179	J-83	J-131	152	103	130.0	0.01	2	0.11
P-366	J-236	J-239	250	104	130.0	0.01	5	0.11
P-323	J-210	J-82	150	81	123.0	0.01	-2	0.11
P-45	J-36	J-35	250	90	123.0	0.01	5	0.11
P-416	J-270	J-58	250	126	130.0	0.01	-5	0.10
P-54	J-42	J-43	150	92	123.0	0.01	2	0.10
P-377	J-248	J-249	250	82	130.0	0.00	-5	0.10
P-376	J-247	J-248	250	108	130.0	0.01	-5	0.10
P-19	J-18	J-19	250	169	110.0	0.01	5	0.10
P-415	J-245	J-270	250	154	130.0	0.01	-5	0.09
P-204	J-19	J-147	250	38	130.0	0.00	5	0.09
P-36	J-33	J-12	250	115	123.0	0.01	-5	0.09
P-397	J-261	J-262	200	93	130.0	0.01	3	0.09
P-62	J-50	J-42	150	95	123.0	0.01	-2	0.09
P-23	J-22	J-23	150	118	123.0	0.01	2	0.09
P-89	J-22	J-107	150	112	123.0	0.01	-2	0.09
P-381	J-252	J-246	200	169	130.0	0.01	3	0.09
P-325	J-211	J-210	150	94	123.0	0.01	-2	0.09
P-349	J-39	J-226	150	165	130.0	0.01	2	0.09
P-84	J-66	J-68	150	349	123.0	0.03	-1	0.08
P-329	J-66	J-214	150	75	123.0	0.01	1	0.08
P-373	J-244	J-245	200	212	130.0	0.01	-2	0.08
P-272	J-28	J-185	250	22	130.0	0.00	4	0.08
P-122	J-56	J-89	200	138	123.0	0.01	2	0.07
P-324	J-85	J-211	150	92	123.0	0.01	-1	0.07
P-390	J-256	J-257	250	124	130.0	0.00	-4	0.07
P-391	J-257	J-258	250	61	130.0	0.00	-4	0.07
P-392	J-245	J-258	250	132	130.0	0.00	4	0.07
P-326	J-83	J-212	150	190	123.0	0.01	1	0.07
P-374	J-245	J-246	250	94	130.0	0.00	-3	0.07
P-356	J-229	J-230	50	80	130.0	0.01	0	0.07
P-64	J-45	J-51	150	124	123.0	0.01	-1	0.07
P-364	J-236	J-237	200	282	130.0	0.01	2	0.06
P-124	J-90	J-87	300	139	123.0	0.00	4	0.06
P-270	J-86	J-185	250	245	123.0	0.01	-3	0.05
P-361	J-234	J-72	250	70	123.0	0.00	3	0.05
P-367	J-239	J-238	250	81	130.0	0.00	3	0.05
P-73	J-55	J-59	150	92	123.0	0.00	1	0.05
P-98	J-76	J-77	200	86	123.0	0.00	2	0.05
P-120	J-87	J-88	300	100	123.0	0.00	4	0.05
P-38	J-9	J-34	150	172	123.0	0.01	-1	0.05
P-327	J-212	J-84	150	51	123.0	0.00	1	0.05
P-96	J-72	J-76	250	46	123.0	0.00	2	0.05

Active Scenario: Existing Sys- Peak Hourly Demand
FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-368	J-238	J-240	250	83	130.0	0.00	2	0.04
P-180	J-131	J-132	152	25	130.0	0.00	1	0.04
P-60	J-48	J-49	150	99	123.0	0.00	-1	0.04
P-78	J-63	J-64	150	172	123.0	0.00	1	0.04
P-372	J-243	J-244	200	127	130.0	0.00	-1	0.04
P-55	J-43	J-44	150	92	123.0	0.00	1	0.04
P-358	J-228	J-233	50	137	130.0	0.01	0	0.04
P-382	J-248	J-252	200	196	130.0	0.00	-1	0.04
P-3	J-1	J-241	200	187	130.0	0.00	1	0.04
P-388	J-255	J-254	250	123	130.0	0.00	-2	0.04
P-74	J-59	J-60	150	149	123.0	0.00	1	0.04
P-126	J-67	J-92	150	50	123.0	0.00	-1	0.04
P-63	J-43	J-46	150	173	123.0	0.00	1	0.04
P-81	J-50	J-49	150	187	123.0	0.00	1	0.04
P-344	J-45	J-224	150	45	123.0	0.00	1	0.04
P-375	J-246	J-247	250	255	130.0	0.00	-2	0.04
P-132	J-96	J-88	300	74	130.0	0.00	-3	0.04
P-49	J-37	J-38	200	167	123.0	0.00	-1	0.03
P-61	J-49	J-50	150	205	123.0	0.00	-1	0.03
P-291	J-73	J-189	200	87	123.0	0.00	1	0.03
P-292	J-189	J-74	150	213	123.0	0.00	1	0.03
P-136	J-88	J-100	200	217	123.0	0.00	1	0.03
P-140	J-102	J-96	300	217	130.0	0.00	-2	0.03
P-389	J-254	J-256	250	93	130.0	0.00	-2	0.03
P-201	J-146	J-89	250	260	130.0	0.00	-2	0.03
P-203	J-147	J-146	250	109	130.0	0.00	-2	0.03
P-313	J-84	J-205	200	95	130.0	0.00	1	0.03
P-82	J-48	J-66	150	99	123.0	0.00	1	0.03
P-111	J-75	J-77	200	223	123.0	0.00	-1	0.03
P-4	J-214	J-2	250	100	130.0	0.00	1	0.03
P-5	J-2	J-215	250	51	130.0	0.00	1	0.03
P-319	J-208	J-132	152	80	130.0	0.00	-1	0.03
P-383	J-253	J-248	200	115	130.0	0.00	-1	0.03
P-384	J-235	J-247	250	255	130.0	0.00	-1	0.03
P-2	J-240	J-1	250	122	130.0	0.00	1	0.03
P-352	J-227	J-228	150	84	130.0	0.00	0	0.02
P-59	J-47	J-48	150	148	123.0	0.00	0	0.02
P-100	J-78	J-79	250	214	123.0	0.00	-1	0.02
P-271	J-185	J-79	250	104	123.0	0.00	1	0.02
P-139	J-95	J-102	300	90	130.0	0.00	-2	0.02
P-314	J-205	J-206	200	89	130.0	0.00	1	0.02
P-116	J-84	J-85	200	170	123.0	0.00	-1	0.02
P-99	J-73	J-78	250	180	123.0	0.00	-1	0.02
P-171	J-60	J-126	150	125	123.0	0.00	0	0.02
P-172	J-126	J-61	150	152	123.0	0.00	0	0.02

Active Scenario: Existing Sys- Peak Hourly Demand

FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-386	J-244	J-254	250	115	130.0	0.00	1	0.02
P-359	J-229	J-233	50	49	130.0	0.00	0	0.02
P-387	J-243	J-255	250	84	130.0	0.00	-1	0.02
P-46	J-5	J-36	250	94	123.0	0.00	-1	0.02
P-13	J-12	J-13	250	94	123.0	0.00	-1	0.02
P-295	J-192	J-75	150	97	123.0	0.00	0	0.02
P-129	J-93	J-94	250	74	123.0	0.00	-1	0.02
P-12	J-5	J-131	250	272	130.0	0.00	-1	0.02
P-16	J-149	J-7	250	176	130.0	0.00	-1	0.02
P-17	J-7	J-5	250	109	130.0	0.00	-1	0.02
P-302	J-197	J-198	250	134	130.0	0.00	-1	0.02
P-303	J-198	J-199	250	86	130.0	0.00	-1	0.02
P-304	J-199	J-202	250	117	130.0	0.00	-1	0.02
P-309	J-202	J-149	250	58	130.0	0.00	-1	0.02
P-300	J-195	J-196	200	85	130.0	0.00	-1	0.02
P-328	J-213	J-84	150	120	130.0	0.00	0	0.02
P-357	J-21	J-231	150	256	130.0	0.00	0	0.02
P-336	J-215	J-220	250	64	130.0	0.00	1	0.02
P-298	J-194	J-125	200	168	130.0	0.00	0	0.02
P-398	J-262	J-263	200	80	130.0	0.00	0	0.02
P-130	J-94	J-95	300	101	130.0	0.00	-1	0.02
P-301	J-196	J-197	250	54	130.0	0.00	-1	0.01
P-330	J-214	J-67	150	63	123.0	0.00	0	0.01
P-353	J-228	J-229	150	166	130.0	0.00	0	0.01
P-138	J-100	J-101	150	42	123.0	0.00	0	0.01
P-141	J-102	J-103	150	49	130.0	0.00	0	0.01
P-127	J-92	J-81	250	67	123.0	0.00	-1	0.01
P-135	J-95	J-99	150	82	130.0	0.00	0	0.01
P-345	J-224	J-46	150	63	123.0	0.00	0	0.01
P-58	J-46	J-47	150	89	123.0	0.00	0	0.01
P-365	J-237	J-238	200	88	130.0	0.00	0	0.01
P-6	J-224	J-3	200	153	130.0	0.00	0	0.01
P-7	J-3	Elementary School	200	85	130.0	0.00	0	0.01
P-128	J-81	J-93	250	71	123.0	0.00	-1	0.01
P-299	J-125	J-195	200	149	130.0	0.00	0	0.01
P-317	J-206	J-207	200	65	130.0	0.00	0	0.01
P-385	J-239	J-244	200	432	130.0	0.00	0	0.01
P-321	J-209	J-208	152	89	130.0	0.00	0	0.01
P-297	J-193	J-58	250	116	130.0	0.00	-1	0.01
P-335	J-218	J-215	200	159	130.0	0.00	0	0.01
P-338	J-221	J-67	150	72	130.0	0.00	0	0.01
P-97	J-76	J-73	250	135	123.0	0.00	1	0.01
P-342	J-46	J-223	150	53	130.0	0.00	0	0.01
P-343	J-223	J-47	150	107	130.0	0.00	0	0.01

Active Scenario: Existing Sys- Peak Hourly Demand

FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-137	J-100	J-81	200	168	123.0	0.00	0	0.01
P-337	J-220	J-216	250	127	130.0	0.00	0	0.01
P-312	J-204	J-85	200	179	130.0	0.00	0	0.01
P-305	J-200	J-194	150	63	130.0	0.00	0	0.01
P-306	J-194	J-201	150	127	130.0	0.00	0	0.01
P-294	J-74	J-192	150	86	123.0	0.00	0	0.01
P-296	J-125	J-193	250	91	130.0	0.00	0	0.01
P-370	J-240	J-242	250	71	130.0	0.00	0	0.01
P-371	J-242	J-243	250	93	130.0	0.00	0	0.01
P-333	J-216	J-217	250	76	130.0	0.00	0	0.01
P-163	J-118	J-58	200	92	130.0	0.00	0	0.01
P-320	J-207	J-209	152	94	130.0	0.00	0	0.00
P-174	J-127	J-125	250	171	130.0	0.00	0	0.00
P-56	J-44	J-45	150	304	123.0	0.00	0	0.00
P-334	J-216	J-218	200	95	130.0	0.00	0	0.00
P-134	J-94	J-98	300	59	123.0	0.00	0	0.00
P-340	J-222	J-90	300	56	130.0	0.00	0	0.00
P-182	J-105	J-133	200	25	123.0	0.00	0	0.00
P-183	J-133	J-134	150	69	123.0	0.00	0	0.00
P-125	J-87	J-91	150	76	123.0	0.00	0	0.00
P-133	J-93	J-97	150	84	123.0	0.00	0	0.00
P-315	J-203	J-207	152	140	130.0	0.00	0	0.00
P-409	J-149	J-268	250	100	130.0	0.00	0	0.00

Active Scenario: Existing Sys- Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-1	500	74	69	J-134	True	True
J-2	500	64	64	J-134	True	True
J-3	500	37	43	J-4	True	True
J-4	500	29	40	J-5	True	True
J-5	500	27	35	J-6	True	True
J-7	500	56	56	J-10	True	True
J-11	500	28	32	J-10	True	True
J-12	500	23	32	J-33	True	True
J-13	500	30	33	J-14	True	True
J-34	500	39	42	J-10	True	True
J-35	500	32	38	J-36	True	True
J-36	500	28	37	J-5	True	True
J-33	498	22	27	J-69	True	True
J-104	486	22	41	J-134	True	True
J-32	476	22	26	J-31	True	True
J-69	449	22	37	J-33	True	True
J-14	447	22	24	J-20	True	True
J-29	433	22	30	J-27	True	True
J-25	410	22	22	J-26	True	True
J-6	407	22	38	J-52	True	True
J-52	404	22	24	J-53	True	True
J-245	404	22	24	J-255	True	True
J-247	401	23	22	J-253	True	True
J-53	395	22	23	J-62	True	True
J-234	393	22	23	J-72	True	True
J-235	393	26	22	J-262	True	True
J-246	393	22	26	J-252	True	True
J-236	387	24	22	J-237	True	True
J-107	387	22	23	J-70	True	True
J-248	377	23	22	J-253	True	True
J-70	376	22	27	J-107	True	True
J-20	375	22	33	J-230	True	True
J-249	372	22	22	J-250	True	True
J-239	372	22	23	J-238	True	True
J-258	371	22	25	J-257	True	True
J-270	369	22	25	J-118	True	True
J-244	368	22	25	J-255	True	True
J-251	367	22	24	J-259	True	True
J-257	367	22	26	J-258	True	True
J-254	366	22	23	J-255	True	True
J-256	364	22	26	J-254	True	True
J-238	360	22	23	J-241	True	True

Active Scenario: Existing Sys- Maximum Daily Demand+ Fire Flow
Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-72	359	22	22	J-76	True	True
J-250	358	22	27	J-251	True	True
J-259	358	22	27	J-19	True	True
J-243	358	22	24	J-255	True	True
J-252	354	22	30	J-251	True	True
J-58	353	22	22	J-118	True	True
J-147	351	22	22	J-19	True	True
J-255	350	22	27	J-243	True	True
J-242	349	22	24	J-241	True	True
J-56	349	22	34	J-89	True	True
J-240	346	23	22	J-241	True	True
J-54	345	22	26	J-55	True	True
J-55	344	22	22	J-59	True	True
J-76	343	22	23	J-77	True	True
J-15	338	22	27	J-16	True	True
J-19	333	22	24	J-18	True	True
J-146	322	22	33	J-19	True	True
J-73	320	22	22	J-189	True	True
J-62	319	22	27	J-63	True	True
J-89	317	22	31	J-146	True	True
J-193	316	22	23	J-201	True	True
J-57	310	22	43	J-146	True	True
J-237	304	22	42	J-238	True	True
J-24	299	22	23	J-26	True	True
J-125	295	22	22	J-201	True	True
J-260	293	25	22	J-262	True	True
J-78	287	22	26	J-79	True	True
J-1	285	22	22	J-241	True	True
J-10	285	22	50	J-9	True	True
J-186	279	22	40	J-16	True	True
J-18	276	22	37	J-17	True	True
J-9	273	22	41	J-8	True	True
J-79	271	22	23	J-86	True	True
J-37	271	22	29	J-39	True	True
J-38	264	22	23	J-134	True	True
J-63	263	22	25	J-65	True	True
J-28	263	22	22	J-86	True	True
J-185	262	23	22	J-86	True	True
J-16	261	22	46	J-186	True	True
J-77	258	22	25	J-75	True	True
J-105	253	25	22	J-134	True	True
J-189	250	22	37	J-74	True	True

Active Scenario: Existing Sys- Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-106	248	22	72	J-134	True	True
J-65	248	22	25	J-151	True	True
J-118	247	22	54	J-58	True	True
J-127	244	22	42	J-201	True	True
J-195	242	22	24	J-196	True	True
J-51	241	22	40	J-45	True	True
J-26	239	22	29	J-27	True	True
J-253	236	22	55	J-146	True	True
J-261	235	23	22	J-262	True	True
J-226	232	22	30	J-39	True	True
J-151	231	22	27	J-6	True	True
J-133	229	24	22	J-134	True	True
J-196	226	22	22	J-197	True	True
J-197	223	22	22	J-198	True	True
J-6	219	22	23	J-80	True	True
J-27	219	22	37	J-26	True	True
J-17	219	22	52	J-18	True	True
J-40	218	22	27	J-91	True	True
J-80	217	22	25	J-6	True	True
J-198	215	22	23	J-199	True	True
J-71	214	22	41	J-231	True	True
J-23	213	22	44	J-22	True	True
J-8	212	22	55	J-9	True	True
J-199	211	22	22	J-202	True	True
J-39	210	22	43	J-40	True	True
J-131	206	22	22	J-132	True	True
J-202	206	22	23	J-149	True	True
J-149	205	22	22	J-268	True	True
J-82	204	22	22	J-210	True	True
J-227	203	22	24	J-233	True	True
J-7	203	22	24	J-5	True	True
J-5	201	22	25	J-7	True	True
J-22	201	22	46	J-23	True	True
J-86	199	22	44	J-185	True	True
J-83	199	22	28	J-212	True	True
J-230	198	22	32	J-231	True	True
J-75	194	22	32	J-192	True	True
J-268	192	22	29	J-149	True	True
J-194	191	22	22	J-201	True	True
J-262	190	22	24	J-263	True	True
J-21	189	22	22	J-231	True	True
J-132	189	22	24	J-208	True	True

Active Scenario: Existing Sys- Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-31	187	22	29	J-264	True	True
J-45	184	22	26	J-44	True	True
J-241	181	22	59	J-1	True	True
J-46	170	22	23	J-223	True	True
J-224	170	22	22	Elementary School	True	True
J-263	169	22	34	J-262	True	True
J-41	168	28	22	J-91	True	True
J-42	168	22	26	J-50	True	True
J-264	167	22	35	J-30	True	True
J-192	165	22	35	J-74	True	True
J-84	164	22	22	J-213	True	True
J-43	162	22	24	J-44	True	True
J-74	161	22	37	J-192	True	True
J-47	161	22	28	J-223	True	True
J-208	161	22	28	J-209	True	True
J-48	160	22	26	J-91	True	True
J-210	159	22	31	J-211	True	True
J-205	158	22	23	J-206	True	True
J-30	158	22	40	J-264	True	True
J-212	157	22	33	J-84	True	True
J-206	154	22	23	J-207	True	True
J-85	154	23	22	J-204	True	True
J-223	153	22	33	J-47	True	True
J-207	151	22	23	J-203	True	True
J-68	150	25	22	J-91	True	True
J-209	150	22	33	J-207	True	True
J-211	149	22	37	J-204	True	True
J-66	149	22	25	J-214	True	True
J-49	144	22	29	J-50	True	True
J-50	144	22	30	J-49	True	True
J-3	140	22	22	Elementary School	True	True
J-59	140	22	23	J-60	True	True
J-200	138	22	52	J-201	True	True
J-44	136	22	44	J-43	True	True
J-92	136	26	22	J-91	True	True
J-214	135	22	22	J-220	True	True
J-81	135	25	22	J-91	True	True
J-222	135	24	22	J-91	True	True
J-67	135	22	22	J-221	True	True
J-90	135	25	22	J-91	True	True

