



Platinum member

## Castle Area Structure Plan

Prepared: July 7, 2025

Revised: November 20, 2025

## Master Serving Study

Submitted to: Castle and Land Development Ltd.

Prepared by McElhanney

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November 20, 2025  
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Attention: David Mulholland

## Castle Area Structure Plan – Master Servicing Study -Draft

McElhanney is pleased to present the Master Servicing Study for the Castle Area Structure Plan (ASP). This study provides concept layouts for the water, wastewater, and stormwater systems for the ASP and reviews impacts to the existing Town system.

We look forward to any comments prior to submitting to the Town for circulation.

Sincerely,

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## Executive Summary

This report provides conceptual layouts for the water, wastewater, and stormwater infrastructure for the Castle Area Structure Plan (Castle ASP) in the Town of Claresholm. The Castle ASP lands cover approximately 183 hectares (451 acres) of land in the Town and includes lands, west of the Town, from the following quarter sections:

The Castle ASP lands are located along the western boundary of the Town, between 59th Avenue W to the north, 8<sup>th</sup> Street W to the east, and Kin Trail to the south. The lands include portions of quarter sections NE 27-12-27 W4, SE 27-12-27 W4, and NE 22-12-27 W4. These lands were annexed by the Town in 2023 to increase residential land supply and provide capacity for additional institutional uses and recreational space.

Based on the land use concept, the ASP will accommodate approximately 1,546 dwelling units, housing an estimated population of 3,255 at full buildout. The land use includes 72.0 ha of low-density residential, 31.5 ha of country residential, 23.3 ha of medium-density residential (including duplexes, six-plexes and apartments), and 6.5 ha of commercial development.

### Water System

The Town's existing water system was reviewed against future growth scenarios that both include and exclude the Castle ASP lands. Based on the Town of Claresholm – Infrastructure Master Plan (Associated Engineering, 2021), herein referred to as the IMP, there are existing limitations to the Town's water infrastructure to provide adequate fire flows to various areas of the Town including the downtown and the north end of Town. The report identified upgrades and improvements to improve fire flows in areas with deficient fire flows

The IMP also provided a conceptual water system for build-out of the Town which identified upgrades and watermains required to facilitate development. The conceptual water system provided a system that met Town requirements.

McElhanney reviewed the IMP and completed water modeling to determine impacts the Castle ASP would have on the Town's water system and developed a conceptual layout that meets design criteria. The following summarizes the results:

- The conceptual water concept consists of watermains varying in size from 150mm to 300mm diameter.

- Additional water storage will be needed once the Town's population increases by approximately 1,260 people through any proposed ASP development. The existing capacity, however, is sufficient to support initial phases of the Castle ASP without immediate reservoir construction.
- Additional water license will be required once a population of approximately 10,000 is reached. The existing license can support the existing population, the Castle ASP, the North Point ASP, and the Prairie Shores ASP with the exclusion of the Evolution ASP.
- The proposed water distribution system creates new looping opportunities that benefits the Town's overall system, improving existing fireflows in the north area. It allows the Town to eliminate several previously identified water system improvements (pending phasing of the Castle ASP with other ASP's):
  - WG3: 5 St E Looping Ph 1
  - WG4: Columbia Dr. Looping
  - W5: Division Av. to 2 St E Connector

## **Wastewater System**

The Town's existing wastewater main along 8<sup>th</sup> Street W was assessed against future growth scenarios that both include and exclude the Castle ASP lands. Based on the IMP, there are existing limitations to the Town's wastewater infrastructure along 8<sup>th</sup> Street W with two sections of pipe exceeding 100% capacity and the other two sections exceeding 86% capacity. It is the Town's requirement for wastewater mains to not exceed 86% of their capacity.

The IMP also provided a conceptual water system for build-out of the Town. With the future build-out, the 8<sup>th</sup> Street W wastewater main exceed capacity in most of the pipes, mainly due to the Prairie Shores ASP wastewater flows from the north.

McElhanney reviewed the IMP and completed wastewater modeling to determine impacts the Castle ASP has on the Town's wastewater system along 8<sup>th</sup> Street W and provides a conceptual layout for the ASP to allow for wastewater design criteria for the ASP to be met. The following summarizes the results:

- The conceptual wastewater system for the ASP consists of wastewater mains from 250mm to 275mm diameter if designed independently, or 250mm to 450mm diameter if flows for the Prairie Shores ASP is conveyed through the Castle ASP lands.
- The Town's wastewater lagoon capacity can support a population between 4,312 and 6,126 (depending on whether evaporation is considered). A review of lagoon operations is recommended to determine timing for future upgrades.
- Several sections of the Town's existing wastewater mains along 8<sup>th</sup> Street W currently exceed capacity without any contribution from Castle ASP. Upgrades are likely required, and it is recommended the Town undertake flow monitoring to determine the actual flows experienced in



these sections of main. Design criteria is typically conservative with actual flows being somewhat less, allowing for additional development before replacement or upgrades.

- The alternate concept alignment for the Prairie Shores ASP wastewater flowing through the Castle ASP lands can be accommodated with an increase in pipe diameters with an approximate 2.6km of wastewater main. Note that the costs for the 8<sup>th</sup> Street W upgrades in the IMP identified project SG5 with a cost of \$1,047,000 and project SG6 with a cost of \$2,151,000 based on 2021 dollars.

### **Stormwater System**

The site topography gently slopes from the northwest toward the southeast, with elevations ranging from 1,045 to 1,038 metres. The site has relatively shallow slopes with average overland grades of 0.5-1%. The pre-developed condition of the region was primarily agricultural land, including horse pasture and highway advertising since 2003. McElhanney developed a stormwater management plan incorporating both minor and major drainage systems to manage runoff while maintaining pre-development flow rates to downstream systems.

The Castle ASP lands conceptual stormwater system will consist of:

- A minor piped system to convey 1:5 year storms along with ditch conveyance
- A major system to convey 1:100 year storm using overland conveyance using ditches
- Three stormwater ponds with controlled discharge at pre-development flow rates
  - The north stormwater pond will spill to the central pond
  - The central pond will discharge to the 8<sup>th</sup> Street W drainage ditch
  - The south pond will discharge to 39<sup>th</sup> Avenue
- Provisions for Low Impact Development measures in country residential areas and portions of low-density residential areas
- Independent operation from the Town's existing stormwater system, with no adverse impacts to existing infrastructure

### **Conclusion**

The conceptual designs for water, wastewater, and stormwater infrastructure for the Castle ASP meet the Town of Claresholm's requirements while presenting opportunities to enhance the Town's overall servicing network. The proposed systems not only accommodate development within the Castle ASP lands but also present solutions that could reduce infrastructure costs for both the Town and adjacent future development areas.