Active Scenario: Existing Sys- Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-93	135	27	22	J-91	True	True
J-94	135	26	22	J-91	True	True
J-98	135	25	22	J-91	True	True
J-95	134	26	22	J-91	True	True
J-102	134	27	22	J-91	True	True
J-96	134	28	22	J-91	True	True
J-88	134	26	22	J-91	True	True
J-87	133	24	22	J-91	True	True
J-228	133	22	22	J-233	True	True
J-100	133	22	23	J-101	True	True
J-2	131	22	22	J-220	True	True
J-134	130	22	57	J-133	True	True
Elementary School	129	22	31	J-3	True	True
J-204	129	22	42	J-85	True	True
J-215	129	22	22	J-220	True	True
J-220	127	22	22	J-216	True	True
J-216	126	22	22	J-217	True	True
J-218	124	22	24	J-216	True	True
J-217	123	22	24	J-216	True	True
J-103	117	22	33	J-91	True	True
J-101	113	22	36	J-91	True	True
J-201	113	22	64	J-200	True	True
J-213	108	22	58	J-84	True	True
J-221	106	22	43	J-91	True	True
J-64	105	22	72	J-146	True	True
J-99	104	22	41	J-91	True	True
J-97	103	22	42	J-91	True	True
J-203	102	22	56	J-207	True	True
J-91	99	22	46	J-87	True	True
J-229	92	22	22	J-233	True	True
J-60	90	22	23	J-61	True	True
J-231	81	22	69	J-21	True	True
J-126	73	23	22	J-61	True	True
J-61	61	22	41	J-126	True	True
Golf Course	33	22	73	J-134	True	True
J-233	12	22	74	J-134	True	True
J-233	7	22	74	J-134	True	True

Active Scenario: Improved Sys-Peak Hourly Demand
FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-134	1,062.57	0	True	1,114.38	74
J-91	1,061.50	0	True	1,113.60	74
J-27	1,060.77	2	True	1,113.47	75
J-10	1,060.90	0	True	1,114.06	75
J-11	1,060.74	0	True	1,114.04	76
J-26	1,060.16	0	True	1,113.50	76
J-133	1,061.00	0	True	1,114.38	76
J-5	1,060.51	0	True	1,113.90	76
J-146	1,060.14	0	True	1,113.60	76
J-87	1,060.00	1	True	1,113.60	76
J-32	1,060.31	1	True	1,113.96	76
J-36	1,060.16	0	True	1,113.90	76
J-9	1,060.28	1	True	1,114.12	76
J-31	1,059.94	1	True	1,113.88	77
J-39	1,060.29	0	True	1,114.24	77
J-34	1,060.13	1	True	1,114.12	77
J-264	1,059.80	0	True	1,113.85	77
J-19	1,059.54	0	True	1,113.62	77
J-38	1,060.25	1	True	1,114.35	77
J-30	1,059.61	1	True	1,113.80	77
J-35	1,059.54	1	True	1,113.89	77
J-105	1,060.00	0	True	1,114.38	77
J-17	1,059.17	0	True	1,113.64	77
J-69	1,059.38	1	True	1,113.85	77
J-18	1,059.09	1	True	1,113.63	77
J-90	1,059.00	1	True	1,113.60	78
J-222	1,059.00	0	True	1,113.60	78
J-147	1,059.00	0	True	1,113.61	78
J-16	1,059.02	0	True	1,113.63	78
J-13	1,059.17	0	True	1,113.82	78
J-23	1,058.71	2	True	1,113.43	78
J-29	1,058.92	1	True	1,113.71	78
J-3	1,059.19	0	True	1,114.09	78
J-86	1,058.50	3	True	1,113.42	78
J-8	1,059.24	0	True	1,114.17	78
J-15	1,058.70	0	True	1,113.64	78
J-68	1,058.67	1	True	1,113.63	78
J-14	1,058.69	0	True	1,113.69	78
J-33	1,058.75	0	True	1,113.81	78
J-7	1,059.15	1	True	1,114.28	78
J-4	1,058.86	0	True	1,113.99	78
J-12	1,058.67	1	True	1,113.82	78
J-28	1,058.24	2	True	1,113.42	78
J-24	1,058.31	2	True	1,113.53	78
J-106	1,059.00	0	True	1,114.37	79

Active Scenario: Improved Sys-Peak Hourly Demand
FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-20	1,058.26	0	True	1,113.64	79
J-185	1,058.00	0	True	1,113.42	79
J-2	1,058.87	1	True	1,114.38	79
J-6	1,058.21	0	True	1,113.77	79
J-1	1,058.87	10	True	1,114.44	79
J-227	1,058.00	0	True	1,113.61	79
J-186	1,057.76	0	True	1,113.62	79
J-88	1,057.60	0	True	1,113.60	79
J-25	1,057.55	1	True	1,113.58	80
J-99	1,057.40	0	True	1,113.60	80
J-104	1,058.00	0	True	1,114.43	80
J-22	1,056.96	0	True	1,113.45	80
J-70	1,056.90	0	True	1,113.48	80
J-100	1,057.00	0	True	1,113.60	80
J-71	1,056.90	0	True	1,113.50	80
J-231	1,056.80	0	True	1,113.56	81
J-230	1,056.80	0	True	1,113.59	81
J-229	1,056.80	0	True	1,113.59	81
J-233	1,056.80	0	True	1,113.59	81
J-228	1,056.80	0	True	1,113.60	81
J-233	1,056.80	0	True	1,113.60	81
J-79	1,056.50	0	True	1,113.41	81
J-259	1,056.35	0	True	1,113.28	81
J-37	1,057.29	0	True	1,114.33	81
J-40	1,057.00	0	True	1,114.12	81
J-21	1,056.40	0	True	1,113.56	81
J-81	1,056.40	0	True	1,113.60	81
J-101	1,056.40	0	True	1,113.60	81
J-98	1,056.40	0	True	1,113.60	81
Golf Course	1,056.00	2	True	1,113.21	81
J-226	1,057.00	0	True	1,114.22	81
J-44	1,056.28	1	True	1,113.61	81
J-41	1,056.36	0	True	1,113.69	81
J-53	1,056.26	1	True	1,113.61	81
J-52	1,056.26	0	True	1,113.63	81
J-107	1,056.00	0	True	1,113.46	82
J-94	1,056.00	0	True	1,113.60	82
J-95	1,056.00	0	True	1,113.60	82
J-96	1,056.00	0	True	1,113.60	82
J-89	1,055.80	1	True	1,113.58	82
J-102	1,055.80	0	True	1,113.60	82
J-78	1,055.50	0	True	1,113.39	82
J-103	1,055.60	0	True	1,113.60	82
J-62	1,055.55	1	True	1,113.58	82
J-214	1,055.50	0	True	1,113.59	82

Active Scenario: Improved Sys-Peak Hourly Demand

FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-221	1,055.50	0	True	1,113.59	82
J-67	1,055.46	0	True	1,113.59	83
J-56	1,055.39	1	True	1,113.55	83
J-220	1,055.40	0	True	1,113.59	83
J-215	1,055.40	0	True	1,113.59	83
J-2	1,055.40	0	True	1,113.59	83
J-93	1,055.40	0	True	1,113.60	83
J-97	1,055.40	0	True	1,113.60	83
J-251	1,054.92	1	True	1,113.28	83
J-216	1,055.20	0	True	1,113.59	83
J-218	1,055.20	0	True	1,113.59	83
J-54	1,055.06	0	True	1,113.57	83
J-172	1,055.00	0	True	1,113.58	83
J-217	1,055.00	0	True	1,113.59	83
J-92	1,055.00	0	True	1,113.60	83
J-50	1,054.88	0	True	1,113.61	83
J-42	1,054.79	1	True	1,113.62	84
J-234	1,054.50	0	True	1,113.37	84
J-66	1,054.54	1	True	1,113.60	84
J-51	1,054.57	1	True	1,113.64	84
J-55	1,054.35	0	True	1,113.56	84
J-250	1,053.99	0	True	1,113.28	84
J-72	1,054.00	0	True	1,113.37	84
J-76	1,054.00	0	True	1,113.37	84
J-43	1,054.22	0	True	1,113.61	84
J-59	1,053.85	0	True	1,113.54	85
J-262	1,053.54	2	True	1,113.26	85
J-49	1,053.85	0	True	1,113.60	85
J-252	1,053.17	1	True	1,113.28	85
J-60	1,053.29	0	True	1,113.51	85
J-75	1,053.00	1	True	1,113.37	86
J-77	1,053.00	1	True	1,113.37	86
J-48	1,053.23	1	True	1,113.60	86
J-189	1,053.00	0	True	1,113.37	86
J-73	1,053.00	0	True	1,113.38	86
J-63	1,053.14	1	True	1,113.56	86
J-202	1,053.00	0	True	1,113.45	86
J-45	1,053.15	1	True	1,113.61	86
J-149	1,053.00	0	True	1,113.46	86
Elementary School	1,053.00	0	True	1,113.58	86
J-3	1,053.00	0	True	1,113.59	86
J-224	1,053.00	0	True	1,113.60	86
J-47	1,052.88	0	True	1,113.60	86
J-46	1,052.82	0	True	1,113.60	86
J-268	1,052.67	0	True	1,113.46	86

Active Scenario: Improved Sys-Peak Hourly Demand

FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-61	1,052.67	0	True	1,113.46	86
J-223	1,052.80	0	True	1,113.60	86
J-192	1,052.50	0	True	1,113.37	86
J-261	1,052.38	3	True	1,113.26	86
J-263	1,052.23	0	True	1,113.26	87
J-199	1,052.20	0	True	1,113.45	87
J-237	1,052.00	2	True	1,113.28	87
J-253	1,052.00	1	True	1,113.28	87
J-241	1,051.93	1	True	1,113.27	87
J-65	1,052.21	1	True	1,113.56	87
J-74	1,052.00	0	True	1,113.37	87
J-198	1,052.00	0	True	1,113.44	87
J-57	1,052.00	0	True	1,113.45	87
J-126	1,052.00	0	True	1,113.49	87
J-151	1,052.00	0	True	1,113.53	87
J-1	1,051.50	0	True	1,113.28	88
J-238	1,051.46	0	True	1,113.28	88
J-240	1,051.44	1	True	1,113.28	88
J-260	1,051.18	1	True	1,113.28	88
J-207	1,051.24	0	True	1,113.45	88
J-248	1,051.01	0	True	1,113.28	88
J-196	1,051.00	0	True	1,113.43	89
J-197	1,051.00	0	True	1,113.43	89
J-209	1,050.98	0	True	1,113.46	89
J-270	1,050.80	0	True	1,113.34	89
J-6	1,050.80	0	True	1,113.48	89
J-206	1,050.61	0	True	1,113.45	89
J-239	1,050.43	2	True	1,113.28	89
J-80	1,050.63	0	True	1,113.48	89
J-242	1,050.42	1	True	1,113.28	89
J-64	1,050.68	1	True	1,113.54	89
J-58	1,050.50	0	True	1,113.38	89
J-118	1,050.50	0	True	1,113.38	89
J-193	1,050.50	0	True	1,113.38	89
J-201	1,050.50	0	True	1,113.39	89
J-200	1,050.50	0	True	1,113.39	89
J-194	1,050.50	0	True	1,113.39	89
J-125	1,050.50	0	True	1,113.39	89
J-127	1,050.50	0	True	1,113.39	89
J-195	1,050.50	0	True	1,113.41	89
J-249	1,050.29	1	True	1,113.28	89
J-235	1,050.26	0	True	1,113.29	89
J-210	1,050.41	0	True	1,113.46	90
J-205	1,050.34	0	True	1,113.45	90
J-246	1,050.03	1	True	1,113.29	90

Active Scenario: Improved Sys-Peak Hourly Demand

FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-255	1,050.00	1	True	1,113.28	90
J-211	1,050.15	0	True	1,113.46	90
J-204	1,050.13	0	True	1,113.45	90
J-243	1,049.90	2	True	1,113.28	90
J-7	1,050.00	0	True	1,113.46	90
J-5	1,050.00	0	True	1,113.47	90
J-82	1,049.90	0	True	1,113.47	90
J-84	1,049.76	0	True	1,113.45	90
J-208	1,049.58	0	True	1,113.46	91
J-213	1,049.56	0	True	1,113.45	91
J-236	1,049.37	0	True	1,113.29	91
J-85	1,049.54	0	True	1,113.45	91
J-83	1,049.37	0	True	1,113.46	91
J-254	1,049.16	1	True	1,113.28	91
J-212	1,049.30	0	True	1,113.46	91
J-244	1,049.00	1	True	1,113.28	91
J-245	1,048.21	2	True	1,113.29	92
J-132	1,048.35	0	True	1,113.46	92
J-131	1,048.33	0	True	1,113.46	92
J-247	1,047.90	2	True	1,113.29	93
J-256	1,047.00	2	True	1,113.28	94
J-258	1,046.57	0	True	1,113.29	95
J-257	1,046.25	0	True	1,113.28	95

Active Scenario: Improved Sys-Peak Hourly Demand

FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-148	R & Pump House	J-1	300	151	130.0	0.06	97	1.37
P-7	J-1	J-7	250	56	123.0	0.16	38	0.77
P-52	J-40	J-41	150	91	123.0	0.42	13	0.72
P-2	J-1	J-2	250	31	123.0	0.06	31	0.64
P-3	J-2	J-3	250	178	123.0	0.29	28	0.57
P-40	J-7	J-34	250	98	123.0	0.15	27	0.55
P-347	J-40	J-226	150	49	123.0	0.11	-9	0.48
P-14	J-13	J-14	250	120	123.0	0.13	22	0.45
P-4	J-3	J-4	250	95	123.0	0.10	22	0.44
P-20	J-14	J-20	200	39	123.0	0.05	14	0.43
P-41	J-34	J-11	250	96	123.0	0.09	20	0.41
P-31	J-25	J-29	250	157	123.0	0.14	-20	0.40
P-37	J-11	J-32	250	97	123.0	0.08	20	0.40
P-348	J-226	J-37	150	76	123.0	0.10	-7	0.38
P-50	J-38	J-39	150	76	123.0	0.10	7	0.37
P-43	J-35	J-13	250	98	123.0	0.07	18	0.36
P-146	J-35	J-106	150	323	110.0	0.48	-6	0.35
P-147	J-106	J-1	150	50	110.0	0.07	-6	0.35
P-47	J-33	J-29	250	153	123.0	0.10	17	0.35
P-145	J-105	J-38	200	43	123.0	0.04	11	0.35
P-67	J-52	J-53	250	39	123.0	0.03	17	0.34
P-44	J-3	J-36	150	169	123.0	0.19	6	0.34
P-42	J-7	J-35	150	338	123.0	0.39	6	0.34
P-5	J-4	J-5	250	167	123.0	0.10	16	0.33
P-6	J-5	J-6	250	224	123.0	0.13	16	0.32
P-66	J-52	J-6	250	235	123.0	0.14	-16	0.32
P-360	J-107	J-234	250	176	123.0	0.09	15	0.31
P-25	J-24	J-25	250	109	130.0	0.05	-15	0.30
P-39	J-34	J-13	150	339	123.0	0.31	5	0.30
P-87	J-32	J-69	250	214	123.0	0.10	14	0.29
P-341	J-4	J-51	150	460	130.0	0.35	5	0.29
P-53	J-41	J-42	150	91	123.0	0.07	5	0.28
P-71	J-56	J-57	200	176	123.0	0.10	9	0.28
P-72	J-57	J-58	200	131	123.0	0.07	9	0.28
P-34	J-31	J-32	150	99	123.0	0.07	-5	0.27
P-88	J-69	J-33	250	105	123.0	0.04	13	0.27
P-15	J-14	J-15	200	96	123.0	0.05	8	0.26
P-149	J-70	J-107	250	43	123.0	0.02	13	0.26
P-267	J-25	J-70	250	254	123.0	0.10	13	0.26
P-413	J-28	Golf Course	100	222	130.0	0.21	2	0.25
P-416	J-270	J-58	250	126	130.0	0.04	-12	0.25
P-12	J-11	J-12	150	343	123.0	0.22	4	0.25
P-85	J-68	J-41	200	133	123.0	0.06	-8	0.25
P-10	J-9	J-10	150	97	123.0	0.06	4	0.25

Active Scenario: Improved Sys-Peak Hourly Demand
FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-362	J-234	J-235	300	306	130.0	0.08	17	0.24
P-415	J-245	J-270	250	154	130.0	0.05	-12	0.24
P-8	J-7	J-8	150	172	123.0	0.10	4	0.24
P-355	J-230	J-21	150	53	123.0	0.03	4	0.24
P-51	J-39	J-40	150	213	123.0	0.13	4	0.24
P-9	J-8	J-9	150	98	123.0	0.05	4	0.23
P-399	J-30	J-264	150	95	123.0	0.05	-4	0.23
P-400	J-264	J-31	150	60	123.0	0.03	-4	0.23
P-90	J-107	J-71	150	74	123.0	0.04	-4	0.22
P-91	J-71	J-21	150	117	123.0	0.06	-4	0.22
P-395	J-235	J-260	200	52	130.0	0.02	7	0.21
P-24	J-23	J-24	150	201	123.0	0.09	-4	0.21
P-351	J-227	J-20	250	150	123.0	0.04	-10	0.20
P-250	J-24	J-26	250	122	130.0	0.03	10	0.20
P-28	J-26	J-27	250	151	130.0	0.03	10	0.20
P-354	J-20	J-230	150	126	123.0	0.05	3	0.19
P-396	J-260	J-261	200	63	130.0	0.01	6	0.18
P-13	J-151	J-6	250	269	123.0	0.05	9	0.18
P-32	J-29	J-30	150	257	123.0	0.09	-3	0.18
P-350	J-25	J-227	250	162	123.0	0.03	-9	0.18
P-272	J-28	J-185	250	22	130.0	0.00	9	0.17
P-76	J-53	J-62	250	145	123.0	0.03	8	0.17
P-123	J-68	J-90	200	136	123.0	0.03	5	0.17
P-122	J-56	J-89	200	138	123.0	0.03	-5	0.17
P-29	J-27	J-28	250	301	130.0	0.05	8	0.17
P-48	J-2	J-37	150	168	123.0	0.05	3	0.16
P-64	J-45	J-51	150	124	123.0	0.04	-3	0.16
P-300	J-195	J-196	200	85	130.0	0.02	-5	0.16
P-299	J-125	J-195	200	149	130.0	0.03	-5	0.16
P-211	J-65	J-151	250	214	123.0	0.03	8	0.15
P-143	J-1	J-104	300	58	123.0	0.01	11	0.15
P-144	J-104	J-105	300	281	100.0	0.05	11	0.15
P-68	J-53	J-54	250	260	123.0	0.04	7	0.15
P-73	J-55	J-59	150	92	123.0	0.02	3	0.15
P-69	J-54	J-55	250	55	123.0	0.01	7	0.15
P-363	J-235	J-236	250	52	130.0	0.01	7	0.14
P-275	J-16	J-186	152	81	123.0	0.02	2	0.14
P-74	J-59	J-60	150	149	123.0	0.03	2	0.13
P-70	J-55	J-56	200	83	123.0	0.01	4	0.13
P-45	J-36	J-35	250	90	123.0	0.01	6	0.13
P-239	J-65	J-172	250	152	123.0	0.02	-6	0.13
P-201	J-146	J-89	250	260	130.0	0.02	6	0.12
P-203	J-147	J-146	250	109	130.0	0.01	6	0.12
P-11	J-10	J-11	200	169	123.0	0.02	4	0.12
P-344	J-45	J-224	150	45	123.0	0.01	2	0.12

Active Scenario: Improved Sys-Peak Hourly Demand
FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-100	J-78	J-79	250	214	123.0	0.02	-6	0.12
P-271	J-185	J-79	250	104	123.0	0.01	6	0.12
P-49	J-37	J-38	200	167	123.0	0.02	-4	0.12
P-99	J-73	J-78	250	180	123.0	0.02	-6	0.12
P-171	J-60	J-126	150	125	123.0	0.02	2	0.12
P-172	J-126	J-61	150	152	123.0	0.02	2	0.12
P-17	J-15	J-17	250	91	123.0	0.01	6	0.12
P-54	J-42	J-43	150	92	123.0	0.01	2	0.11
P-302	J-197	J-198	250	134	130.0	0.01	-5	0.11
P-303	J-198	J-199	250	86	130.0	0.01	-5	0.11
P-304	J-199	J-202	250	117	130.0	0.01	-5	0.11
P-309	J-202	J-149	250	58	130.0	0.00	-5	0.11
P-349	J-39	J-226	150	165	130.0	0.02	2	0.11
P-78	J-63	J-64	150	172	123.0	0.02	2	0.11
P-18	J-17	J-18	250	97	123.0	0.01	5	0.11
P-366	J-236	J-239	250	104	130.0	0.01	5	0.11
P-62	J-50	J-42	150	95	123.0	0.01	-2	0.11
P-301	J-196	J-197	250	54	130.0	0.00	-5	0.11
P-7	J-3	Elementary School	200	85	130.0	0.01	3	0.10
P-23	J-22	J-23	150	118	123.0	0.01	2	0.10
P-89	J-22	J-107	150	112	123.0	0.01	-2	0.10
P-411	J-61	J-268	150	59	130.0	0.01	2	0.10
P-19	J-18	J-19	250	169	110.0	0.01	5	0.10
P-84	J-66	J-68	150	349	123.0	0.04	-2	0.09
P-397	J-261	J-262	200	93	130.0	0.01	3	0.09
P-204	J-19	J-147	250	38	130.0	0.00	5	0.09
P-77	J-62	J-63	250	285	123.0	0.02	5	0.09
P-6	J-224	J-3	200	153	130.0	0.01	3	0.09
P-36	J-33	J-12	250	115	123.0	0.01	-4	0.09
P-113	J-80	J-82	200	196	123.0	0.01	3	0.09
P-329	J-66	J-214	150	75	123.0	0.01	2	0.09
P-180	J-131	J-132	152	25	130.0	0.00	2	0.08
P-296	J-125	J-193	250	91	130.0	0.00	4	0.08
P-15	J-5	J-6	300	377	130.0	0.01	-6	0.08
P-97	J-76	J-73	250	135	123.0	0.01	-4	0.08
P-297	J-193	J-58	250	116	130.0	0.00	4	0.08
P-16	J-15	J-16	200	152	123.0	0.01	2	0.08
P-373	J-244	J-245	200	212	130.0	0.01	-2	0.08
P-374	J-245	J-246	250	94	130.0	0.00	4	0.08
P-30	J-28	J-23	250	241	123.0	0.01	-4	0.08
P-65	J-51	J-52	150	140	123.0	0.01	1	0.08
P-16	J-149	J-7	250	176	130.0	0.01	-4	0.07
P-17	J-7	J-5	250	109	130.0	0.00	-4	0.07
P-323	J-210	J-82	150	81	123.0	0.01	-1	0.07

Active Scenario: Improved Sys-Peak Hourly Demand
FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-390	J-256	J-257	250	124	130.0	0.00	-4	0.07
P-391	J-257	J-258	250	61	130.0	0.00	-4	0.07
P-392	J-245	J-258	250	132	130.0	0.00	4	0.07
P-352	J-227	J-228	150	84	130.0	0.00	1	0.07
P-384	J-235	J-247	250	255	130.0	0.01	3	0.07
P-240	J-172	J-62	250	81	123.0	0.00	-3	0.07
P-319	J-208	J-132	152	80	130.0	0.00	-1	0.07
P-124	J-90	J-87	300	139	123.0	0.00	5	0.07
P-213	J-64	J-151	150	179	123.0	0.01	1	0.07
P-126	J-67	J-92	150	50	123.0	0.00	-1	0.06
P-14	J-6	J-80	250	71	123.0	0.00	3	0.06
P-364	J-236	J-237	200	282	130.0	0.01	2	0.06
P-353	J-228	J-229	150	166	130.0	0.01	1	0.06
P-326	J-83	J-212	150	190	123.0	0.01	1	0.06
P-63	J-43	J-46	150	173	123.0	0.01	1	0.06
P-60	J-48	J-49	150	99	123.0	0.00	-1	0.06
P-376	J-247	J-248	250	108	130.0	0.00	3	0.06
P-120	J-87	J-88	300	100	123.0	0.00	4	0.06
P-414	Elementary School	J-172	250	225	130.0	0.00	3	0.06
P-325	J-211	J-210	150	94	123.0	0.00	-1	0.06
P-270	J-86	J-185	250	245	123.0	0.01	-3	0.05
P-356	J-229	J-230	150	80	130.0	0.00	1	0.05
P-367	J-239	J-238	250	81	130.0	0.00	3	0.05
P-321	J-209	J-208	152	89	130.0	0.00	-1	0.05
P-38	J-9	J-34	150	172	123.0	0.01	-1	0.05
P-96	J-72	J-76	250	46	123.0	0.00	-2	0.05
P-292	J-189	J-74	150	213	123.0	0.01	1	0.05
P-381	J-252	J-246	200	169	130.0	0.00	-2	0.05
P-98	J-76	J-77	200	86	123.0	0.00	1	0.04
P-368	J-238	J-240	250	83	130.0	0.00	2	0.04
P-81	J-50	J-49	150	187	123.0	0.00	1	0.04
P-12	J-5	J-131	250	272	130.0	0.00	2	0.04
P-327	J-212	J-84	150	51	123.0	0.00	1	0.04
P-361	J-234	J-72	250	70	123.0	0.00	-2	0.04
P-291	J-73	J-189	200	87	123.0	0.00	1	0.04
P-372	J-243	J-244	200	127	130.0	0.00	-1	0.04
P-61	J-49	J-50	150	205	123.0	0.00	-1	0.04
P-79	J-63	J-65	250	146	123.0	0.00	2	0.04
P-274	J-186	J-147	250	362	130.0	0.00	2	0.04
P-324	J-85	J-211	150	92	123.0	0.00	-1	0.04
P-388	J-255	J-254	250	123	130.0	0.00	-2	0.04
P-132	J-96	J-88	300	74	130.0	0.00	-3	0.04
P-3	J-1	J-241	200	187	130.0	0.00	1	0.04
P-330	J-214	J-67	150	63	123.0	0.00	-1	0.04

Active Scenario: Improved Sys-Peak Hourly Demand
FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-4	J-214	J-2	250	100	130.0	0.00	2	0.04
P-136	J-88	J-100	200	217	123.0	0.00	1	0.04
P-140	J-102	J-96	300	217	130.0	0.00	-3	0.04
P-320	J-207	J-209	152	94	130.0	0.00	-1	0.04
P-114	J-82	J-83	200	135	123.0	0.00	1	0.03
P-409	J-149	J-268	250	100	130.0	0.00	-2	0.03
P-389	J-254	J-256	250	93	130.0	0.00	-2	0.03
P-345	J-224	J-46	150	63	123.0	0.00	-1	0.03
P-55	J-43	J-44	150	92	123.0	0.00	1	0.03
P-5	J-2	J-215	250	51	130.0	0.00	1	0.03
P-383	J-253	J-248	200	115	130.0	0.00	-1	0.03
P-377	J-248	J-249	250	82	130.0	0.00	1	0.03
P-380	J-251	J-252	200	81	130.0	0.00	-1	0.03
P-139	J-95	J-102	300	90	130.0	0.00	-2	0.03
P-2	J-240	J-1	250	122	130.0	0.00	1	0.03
P-129	J-93	J-94	250	74	123.0	0.00	-1	0.02
P-294	J-74	J-192	150	86	123.0	0.00	0	0.02
P-82	J-48	J-66	150	99	123.0	0.00	0	0.02
P-127	J-92	J-81	250	67	123.0	0.00	-1	0.02
P-375	J-246	J-247	250	255	130.0	0.00	1	0.02
P-111	J-75	J-77	200	223	123.0	0.00	-1	0.02
P-386	J-244	J-254	250	115	130.0	0.00	1	0.02
P-387	J-243	J-255	250	84	130.0	0.00	-1	0.02
P-130	J-94	J-95	300	101	130.0	0.00	-1	0.02
P-128	J-81	J-93	250	71	123.0	0.00	-1	0.02
P-328	J-213	J-84	150	120	130.0	0.00	0	0.02
P-8	J-2	J-3	200	474	130.0	0.00	1	0.02
P-357	J-21	J-231	150	256	130.0	0.00	0	0.02
P-336	J-215	J-220	250	64	130.0	0.00	1	0.02
P-298	J-194	J-125	200	168	130.0	0.00	0	0.02
P-398	J-262	J-263	200	80	130.0	0.00	0	0.02
P-137	J-100	J-81	200	168	123.0	0.00	0	0.01
P-179	J-83	J-131	152	103	130.0	0.00	0	0.01
P-138	J-100	J-101	150	42	123.0	0.00	0	0.01
P-141	J-102	J-103	150	49	130.0	0.00	0	0.01
P-135	J-95	J-99	150	82	130.0	0.00	0	0.01
P-365	J-237	J-238	200	88	130.0	0.00	0	0.01
P-13	J-12	J-13	250	94	123.0	0.00	-1	0.01
P-335	J-218	J-215	200	159	130.0	0.00	0	0.01
P-338	J-221	J-67	150	72	130.0	0.00	0	0.01
P-385	J-239	J-244	200	432	130.0	0.00	0	0.01
P-317	J-206	J-207	200	65	130.0	0.00	0	0.01
P-378	J-249	J-250	250	85	130.0	0.00	1	0.01
P-379	J-250	J-251	250	72	130.0	0.00	1	0.01
P-394	J-251	J-259	250	70	130.0	0.00	0	0.01

Active Scenario: Improved Sys-Peak Hourly Demand

FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-337	J-220	J-216	250	127	130.0	0.00	0	0.01
P-312	J-204	J-85	200	179	130.0	0.00	0	0.01
P-305	J-200	J-194	150	63	130.0	0.00	0	0.01
P-306	J-194	J-201	150	127	130.0	0.00	0	0.01
P-313	J-84	J-205	200	95	130.0	0.00	0	0.01
P-371	J-242	J-243	250	93	130.0	0.00	0	0.01
P-56	J-44	J-45	150	304	123.0	0.00	0	0.01
P-370	J-240	J-242	250	71	130.0	0.00	0	0.01
P-333	J-216	J-217	250	76	130.0	0.00	0	0.01
P-163	J-118	J-58	200	92	130.0	0.00	0	0.01
P-358	J-228	J-233	150	137	130.0	0.00	0	0.00
P-382	J-248	J-252	200	196	130.0	0.00	0	0.00
P-295	J-192	J-75	150	97	123.0	0.00	0	0.00
P-46	J-5	J-36	250	94	123.0	0.00	0	0.00
P-116	J-84	J-85	200	170	123.0	0.00	0	0.00
P-174	J-127	J-125	250	171	130.0	0.00	0	0.00
P-334	J-216	J-218	200	95	130.0	0.00	0	0.00
P-359	J-229	J-233	150	49	130.0	0.00	0	0.00
P-134	J-94	J-98	300	59	123.0	0.00	0	0.00
P-59	J-47	J-48	150	148	123.0	0.00	0	0.00
P-340	J-222	J-90	300	56	130.0	0.00	0	0.00
P-342	J-46	J-223	150	53	130.0	0.00	0	0.00
P-343	J-223	J-47	150	107	130.0	0.00	0	0.00
P-314	J-205	J-206	200	89	130.0	0.00	0	0.00
P-58	J-46	J-47	150	89	123.0	0.00	0	0.00
P-133	J-93	J-97	150	84	123.0	0.00	0	0.00
P-125	J-87	J-91	150	76	123.0	0.00	0	0.00
P-183	J-133	J-134	300	69	123.0	0.00	0	0.00
P-182	J-105	J-133	300	25	123.0	0.00	0	0.00

Active Scenario: Improved Sys-Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-1	500	77	72	J-134	True	True
J-2	500	67	69	J-91	True	True
J-3	500	41	47	J-4	True	True
J-4	500	33	45	J-5	True	True
J-5	500	33	42	J-6	True	True
J-7	500	60	59	J-10	True	True
J-11	500	33	37	J-10	True	True
J-12	500	29	38	J-33	True	True
J-13	500	36	40	J-14	True	True
J-33	500	28	32	J-69	True	True
J-34	500	43	46	J-10	True	True
J-35	500	37	44	J-36	True	True
J-36	500	34	42	J-5	True	True
J-104	500	69	64	J-134	True	True
J-105	500	26	22	J-134	True	True
J-32	500	22	26	J-31	True	True
J-14	496	22	26	J-17	True	True
J-133	478	24	22	J-134	True	True
J-69	472	22	39	J-33	True	True
J-29	467	22	32	J-27	True	True
J-52	456	22	26	J-53	True	True
J-53	455	22	26	J-52	True	True
J-25	448	25	22	J-27	True	True
J-38	446	22	31	J-39	True	True
J-20	445	22	30	J-227	True	True
J-6	438	22	43	J-52	True	True
J-227	427	22	26	J-233	True	True
J-134	424	22	34	J-133	True	True
J-62	410	22	25	J-172	True	True
J-107	403	22	23	J-70	True	True
J-172	401	22	27	J-62	True	True
J-234	396	22	24	J-72	True	True
J-70	393	22	27	J-107	True	True
J-65	391	22	25	J-63	True	True
J-55	391	22	25	J-54	True	True
J-54	388	22	27	J-55	True	True
J-56	383	22	34	J-89	True	True
J-58	381	22	22	J-118	True	True
J-24	379	23	22	J-26	True	True
J-270	372	22	27	J-259	True	True
J-37	372	22	44	J-226	True	True
J-235	371	27	22	J-259	True	True

Active Scenario: Improved Sys-Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-72	370	22	23	J-76	True	True
J-63	368	22	31	J-64	True	True
J-236	367	24	22	J-237	True	True
J-245	360	30	22	J-259	True	True
Elementary School	357	22	32	J-3	True	True
J-76	357	22	23	J-77	True	True
J-258	356	22	23	J-259	True	True
J-239	353	22	23	J-238	True	True
J-257	352	22	25	J-259	True	True
J-244	352	22	24	J-255	True	True
J-254	350	22	23	J-255	True	True
J-256	349	22	26	J-254	True	True
J-193	349	22	24	J-201	True	True
J-151	347	22	31	J-6	True	True
J-238	342	22	23	J-241	True	True
J-73	342	22	22	J-189	True	True
J-243	342	22	24	J-255	True	True
J-15	340	22	22	J-17	True	True
J-246	339	28	22	J-259	True	True
J-3	338	22	27	J-91	True	True
J-255	335	22	27	J-243	True	True
J-242	334	22	23	J-241	True	True
J-26	333	22	25	J-27	True	True
J-28	332	22	22	J-86	True	True
J-125	332	22	22	J-201	True	True
J-57	331	22	48	J-56	True	True
J-240	330	23	22	J-241	True	True
J-185	327	23	22	J-86	True	True
J-247	326	32	22	J-259	True	True
J-79	323	22	27	J-86	True	True
J-78	320	22	32	J-79	True	True
J-89	319	22	27	J-146	True	True
J-6	316	22	22	J-80	True	True
J-17	315	22	24	J-18	True	True
J-5	314	22	22	J-209	True	True
J-27	312	22	32	J-26	True	True
J-147	311	22	22	J-19	True	True
J-7	311	22	26	J-149	True	True
J-19	306	22	25	J-147	True	True
J-226	305	22	39	J-39	True	True
J-224	305	22	30	J-44	True	True

Active Scenario: Improved Sys-Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-18	305	22	28	J-17	True	True
J-248	302	28	22	J-259	True	True
J-149	301	22	23	J-268	True	True
J-146	301	22	29	J-147	True	True
J-202	296	22	26	J-149	True	True
J-23	296	22	38	J-86	True	True
J-252	296	22	22	J-259	True	True
J-195	295	22	30	J-196	True	True
J-80	294	22	27	J-210	True	True
J-237	294	22	41	J-238	True	True
J-199	292	22	25	J-198	True	True
J-197	290	22	24	J-196	True	True
J-196	290	22	24	J-197	True	True
J-10	290	22	51	J-9	True	True
J-198	290	22	26	J-199	True	True
J-40	289	22	43	J-39	True	True
J-249	289	28	22	J-259	True	True
J-260	285	25	22	J-262	True	True
J-250	280	23	22	J-259	True	True
J-268	279	22	26	J-61	True	True
J-9	276	22	41	J-8	True	True
J-1	276	22	22	J-241	True	True
J-45	272	22	36	J-44	True	True
J-251	272	24	22	J-259	True	True
J-131	270	22	22	J-209	True	True
J-39	270	22	52	J-226	True	True
J-77	265	22	25	J-75	True	True
J-41	265	22	23	J-91	True	True
J-51	265	22	57	J-45	True	True
J-127	264	22	45	J-201	True	True
J-189	259	22	37	J-74	True	True
J-186	259	22	38	J-16	True	True
J-118	256	22	56	J-58	True	True
J-106	250	22	73	J-134	True	True
J-259	250	22	32	J-251	True	True
J-46	250	22	23	J-223	True	True
J-16	248	22	42	J-186	True	True
J-230	248	22	31	J-231	True	True
J-82	242	22	23	J-210	True	True
J-214	239	22	24	J-220	True	True
J-2	236	22	22	J-220	True	True
J-83	235	22	30	J-212	True	True