# 1. Background and Planning Context

## 1.1. AREA STRUCTURE PLAN OBJECTIVES

Castle and Land Development Ltd. has retained McElhanney Ltd (McElhanney) to prepare the Castle Area Structure Plan (Castle ASP) for a new development on the west side of the Town of Claresholm (the Town). The ASP reviews existing infrastructures and identifies conceptual utility system that will be required to service the new development. This report includes the following components:

- Water supply, treatment, storage and distribution
- Wastewater collection and conveyance to the wastewater treatment system
- Stormwater collection, conveyance and storage

The objectives of the ASP are the following:

- Assess existing infrastructures, such as water supply, wastewater management and stormwater drainage and determine servicing solutions to the ASP area
- Develop a conceptual plan of servicing systems based on proposed land use
- Identify potential shared infrastructure improvements that address existing system deficiencies

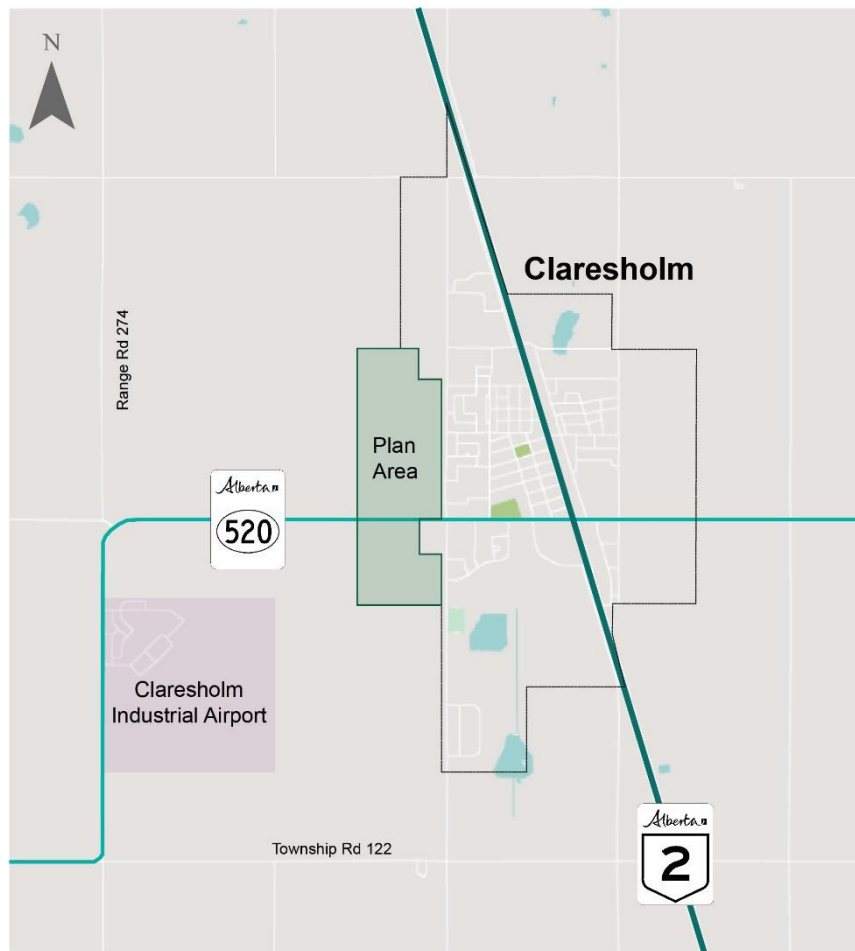
## 1.2. STUDY AREA

The Town of Claresholm (the Town) lies at the intersection of Highway 2 and Highway 520, located at the heart of the Calgary to Lethbridge corridor and offering panoramic views of the scenic Porcupine Hills (see Figure 1). The Town acts as a regional service centre for people in surrounding communities and the Municipal District of Willow Creek (the MD). This Area Structure Plan (the Plan) has been formed to guide the development of recently annexed lands to the west of the Town's built urban area and maintain the Town's supply of available land to accommodate new residential development over the next 25 years

The Castle Area Structure Plan lands cover approximately 183 hectares (451 acres) of land in the Town (see *Sketch 1*) and includes lands from the following quarter sections:

- NE 27-12-27 W4
- SE 27-12-27 W4
- NE 22-12-27 W4

The land runs adjacent to the Town's municipal boundary on its western edge and is contained between 59th Avenue W to the north, 8<sup>th</sup> Street W to the east and Kin Trail to the south. The land designated for the Plan Area was part of the MD until 2023, when the Town annexed the land to increase its supply of residential land in addition to adding capacity to meet community needs for additional institutional uses and recreational space. Adjacent lands to the north, west and south of the Plan Area are agricultural



*Sketch 1: Context Map of Claresholm*

lands with the MD, while lands to the east are predominately low-density residential areas within the Town.

### 1.3. PREVIOUS STUDIES

McElhanney obtained and reviewed reports and background information provided by the Town of Claresholm. The documents reviewed as part of this study include the following:

- Town of Claresholm – Infrastructure Master Plan (Associated Engineering, 2021), hereafter referred to as the **IMP**.
- Town of Claresholm – Servicing Standards for Municipal Improvements (Town of Claresholm, 2017), hereafter referred to as the **Servicing Standards**.



- Town of Claresholm – Revised Storm Drainage Plan Claresholm Residential Development (Lee Maher Engineering Associates Ltd, 2010), hereafter referred to as the **SDP**.
- Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems (Alberta Environment and Sustainable Resource Development, 2012-2013), hereafter referred to as the **AEP Standards and Guidelines**.
- PCSWMM Reference Tables, extracted from the US Environmental Protection Agency (EPA) SWMM system (available online), hereafter referred to as **SWMM Reference**.
- The City of Calgary Stormwater Management & Design Manual (The City of Calgary Water Resources Division, 2011), hereafter referred to as **SWM Guidance**.
- City of Calgary, Design Guidelines for Subdivision Servicing 2020, hereafter referred to as the **AEP Standards and Guidelines**.
- Airborne Imaging LiDAR 7.5m DEM w/ 30cm accuracy, hereafter referred to as **LiDAR**.