Active Scenario: Improved Sys-Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-42	233	22	31	J-50	True	True
J-261	231	23	22	J-262	True	True
J-132	230	22	24	J-208	True	True
J-68	230	22	22	J-91	True	True
J-86	226	22	50	J-185	True	True
J-215	225	22	22	J-220	True	True
J-66	224	22	36	J-91	True	True
J-71	223	22	46	J-231	True	True
J-48	222	22	32	J-49	True	True
J-47	221	22	34	J-223	True	True
J-43	219	22	27	J-44	True	True
J-253	217	22	48	J-259	True	True
J-228	217	22	22	J-233	True	True
J-220	217	22	23	J-216	True	True
J-22	216	22	56	J-23	True	True
J-8	214	22	56	J-9	True	True
J-21	213	22	22	J-231	True	True
J-216	209	22	22	J-217	True	True
J-61	205	22	38	J-126	True	True
J-223	205	22	41	J-47	True	True
J-218	203	22	28	J-216	True	True
J-92	202	23	22	J-91	True	True
J-194	201	22	22	J-201	True	True
J-67	201	22	22	J-221	True	True
J-229	200	22	22	J-233	True	True
J-81	199	23	22	J-91	True	True
J-217	198	22	27	J-216	True	True
J-93	198	24	22	J-91	True	True
J-75	197	22	32	J-192	True	True
J-94	196	24	22	J-91	True	True
J-222	196	23	22	J-91	True	True
J-90	196	25	22	J-91	True	True
J-95	196	24	22	J-91	True	True
J-102	196	25	22	J-91	True	True
J-98	195	22	22	J-91	True	True
J-96	195	27	22	J-91	True	True
J-64	194	22	64	J-91	True	True
J-88	194	26	22	J-91	True	True
J-59	193	22	38	J-60	True	True
J-87	192	24	22	J-91	True	True
J-31	189	22	29	J-264	True	True
J-262	187	22	24	J-263	True	True

Active Scenario: Improved Sys-Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-84	185	22	22	J-213	True	True
J-49	184	22	33	J-50	True	True
J-50	184	22	34	J-49	True	True
J-208	183	22	29	J-209	True	True
J-100	182	22	23	J-101	True	True
J-241	178	22	58	J-1	True	True
J-205	177	22	24	J-206	True	True
J-210	177	22	33	J-211	True	True
J-212	176	22	36	J-84	True	True
J-206	173	22	23	J-207	True	True
J-85	171	23	22	J-204	True	True
J-207	169	22	27	J-206	True	True
J-44	169	22	53	J-43	True	True
J-264	168	22	35	J-30	True	True
J-209	168	22	36	J-207	True	True
J-263	167	22	34	J-262	True	True
J-192	167	22	36	J-74	True	True
J-211	164	22	40	J-204	True	True
J-74	163	22	38	J-192	True	True
J-126	161	22	39	J-60	True	True
J-30	159	22	40	J-264	True	True
J-60	157	22	43	J-126	True	True
J-103	147	22	43	J-91	True	True
J-233	145	22	48	J-229	True	True
J-200	142	22	54	J-201	True	True
J-101	140	22	44	J-100	True	True
J-204	139	22	44	J-85	True	True
J-221	133	22	54	J-91	True	True
J-99	125	22	51	J-91	True	True
J-97	123	22	52	J-91	True	True
J-91	118	22	55	J-87	True	True
J-201	115	22	65	J-200	True	True
J-213	114	22	62	J-84	True	True
J-233	109	22	64	J-228	True	True
J-231	83	22	71	J-21	True	True
Golf Course	34	22	74	J-134	True	True

Active Scenario: Future Sys- Peak Hourly Demand

FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-158	1,070.31	17	True	1,108.92	55
J-16	1,064.14	8	True	1,104.92	58
J-156	1,064.65	2	True	1,105.72	58
J-153	1,063.42	8	True	1,104.92	59
J-155	1,063.04	11	True	1,105.24	60
J-180	1,063.71	0	True	1,108.12	63
J-159	1,063.77	10	True	1,108.51	64
J-160	1,063.05	10	True	1,108.63	65
J-145	1,063.13	0	True	1,109.41	66
J-15	1,062.39	0	True	1,109.04	66
J-179	1,062.30	0	True	1,108.97	66
J-154	1,058.26	8	True	1,104.93	66
J-182	1,057.84	13	True	1,104.74	67
J-21	1,062.45	17	True	1,109.40	67
J-139	1,062.93	0	True	1,109.91	67
J-187	1,062.09	17	True	1,109.10	67
J-144	1,062.39	0	True	1,109.41	67
J-23	1,061.61	10	True	1,108.70	67
J-136	1,062.71	0	True	1,109.89	67
J-161	1,061.10	13	True	1,108.31	67
J-143	1,062.03	0	True	1,109.41	67
J-134	1,062.57	0	True	1,110.13	68
J-142	1,061.24	0	True	1,109.41	68
J-91	1,061.50	0	True	1,109.76	68
J-22	1,060.10	10	True	1,108.56	69
J-138	1,061.34	0	True	1,109.82	69
J-178	1,060.86	0	True	1,109.43	69
J-140	1,058.39	0	True	1,106.97	69
J-27	1,060.77	2	True	1,109.41	69
J-137	1,061.11	0	True	1,109.85	69
J-135	1,061.08	0	True	1,109.98	69
J-152	1,055.03	17	True	1,104.26	70
J-26	1,060.16	0	True	1,109.47	70
J-87	1,060.00	1	True	1,109.55	70
J-133	1,061.00	0	True	1,110.65	70
J-264	1,059.80	0	True	1,109.49	71
J-146	1,060.14	0	True	1,109.99	71
J-30	1,059.61	1	True	1,109.52	71
J-31	1,059.94	1	True	1,110.11	71
J-86	1,058.50	3	True	1,108.78	71
J-19	1,059.54	0	True	1,109.98	72
J-39	1,060.29	0	True	1,110.77	72
J-183	1,053.29	17	True	1,103.78	72
J-38	1,060.25	1	True	1,110.85	72
J-23	1,058.71	2	True	1,109.36	72

Active Scenario: Future Sys- Peak Hourly Demand

FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-29	1,058.92	1	True	1,109.62	72
J-5	1,060.51	0	True	1,111.22	72
J-90	1,059.00	1	True	1,109.77	72
J-105	1,060.00	0	True	1,110.84	72
J-222	1,059.00	0	True	1,109.84	72
J-17	1,059.17	0	True	1,110.05	72
J-32	1,060.31	1	True	1,111.21	72
J-18	1,059.09	1	True	1,110.03	72
J-147	1,059.00	0	True	1,109.98	72
J-10	1,060.90	0	True	1,111.89	72
J-11	1,060.74	0	True	1,111.74	72
J-16	1,059.02	0	True	1,110.05	72
J-36	1,060.16	0	True	1,111.22	72
J-28	1,058.24	2	True	1,109.30	72
J-68	1,058.67	1	True	1,109.80	73
J-24	1,058.31	2	True	1,109.53	73
J-14	1,056.96	13	True	1,108.24	73
J-185	1,058.00	0	True	1,109.29	73
J-69	1,059.38	1	True	1,110.73	73
J-15	1,058.70	0	True	1,110.07	73
J-99	1,057.40	0	True	1,108.84	73
J-12	1,057.15	13	True	1,108.65	73
J-14	1,058.69	0	True	1,110.22	73
J-13	1,059.17	0	True	1,110.71	73
J-35	1,059.54	1	True	1,111.14	73
J-88	1,057.60	0	True	1,109.33	73
J-20	1,058.26	0	True	1,110.00	73
J-33	1,058.75	0	True	1,110.52	73
J-227	1,058.00	0	True	1,109.82	74
J-9	1,060.28	1	True	1,112.25	74
J-12	1,058.67	1	True	1,110.66	74
J-25	1,057.55	1	True	1,109.62	74
J-100	1,057.00	0	True	1,109.13	74
J-34	1,060.13	1	True	1,112.27	74
J-13	1,056.03	13	True	1,108.26	74
J-186	1,057.76	0	True	1,109.99	74
J-98	1,056.40	0	True	1,108.81	74
J-6	1,058.21	0	True	1,110.70	75
J-22	1,056.96	0	True	1,109.48	75
J-81	1,056.40	0	True	1,108.99	75
J-70	1,056.90	0	True	1,109.61	75
J-101	1,056.40	0	True	1,109.13	75
J-71	1,056.90	0	True	1,109.67	75
J-79	1,056.50	0	True	1,109.33	75
J-94	1,056.00	0	True	1,108.84	75

Active Scenario: Future Sys- Peak Hourly Demand

FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-95	1,056.00	0	True	1,108.84	75
J-4	1,058.86	0	True	1,111.72	75
J-231	1,056.80	0	True	1,109.78	75
J-3	1,059.19	0	True	1,112.18	75
J-233	1,056.80	0	True	1,109.82	75
J-228	1,056.80	0	True	1,109.82	75
J-229	1,056.80	0	True	1,109.83	75
J-233	1,056.80	0	True	1,109.83	75
J-230	1,056.80	0	True	1,109.83	75
Golf Course	1,056.00	2	True	1,109.09	75
J-102	1,055.80	0	True	1,108.95	75
J-96	1,056.00	0	True	1,109.23	76
J-8	1,059.24	0	True	1,112.56	76
J-103	1,055.60	0	True	1,108.95	76
J-21	1,056.40	0	True	1,109.78	76
J-44	1,056.28	1	True	1,109.74	76
J-93	1,055.40	0	True	1,108.92	76
J-97	1,055.40	0	True	1,108.92	76
J-259	1,056.35	0	True	1,109.88	76
J-41	1,056.36	0	True	1,109.89	76
J-40	1,057.00	0	True	1,110.58	76
J-107	1,056.00	0	True	1,109.60	76
J-221	1,055.50	0	True	1,109.21	76
J-67	1,055.46	0	True	1,109.21	76
J-37	1,057.29	0	True	1,111.05	76
J-226	1,057.00	0	True	1,110.77	76
J-53	1,056.26	1	True	1,110.07	76
J-52	1,056.26	0	True	1,110.16	77
J-78	1,055.50	0	True	1,109.41	77
J-7	1,059.15	1	True	1,113.12	77
J-214	1,055.50	0	True	1,109.47	77
J-92	1,055.00	0	True	1,109.01	77
J-220	1,055.40	0	True	1,109.48	77
J-215	1,055.40	0	True	1,109.48	77
J-2	1,055.40	0	True	1,109.48	77
J-162	1,054.60	9	True	1,108.76	77
J-89	1,055.80	1	True	1,110.01	77
J-62	1,055.55	1	True	1,109.80	77
J-216	1,055.20	0	True	1,109.48	77
J-218	1,055.20	0	True	1,109.48	77
J-217	1,055.00	0	True	1,109.48	77
J-106	1,059.00	0	True	1,113.61	78
J-56	1,055.39	1	True	1,110.05	78
J-2	1,058.87	1	True	1,113.55	78
J-172	1,055.00	0	True	1,109.73	78

Active Scenario: Future Sys- Peak Hourly Demand
FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-50	1,054.88	0	True	1,109.71	78
J-251	1,054.92	1	True	1,109.83	78
J-163	1,054.07	9	True	1,109.00	78
J-42	1,054.79	1	True	1,109.75	78
J-54	1,055.06	0	True	1,110.06	78
J-66	1,054.54	1	True	1,109.60	78
J-234	1,054.50	0	True	1,109.60	78
J-1	1,058.87	10	True	1,113.99	78
J-43	1,054.22	0	True	1,109.73	79
J-76	1,054.00	0	True	1,109.53	79
J-72	1,054.00	0	True	1,109.55	79
J-51	1,054.57	1	True	1,110.16	79
J-104	1,058.00	0	True	1,113.60	79
J-55	1,054.35	0	True	1,110.06	79
J-250	1,053.99	0	True	1,109.81	79
J-49	1,053.85	0	True	1,109.69	79
J-262	1,053.54	2	True	1,109.60	80
J-164	1,053.00	9	True	1,109.15	80
J-59	1,053.85	0	True	1,110.08	80
J-48	1,053.23	1	True	1,109.66	80
J-73	1,053.00	0	True	1,109.48	80
J-189	1,053.00	0	True	1,109.48	80
J-174	1,052.66	9	True	1,109.15	80
J-75	1,053.00	1	True	1,109.51	80
J-77	1,053.00	1	True	1,109.52	80
J-63	1,053.14	1	True	1,109.74	80
Elementary School	1,053.00	0	True	1,109.60	80
J-3	1,053.00	0	True	1,109.61	80
J-45	1,053.15	1	True	1,109.77	80
J-252	1,053.17	1	True	1,109.80	80
J-224	1,053.00	0	True	1,109.68	80
J-47	1,052.88	0	True	1,109.68	81
J-60	1,053.29	0	True	1,110.11	81
J-46	1,052.82	0	True	1,109.68	81
J-223	1,052.80	0	True	1,109.68	81
J-192	1,052.50	0	True	1,109.49	81
J-149	1,053.00	0	True	1,110.20	81
J-202	1,053.00	0	True	1,110.20	81
J-261	1,052.38	3	True	1,109.61	81
J-263	1,052.23	0	True	1,109.60	81
J-74	1,052.00	0	True	1,109.49	82
J-61	1,052.67	0	True	1,110.18	82
J-65	1,052.21	1	True	1,109.72	82
J-268	1,052.67	0	True	1,110.20	82
J-266	1,046.55	17	True	1,104.09	82

Active Scenario: Future Sys- Peak Hourly Demand
FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-237	1,052.00	2	True	1,109.64	82
J-151	1,052.00	0	True	1,109.68	82
J-241	1,051.93	1	True	1,109.65	82
J-253	1,052.00	1	True	1,109.78	82
J-175	1,051.26	9	True	1,109.22	82
J-199	1,052.20	0	True	1,110.20	82
J-57	1,052.00	0	True	1,110.07	82
J-126	1,052.00	0	True	1,110.14	83
J-1	1,051.50	0	True	1,109.66	83
J-238	1,051.46	0	True	1,109.65	83
J-198	1,052.00	0	True	1,110.20	83
J-240	1,051.44	1	True	1,109.66	83
J-207	1,051.24	0	True	1,109.47	83
J-165	1,051.07	9	True	1,109.33	83
J-260	1,051.18	1	True	1,109.62	83
J-173	1,050.88	0	True	1,109.43	83
J-209	1,050.98	0	True	1,109.53	83
J-123	1,051.55	0	True	1,110.30	83
J-80	1,050.63	0	True	1,109.39	83
J-248	1,051.01	0	True	1,109.78	83
J-6	1,050.80	0	True	1,109.61	83
J-206	1,050.61	0	True	1,109.45	84
J-210	1,050.41	0	True	1,109.41	84
J-64	1,050.68	1	True	1,109.70	84
J-122	1,051.25	0	True	1,110.34	84
J-205	1,050.34	0	True	1,109.44	84
J-270	1,050.80	0	True	1,109.94	84
J-196	1,051.00	0	True	1,110.19	84
J-197	1,051.00	0	True	1,110.19	84
J-204	1,050.13	0	True	1,109.33	84
J-239	1,050.43	2	True	1,109.65	84
J-242	1,050.42	1	True	1,109.66	84
J-203	1,050.22	0	True	1,109.47	84
J-211	1,050.15	0	True	1,109.40	84
J-235	1,050.26	0	True	1,109.64	84
J-249	1,050.29	1	True	1,109.80	84
J-82	1,049.90	0	True	1,109.42	84
J-58	1,050.50	0	True	1,110.08	85
J-193	1,050.50	0	True	1,110.13	85
J-118	1,050.50	0	True	1,110.15	85
J-84	1,049.76	0	True	1,109.43	85
J-201	1,050.50	0	True	1,110.18	85
J-200	1,050.50	0	True	1,110.18	85
J-194	1,050.50	0	True	1,110.18	85
J-125	1,050.50	0	True	1,110.18	85

Active Scenario: Future Sys- Peak Hourly Demand

FlexTable: Junction Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Is Active?	Hydraulic Grade (m)	Pressure (psi)
J-195	1,050.50	0	True	1,110.19	85
J-255	1,050.00	1	True	1,109.68	85
J-127	1,050.50	0	True	1,110.25	85
J-246	1,050.03	1	True	1,109.78	85
J-243	1,049.90	2	True	1,109.68	85
J-5	1,050.00	0	True	1,109.83	85
J-85	1,049.54	0	True	1,109.39	85
J-213	1,049.56	0	True	1,109.43	85
J-208	1,049.58	0	True	1,109.60	85
J-176	1,049.46	13	True	1,109.52	85
J-8	1,050.30	0	True	1,110.37	85
J-83	1,049.37	0	True	1,109.47	85
J-212	1,049.30	0	True	1,109.44	85
J-7	1,050.00	0	True	1,110.20	85
J-236	1,049.37	0	True	1,109.64	86
J-254	1,049.16	1	True	1,109.70	86
J-121	1,049.72	0	True	1,110.37	86
J-244	1,049.00	1	True	1,109.70	86
J-128	1,049.18	0	True	1,110.43	87
J-132	1,048.35	0	True	1,109.67	87
J-131	1,048.33	0	True	1,109.70	87
J-245	1,048.21	2	True	1,109.78	87
J-17	1,049.37	0	True	1,111.06	88
J-247	1,047.90	2	True	1,109.76	88
J-20	1,049.74	15	True	1,112.20	89
J-129	1,047.90	0	True	1,110.49	89
J-256	1,047.00	2	True	1,109.71	89
J-258	1,046.57	0	True	1,109.75	90
J-257	1,046.25	0	True	1,109.74	90
J-117	1,046.00	10	True	1,110.19	91
J-116	1,046.00	10	True	1,110.42	91
J-24	1,044.69	13	True	1,109.97	93
J-170	1,047.77	15	True	1,113.36	93
J-265	1,047.42	15	True	1,113.07	93
J-267	1,045.44	5	True	1,112.42	95
J-18	1,045.40	5	True	1,112.41	95
J-115	1,043.47	10	True	1,111.21	96
J-177	1,042.89	13	True	1,110.80	96
J-114	1,043.30	0	True	1,111.21	96
J-120	1,044.25	10	True	1,112.19	96
J-119	1,041.23	10	True	1,111.56	100
J-19	1,041.93	5	True	1,112.41	100

Active Scenario: Future Sys- Peak Hourly Demand

FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-197	J-143	J-144	200	74	130.0	0.00	0	0.00
P-196	J-142	J-143	200	189	130.0	0.00	0	0.00
P-18	J-121	J-8	250	137	130.0	0.00	0	0.00
P-133	J-93	J-97	150	84	123.0	0.00	0	0.00
P-199	J-145	J-27	200	220	130.0	0.00	0	0.00
P-159	J-114	J-115	300	165	130.0	0.00	0	0.00
P-198	J-144	J-145	200	78	130.0	0.00	0	0.00
P-315	J-203	J-207	152	140	130.0	0.00	0	0.00
P-334	J-216	J-218	200	95	130.0	0.00	0	0.00
P-359	J-229	J-233	150	49	130.0	0.00	0	0.00
P-358	J-228	J-233	150	137	130.0	0.00	0	0.00
P-333	J-216	J-217	250	76	130.0	0.00	0	0.01
P-335	J-218	J-215	200	159	130.0	0.00	0	0.01
P-305	J-200	J-194	150	63	130.0	0.00	0	0.01
P-306	J-194	J-201	150	127	130.0	0.00	0	0.01
P-65	J-51	J-52	150	140	123.0	0.00	0	0.01
P-338	J-221	J-67	150	72	130.0	0.00	0	0.01
P-337	J-220	J-216	250	127	130.0	0.00	1	0.01
P-135	J-95	J-99	150	82	130.0	0.00	0	0.01
P-138	J-100	J-101	150	42	123.0	0.00	0	0.01
P-141	J-102	J-103	150	49	130.0	0.00	0	0.01
P-349	J-39	J-226	150	165	130.0	0.00	0	0.01
P-364	J-236	J-237	200	282	130.0	0.00	0	0.02
P-298	J-194	J-125	200	168	130.0	0.00	0	0.02
P-398	J-262	J-263	200	80	130.0	0.00	0	0.02
P-16	J-149	J-7	250	176	130.0	0.00	-1	0.02
P-357	J-21	J-231	150	256	130.0	0.00	0	0.02
P-328	J-213	J-84	150	120	130.0	0.00	0	0.02
P-291	J-73	J-189	200	87	123.0	0.00	-1	0.02
P-336	J-215	J-220	250	64	130.0	0.00	1	0.02
P-386	J-244	J-254	250	115	130.0	0.00	-1	0.02
P-2	J-240	J-1	250	122	130.0	0.00	1	0.03
P-383	J-253	J-248	200	115	130.0	0.00	-1	0.03
P-5	J-2	J-215	250	51	130.0	0.00	1	0.03
P-345	J-224	J-46	150	63	123.0	0.00	-1	0.03
P-130	J-94	J-95	300	101	130.0	0.00	-2	0.03
P-352	J-227	J-228	150	84	130.0	0.00	-1	0.04
P-3	J-1	J-241	200	187	130.0	0.00	1	0.04
P-31	J-25	J-29	250	157	123.0	0.00	-2	0.04
P-353	J-228	J-229	150	166	130.0	0.00	-1	0.05
P-342	J-46	J-223	150	53	130.0	0.00	1	0.05
P-343	J-223	J-47	150	107	130.0	0.00	1	0.05
P-309	J-202	J-149	250	58	130.0	0.00	2	0.05
P-69	J-54	J-55	250	55	123.0	0.00	2	0.05
P-401	J-165	J-204	300	314	130.0	0.00	3	0.05

Active Scenario: Future Sys- Peak Hourly Demand
FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-356	J-229	J-230	150	80	130.0	0.00	-1	0.05
P-68	J-53	J-54	250	260	123.0	0.01	3	0.05
P-367	J-239	J-238	250	81	130.0	0.00	-3	0.05
P-55	J-43	J-44	150	92	123.0	0.00	-1	0.06
P-292	J-189	J-74	150	213	123.0	0.01	-1	0.06
P-58	J-46	J-47	150	89	123.0	0.00	1	0.06
P-301	J-196	J-197	250	54	130.0	0.00	-3	0.06
P-409	J-149	J-268	250	100	130.0	0.00	3	0.06
P-302	J-197	J-198	250	134	130.0	0.00	-3	0.06
P-303	J-198	J-199	250	86	130.0	0.00	-3	0.06
P-304	J-199	J-202	250	117	130.0	0.00	-3	0.06
P-374	J-245	J-246	250	94	130.0	0.00	3	0.07
P-239	J-65	J-172	250	152	123.0	0.00	-3	0.07
P-244	J-174	J-164	250	128	130.0	0.00	3	0.07
P-35	J-267	J-19	300	179	130.0	0.00	5	0.07
P-360	J-107	J-234	250	176	123.0	0.01	4	0.08
P-7	J-3	Elementary School	200	85	130.0	0.00	2	0.08
P-111	J-75	J-77	200	223	123.0	0.01	-3	0.08
P-294	J-74	J-192	150	86	123.0	0.01	-1	0.08
P-299	J-125	J-195	200	149	130.0	0.01	-3	0.08
P-366	J-236	J-239	250	104	130.0	0.00	-4	0.09
P-274	J-186	J-147	250	362	130.0	0.02	4	0.09
P-149	J-70	J-107	250	43	123.0	0.00	4	0.09
P-267	J-25	J-70	250	254	123.0	0.01	4	0.09
P-365	J-237	J-238	200	88	130.0	0.01	-3	0.09
P-300	J-195	J-196	200	85	130.0	0.01	-3	0.09
P-61	J-49	J-50	150	205	123.0	0.02	-2	0.09
P-324	J-85	J-211	150	92	123.0	0.01	-2	0.09
P-397	J-261	J-262	200	93	130.0	0.01	3	0.09
P-38	J-9	J-34	150	172	123.0	0.02	-2	0.09
P-363	J-235	J-236	250	52	130.0	0.00	-5	0.09
P-81	J-50	J-49	150	187	123.0	0.02	2	0.10
P-382	J-248	J-252	200	196	130.0	0.01	-3	0.10
P-56	J-44	J-45	150	304	123.0	0.03	-2	0.10
P-213	J-64	J-151	150	179	123.0	0.02	2	0.10
P-46	J-5	J-36	250	94	123.0	0.01	5	0.10
P-4	J-214	J-2	250	100	130.0	0.01	-5	0.10
P-71	J-56	J-57	200	176	123.0	0.01	-3	0.10
P-72	J-57	J-58	200	131	123.0	0.01	-3	0.10
P-98	J-76	J-77	200	86	123.0	0.01	3	0.10
P-34	J-267	J-18	250	187	130.0	0.01	5	0.10
P-59	J-47	J-48	150	148	123.0	0.02	2	0.11
P-325	J-211	J-210	150	94	123.0	0.01	-2	0.11
P-295	J-192	J-75	150	97	123.0	0.01	-2	0.11

Active Scenario: Future Sys- Peak Hourly Demand
FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-368	J-238	J-240	250	83	130.0	0.01	-5	0.11
P-327	J-212	J-84	150	51	123.0	0.01	2	0.11
P-387	J-243	J-255	250	84	130.0	0.01	-6	0.11
P-201	J-146	J-89	250	260	130.0	0.02	-6	0.12
P-203	J-147	J-146	250	109	130.0	0.01	-6	0.12
P-263	J-154	J-153	300	185	130.0	0.01	8	0.12
P-31	J-154	J-16	300	127	130.0	0.01	8	0.12
P-375	J-246	J-247	250	255	130.0	0.02	6	0.12
P-385	J-239	J-244	200	432	130.0	0.05	-4	0.12
P-73	J-55	J-59	150	92	123.0	0.02	-2	0.12
P-381	J-252	J-246	200	169	130.0	0.02	4	0.12
P-323	J-210	J-82	150	81	123.0	0.01	-2	0.13
P-54	J-42	J-43	150	92	123.0	0.02	2	0.13
P-70	J-55	J-56	200	83	123.0	0.01	4	0.13
P-79	J-63	J-65	250	146	123.0	0.01	6	0.13
P-326	J-83	J-212	150	190	123.0	0.04	2	0.13
P-388	J-255	J-254	250	123	130.0	0.01	-6	0.13
P-313	J-84	J-205	200	95	130.0	0.01	-4	0.13
P-74	J-59	J-60	150	149	123.0	0.03	-2	0.14
P-113	J-80	J-82	200	196	123.0	0.03	-4	0.14
P-372	J-243	J-244	200	127	130.0	0.02	-4	0.14
P-78	J-63	J-64	150	172	123.0	0.04	2	0.14
P-314	J-205	J-206	200	89	130.0	0.01	-5	0.14
P-399	J-30	J-264	150	95	123.0	0.02	3	0.15
P-370	J-240	J-242	250	71	130.0	0.01	-7	0.15
P-16	J-15	J-16	200	152	123.0	0.03	5	0.15
P-123	J-68	J-90	200	136	123.0	0.03	5	0.15
P-171	J-60	J-126	150	125	123.0	0.03	-3	0.15
P-172	J-126	J-61	150	152	123.0	0.04	-3	0.15
P-317	J-206	J-207	200	65	130.0	0.01	-5	0.15
P-60	J-48	J-49	150	99	123.0	0.03	-3	0.16
P-63	J-43	J-46	150	173	123.0	0.05	3	0.16
P-371	J-242	J-243	250	93	130.0	0.01	-8	0.16
P-389	J-254	J-256	250	93	130.0	0.01	-8	0.17
P-411	J-61	J-268	150	59	130.0	0.02	-3	0.17
P-116	J-84	J-85	200	170	123.0	0.04	6	0.18
P-377	J-248	J-249	250	82	130.0	0.01	-9	0.18
P-362	J-234	J-235	300	306	130.0	0.04	-13	0.18
P-396	J-260	J-261	200	63	130.0	0.01	6	0.18
P-25	J-161	J-13	300	342	130.0	0.05	13	0.18
P-26	J-161	J-14	300	451	130.0	0.06	13	0.18
P-211	J-65	J-151	250	214	123.0	0.04	9	0.18
P-204	J-19	J-147	250	38	130.0	0.01	9	0.19
P-19	J-18	J-19	250	169	110.0	0.04	9	0.19
P-77	J-62	J-63	250	285	123.0	0.06	9	0.19

Active Scenario: Future Sys- Peak Hourly Demand

FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-30	J-28	J-23	250	241	123.0	0.05	-9	0.19
P-32	J-29	J-30	150	257	123.0	0.10	3	0.20
P-40	J-159	J-22	250	252	130.0	0.05	-10	0.20
P-42	J-160	J-23	250	375	130.0	0.08	-10	0.20
P-378	J-249	J-250	250	85	130.0	0.02	-10	0.20
P-379	J-250	J-251	250	72	130.0	0.01	-10	0.20
P-8	J-2	J-3	200	474	130.0	0.13	-6	0.20
P-18	J-17	J-18	250	97	123.0	0.02	10	0.20
P-145	J-105	J-38	200	43	123.0	0.01	-6	0.20
P-390	J-256	J-257	250	124	130.0	0.03	-10	0.21
P-391	J-257	J-258	250	61	130.0	0.01	-10	0.21
P-392	J-245	J-258	250	132	130.0	0.03	10	0.21
P-62	J-50	J-42	150	95	123.0	0.04	-4	0.21
P-310	J-177	J-17	250	1,154	130.0	0.26	-10	0.21
P-186	J-136	J-137	150	86	130.0	0.04	4	0.21
P-187	J-137	J-138	150	62	130.0	0.03	4	0.21
P-190	J-139	J-136	150	58	130.0	0.02	4	0.21
P-122	J-56	J-89	200	138	123.0	0.05	7	0.21
P-17	J-15	J-17	250	91	123.0	0.02	10	0.21
P-260	J-204	J-176	250	793	130.0	0.19	-10	0.21
P-376	J-247	J-248	250	108	130.0	0.03	-10	0.21
P-395	J-235	J-260	200	52	130.0	0.02	7	0.21
P-114	J-82	J-83	200	135	123.0	0.05	-7	0.22
P-13	J-151	J-6	250	269	123.0	0.07	11	0.22
P-312	J-204	J-85	200	179	130.0	0.06	-7	0.22
P-82	J-48	J-66	150	99	123.0	0.05	4	0.23
P-84	J-66	J-68	150	349	123.0	0.19	-4	0.23
P-162	J-117	J-118	250	109	130.0	0.03	12	0.24
P-127	J-92	J-81	250	67	123.0	0.02	12	0.24
P-248	J-174	J-175	250	207	130.0	0.06	-12	0.24
P-405	J-152	J-266	300	692	130.0	0.17	17	0.24
P-28	J-187	J-158	300	729	130.0	0.18	17	0.24
P-380	J-251	J-252	200	81	130.0	0.03	8	0.24
P-373	J-244	J-245	200	212	130.0	0.09	-8	0.25
P-413	J-28	Golf Course	100	222	130.0	0.21	2	0.25
P-275	J-16	J-186	152	81	123.0	0.05	5	0.26
P-97	J-76	J-73	250	135	123.0	0.05	13	0.26
P-100	J-78	J-79	250	214	123.0	0.08	13	0.26
P-271	J-185	J-79	250	104	123.0	0.04	-13	0.26
P-99	J-73	J-78	250	180	123.0	0.07	13	0.26
P-29	J-27	J-28	250	301	130.0	0.11	13	0.26
P-6	J-224	J-3	200	153	130.0	0.08	9	0.27
P-174	J-127	J-125	250	171	130.0	0.07	14	0.28
P-250	J-8	J-122	250	80	130.0	0.03	14	0.28
P-168	J-122	J-123	250	85	130.0	0.03	14	0.28

Active Scenario: Future Sys- Peak Hourly Demand
FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-173	J-123	J-127	250	144	130.0	0.06	14	0.28
P-320	J-207	J-209	152	94	130.0	0.07	-5	0.28
P-24	J-23	J-24	150	201	123.0	0.17	-5	0.29
P-250	J-24	J-26	250	122	130.0	0.05	14	0.29
P-28	J-26	J-27	250	151	130.0	0.07	14	0.29
P-51	J-39	J-40	150	213	123.0	0.19	5	0.30
P-13	J-12	J-13	250	94	123.0	0.05	-15	0.30
P-321	J-209	J-208	152	89	130.0	0.07	-5	0.30
P-19	J-8	J-202	152	206	130.0	0.16	5	0.30
P-90	J-107	J-71	150	74	123.0	0.07	-5	0.30
P-91	J-71	J-21	150	117	123.0	0.10	-5	0.30
P-384	J-235	J-247	250	255	130.0	0.12	-15	0.30
P-189	J-135	J-139	200	112	130.0	0.07	10	0.30
P-85	J-68	J-41	200	133	123.0	0.09	-10	0.31
P-319	J-208	J-132	152	80	130.0	0.07	-6	0.31
P-297	J-193	J-58	250	116	130.0	0.06	15	0.31
P-296	J-125	J-193	250	91	130.0	0.05	16	0.32
P-355	J-230	J-21	150	53	123.0	0.05	6	0.32
P-12	J-5	J-131	250	272	130.0	0.14	16	0.32
P-96	J-72	J-76	250	46	123.0	0.03	16	0.33
P-180	J-131	J-132	152	25	130.0	0.02	6	0.33
P-191	J-138	J-139	150	88	130.0	0.09	-6	0.33
P-23	J-22	J-23	150	118	123.0	0.13	6	0.33
P-89	J-22	J-107	150	112	123.0	0.12	-6	0.33
P-50	J-38	J-39	150	76	123.0	0.08	6	0.33
P-29	J-179	J-15	300	146	130.0	0.07	-24	0.34
P-30	J-15	J-187	300	143	130.0	0.06	-24	0.34
P-361	J-234	J-72	250	70	123.0	0.04	17	0.34
P-414	Elementary School	J-172	250	225	130.0	0.13	-17	0.34
P-24	J-98	J-12	300	357	130.0	0.16	24	0.34
P-137	J-100	J-81	200	168	123.0	0.14	11	0.34
P-134	J-94	J-98	300	59	123.0	0.03	24	0.34
P-11	J-10	J-11	200	169	123.0	0.14	11	0.35
P-262	J-152	J-183	250	801	130.0	0.48	17	0.35
P-217	J-154	J-155	300	607	130.0	0.30	-25	0.36
P-136	J-88	J-100	200	217	123.0	0.20	11	0.36
P-243	J-163	J-164	300	286	130.0	0.15	-26	0.36
P-163	J-118	J-58	200	92	130.0	0.08	11	0.37
P-394	J-251	J-259	250	70	130.0	0.05	-18	0.37
P-354	J-20	J-230	150	126	123.0	0.17	7	0.37
P-241	J-163	J-173	250	613	130.0	0.43	-19	0.38
P-242	J-173	Elementary School	250	250	130.0	0.17	-19	0.38
P-1	J-147	J-259	250	143	130.0	0.10	19	0.38

Active Scenario: Future Sys- Peak Hourly Demand
FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-272	J-28	J-185	250	22	130.0	0.02	19	0.38
P-23	J-12	J-162	300	192	130.0	0.11	-27	0.39
P-45	J-36	J-35	250	90	123.0	0.07	19	0.39
P-176	J-8	J-128	250	82	130.0	0.06	-19	0.39
P-177	J-128	J-129	250	85	130.0	0.06	-19	0.39
P-41	J-22	J-95	250	376	130.0	0.28	-19	0.39
P-43	J-23	J-95	250	188	130.0	0.14	-19	0.39
P-15	J-5	J-6	300	377	130.0	0.23	28	0.39
P-53	J-41	J-42	150	91	123.0	0.14	7	0.40
P-240	J-172	J-62	250	81	123.0	0.07	-20	0.41
P-49	J-37	J-38	200	167	123.0	0.19	13	0.41
P-245	J-175	J-204	250	136	130.0	0.11	-20	0.42
P-25	J-24	J-25	250	109	130.0	0.09	-21	0.43
P-329	J-66	J-214	150	75	123.0	0.13	8	0.43
P-227	J-164	J-165	300	251	130.0	0.18	-31	0.44
P-129	J-93	J-94	250	74	123.0	0.08	22	0.44
P-161	J-116	J-117	250	252	130.0	0.24	22	0.45
P-128	J-81	J-93	250	71	123.0	0.07	22	0.45
P-344	J-45	J-224	150	45	123.0	0.09	8	0.46
P-415	J-245	J-270	250	154	130.0	0.16	-23	0.47
P-44	J-176	J-24	250	440	130.0	0.46	-23	0.47
P-416	J-270	J-58	250	126	130.0	0.14	-24	0.48
P-351	J-227	J-20	250	150	123.0	0.18	-24	0.48
P-15	J-14	J-15	200	96	123.0	0.15	15	0.48
P-350	J-25	J-227	250	162	123.0	0.20	-24	0.49
P-36	J-33	J-12	250	115	123.0	0.14	-24	0.49
P-259	J-182	J-155	300	531	130.0	0.50	-35	0.50
P-39	J-21	J-187	300	312	130.0	0.30	36	0.51
P-225	J-162	J-163	300	254	130.0	0.24	-36	0.51
P-179	J-83	J-131	152	103	130.0	0.22	-9	0.52
P-125	J-87	J-91	150	76	123.0	0.20	-10	0.54
P-188	J-138	J-91	150	28	130.0	0.07	10	0.54
P-22	J-161	J-12	300	312	130.0	0.34	-38	0.54
P-340	J-222	J-90	300	56	130.0	0.07	40	0.57
P-339	J-135	J-222	300	111	130.0	0.13	41	0.57
P-139	J-95	J-102	300	90	130.0	0.11	-41	0.58
P-9	J-8	J-9	150	98	123.0	0.31	10	0.59
P-64	J-45	J-51	150	124	123.0	0.39	-10	0.59
P-12	J-11	J-12	150	343	123.0	1.08	10	0.59
P-140	J-102	J-96	300	217	130.0	0.28	-42	0.59
P-132	J-96	J-88	300	74	130.0	0.10	-42	0.60
P-164	J-115	J-119	300	270	130.0	0.35	-42	0.60
P-8	J-7	J-8	150	172	123.0	0.56	11	0.60
P-228	J-165	J-80	300	47	130.0	0.06	-43	0.60
P-76	J-53	J-62	250	145	123.0	0.27	30	0.61