## 1.4. POPULATION AND FUTURE GROWTH

### 1.4.1. Town of Claresholm Population Overview

The IMP provided a population for the Town of Claresholm in 2021 of 3,910 with logarithmic projected 2026 population of 4,102. The most recent census completed provides a population of 4,127 in 2024. While the 2024 population is higher than the project 2026 population (25 persons or 0.6%), the difference is marginal and thus any information obtained from the IMP can be considered accurate for the infrastructure analyses.

### 1.4.2. Castle ASP Land Use Concept Population Estimates

The land use concept shown in [Appendix A - Land Use Concept](#) provides a general land use plan for the area and is supported by the Town's Growth Strategy within the MDP. The main features of the concept are:

#### **Residential Land Uses**

This category includes a range of residential uses as outlined in the LUB, such as single-detached residential, duplex residential, country residential, multiple residential and apartments.

#### **Neighbourhood Commercial Land Use**

This category includes small-scale commercial uses that complement and are within walkable distances of residential areas, such as cafes, restaurants, retail stores and fitness centres.

#### **Public Amenity Land Uses**



This category includes uses such as public parks, open space corridors and stormwater facilities. Generally, these align with areas that are not developable due to constraints such as topography, development setbacks and utility right-of-way corridor and provide buffers between incompatible land uses.

### Arterial, Collector and Local Road Network

The Land Use concept identifies which roadways are proposed to be arterial, collector or local roadways.

#### 1.4.3. Castle ASP Population Estimates

The population estimates are based on inclusion of the only the residential and commercial land uses. Public amenity spaces and the road network is removed from the population calculation for servicing needs.

The population estimate within the Castle ASP area was estimated based on typical dwelling unit density ranges as provided in *Table 1*.

*Table 1: Dwelling Type and Density Range*

Dwelling Type	Typical Density Range (dwelling units per hectare, du/ha)
<b>Single-family</b>	8 – 18
<b>Duplex</b>	12 – 20
<b>Six-plex</b>	30 – 60
<b>Apartment</b>	60 – 95
<b>Country Residential</b>	~0.5

Based on these ranges, specific residential density assumptions were selected for the population calculation as follows:

- Low-density residential (or single-family): 12 du/ha
- Duplex: 16 du/ha
- Six-plex: 50 du/ha
- Apartment: 80 du/ha
- Country residential: 0.5 du/ha

Additionally, the following average household size were assumed for each dwelling type:

- An average household size of 2.1 persons per dwelling unit was applied for low to medium-density residential areas, as per Statistics Canada – Census Profile, 2021)
- An average household size of 2.6 persons per dwelling unit was applied for country residential and low-density areas (as per average family size per Statistics Canada – Census Profile, 2021)



Using the assumed population densities and average household sizes, the total number of dwelling units and population were calculated for each dwelling type and provided in [Table 2](#).

*Table 2: Population Estimate*

Dwelling Type	Land Use Designation	Area (ha)	Total Dwelling Units	Person per Dwelling	Population
<b>Low-Density Residential</b>	R1	72.0	867	2.1	1,821
<b>Country Residential</b>	R3	31.5	16	2.6	42
<b>Multi-Density Residential</b>					
<b>Duplex</b>	R4	12.0	198	2.1	416
<b>Multi-Family (6-plex)</b>	R4	10.3	384	2.1	806
<b>Apartment</b>	R5	1.0	81	2.1	170
<b>Commercial</b>	C3	6.5	0	0	0*
<b>TOTAL</b>		<b>133.3</b>	<b>1,546</b>		<b>3,255</b>

\*Equivalent population for commercial areas.

These population estimates represent the total estimated population within Castle ASP at its full buildout conditions and will guide the sizing of the municipal infrastructure.



## 2. Water Distribution System

This section presents the conceptual water infrastructure system for the Castle ASP. The activities undertaken as part of this plan include:

- Review of background information;
- Use of existing hydraulic model to analyze the performance of the conceptual water system; and
- Completion of a water servicing strategy for the proposed development areas.

As part of the analysis, McElhanney reviewed relevant data available on the existing infrastructure including the reservoirs, pumping systems and distribution network.

### 2.1. EXISTING WATER SYSTEM

The existing water system summary below has been extracted from the IMP.

#### 2.1.1. Water Supply

The primary source of raw water is the Pine Coulee Reservoir, situated approximately 15km northeast of Claresholm. Raw water is conveyed from the reservoir to the Town via a dedicated raw water pipeline, supplying both the raw water pond and the water treatment plant.

#### 2.1.2. Raw Water Reservoir

The Town's raw water supply is stored in a single raw water pond with a total volume of 223,228 m<sup>3</sup>. This reservoir feeds the Water Treatment Plant.

#### 2.1.3. Water Treatment Plant

The Town of Claresholm's Water Treatment Plant (WTP) has a rated capacity of 8,840 m<sup>3</sup>/day. The treatment process consists of enhanced coagulation, flocculation, Dissolved Air Flotation (DAF) clarification, membrane filtration, and chlorination for disinfection.

Treated water is conveyed through a diffusion header into the treated water reservoir (clearwell), which provides the required chlorine contact time before the water is pumped into the distribution system.

As stated in the Infrastructure Master Plan (IMP), the current treatment capacity is sufficient to meet the Town's projected long-term water demands. However, chlorine contact time requirements should be reassessed upon the addition of a new reservoir and pump station. While no specific upgrades have been proposed, the IMP notes that additional treatment capacity may be required at full buildout.

### 2.1.4. Treated Water Reservoir

The Town's treated water storage system consists of three separate facilities that provide a combined total capacity of 5,644 m<sup>3</sup>. *Table 3* provides a summary of the existing treated water reservoirs.

*Table 3: Existing Treated Water Storage Capacity*

Treated Water Reservoir	Volume (m <sup>3</sup> )
Water Treatment Plant Clearwell	2,269
Highway Pump Station and Reservoir	625
East Side Reservoir	2,750
<b>TOTAL</b>	<b>5,644</b>

### 2.1.5. Distribution Pumps

The Town's water distribution system is supported by two key pumping facilities: the Water Treatment Plant (WTP) and the Highway Pump Station and Reservoir. These facilities work in coordination to supply treated water throughout the community.