Active Scenario: Future Sys- Peak Hourly Demand
FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-178	J-129	J-7	300	201	130.0	0.29	44	0.63
P-124	J-90	J-87	300	139	123.0	0.22	45	0.63
P-348	J-226	J-37	150	76	123.0	0.28	-11	0.64
P-270	J-86	J-185	250	245	123.0	0.50	-32	0.64
P-88	J-69	J-33	250	105	123.0	0.22	32	0.65
P-10	J-9	J-10	150	97	123.0	0.36	11	0.65
P-341	J-4	J-51	150	460	130.0	1.56	11	0.65
P-347	J-40	J-226	150	49	123.0	0.19	-12	0.65
P-160	J-115	J-116	250	414	130.0	0.79	32	0.65
P-126	J-67	J-92	150	50	123.0	0.20	12	0.66
P-87	J-32	J-69	250	214	123.0	0.47	33	0.67
P-330	J-214	J-67	150	63	123.0	0.26	12	0.68
P-67	J-52	J-53	250	39	123.0	0.09	34	0.68
P-6	J-5	J-6	250	224	123.0	0.52	34	0.69
P-66	J-52	J-6	250	235	123.0	0.54	-34	0.69
P-251	J-29	J-178	300	108	130.0	0.19	50	0.70
P-252	J-178	J-179	300	261	130.0	0.46	50	0.70
P-184	J-134	J-135	300	85	130.0	0.15	50	0.71
P-27	J-264	J-187	200	137	130.0	0.39	22	0.71
P-39	J-34	J-13	150	339	123.0	1.56	13	0.72
P-257	J-152	J-182	300	249	130.0	0.47	-52	0.73
P-45	J-24	J-177	250	349	130.0	0.82	-36	0.73
P-165	J-119	J-120	300	320	130.0	0.63	-53	0.74
P-38	J-134	J-21	300	368	130.0	0.73	53	0.75
P-120	J-87	J-88	300	100	123.0	0.23	54	0.76
P-408	J-267	J-265	300	320	130.0	0.66	-54	0.76
P-5	J-4	J-5	250	167	123.0	0.49	39	0.79
P-407	J-177	J-267	250	606	130.0	1.62	-39	0.79
P-14	J-6	J-80	250	71	123.0	0.21	39	0.79
P-44	J-3	J-36	150	169	123.0	0.96	14	0.81
P-42	J-7	J-35	150	338	123.0	1.97	15	0.82
P-146	J-35	J-106	150	323	110.0	2.47	-15	0.85
P-147	J-106	J-1	150	50	110.0	0.38	-15	0.85
P-236	J-170	J-120	300	431	130.0	1.17	63	0.89
P-17	J-7	J-5	250	109	130.0	0.37	44	0.89
P-32	J-129	J-17	300	205	130.0	0.57	-64	0.90
P-14	J-13	J-14	250	120	123.0	0.48	46	0.93
P-52	J-40	J-41	150	91	123.0	0.69	17	0.95
P-20	J-14	J-20	200	39	123.0	0.22	30	0.97
P-43	J-35	J-13	250	98	123.0	0.43	48	0.97
P-403	J-265	R-2	300	438	130.0	1.43	-69	0.98
P-218	J-155	J-156	300	139	130.0	0.48	-72	1.02
P-4	J-3	J-4	250	95	123.0	0.46	50	1.03
P-253	J-179	J-180	300	233	130.0	0.85	73	1.04
P-276	J-180	J-156	300	661	130.0	2.40	73	1.04

Active Scenario: Future Sys- Peak Hourly Demand
FlexTable: Pipe Table (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Start Node	Stop Node	Diameter (mm)	Length (Scaled) (m)	Hazen-Williams C	Headloss (m)	Flow (L/s)	Velocity (m/s)
P-36	J-17	J-20	300	311	130.0	1.14	-74	1.04
P-41	J-34	J-11	250	96	123.0	0.53	54	1.09
P-37	J-11	J-32	250	97	123.0	0.53	54	1.10
P-281	R-2	J-170	300	279	130.0	1.14	78	1.11
P-400	J-264	J-31	150	60	123.0	0.61	-20	1.12
P-47	J-33	J-29	250	153	123.0	0.90	56	1.14
P-34	J-31	J-32	150	99	123.0	1.10	-20	1.16
P-37	J-20	R-2	300	442	130.0	2.30	-89	1.26
P-3	J-2	J-3	250	178	123.0	1.38	65	1.32
P-48	J-2	J-37	150	168	123.0	2.51	24	1.36
P-143	J-1	J-104	300	58	123.0	0.39	97	1.37
P-144	J-104	J-105	300	281	100.0	2.76	97	1.37
P-40	J-7	J-34	250	98	123.0	0.85	69	1.40
P-182	J-105	J-133	300	25	123.0	0.19	103	1.46
P-183	J-133	J-134	300	69	123.0	0.52	103	1.46
P-193	J-86	J-140	152	104	130.0	1.81	29	1.58
P-194	J-140	J-182	152	128	130.0	2.24	29	1.58
P-2	J-1	J-2	250	31	123.0	0.44	89	1.82
P-7	J-1	J-7	250	56	123.0	0.88	94	1.92
P-148	R & Pump House	J-1	300	151	130.0	0.51	306	4.33

Active Scenario: Future Sys- Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-1	500	76	59	J-158	True	True
J-2	500	67	57	J-158	True	True
J-3	500	45	53	J-4	True	True
J-4	500	41	52	J-158	True	True
J-5	500	44	51	J-158	True	True
J-6	500	24	51	J-158	True	True
J-7	500	61	53	J-158	True	True
J-11	500	41	44	J-10	True	True
J-12	500	43	44	J-158	True	True
J-13	500	51	46	J-158	True	True
J-14	500	41	45	J-158	True	True
J-20	500	29	40	J-227	True	True
J-25	500	40	35	J-145	True	True
J-29	500	43	37	J-158	True	True
J-32	500	35	44	J-158	True	True
J-33	500	44	42	J-158	True	True
J-34	500	48	50	J-158	True	True
J-35	500	48	49	J-158	True	True
J-36	500	45	50	J-158	True	True
J-38	500	24	32	J-39	True	True
J-52	500	40	47	J-53	True	True
J-53	500	43	46	J-52	True	True
J-69	500	30	42	J-158	True	True
J-58	500	51	50	J-158	True	True
J-62	500	38	45	J-172	True	True
J-65	500	35	40	J-63	True	True
J-80	500	49	49	J-161	True	True
J-87	500	34	35	J-159	True	True
J-88	500	32	29	J-159	True	True
J-90	500	41	41	J-159	True	True
J-96	500	30	26	J-159	True	True
J-104	500	69	56	J-158	True	True
J-105	500	52	46	J-158	True	True
J-107	500	26	28	J-70	True	True
J-120	500	28	37	J-119	True	True
J-122	500	31	36	J-123	True	True
J-123	500	25	38	J-122	True	True
J-125	500	41	41	J-201	True	True
J-127	500	27	40	J-123	True	True
J-128	500	48	51	J-8	True	True
J-129	500	64	53	J-158	True	True
J-133	500	49	46	J-158	True	True

Active Scenario: Future Sys- Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-134	500	46	44	J-158	True	True
J-135	500	44	41	J-139	True	True
J-147	500	22	23	J-19	True	True
J-149	500	33	34	J-268	True	True
J-151	500	26	40	J-64	True	True
J-163	500	36	35	J-161	True	True
J-164	500	41	44	J-161	True	True
J-165	500	48	48	J-161	True	True
J-170	500	58	59	J-158	True	True
J-172	500	38	44	J-62	True	True
J-174	500	23	40	J-175	True	True
J-175	500	23	38	J-174	True	True
J-178	500	34	34	J-158	True	True
J-179	500	27	24	J-156	True	True
J-193	500	42	51	J-201	True	True
J-202	500	28	33	J-199	True	True
J-204	500	42	43	J-175	True	True
J-222	500	42	43	J-159	True	True
Elementary School	500	33	44	J-173	True	True
J-227	500	26	31	J-233	True	True
J-234	500	32	34	J-72	True	True
J-235	500	38	34	J-262	True	True
J-236	500	32	32	J-237	True	True
J-239	500	22	26	J-238	True	True
J-244	500	22	28	J-255	True	True
J-245	500	44	46	J-241	True	True
J-246	500	36	43	J-252	True	True
J-247	500	38	38	J-253	True	True
J-248	500	28	27	J-253	True	True
J-249	500	23	26	J-250	True	True
J-251	500	24	29	J-250	True	True
J-258	500	23	28	J-257	True	True
J-265	500	47	54	J-267	True	True
J-267	500	30	30	J-18	True	True
J-270	500	39	49	J-158	True	True
J-5	500	52	52	J-158	True	True
J-6	500	50	51	J-161	True	True
J-7	500	58	52	J-158	True	True
J-8	500	40	41	J-121	True	True
J-15	500	27	24	J-158	True	True
J-17	500	62	54	J-158	True	True

Active Scenario: Future Sys- Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-20	500	61	56	J-158	True	True
J-21	500	30	30	J-158	True	True
J-162	500	25	22	J-161	True	True
J-98	500	25	22	J-159	True	True
J-63	499	22	38	J-64	True	True
J-177	498	22	32	J-24	True	True
J-55	497	22	28	J-54	True	True
J-70	497	22	30	J-107	True	True
J-254	497	22	25	J-255	True	True
J-259	494	22	32	J-251	True	True
J-54	492	22	29	J-55	True	True
J-257	492	22	30	J-258	True	True
J-56	492	22	42	J-89	True	True
J-94	486	30	22	J-159	True	True
J-256	485	22	31	J-254	True	True
J-250	485	22	31	J-251	True	True
J-238	481	22	25	J-237	True	True
J-24	480	22	22	J-145	True	True
J-72	480	22	24	J-76	True	True
J-93	479	22	22	J-97	True	True
J-119	477	22	25	J-115	True	True
J-102	476	29	22	J-159	True	True
J-243	475	22	27	J-255	True	True
J-187	474	34	22	J-158	True	True
J-252	473	22	38	J-251	True	True
J-3	469	22	39	J-224	True	True
J-19	466	22	31	J-147	True	True
J-255	460	22	31	J-243	True	True
J-199	458	22	26	J-198	True	True
J-95	456	33	22	J-159	True	True
J-242	456	22	26	J-241	True	True
J-15	454	22	26	J-17	True	True
J-240	452	23	22	J-241	True	True
J-12	451	28	22	J-161	True	True
J-76	451	22	23	J-77	True	True
J-131	449	22	24	J-132	True	True
J-81	449	22	25	J-92	True	True
J-173	446	22	50	J-159	True	True
J-19	445	22	43	J-267	True	True
J-118	442	22	33	J-117	True	True
J-115	439	22	22	J-114	True	True
J-117	434	22	31	J-118	True	True

Active Scenario: Future Sys- Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-268	431	22	27	J-61	True	True
J-146	430	22	40	J-89	True	True
J-198	430	22	30	J-197	True	True
J-28	427	22	24	J-185	True	True
J-185	426	22	23	J-86	True	True
J-17	420	22	28	J-18	True	True
J-73	418	22	22	J-189	True	True
J-57	416	22	52	J-158	True	True
J-18	410	22	31	J-17	True	True
J-197	410	22	25	J-196	True	True
J-92	409	22	33	J-81	True	True
J-195	406	22	38	J-196	True	True
J-89	406	22	39	J-146	True	True
J-196	404	22	27	J-197	True	True
J-116	404	22	45	J-117	True	True
J-26	400	22	23	J-145	True	True
J-79	399	22	33	J-185	True	True
J-68	396	22	43	J-41	True	True
J-82	391	22	32	J-210	True	True
J-121	388	22	55	J-158	True	True
J-37	386	22	46	J-226	True	True
J-24	385	22	36	J-176	True	True
J-224	384	22	36	J-45	True	True
J-78	384	22	37	J-79	True	True
J-85	382	22	34	J-211	True	True
J-114	380	22	39	J-115	True	True
J-41	372	22	44	J-68	True	True
J-180	369	23	22	J-156	True	True
J-237	368	22	50	J-238	True	True
J-83	364	22	47	J-82	True	True
J-264	363	22	33	J-30	True	True
J-27	357	25	22	J-145	True	True
J-260	349	25	22	J-262	True	True
J-23	347	22	43	J-145	True	True
J-176	345	22	54	J-24	True	True
J-18	343	22	59	J-158	True	True
J-1	338	22	22	J-241	True	True
J-214	328	22	25	J-220	True	True
J-100	326	22	23	J-101	True	True
J-139	326	22	24	J-136	True	True
J-132	324	22	31	J-208	True	True
J-186	320	22	43	J-16	True	True

Active Scenario: Future Sys- Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-226	316	22	40	J-39	True	True
J-84	315	22	22	J-213	True	True
J-2	315	22	22	J-220	True	True
J-45	312	22	44	J-44	True	True
J-40	307	22	43	J-39	True	True
J-161	304	22	28	J-14	True	True
J-86	299	22	34	J-140	True	True
J-77	296	22	26	J-75	True	True
J-10	294	22	51	J-9	True	True
J-16	294	22	51	J-186	True	True
J-46	293	22	24	J-223	True	True
J-67	293	22	22	J-221	True	True
J-215	290	22	22	J-220	True	True
J-66	288	22	51	J-48	True	True
J-189	287	22	40	J-74	True	True
J-51	284	22	56	J-158	True	True
J-42	282	22	35	J-50	True	True
J-9	279	22	41	J-8	True	True
J-138	278	22	29	J-137	True	True
J-39	276	22	54	J-226	True	True
J-23	273	24	22	J-160	True	True
J-220	273	22	23	J-216	True	True
J-91	269	22	35	J-138	True	True
J-205	269	22	25	J-206	True	True
J-31	268	22	51	J-158	True	True
J-48	264	22	37	J-49	True	True
J-253	263	22	55	J-158	True	True
J-261	261	23	22	J-262	True	True
J-230	261	22	32	J-231	True	True
J-13	260	22	34	J-161	True	True
J-216	257	22	22	J-217	True	True
J-47	251	22	37	J-223	True	True
J-43	251	22	29	J-44	True	True
J-106	249	22	59	J-158	True	True
J-212	247	22	55	J-84	True	True
J-218	246	22	31	J-216	True	True
J-206	246	22	24	J-207	True	True
J-156	245	22	23	J-16	True	True
J-14	243	22	38	J-161	True	True
J-61	238	22	40	J-126	True	True
J-217	237	22	30	J-216	True	True
J-210	236	22	47	J-211	True	True

Active Scenario: Future Sys- Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-194	236	22	22	J-201	True	True
J-155	235	23	22	J-16	True	True
J-71	234	22	48	J-231	True	True
J-207	233	22	23	J-203	True	True
J-182	232	22	26	J-152	True	True
J-211	232	22	48	J-210	True	True
J-208	232	22	37	J-209	True	True
J-22	229	22	55	J-158	True	True
J-223	227	22	45	J-47	True	True
J-228	225	22	22	J-233	True	True
J-21	221	22	22	J-231	True	True
J-136	217	22	40	J-137	True	True
J-137	215	22	38	J-136	True	True
J-8	213	22	56	J-9	True	True
J-152	213	22	24	J-183	True	True
J-209	212	22	48	J-207	True	True
J-158	210	22	59	J-156	True	True
J-140	209	22	45	J-16	True	True
J-64	208	22	58	J-158	True	True
J-75	208	22	33	J-192	True	True
J-22	207	27	22	J-159	True	True
J-49	206	22	35	J-50	True	True
J-50	206	22	37	J-49	True	True
J-229	205	22	22	J-233	True	True
J-59	204	22	40	J-60	True	True
J-262	202	22	24	J-263	True	True
J-30	200	22	53	J-158	True	True
J-103	199	22	57	J-158	True	True
J-241	192	22	57	J-158	True	True
J-266	189	22	32	J-152	True	True
J-101	181	22	57	J-158	True	True
J-44	181	22	58	J-158	True	True
J-160	178	22	49	J-23	True	True
J-263	177	22	35	J-262	True	True
J-154	174	30	22	J-16	True	True
J-192	173	22	36	J-74	True	True
J-126	170	22	40	J-60	True	True
J-74	169	22	39	J-192	True	True
J-16	167	22	26	J-153	True	True
J-159	167	22	42	J-22	True	True
J-153	166	22	25	J-16	True	True
J-60	165	22	45	J-126	True	True

Active Scenario: Future Sys- Maximum Daily Demand+ Fire Flow

Fire Flow Node FlexTable: Fire Flow Report (Carstairs Water Model-Rev2.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (L/s)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?	Is Active?
J-145	164	22	23	J-144	True	True
J-99	154	22	58	J-158	True	True
J-200	153	22	59	J-201	True	True
J-221	151	22	58	J-158	True	True
J-97	148	22	58	J-158	True	True
J-233	146	22	48	J-229	True	True
J-144	146	22	22	J-143	True	True
J-183	133	22	50	J-16	True	True
J-143	133	22	23	J-142	True	True
J-213	132	22	59	J-158	True	True
J-201	120	22	59	J-158	True	True
J-203	119	22	59	J-158	True	True
J-142	111	22	36	J-143	True	True
J-233	109	22	59	J-158	True	True
J-231	83	22	59	J-158	True	True
Golf Course	33	22	60	J-158	True	True

Appendix 5

Sanitary System Model

- Existing System Results

Project: Carstairs MSS 2010
Existing Sanitary Sewer Trunk System Model

Population Density (A)	13.68	People/ha	existing town
Water Demand	257	l/c/d	
Infiltration Allowance	0.2	l/s/ha	
Industrial & Commercial	0.66	l/s/ha	

🟩 Point load with no additional population contribution

No. of Garbage Bin @ December 2009 = 1284
Population density = 2.7 people/unit

		Pipe Characteristics			Developed Area			Estimated WW Contribution(s)										
Point Node		**Dia.**	**Slope**	**Manning's**	**New Area**	**Area Contributing**	**Area Fully Developed (Y/N?)**	**Total Contributing Area**	**Pop Feeding System**	**DWF**	**Pf**	**PDWF**	**WWF**	**PWWF**	**pt. load**	**Total**	**Pipe Diameter Required from Excel Tool**	**Is Current Pipe Adequate**
Upstream	Comments	(mm)	(%)	n'	(ha)			(ha)	est	(L/s)	-	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(mm)	
1	No Predecessors	300	0.20%	0.013	64.75	0.00	N	0.00	0	0.00	N/A	N/A	0.00	N/A		0.00	300	Y
2	Preceded by 1	375	0.20%	0.013	16.19	16.19	Y	16.19	221	0.66	6.76	4.45	3.24	7.69		7.69	250	Y
6'		375	0.20%	0.013	19.43	0.00	N	16.19	0						12.82	12.82	250	Y
6	Preceded by 2	450	0.20%	0.013	19.43	19.43	Y	51.80	487	1.45	5.77	8.37	10.36	18.73		18.73	300	Y
3	No Predecessors	300	0.20%	0.013	40.47	40.47	Y	40.47	554	1.65	5.63	9.27	8.09	17.36		17.36	300	Y
4	Preceded by 3	300	0.20%	0.013	24.28	24.28	Y	64.75	886	2.63	5.12	13.50	12.95	26.45		26.45	300	Y
5	Preceded by 4	300	0.20%	0.013	0.00	0.00	Y	64.75	886	2.63	5.12	13.50	12.95	26.45		26.45	300	Y
7	No Predecessors	300	0.20%	0.013	46.94	46.94	Y	46.94	642	1.91	5.46	10.44	9.39	19.82		19.82	300	Y
8	Preceeded by 5 & 7	300	0.20%	0.013	0.00	0.00	Y	111.69	1528	4.55	4.59	20.88	22.34	43.22		43.22	300	Y
9	Preceeded by 8	300	0.20%	0.013	12.95	12.95	Y	124.64	1705	5.07	4.49	22.79	24.93	47.72		47.72	300	Y
10	Preceeeded by 14	450	0.60%	0.013	110.08	58.95	Y	58.95	806	2.40	5.22	12.52	11.79	24.31		24.31	300	Y
11	Preceeded by 10	450	0.20%	0.013	58.28	58.28	Y	117.23	1604	4.77	4.55	21.70	23.45	45.15		45.15	375	Y
12	Preceeded by 09 & 11	450	0.20%	0.013	12.95	0.00	N	241.87	3309	9.84	3.94	38.74	48.37	87.11		87.11	375	Y
13	Preceeded by 06 & 12	450	0.20%	0.013	48.56	0.00	N	293.67	3796	11.29	3.83	43.24	58.73	101.97		101.97	375	Y
15	Preceeded by 13, G & S	450	0.20%	0.013	16.19	0.00	N	293.67	3796	11.29	3.83	43.24	58.73	101.97		101.97	450	Y
16	Preceded by 15 & J	450	0.20%	0.013	0.00	0.00	N	293.67	3796	11.29	3.83	43.24	58.73	101.97		101.97	450	Y
17	Preceded by 16, K & Q	450	0.20%	0.013	0.00	0.00	N	293.67	3796	11.29	3.83	43.24	58.73	101.97		101.97	450	Y
Lagoon	Preceded by 17	450	0.20%	0.013	0.00	0.00	N	293.67	3796	11.29	3.83	43.24	58.73	101.97		101.97	450	Y

Appendix 6

Sanitary System Model

- Results for 2041 Development

Project: Carstairs MSS 2010

Sanitary Sewer Trunk System Model Results for 2041 Population

Population Density (B)	54	People/ha	target for new areas
Population Density (A)	13.68	People/ha	existing town
Water Demand	257	l/c/d	
Infiltration Allowance	0.2	l/s/ha	
Industrial & Commercial	0.66	l/s/ha	

🟥 Node at which population density becomes composite of existing and new

🟩 Point load with no additional population contribution

No. of Garbage Bin @ December 2009 = 1284

Population density = 2.7 people/unit

		Pipe Characteristics			Developed Area			Estimated WW Contribution(s)										
Point Node on System		**Dia.**	**Slope**	**Manning's**	**New Area**	**Estimated Area Contributing**	**Area Developed (Y/N?)**	**Total Contributing Area**	**Pop Feeding System**	**Estimated Composite Population Density**	**DWF**	**Pf**	**PDWF**	**WWF**	**PWWF**	**pt. load**	**Total**	**Pipe Diameter Required from Excel Tool**
Upstream	Comments	(mm)	(%)	n'	(ha)			(ha)	ea		(L/s)	-	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(mm)
A	No predecessors	375	0.60%	0.013	32.38	0.00	N	0.00	0	N/A	0.00	N/A	N/A	0.00	N/A		0.00	
B	No predecessors	375	0.20%	0.013	16.19	13.76	Y	13.76	743.121	N/A	2.21	5.31	11.73	2.75	14.48		14.48	375
C	Preceded by A&B - pumped	375	0.20%	0.013	80.94	56.66	Y	70.42	3802.56	N/A	11.31	3.83	43.30	14.08	57.38		57.38	pumped - N/A
D	Preceded by C - Pumped	375	0.20%	0.013	0.00	0.00	Y	70.42	3802.56	N/A	11.31	3.83	43.30	14.08	57.38		57.38	pumped - N/A
E	No Predecessors	250	0.62%	0.013	32.38	32.38	Y	32.38	1748.25	N/A	5.20	4.47	23.25	6.48	29.73		29.73	250
F	Preceded by D & E	375	0.20%	0.013	0.00	0.00	Y	102.79	5550.81	N/A	16.51	3.55	58.60	20.56	79.16		79.16	pumped - n/a
G	Preceded by F	375	0.20%	0.013	19.43	16.51	Y	119.30	6442	N/A	19.16	3.44	66.01	23.86	89.87		89.87	pumped - n/a
H	No Predecessors	375	0.20%	0.013	38.85	19.43	Y	19.43	0	N/A	0.00	N/A	N/A	3.89	N/A	12.82	12.82	375
K	Preceded by H (pumped)	375	0.20%	0.013	9.71	8.74	Y	28.17	472	N/A	1.40	5.81	8.16	5.63	13.79		13.79	pumped - n/a
J	No Predecessors	250	0.20%	0.013	9.71	8.74	Y	8.74	472	N/A	1.40	5.81	8.16	1.75	9.91		9.91	250
L	No Predecessors	375	0.20%	0.013	64.75	0.00	N	0.00	0	N/A	0.00	N/A	N/A	0.00	N/A		0.00	
M	Preceded by L	375	0.75%	0.013	45.33	43.06	Y	43.06	2325	N/A	6.92	4.22	29.21	8.61	37.82		37.82	375
14	Preceded by M	375	0.50%	0.013	25.90	24.61	Y	67.66	2662	39	7.92	4.11	32.55	13.53	46.08		46.08	300
N'	No Predecessors	375	1.30%	0.013	45.33	0.00	N	0.00	0	N/A	0.00	N/A	N/A	0.00	N/A		0.00	
N	Preceded by N'	375	1.30%	0.013	32.38	30.76	Y	30.76	1661	N/A	4.94	4.52	22.32	6.15	28.47		28.47	375
O	Preceded by N	375	0.20%	0.013	6.48	0.00	N	30.76	1661	N/A	4.94	4.52	22.32	6.15	28.47		28.47	375
P	Preceded by O	375	0.20%	0.013	80.94	0.00	N	30.76	1661	N/A	4.94	4.52	22.32	6.15	28.47		28.47	375
R	No Predecessors	375	0.20%	0.013	25.90	0.00	Y	0.00	0	0	0.00	N/A	N/A	0.00	N/A	17.09	17.09	375
Q	Preceded by R & P (pumped)	375	0.20%	0.013	32.38	0.00	Y	30.76	1661	54	4.94	4.52	22.32	6.15	28.47		28.47	300
S	No Predecessors	375	0.38%	0.013	32.38	32.38	Y	0.00	0	0	0.00	N/A	N/A	6.48	N/A	21.37	21.37	300
1	No Predecessors	300	0.20%	0.013	64.75	58.28	Y	58.28	797	N/A	2.37	5.23	12.41	11.66	24.06		24.06	300
2	Preceded by 1	375	0.20%	0.013	16.19	16.19	Y	74.46	1019	N/A	3.03	4.98	15.09	14.89	29.99		29.99	300
6'		375	0.20%	0.013	19.43	0.00	Y	74.46	0	N/A						12.82	12.82	300
6	Preceded by 2	450	0.20%	0.013	19.43	19.43	Y	168.35	1284	N/A	3.82	4.76	18.17	33.67	51.84		51.84	375
3	No Predecessors	300	0.20%	0.013	40.47	40.47	Y	40.47	554	N/A	1.65	5.63	9.27	8.09	17.36		17.36	300
4	Preceded by 3	300	0.20%	0.013	24.28	24.28	Y	64.75	886	N/A	2.63	5.12	13.50	12.95	26.45		26.45	300
5	Preceded by 4	300	0.20%	0.013	0.00	0.00	Y	64.75	886	N/A	2.63	5.12	13.50	12.95	26.45		26.45	300
7	No Predecessors	300	0.20%	0.013	46.94	46.94	Y	46.94	642	N/A	1.91	5.46	10.44	9.39	19.82		19.82	300
8	Preceeded by 5 & 7	300	0.20%	0.013	0.00	0.00	Y	111.69	1528	N/A	4.55	4.59	20.88	22.34	43.22		43.22	300
9	Preceeded by 8	300	0.20%	0.013	12.95	12.95	Y	124.64	1705	N/A	5.07	4.49	22.79	24.93	47.72		47.72	300
10	Preceeeded by 14	525	0.60%	0.013	110.08	99.07	Y	166.73	4017	24	11.95	3.79	45.24	33.35	78.59		78.59	375
11	Preceeded by 10	450 & 600	0.20%	0.013	58.28	58.28	Y	225.01	4814	21	14.32	3.65	52.29	45.00	97.29		97.29	450
12	Preceeded by 09 & 11	450 & 600	0.20%	0.013	12.95	0.00	Y	349.65	6519	19	19.39	3.44	66.64	69.93	136.57	8.55	145.12	525

		Pipe Characteristics			Developed Area			Estimated WW Contribution(s)										
Point Node on System		**Dia.**	**Slope**	**Manning's**	**New Area**	**Estimated Area Contributing**	**Area Developed (Y/N?)**	**Total Contributing Area**	**Pop Feeding System**	**Estimated Composite Population Density**	**DWF**	**Pf**	**PDWF**	**WWF**	**PWWF**	**pt. load**	**Total**	**Pipe Diameter Required from Excel Tool**
13	Preceeded by 06 & 12	450 & 600	0.20%	0.013	48.56	24.28	Y	542.28	7804	14	23.21	3.32	76.95	108.46	185.41	32.05	217.46	600
15	Preceeded by 13, G & S	450 & 600	0.20%	0.013	16.19	16.19	Y	677.77	14468	21	43.03	2.93	126.10	135.55	261.65		261.65	675
16	Preceded by 15 & J	450 & 600	0.20%	0.013	0.00	0.00	Y	686.51	14940	22	44.44	2.91	129.38	137.30	266.68		266.68	675
17	Preceded by 16, K & Q	450 & 600	0.20%	0.013	0.00	0.00	Y	745.44	17072	23	50.78	2.83	143.95	149.09	293.04		293.04	675
Lagoon	Preceded by 17	450 & 600	0.20%	0.013	0.00	0.00	Y	745.44	17072	23	50.78	2.83	143.95	149.09	293.04		293.04	675

AECOM

Appendix 7

Sanitary System Model

- Results For Full Development

Project: Carstairs MSS 2010

Sanitary Sewer Trunk System For Full Development Model Result

Population Density (B)	54	People/ha
Population Density (A)	13.68	People/ha
Water Demand	257	l/c/d
Infiltration Allowance	0.2	l/s/ha
Industrial & Commerical	0.66	l/s/ha

🟥	Node at which population density becomes composite of existing and new
🟩	Point load with no additional population contribution

No. of Garbage Bin @ December 2009 = 1284

Population density = 2.7 people/unit

		Pipe Characteristics			Developed Area			Estimated WW Contribution(s)										
Manhole (From TCA)		**Dia.**	**Slope**	**Manning's**	**New Area**	**Area Contributing**	**Area Developed (Y/N?)**	**Total Contributing Area**	**Pop Feeding System**	**Estimated Composite Population Density**	**DWF**	**Pf**	**PDWF**	**WWF**	**PWWF**	**pt. load**	**Total**	**Pipe Diameter Required**
Upstream	Comments	(mm)	(%)	n'	(ha)			(ha)	ea	people/ha	(L/s)	-	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	
A	No predecessors	375	0.60%	0.013	32.38	16.19	Y	16.19	874	N/A	2.60	5.14	13.36	3.24	16.59	10.69	27.28	250
B	No predecessors	375	0.20%	0.013	16.19	12.14	Y	12.14	656	N/A	1.95	5.44	10.61	2.43	13.04	2.67	15.71	375
C	Preceded by B&C	375	0.20%	0.013	80.94	68.80	Y	97.13	5245	N/A	15.60	3.59	56.00	19.43	75.43		75.43	pumped - N/a
D	Preceded by C - Pumped	375	0.20%	0.013	0.00	0.00	Y	97.13	5245	N/A	15.60	3.59	56.00	19.43	75.43		75.43	pumped - N/a
E	No Predecessors	250	0.62%	0.013	32.38	32.38	Y	32.38	1749	N/A	5.20	4.47	23.26	6.48	29.73		29.73	250
F	Preceded by D & E	375	0.20%	0.013	0.00	0.00	Y	129.51	6994	N/A	20.80	3.39	70.49	25.90	96.39		96.39	pumped - N/A
G	Preceded by F	375	0.20%	0.013	19.43	16.51	Y	146.02	7885	N/A	23.45	3.31	77.60	29.20	106.80		106.80	pumped - N/A
H	No Predecessors	375	0.20%	0.013	38.85	38.85	Y	0.00	0	N/A	0.00	N/A	N/A	0.00	N/A	25.64	25.64	250
K	Preceded by H (pumped)	375	0.20%	0.013	9.71	8.74	Y	8.74	472	N/A	1.40	5.81	8.16	1.75	9.91		9.91	pumped - N/A
J	No Predecessors	250	0.20%	0.013	9.71	8.74	Y	8.74	472	N/A	1.40	5.81	8.16	1.75	9.91		9.91	250
L	No Predecessors	375	0.20%	0.013	64.75	32.38	Y	32.38	1748	N/A	5.20	4.47	23.25	6.48	29.73	21.37	51.10	375
M	Preceded by L	375	0.75%	0.013	45.33	43.06	Y	75.43	4073	N/A	12.12	3.78	45.75	15.09	60.83		60.83	375
14	Preceded by M	375	0.50%	0.013	25.90	24.61	Y	100.04	4410	44	13.12	3.72	48.75	20.01	68.75		68.75	375
N'	No Predecessors	375	1.30%	0.013	45.33	33.99	Y	33.99	1836	N/A	5.46	4.43	24.18	6.80	30.98		30.98	300
N	Preceded by N'	375	1.30%	0.013	32.38	30.76	Y	64.75	3497	N/A	10.40	3.89	40.49	12.95	53.44		53.44	300
O	Preceded by N	375	0.20%	0.013	6.48	4.86	Y	69.61	3759	N/A	11.18	3.84	42.90	13.92	56.82		56.82	375
P	Preceded by O	375	0.20%	0.013	80.94	16.19	Y	85.79	4633	N/A	13.78	3.68	50.71	17.16	67.87	42.74	110.60	450
R	No Predecessors	375	0.20%	0.013	25.90	25.90	Y	25.90	0	N/A	0.00	N/A	N/A	5.18	N/A	17.09	17.09	300
Q	Preceded by R & P (pumped)	375	0.20%	0.013	32.38	32.38	Y	144.07	4633	32	13.78	3.68	50.71	28.81	79.52		79.52	525
S	No Predecessors	375	0.38%	0.013	32.38	32.38	Y	32.38	0	N/A	0.00	N/A	N/A	6.48	N/A	21.37	21.37	300
1	No Predecessors	300	0.20%	0.013	64.75	58.28	Y	58.28	797	N/A	2.37	5.23	12.41	11.66	24.06		24.06	300
2	Preceded by 1	375	0.20%	0.013	16.19	16.19	Y	74.46	1019	N/A	3.03	4.98	15.09	14.89	29.99		29.99	300
6'		375	0.20%	0.013	19.43	19.43	Y	93.89	0	N/A	0.00	N/A	N/A	18.78	N/A	12.82	12.82	300
6	Preceded by 2	450	0.20%	0.013	19.43	19.43	Y	93.89	1284	N/A	3.82	4.76	18.17	18.78	36.95		36.95	375
3	No Predecessors	300	0.20%	0.013	40.47	40.47	Y	40.47	554	N/A	1.65	5.63	9.27	8.09	17.36		17.36	300
4	Preceded by 3	300	0.20%	0.013	24.28	24.28	Y	64.75	886	N/A	2.63	5.12	13.50	12.95	26.45		26.45	300
5	Preceded by 4	300	0.20%	0.013	0.00	0.00	Y	64.75	886	N/A	2.63	5.12	13.50	12.95	26.45		26.45	300
7	No Predecessors	300	0.20%	0.013	46.94	46.94	Y	46.94	642	N/A	1.91	5.46	10.44	9.39	19.82		19.82	300
8	Preceeded by 5 & 7	300	0.20%	0.013	0.00	0.00	Y	111.69	1528	N/A	4.55	4.59	20.88	22.34	43.22		43.22	300
9	Preceeded by 8	300	0.20%	0.013	12.95	12.95	Y	124.64	1705	N/A	5.07	4.49	22.79	24.93	47.72		47.72	300
10	Preceeeded by 14	525	0.60%	0.013	110.08	99.07	Y	199.11	5765	29	17.15	3.52	60.40	39.82	100.22		100.22	450
11	Preceeded by 10	450 & 600	0.20%	0.013	58.28	58.28	Y	257.38	6562	25	19.52	3.43	67.00	51.48	118.47		118.47	525
12	Preceeded by 09 & 11	450 & 600	0.20%	0.013	12.95	0.00	Y	382.03	8268	22	24.59	3.28	80.59	76.41	157.00	8.55	165.54	525

		Pipe Characteristics			Developed Area			Estimated WW Contribution(s)										
Manhole (From TCA)		**Dia.**	**Slope**	**Manning's**	**New Area**	**Area Contributing**	**Area Developed (Y/N?)**	**Total Contributing Area**	**Pop Feeding System**	**Estimated Composite Population Density**	**DWF**	**Pf**	**PDWF**	**WWF**	**PWWF**	**pt. load**	**Total**	**Pipe Diameter Required**
Upstream	Comments	(mm)	(%)	n'	(ha)			(ha)	ea	people/ha	(L/s)	-	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	
13	Preceeded by 06 & 13	450 & 600	0.20%	0.013	48.56	24.28	Y	500.19	9552	19	28.41	3.18	90.46	100.04	190.50	32.05	222.55	600
15	Preceeded by 13, G & S	450 & 600	0.20%	0.013	16.19	16.19	Y	694.78	17659	25	52.53	2.82	147.89	138.96	286.85		286.85	675
16	Preceded by 15 & J	450 & 600	0.20%	0.013	0.00	0.00	Y	703.52	18131	26	53.93	2.80	151.05	140.70	291.75		291.75	675
17	Preceded by 16, K & Q	450 & 600	0.20%	0.013	0.00	0.00	Y	856.33	23235	27	69.11	2.67	184.21	171.27	355.47		355.47	750
Lagoon	Preceded by 17	450 & 600	0.20%	0.013	0.00	0.00	Y	856.33	23235	27	69.11	2.67	184.21	171.27	355.47		355.47	750