#### 2.1.5.1. Water Treatment Plant (WTP)

The WTP is the Town's primary water supply source. It includes five high lift distribution pumps that convey treated water directly into the distribution network. The total design capacity of the WTP distribution system is approximately 232.4L/s at 580kPa, with a firm capacity (i.e., with the largest pump out of service) of 180.7L/s.

In addition to the distribution pumps, the WTP houses two dedicated transfer pumps (TP 1601 and TP 1602) that deliver treated water to the Highway Pump Station and Reservoir. Each transfer pump is rated at 59.3L/s at 269kPa, yielding a combined design capacity of 118.6L/s, and a firm capacity of 59.3L/s.

#### 2.1.5.2. Highway Pump Station and Reservoir

Located east of Highway 2, this facility provides additional pumping capacity to the distribution system through four high lift pumps. The station is designed to deliver up to 213.5L/s at 488kPa, with a firm capacity of 153L/s. These pumps draw from the associated reservoir and act as a secondary supply and reinforcement point for the overall system.

#### 2.1.5.3. Pump Performance Summary

*Table 4* provides a detailed breakdown of pump head, flow capacities, motor size, drive speed, and power source for both the WTP and Highway Pump Station. All pumps operate on variable-speed electric drives, allowing for operational flexibility under varying demand conditions.



Table 4 – Treated Water Pumping Capacity

Pump	Design Head (m)	Design Head (kPa)	Design Flow (l/s)	Size (hp)	Drive Speed	Power Source	Notes
<b>Distribution and Transmission Pumping</b>							
TP 1601	27.4	269	59.3	30	1765 V	E	Transfer Pump
TP 1602	27.4	269	59.3	30	1765 V	E	Transfer Pump
HLP 1701	58.5	573	25.6	30	1765 V	E	Distribution Pump
HLP 1702	59.4	582	51.7	50	1780 V	E	Distribution Pump
HLP 1703	59.4	582	51.7	50	1780 V	E	Distribution Pump
HLP 1704	59.4	582	51.7	50	1780 V	E	Distribution Pump
HLP 1705	59.4	582	51.7	50	1780 V	E	Distribution Pump
<b>Highway Pump Station</b>							
HLP 1706	48.6	476	32.0	30	1765 V	E	Distribution Pump
HLP 1707	49.8	488	60.5	60	1780 V	E	Distribution Pump
HLP 1708	4.8	488	60.5	60	1780 V	E	Distribution Pump
HLP 1709	49.8	488	60.5	60	1780 V	E	Distribution Pump

### 2.1.6. Distribution System

The Town of Claresholm's water distribution system supplies treated potable water and fire protection services to a population of approximately 4,127 (2024). In addition to meeting local demand, the Town provides water to the Municipal District of Willow Creek via a regional transmission system, which services the Hamlet of Granum and other surrounding areas. Regional connections are located west of the Water Treatment Plant (WTP) and at the southeast boundary of the Town.

## 2.2. DESIGN CRITERIA

The conceptual water system for the Claresholm Area Structure Plan (ASP) was developed based on design criteria adopted from the Infrastructure Master Plan (IMP). In cases where there is conflicting information between the IMP and the Servicing Standards, the IMP takes precedence. Where the IMP does not provide specific guidance, the Servicing Standards are used to supplement the design.

### 2.2.1. Water Demands

Water supply demands for Claresholm ASP were developed and calculated based on the criteria provided in [Table 4](#). Population densities based on land use are provided in [Section 1.4](#).



Table 4: Water Demand Design Criteria

Parameter	Assumption	Notes
<b>Average Day Demand (ADD)</b>	520 litres per capita per day (L/c/d)	As per the IMP and Servicing Standards.
<b>Maximum Day Demand (MDD)</b>	ADD x 2.6 = 1,352L/c/d	As per the IMP and Servicing Standards.
<b>Peak Hourly Demand (PHD)</b>	ADD x 5.2 = 2,704L/c/d	As per the IMP and Servicing Standards.

### 2.2.2. Fire Flow Requirements

Fire flow demands based on land use are provided in [Table 5](#).

Table 5: Fire Flow Requirements

Parameter	Assumption	Notes
<b>Single Family Residential</b>	67L/s	As per the IMP and Servicing Standards.
<b>Multi-Family Residential</b>	151L/s	As per the IMP and Servicing Standards.
<b>Commercial, Institutional and Industrial</b>	189L/s	As per the IMP and Servicing Standards.

### 2.2.3. Potable Water Storage Requirement

Calculation of the required treated water storage (or reservoir) is based on the required volumes to meet the fire flows and water demands. The sizing is determined using an empirical formula, provided in the IMP, which aligns with the AEP Standards and Guidelines. The total reservoir volume calculated in the IMP did not include provisions for emergency storage. However, this was considered and added in the design of the conceptual treated water storage.

- Total Storage Requirement:

**S = Fire + EQ + (the larger of EM or CT)**, where

- **S:** Storage (m<sup>3</sup>)
- **Fire:** Required Fire Storage
- **EQ:** Equalization Storage, 25% MDD
- **EM:** Emergency Storage, 15% ADD
- **CT:** Storage for Contact Time



## 2.2.4. Water Distribution System Parameters

Table 6 provides the watermain design parameters for the distribution system.

Table 6: Water Distribution System Parameters

Parameter	Assumption	Notes
<b>Minimum Distribution Main Size – Single Family Residential</b>	200mm	As per the IMP and Servicing Standards.
<b>Minimum Distribution Main Size – Multi-Family Residential</b>	200mm	As per the IMP and Servicing Standards.
<b>Minimum Distribution Main Size – Commercial, Institutional and Industrial</b>	250mm	As per the IMP and Servicing Standards.
<b>Material</b>	PVC	As per the Servicing Standards.
<b>Hazen-Williams Coefficient</b>	130	As per the Servicing Standards.
<b>Hydrant Coverage – Low Density Residential</b>	180m	As per the IMP and Servicing Standards.
<b>Hydrant Coverage – Multi-Family, Commercial, Institutional and Industrial</b>	90m	As per the IMP and Servicing Standards.

## 2.2.5. Water Distribution System Pressure Requirements

Table 7 provides the water distribution system pressure requirements.

Table 7: Water Distribution System Pressure Requirements

Parameter	Assumption	Notes
<b>Minimum Residential Pressure during MDD plus Fire Flow conditions</b>	22psi (150kPa)	As per the IMP and Servicing Standards.
<b>Minimum Pressure during PHD conditions</b>	45psi (310kPa)	As per the IMP and Servicing Standards.
<b>Maximum Pressure at all times</b>	80psi (550kPa)	As per the IMP.

## 2.3. METHODOLOGY

### 2.3.1. Hydraulic Modeling

Model development and analysis of the conceptual water distribution system was completed using Bentley OpenFlows WaterCAD. The Town's existing water model was used to evaluate the impacts of the proposed conceptual water distribution system within the ASP area on the overall system flows and pressures. The hydraulic system is modeled as follows:

- A single reservoir, with an elevation equal to the pumps' duty point, represents the pump station with the treated reservoir. By modeling a single node, under steady-state analysis, this eliminates



the need to replicate pump behaviours or determine pump curves, which is beyond the intended scope of this work. This matches the modeling methodology completed for the IMP.

- Water demands for the Castle ASP area were added to the Town's existing water model, while all other demands remained unchanged from the provided model. Evaluation or modification of existing or future demands outside the Castle ASP area was beyond the scope of this assessment.
- Water modeling is completed under steady-state analysis, which is appropriate for the conceptual level of design at this phase.

### 2.3.2. Modeling Scenarios

The conceptual water distribution system is designed and analyzed based on the following:

1. **Peak Hourly Demand (PHD) scenario** – This scenario checks for the maximum and minimum pressures and the maximum allowable velocity during peak hour demand conditions.
2. **Max Day Demand plus Fire Flow (MDD+FF) scenario** – This scenario checks for available fire flows and pressures during an event when the water system is required to meet both the maximum day demands and the fire flows simultaneously.

## 2.4. CONCEPTUAL WATER SYSTEM

The infrastructure master plan (May 2021) included envisioned developments in the north, east and southeast of Claresholm: Prairie Shores ASP (2011) in the northwest, North Point ASP (2024) in the north, Evolution ASP (2024) in the southeast, and other anticipated development areas along the eastern boundary area. Since the IMP was completed, several changes have occurred, including the annexation along the western boundary of the Town of Claresholm in 2023 and a new ASP (Castle ASP, this project) envisioned along the western boundary of the Town of Claresholm.

This ASP evaluates the existing water system with the addition of Castle ASP alongside previously planned ASPs. It uses AE's existing Water Model from the IMP. The goal is to analyze the existing conditions and then determine what upgrades are needed in the system with the addition of the Castle ASP, or alternatively, whether some of the upgrades previously identified in the IMP can now be eliminated as the Castle ASP provides additional looping to the north area.

The following four scenarios have been evaluated:

- **Existing Scenario** - The current conditions in the Town of Claresholm, to validate the WaterCAD model with the results from IMP and determine baseline conditions.
- **Existing + Castle ASP** - Evaluates four sub-scenarios (ADD, MDD, PHD, MDD+FF) to determine required upgrades with Castle ASP implementation and assess potential efficiencies from new looping opportunities that may eliminate previously identified IMP upgrades.



- **Existing + Castle ASP + North Point ASP + Prairie Shores ASP** - Evaluates four sub-scenarios (ADD, MDD, PHD, MDD+FF) to determine required upgrades with Castle ASP implementation and assess potential efficiencies from new looping opportunities that may eliminate previously identified IMP upgrades.
- **Future Ultimate Buildout Scenario** - Same as previous scenario but includes east and southeast ASPs, and future demand conditions to assess how identified upgrades or eliminations affect the overall system under ultimate buildout conditions.

The overarching goal is to assess how the Castle ASP affects the overall system and to ensure that the upgrades identified/eliminated do not adversely affect the overall system.

#### 2.4.1. Distribution Network Demands

The existing WaterCAD model provided by the Town contains two scenarios: "existing conditions" and "future conditions." Review of nodal demands indicates that future conditions have higher demands compared to existing conditions, suggesting the Town previously applied a methodology to project growth demands. The basis for the Town's original demand projections falls outside the current scope of work. The model included demand allocations for all planned development areas except Castle ASP, which wasn't envisioned when the model was originally created.

All original demand assignments from the provided WaterCAD model were used for both existing and future scenarios, assuming these calculations are correct. New demands were added only for the Castle ASP area.

For Castle ASP, water demands were calculated based on the proposed land uses shown in [Figure 1](#). Average day demand (ADD), maximum day demand (MDD), and peak hour demand (PHD) were calculated follow the assumptions and methodology listed in [Section 2](#). Detailed demand calculations as applied to model nodes are included in [Appendix E](#).

#### 2.4.2. Proposed Treated Water Reservoir

The town of Claresholm is licensed to divert water from Pine Coulee Reservoir, located approximately six kilometers west of the Town of Stavely. The license allows for 1,301,235 m<sup>3</sup> of water diversion annually, which translates to a municipal population of approximately 10,000 people (Municipal Development Plan-Bylaw 1490 amended to bylaw 1551, Sept 2010).

As discussed in previous sections, the existing treated water system has a total available volume of 5,644 m<sup>3</sup>. This includes WTP storage of 2,269 m<sup>3</sup> and Highway Pump Station Storage of 3,375 m<sup>3</sup> (IMP, 2021). Design standards specify that the reservoir storage should be sized for fireflow storage + equalization storage (25% of MDD) + emergency storage (15% of ADD).

This analysis evaluates storage requirements based on ASP implementation rather than design horizons, providing a more realistic assessment as areas connect to the existing system. Populations, as listed in [Table 8](#) have been used for determining the sizing requirements for potable water.



Table 8: Populations Per Development Area

Development Area	Population	Source
Existing	4,127	Govt. of Alberta
West of 8 <sup>th</sup> St. W, b/w Starline Rd. and 59 <sup>th</sup> Av. W	3,743	Castle ASP (this project)
East of 8 <sup>th</sup> St. W, b/w Derochie Drive and Township Rd. 130	535	North Point ASP (AE, 2024)
West of 8 <sup>th</sup> St. W, b/w 59 <sup>th</sup> Av. W and Township Rd. 130	1,683	Prairie Shores ASP (Planning Protocol Inc & Southcal Developments Inc, 2011)
West of Township Rd. 123 and south of 39 <sup>th</sup> Av. W and	1,478	Evolution ASP (ISL, 2024)
East of 5 <sup>th</sup> St. E	850*	East growth area in the WaterCAD Model

\*For the east growth area, no ASP currently exist. The population was back calculated using the ADD demands from the WaterCAD model and assuming 520 L/cap/day.