Appendix 8

Excel Tool Analysis

- Pipe Sizing at 54 people / Hectare

Sanitary Sewer Capacities

Population density	54	people/ha	22	people/acre

Average per capita sewage flow (Q_{AVE}) = A 257 l/c/d

Per capita infiltration = B 320 l/c/d or 0.20 l/s/ha

Harmon's Peaking Factor = PF = $1+14/(4+P^{1/2})$ Varies

Peaking Factor 4.31

Peak flow ($Q_{PDW\ without\ infiltration}$) = A x PF 1,107 l/c/d or 0.69 l/s/ha

Peak flow ($Q_{PDW\ with\ infiltration}$) C = A x PF + B 1,427 l/c/d or 0.89 l/s/ha 0.22298639

	Area (ha)	**Peaking Factor**	**Q_{PDW} l/c/d**	**Sewage Flow (l/s)**
	256	2.81	1,043	167
	10	3.96	1,337	8
$^1/_4$ (Q.section)	16	3.84	1,307	13
	24	3.72	1,277	19
$^1/_2$ (Q.section)	32	3.63	1,254	25
	40	3.56	1,235	31
$^3/_4$ (Q.section)	48	3.50	1,218	37
1 (Q.section)	64	3.39	1,191	48
2 (Q.section)	128	3.11	1,120	90
3 (Q.section)	192	2.94	1,075	129
4 (Q.section)	256	2.81	1,043	167
5 (Q.section)	320	2.72	1,018	204

	Area (ha)	**Peaking Factor**	**Q_{PDW} l/c/d**	**Sewage Flow (l/s)**
6 (Q.section)	384	2.64	998	239
7 (Q.section)	448	2.57	980	275
8 (Q.section)	512	2.51	966	309
9 (Q.section)	576	2.46	953	343
10 (Q.section)	640	2.42	941	376
11 (Q.section)	704	2.38	931	410
12 (Q.section)	768	2.34	922	442
13 (Q.section)	832	2.31	913	475
14 (Q.section)	896	2.28	905	507
15 (Q.section)	960	2.25	898	539
16 (Q.section)	1,024	2.22	892	571
17 (Q.section)	1,088	2.20	885	602

Capacity based on Manning's Formula (n = 0.013)

200mm (8") Dia Pipe		
Slope	**Capacity (l/s)**	**Area Served (ha)**
0.80%	29	33
0.90%	31	35
1.00%	33	37
1.20%	36	40
1.40%	39	44
1.60%	41	46
1.80%	44	49

250mm (10") Dia Pipe		
Slope	**Capacity (l/s)**	**Area Served (ha)**
0.40%	38	43
0.50%	42	47
0.60%	46	52
0.70%	50	56
0.80%	53	59
0.90%	56	63
1.00%	59	66

300mm (12") Dia Pipe		
Slope	**Capacity (l/s)**	**Area Served (ha)**
0.32%	55	62
0.40%	61	68
0.50%	68	76
0.60%	75	84
0.70%	81	91
0.80%	86	96
0.90%	92	103
1.00%	97	109
1.20%	106	119
1.40%	114	128
1.60%	122	137
1.80%	130	146

375mm (15") Dia Pipe		
Slope	**Capacity (l/s)**	**Area Served (ha)**
0.24%	86	96
0.30%	96	108
0.40%	111	124
0.50%	124	139
0.60%	136	152
0.70%	147	165
0.80%	157	176
0.90%	166	186
1.00%	175	196
1.20%	192	215
1.40%	207	232
1.60%	222	249

450mm (18") Dia Pipe		
Slope	**Capacity (l/s)**	**Area Served (ha)**
0.18%	121	136
0.20%	128	144
0.30%	156	175
0.40%	180	202
0.50%	202	226
0.60%	221	248
0.70%	239	268
0.80%	255	286
0.90%	270	303
1.00%	285	320
1.20%	312	350
1.40%	337	378
1.60%	361	405
1.80%	383	429

525mm (21") Dia Pipe		
Slope	**Capacity (l/s)**	**Area Served (ha)**
0.16%	172	193
0.20%	192	215
0.30%	236	265
0.40%	272	305
0.50%	304	341
0.60%	333	373
0.70%	360	404
0.80%	385	432
0.90%	408	457
1.00%	430	482
1.20%	471	528
1.40%	509	571
1.60%	544	610
1.80%	577	647

600mm (24") Dia Pipe		
Slope	**Capacity (l/s)**	**Area Served (ha)**
0.12%	213	239
0.20%	275	308
0.30%	336	377
0.40%	388	435
0.50%	434	487
0.60%	476	534
0.70%	514	576
0.80%	549	616
0.90%	582	653
1.00%	614	688
1.20%	673	755
1.40%	727	815
1.60%	777	871
1.80%	824	924

675mm (27") Dia Pipe		
Slope	**Capacity (l/s)**	**Area Served (ha)**
0.10%	266	298
0.20%	376	422
0.30%	460	516
0.40%	532	596
0.50%	594	666
0.60%	651	730
0.70%	703	788
0.80%	752	843
0.90%	797	894
1.00%	841	943
1.20%	921	1,033
1.40%	995	1,116
1.60%	1,063	1,192
1.80%	1,128	1,265

750mm (30") Dia Pipe		
Slope	**Capacity (l/s)**	**Area Served (ha)**
0.10%	352	395
0.20%	498	558
0.30%	610	684
0.40%	704	789
0.50%	787	882
0.60%	862	966
0.70%	931	1,044
0.80%	996	1,117
0.90%	1056	1,184
1.00%	1113	1,248
1.20%	1220	1,368
1.40%	1317	1,477
1.60%	1,408	1,579
1.80%	1,494	1,675

Appendix 9

Excel Tool Analysis

- Pipe Sizing at 13.68 People / Hectare

Sanitary Sewer Capacities

Population density	13.68	people/ha	6	people/acre

Average per capita sewage flow (Q_{AVE}) = A 257 l/c/d

Per capita infiltration = B 1263.1579 l/c/d or 0.20 l/s/ha

Harmon's Peaking Factor = PF = 1+14/(4+$P^{1/2}$) Varies

Peaking Factor 4.40

Peak flow ($Q_{PDW\ without\ infiltration}$) = A x PF 1,131 l/c/d or 0.18 l/s/ha

Peak flow ($Q_{PDW\ with\ infiltration}$) C = A x PF + B 2,394 l/c/d or 0.38 l/s/ha 0.09476659

	Area (ha)	Peaking Factor	Q_{PDW} l/c/d	Sewage Flow (l/s)
	256	3.38	2,133	86
	10	4.20	2,344	4
$^1/_4$ (Q.section)	16	4.13	2,325	6
	24	4.06	2,307	9
$^1/_2$ (Q.section)	32	4.00	2,292	12
	40	3.95	2,279	14
$^3/_4$ (Q.section)	48	3.91	2,268	17
1 (Q.section)	64	3.84	2,249	23
2 (Q.section)	128	3.63	2,196	45
3 (Q.section)	192	3.49	2,160	66
4 (Q.section)	256	3.38	2,133	86
5 (Q.section)	320	3.30	2,111	107

	Area (ha)	Peaking Factor	Q_{PDW} l/c/d	Sewage Flow (l/s)
6 (Q.section)	384	3.23	2,092	127
7 (Q.section)	448	3.16	2,076	147
8 (Q.section)	512	3.11	2,061	167
9 (Q.section)	576	3.06	2,049	187
10 (Q.section)	640	3.01	2,037	206
11 (Q.section)	704	2.97	2,027	226
12 (Q.section)	768	2.93	2,017	245
13 (Q.section)	832	2.90	2,008	265
14 (Q.section)	896	2.87	2,000	284
15 (Q.section)	960	2.84	1,992	303
16 (Q.section)	1,024	2.81	1,985	322
17 (Q.section)	1,088	2.78	1,978	341

Capacity based on Manning's Formula (n = 0.013)

200mm (8") Dia Pipe		
Slope	Capacity (l/s)	Area Served (ha)
0.80%	29	77
0.90%	31	82
1.00%	33	87
1.20%	36	95
1.40%	39	103
1.60%	41	108
1.80%	44	116

250mm (10") Dia Pipe		
Slope	Capacity (l/s)	Area Served (ha)
0.40%	38	100
0.50%	42	111
0.60%	46	121
0.70%	50	132
0.80%	53	140
0.90%	56	148
1.00%	59	156

300mm (12") Dia Pipe		
Slope	Capacity (l/s)	Area Served (ha)
0.32%	55	145
0.40%	61	161
0.50%	68	179
0.60%	75	198
0.70%	81	214
0.80%	86	227
0.90%	92	243
1.00%	97	256
1.20%	106	280
1.40%	114	301
1.60%	122	322
1.80%	130	343

375mm (15") Dia Pipe		
Slope	Capacity (l/s)	Area Served (ha)
0.24%	86	227
0.30%	96	253
0.40%	111	293
0.50%	124	327
0.60%	136	359
0.70%	147	388
0.80%	157	414
0.90%	166	438
1.00%	175	462
1.20%	192	507
1.40%	207	546
1.60%	222	586

450mm (18") Dia Pipe		
Slope	Capacity (l/s)	Area Served (ha)
0.18%	121	319
0.20%	128	338
0.30%	156	412
0.40%	180	475
0.50%	202	533
0.60%	221	583
0.70%	239	630
0.80%	255	673
0.90%	270	712
1.00%	285	752
1.20%	312	823
1.40%	337	889
1.60%	361	952
1.80%	383	1,010

525mm (21") Dia Pipe		
Slope	Capacity (l/s)	Area Served (ha)
0.16%	172	454
0.20%	192	507
0.30%	236	623
0.40%	272	718
0.50%	304	802
0.60%	333	878
0.70%	360	950
0.80%	385	1,016
0.90%	408	1,076
1.00%	430	1,134
1.20%	471	1,243
1.40%	509	1,343
1.60%	544	1,435
1.80%	577	1,522

600mm (24") Dia Pipe		
Slope	Capacity (l/s)	Area Served (ha)
0.12%	213	562
0.20%	275	725
0.30%	336	886
0.40%	388	1,024
0.50%	434	1,145
0.60%	476	1,256
0.70%	514	1,356
0.80%	549	1,448
0.90%	582	1,535
1.00%	614	1,620
1.20%	673	1,775
1.40%	727	1,918
1.60%	777	2,050
1.80%	824	2,174

675mm (27") Dia Pipe		
Slope	Capacity (l/s)	Area Served (ha)
0.10%	266	702
0.20%	376	992
0.30%	460	1,214
0.40%	532	1,403
0.50%	594	1,567
0.60%	651	1,717
0.70%	703	1,855
0.80%	752	1,984
0.90%	797	2,103
1.00%	841	2,219
1.20%	921	2,430
1.40%	995	2,625
1.60%	1,063	2,804
1.80%	1,128	2,976

750mm (30") Dia Pipe		
Slope	Capacity (l/s)	Area Served (ha)
0.10%	352	929
0.20%	498	1,314
0.30%	610	1,609
0.40%	704	1,857
0.50%	787	2,076
0.60%	862	2,274
0.70%	931	2,456
0.80%	996	2,628
0.90%	1056	2,786
1.00%	1113	2,936
1.20%	1220	3,218
1.40%	1317	3,474
1.60%	1,408	3,714
1.80%	1,494	3,941

Appendix 10

Capital Analysis

- **Detailed Tables**

Capital Analysis

Fixed Values Used			Hydrant Price	$8,000	Hydrant every	150	metres on water main
% mark up for Engineering Adminstration & Contingency	35%		250 mm valve	$3,500	Manhole on sanitary line on average every	150	metres
Price per Capacity $ l/s	$5,000		300 mm valve	$4,200	Price of Manhole	$6,000	
					Force Main velocity	1.5	m/s

Table 6.1 Water Storage, Supply & Pumping

Item	Final Cost Estimate ($CND)	Price per m^3 storage ($ CND)	Capacity (m^3)	Estimated Cost ($CND)	Engineering Adminstration & Contingency (35%)
Install 3000 m^3 Reservoir	$1,740,000	$430	3,000	$1,290,000	$451,500
		Price per l/s capacity	Capacity Upgrade Needed (l/s)	Estimated Cost ($CND)	
Upgrade Existing Pumphouse	$470,000	$5,000	70	$350,000	$122,500
New pumphouse with new fire pump for industrial & commercial	$1,570,000	$5,000	233	$1,165,000	$407,750
Re-do Domestic Pumps	$1,420,000	$5,000	210	$1,050,000	$367,500
Sub-Total	$5,200,000			$3,855,000	$1,349,250

Table 6.2 Water – Distribution Network Upgrades to Existing

Item	Final Cost Estimate ($CND)	Pipe Material	Existing Pipe Diameter (mm)	Existing Pipe Replacement Cost per metre $	Estimated Length (m)	Estimated Replacement Cost $	Price per metre $	Estimated Length (m)	Price for Pipe $	No. of Hydrants	Price Per Hydrant $	Cost for Hydrants	No. of Valves	Price per Valve	Cost for Valves	Highway Crossing	Estimated Cost ($CND)	Engineering Adminstration & Contingency (35%)
Upgrade A - Install 300mm main	$170,000	PVC	N/A	N/A	N/A	$0	$410	300	$90,000	2	$8,000	$16,000	4	$4,200	$16,800	$0	$122,800	$42,980
Upgrade B - D - Install 300mm main	$200,000	PVC	N/A	N/A	N/A	$0	$410	350	$122,500	2	$8,000	$16,000	2	$4,200	$8,400	$0	$146,900	$51,415
Upgrade C - Upgrade to 250mm main*	$80,000	PVC	1/3 200 mm, 2/3 150 mm	290 and 250 respectively	350	$92,000	$350	350	$122,500	2	$8,000	$16,000	3	$3,500	$10,500	$0	$57,000	$19,950
Upgrade E - Install 250mm main	$170,000	PVC	N/A	N/A	N/A	$0	$350	250	$62,500	2	$8,000	$16,000	2	$3,500	$7,000	$40,000	$125,500	$43,925
Upgrade F - Install 250mm main	$380,000	PVC	N/A	N/A	N/A	$0	$350	500	$250,000	3	$8,000	$24,000	2	$3,500	$7,000	$0	$281,000	$98,350
Upgrade G - Upgrade to 250mm main*	$1,520,000	PVC	2/3 200mm , 1/3 150mm	290 and 250 respectively	1,200	$332,000	$350	1,200	$1,440,000	0	$8,000	$0	5	$3,500	$17,500	$0	$1,125,500	$393,925
Upgrade H - Upgrade to 250mm main*	$70,000	PVC	150	$250	350	$88,000	$350	350	$122,500	0	$8,000	$0	3	$3,500	$10,500	$0	$45,000	$15,750
Sub-Total	$2,569,995																$1,903,700	$666,295

*The replacement cost for the existing pipe has been deducted from the cost of installing new pipe, presumes hydrants can be re-used

Table 6.3 Waste Water Trunk Pipelines

Item	Final Cost Estimate ($CND)	Pipe Diameter	Pipe Material	Price per metre $	Estimated Length (m)	Estimated Pipe Cost ($CND)	No. of Manholes	Cost of Manholes	Estimated Cost of Sanitary Main	Engineering Adminstration & Contingency (35%)	Highway Crossings
Install Link from CR 1 & CR 2 to Carlinton	$360,000	250	PVC	$250	800	$200,000	5	$30,000	$265,000	$92,750	$35,000
Install Twinning Main to Lagoon to service population projected for 2041											
Points 10 – 11 - 525 mm pipe	$200,000	525	PVC	$450	300	$135,000	2	$12,000	$147,000	$51,450	
Points 11 – 12 - 525 mm pipe	$100,000	525	PVC	$450	150	$67,500	1	$6,000	$73,500	$25,725	
Points 12 -13 – 525 mm pipe	$270,000	525	PVC	$450	400	$180,000	3	$18,000	$198,000	$69,300	
Points 13 – 15 – 525 mm pipe	$270,000	525	PVC	$450	400	$180,000	3	$18,000	$198,000	$69,300	
Points 17 – Lagoon – 600 mm pipe	$1,680,000	600	PVC	$550	2,100	$1,155,000	14	$84,000	$1,239,000	$433,650	
Sub Total Trunk Mains	$2,880,000					$1,917,500				$742,175	

	Final Cost Estimate ($CND)	Price per l/s capacity	Capacity Pumping Needed (l/s)	Estimated Cost ($CND)	Forced Main (m)	Estimated Diameter Force Main (m)	Price for pipe (rounded up to nearest pipe size)	Price Forced Main & Station	Add Engineering Adminstration & Contingency (35%)
Install Lift Station to Service EIS (Point Q)	$1,890,000	$5,000	130	$650,000	1,500	0.33	$500	$1,400,000	$490,000
Water Tight and Raise Manholes at Scarlett Ranch	$30,000								
Sub Total Manhole & Lift Stations	$1,920,000							$3,091,000	$1,081,850

Table 6.4 Waste Water Treatment Systems Upgrade

Item	Final Cost Estimate ($CND)	Increased Volume required (m^3)	Excavation Amount	Price per (m^3) Excavation	Price for Excavation	Surface Area for new Excavation (m^2)	Price per sq m of liner	Price for Lining	Estimated Cost ($CND)	Engineering Adminstration & Contingency (35%)
Upgrade Anaerobic Cells 20 yr design	$370,000	24,000	100%	$6	$144,000	8,400	$15	$126,000	$270,000	$94,500
Upgrade Faculative Cell	$4,160,000	230,000	100%	$3	$690,000	159,000	$15	$2,385,000	$3,075,000	$1,076,250
Upgrade Storage Cell	$13,080,000	1,450,000	50%	$3	$2,175,000	500,500	$15	$7,507,500	$9,682,500	$3,388,875
Associated Piping and Manholes	$410,000								$300,000	$105,000
Sub Total	$18,020,000									

Table 6.5 Stormwater Pond Upgrade

Item	Final Cost Estimate ($CND)	Volume (m^3)	Area (m^2)	Price Per Unit	Estimated Cost ($CND)	Engineering Adminstration & Contingency (35%)
Excavation	$770,000	$57,000	-	$10	$570,000	$199,500
Liner & Landscaping	$850,000	-	$31,200	$20	$624,000	$218,400
Sub-Total	$1,620,000					