Table 9 summarizes available versus required storage volumes for each growth area. The analysis examines cumulative population, applies design criteria, and compares with available volumes.

Design standards typically allow fireflow storage to be combined throughout one pressure zone rather than duplicated in each reservoir, provided a single reservoir can supply adequate fireflows. However, WaterCAD modeling shows the existing reservoir configuration (clearwell + highway pump station) cannot supply required fireflows to north and northwestern areas under future demand scenarios.

It should be noted that the Town-provided model uses a blanket approach with higher future nodal demands throughout the system, likely adopted due to limited information about specific growth areas during original model development. Since the 2021 IMP, multiple new ASPs (Table xx) have identified actual growth areas.

With this new ASP information, storage requirements could potentially be reduced through targeted demand assignment rather than system-wide upscaling. However, reassessing and redistributing nodal demands falls outside the current scope of analysis. This assessment therefore uses the future demands provided in the model (assumed correct) in conjunction with the Castle ASP demands.

Table 9 shows the existing system has a 525 m<sup>3</sup> surplus under current conditions but lacks capacity to service Castle ASP. A new reservoir will be required as the excess capacity is used by development. The 525m<sup>3</sup> excess capacity is anticipated to provide suitable volume for an additional 1,260. Based on topography, placing the new reservoir in the north and northwestern areas at higher elevation would provide dual benefits: maintaining minimum pressures at higher elevations while providing the required storage.



Table 9: Reservoir Volume Requirements Per Development Area

	Existing	Castle ASP	North Point ASP	Prairie Shores ASP	Evolution ASP	East
<b>Population</b>		3,743	535	1,683	1,478	850
<b>Cumulative Population</b>	4,127	7,870	8,405	10,088	11,566	12,416
<b>ADD (m<sup>3</sup>)</b>	2,146	4,092	4,371	5,246	6,014	6,456
<b>MDD (m<sup>3</sup>)</b>	5,580	10,640	11,364	13,639	15,637	16,786
<b>Fire flow Storage – Existing*</b>	3,402	3,402	5,103	5,103	5,103	6,804
<b>New Reservoir Fireflow Storage</b>		1,701			1,701	
<b>25% of MDD (m<sup>3</sup>)</b>	1,395	2,660	2,841	3,410	3,909	4,197
<b>15% of ADD (m<sup>3</sup>)</b>	322	614	656	787	902	968
<b>Total Required Volume (m<sup>3</sup>)</b>	5,119	8,377	8,599	9,300	11,614	11,969
<b>Total Available Volume (current) (m<sup>3</sup>)</b>	5,644	5,644	5,644	5,644	5,644	5,644
<b>Surplus / Deficit (m<sup>3</sup>)</b>	525	-3,571	-3,815	-4,586	-7,132	-7,522

\*Fire flow requirement of 1701 m<sup>3</sup> for each reservoir, based on 189 L/s for 2.5 hours

Given plans for North Point ASP and Prairie Shores ASP in the same area, the reservoir should accommodate these future developments. To service all northern developments, the new reservoir requires a minimum volume of 4,586 m<sup>3</sup>, rounded to approximately 4,600 m<sup>3</sup>.

**Note that there is no immediate need for the north water reservoir as the existing system can support an additional 1,260 people.**

Upgrades to the east: the new reservoir and pump station previously identified during the IMP (WG9 upgrade), will still be required. The original upgrade sizing was based on population projections and information available at that time. Since then, the northern ASPs including Castle, North Point, and Prairie Shores have advanced, changing overall population distribution and water demand patterns. Development parameters for the eastern areas remain relatively uncertain compared to the northern ASPs where population information is better defined. East reservoir and pump station capacity requirements should therefore be reassessed as development information for the east developments becomes available.

### 2.4.3. Water License Requirements

As per the IMP, the current water license supports 10,000 people, which is sufficient to service existing population, Castle ASP, North Point ASP and Prairie Shores ASP. However, with the construction of Prairie Shores the total population will increase to 10,088, slightly exceeding license capacity. Water



license renegotiation should be considered as the population approaches capacity to ensure adequate supply for future developments.

Table 10 provides the water license requirements allowing for a 10% loss during the treatment process and allowing for Alberta Environment's requirement to have 110% available water license to meet annual demands.

Table 10: Water License Requirements

	Existing	Castle ASP	North Point ASP	Prairie Shores ASP	Evolution ASP	East
<b>Population</b>		3,743	535	1,683	1,478	850
<b>Cumulative Population</b>	4,127	7,870	8,405	10,088	11,566	12,416
<b>Total Required Volume (m<sup>3</sup>)</b>	5,119	8,377	8,599	9,300	11,614	11,969
<b>Req. Water License (m<sup>3</sup>)</b>	6,194	10,136	10,405	11,253	14,053	14,482

#### 2.4.4. Water Treatment Plant Capacity

Alberta Environment and Protected Areas (AEPA) guidelines and industry best practices require water treatment plants to be designed with sufficient capacity to meet at least the projected Maximum Day Demand (MDD), including redundancy to ensure reliability even with one critical treatment process offline. The existing Claresholm Water Treatment Plant (WTP), rated at 8,840 m<sup>3</sup>/day (equivalent population of 6,400 people based on the MDD rate of 1,352 L/c/d), currently exceeds the existing MDD of 5,580 m<sup>3</sup>/day, providing a surplus capacity of approximately 58%. However, with the proposed Castle ASP development, the projected MDD will increase to approximately 10,640 m<sup>3</sup>/day, resulting in a capacity shortfall of around 20%. While this immediate capacity shortfall requires an upgrade, it is practical to consider the broader context. Adjacent growth areas, the North Point ASP and Prairie Shores ASP, will further increase water demand, bringing the combined MDD for these developments to approximately 13,639 m<sup>3</sup>/day. Rather than undertaking incremental expansions, it would be strategically advantageous and economically efficient to upgrade the WTP capacity in a single, comprehensive expansion designed to accommodate all planned growth areas.

**Note that there is no immediate need for the water treatment plant expansion as the current WTP has the capacity to handle additional flows from 2,273 people. Once the overall population of the Town of Claresholm reaches or exceeds 6,400 people, upgrades to the WTP will be required.**



## 2.4.5. Proposed Water Distribution Network

### Scenario 1 - Existing System Assessment

The WaterCAD model provided by the Town was used to review existing system conditions. PHD pressure results are shown in *Figure 2.1*, while available fire flows under a maximum day demand (MDD) are illustrated in *Figure 2.2*. This scenario represents the baseline conditions.

Under the PHD scenario, system pressures generally remain within the standard range of 45-80 psi, with the exception of Mountain View Crescent (south of the ex. WTP) where pressures slightly exceed standards at 83-88 psi.

During Maximum Day Demand plus Fire Flow (MDD+FF) scenarios, there are numerous areas of the Town that are deficient for fire flow based on the existing land use. Specific areas with deficient fire flows of note near the Castle ASP include:

- The West Meadow Elementary School and the Claresholm Child Care Society locate immediately to the northeast of the Castle ASP
- Existing development north of 59<sup>th</sup> Avenue

### Scenario 2 - Castle Development Integration Scenario

This scenario was modeled by adding the proposed Castle development area to the existing system. This analysis was conducted to evaluate system response to the Castle development and determine potential benefits to existing fire flows and pressures in the northern region.

In this scenario, PHD pressures in the north decreased marginally compared to existing conditions. The overall system had pressures identical to existing conditions that meet the design requirements of between 45 and 80 psi. Mountain View Crescent still had slightly higher pressures than the Town's design criteria of between 83 to 88 psi. PHD pressures are shown on *Figure 2.3*

Available fire flows in the north improved to 110-160 L/s, compared to Scenario 1 where the available fireflows in the north were in the range of 103-152 L/s, an average increase of 22L/s throughout. This improvement resulted from new looping opportunities created by the Castle development integration. while the available fire flows are shown in *Figure 2.4*.

### Scenario 3 - Castle Development Integration Scenario with North Point ASP and Prairie Shores ASP

This scenario was modeled by adding the proposed Castle development area, North Point ASP, and Prairie Shores ASP to the existing system. This analysis was conducted to evaluate system response to the Castle development and determine potential benefits to existing fireflows and pressures in the northern region.

In this scenario, PHD pressures in the north decreased compared to existing conditions. Prairie Shores and North Point areas experienced pressures of 39-43 psi, below the design requirement of 45 psi. The



remainder of the system had pressures identical to existing conditions that meet the design requirements of between 45 and 80 psi. Mountain View Crescent still had slightly higher pressures than the Town's design criteria of between 81 to 85 psi. PHD pressures are shown on [Figure 2.5](#)

Despite lower pressures, available fireflows in the north improved to 113-171 L/s. This improvement resulted from new looping opportunities created by the Castle development integration. Available fire flows are shown in [Figure 2.6](#).

Given the pressures below 45 psi in the north and the need for additional storage to service new population (as discussed in Section 2.4.4), a new storage tank is recommended for the northern region as a result of development to the north. This will increase available system volume while providing required pressures. **For the Castle development itself, the existing system is sufficient to provide pressures and fireflows meeting design criteria.**

### Scenario 4 - Ultimate Buildout Scenario

The ultimate buildout scenario incorporated all previously planned development areas in the east and southeast that were envisioned during IMP development. These areas were excluded from the previous scenario, which focused specifically on the Castle development and directly adjacent areas. This scenario also included increased demands throughout the system for future ultimate buildout conditions as established during IMP development.

With the new northern storage tank in place and the Castle development area integrated, the following upgrades previously identified in the IMP are no longer required:

- WG3: 5ST E Looping Ph 1
- WG4: Columbia Dr. Looping
- W5: Division Av. to 2 St E Connector

These upgrades were originally designed to provide additional flow routes to the north. The Castle development creates alternative flow paths to northern areas, effectively eliminating the need for these infrastructure improvements.

PHD pressures for this scenario are shown in [Figure 2.7](#). Pressures throughout the entire system remained within the design standard range of 45-80 psi, with the exception of Mountain View Crescent - an existing issue not introduced by the Castle development. Available fireflows are illustrated in [Figure 2.8](#). The sporadic fireflow deficiencies below 67 L/s in the town core and Mountain View Crescent are from existing conditions. Fire flows elsewhere were sufficient, with northern areas generally exceeding 200 L/s.



## 2.5. SUMMARY

Castle ASP's proposed water system is provided as concept for the purpose of this study. The following provides a summary of the water modeling and water demand requirements for the Castle ASP and the Town's water system capacities.

- Additional water storage will be required once an additional population of approximately 1,260 people are added to Claresholm through any of the proposed ASP'. However, there is no need to add a reservoir immediately to allow for the Castle ASP to proceed with a portion of their development.
- Additional water treatment capacity will be required once a population of approximately 6,400 people is reached. The existing water treatment plant has the capacity to handle additional flows from 2,273 people.
- Additional water license will be required once a population of approximately 10,000 is reached. The existing license is suitable to support the existing population, the Castle ASP, the North Point ASP, and the Prairie Shores ASP with the exclusion of the Evolution ASP.
- The conceptual water distribution system provides benefits to the Town to allow the Town to meet MDD plus FF demands for both the Castle ASP and improved demands in the north area. It allows for the following water system improvements to be eliminated (pending phasing of the Castle ASP with other ASP's):
  - WG3: 5ST E Looping Ph 1
  - WG4: Columbia Dr. Looping
  - W5: Division Av. to 2 St E Connector



## 3. Wastewater Collection System

This section presents the conceptual wastewater infrastructure for the Castle ASP. The activities undertaken as part of this plan include:

- Review of background information;
- Use of existing hydraulic model to analyze the performance of the conceptual sanitary system; and
- Completion of a sanitary servicing strategy for the proposed development areas.

As part of the analysis, McElhanney reviewed relevant data available on the existing infrastructure including the lagoon, lift stations and gravity sewer mains.

### 3.1. EXISTING WASTEWATER SYSTEM

#### 3.1.1. Wastewater Collection System

The Town's wastewater collection system includes approximately 47.3 kilometres of gravity wastewater mains, ranging from 200mm to 750mm diameter in size. The network conveys wastewater to the Town's lagoon system for treatment. As indicated in the IMP, approximately 4% of the total collection system is over capacity. Upgrades are required to support existing servicing needs within the 20-year planning horizon. Refer to the IMP for specific improvements required.

Wastewater is conveyed through the wastewater pipes and discharges to two trunk mains running west of the Claresholm into the wastewater lagoon.

#### 3.1.2. Lift Stations and Forcemains

The Town of Claresholm's wastewater collection system includes two lift stations:

- **Harvest Square Lift Station:** Commissioned in 2015, this lift station serves a localized area in the northwest portion of the Town. It has a design capacity of 7L/s at 6m of total dynamic head (TDH) and discharges through a 150mm diameter forcemain to downstream gravity sewer mains. Note that the proposed Castle ASP does not add any flows to this lift station and is not affected by the Castle ASP.
- **Main Lift Station:** Located at the Town's wastewater treatment lagoons and upgraded in 2013, this lift station transfers wastewater from the anaerobic cells to the facultative cells. It has a design capacity of 178L/s at 15.6m of TDH. Flow is conveyed through two forcemains, 250mm and 300mm in diameter, which connect to a valve chamber upstream of the first facultative cell.

### 3.1.3. Wastewater Disposal

Wastewater treatment is provided by a lagoon located 6km west of the town boundary. The Town of Claresholm's existing wastewater lagoon system consists of four anaerobic cells, a transfer pump station, two facultative cells, and two storage cells.

Based on IMP, under current conditions, the lagoon system meets Alberta Environment and Parks (AEP) Code of Practice requirements. However, a new storage cell will be required to support future growth:

- Without considering evaporation, the lagoon reaches capacity at a design population of 4,312.
- With evaporation considered, the lagoon can service up to a population of 6,126.

## 3.2. DESIGN CRITERIA

The conceptual wastewater system for the Castle ASP was developed based on design criteria adopted from the Infrastructure Master Plan (IMP). In cases where there is conflicting information between the IMP and the Servicing Standards, the IMP takes precedence. Where the IMP does not provide specific guidance, the Servicing Standards are used to supplement the design.

### 3.2.1. Wastewater Generation Rates

*Table 11* provides the residential wastewater generation rates used in the calculation of design wastewater flows. Population densities based on land use are provided in [Section 1.4](#).

*Table 11: Wastewater Generation Rates - Residential*

Parameter	Assumption	Notes
<b>Average Sewage Flow</b>	400L/c/d	As per the Servicing Standards.
<b>Peaking Factor</b>	$1 + \frac{14}{4 + \left(\frac{1}{p^2}\right)}$ , where $p$ = population in 1,000s	As per the Servicing Standards.
<b>Inflow – new developments</b>	500L/c/d	As per the Servicing Standards.
<b>Inflow – old developments</b>	2,000L/c/d	As per the Servicing Standards.
<b>Infiltration</b>	150L/c/d	As per the Servicing Standards.

*Table 12* provides the wastewater generation rates for non-residential areas.

*Table 12: Wastewater Generation Rates – Non-Residential*

Parameter	Assumption	Notes
<b>Average Sewage Flow (<math>Q_{avg}</math>) – Commercial</b>	20,000 litres per hectare per day (L/ha/d)	As per the Servicing Standards.
<b>Average Sewage Flow (<math>Q_{avg}</math>) – Industrial</b>	30,000L/ha/d	As per the Servicing Standards.
<b>Average Sewage Flow (<math>Q_{avg}</math>) – Institutional</b>	20,000L/ha/d	As per the Servicing Standards.



Parameter	Assumption	Notes
<b>Peaking Factor</b>	the lesser of $[6.659 Q_{avg}^{-0.168}$ or 5] where, $Q_{avg}$ is in L/s	As per the Servicing Standards.
<b>Inflow</b>	7.5m <sup>3</sup> /ha/d	As per the Servicing Standards.
<b>Infiltration</b>	2.25m <sup>3</sup> /ha/d	As per the Servicing Standards.

### 3.2.2.Wastewater Main Parameters

Table 13 provides the design parameters for the conceptual wastewater system.

Table 13: Wastewater Main Parameters

Parameter	Assumption	Notes
<b>Minimum Sanitary Main Size</b>	250mm	As per the Servicing Standards and Town's requirements.
<b>Required Sanitary Main Capacity</b>	less than 86% of pipe full capacity	During peak wet weather flow conditions, as per the IMP.
<b>Pipe Slope</b>	200 mm → 0.40 % 250 mm → 0.28 % 300 mm → 0.22 % 375 mm → 0.15 % 450 mm → 0.12 % 525 mm → 0.10 % 600 mm → 0.08 %	As per AEP Standards and Guidelines, as indicated in the IMP and Servicing Standards.
<b>Material</b>	PVC	Assumed for both gravity sewers and forcemain.
<b>Manning's Roughness Coefficient</b>	0.013	As per the Servicing Standards.

### 3.2.3.Wastewater System Operational Requirements

Table 14 provides the velocity requirements for the sanitary system.

Table 14: Wastewater System Velocity Requirements

Parameter	Assumption	Notes
<b>Minimum Velocity</b>	0.61m/s	As per the Servicing Standards.
<b>Maximum Velocity</b>	3.0m/s	To minimize turbulence and erosion, as per Part 3 of AEP Standards and Guidelines.

## 3.3. METHODOLOGY

Hydraulic model development of the conceptual wastewater system was developed and analyzed using PCSWMM (version 7.7), developed by Computational Hydraulics International (CHI). A wastewater model was not available for use as the IMP calculated the wastewater system generation and infiltration rates based on Excel spreadsheet. Sanitary shapefile data and peak wet weather flow (PWWF) information for



both existing and future conditions along the 8<sup>th</sup> Street W wastewater mains as well as the north trunk main to the lagoon were provided by Associate Engineering (AE) on June 12, 2025. These flows were used to assess the pipe capacities along 8<sup>th</sup> Street W and the north trunk main under existing and future scenarios. As the Castle ASP only discharges wastewater flows to 8<sup>th</sup> Street W or the north wastewater trunk main this provides sufficient information on the Castle ASP on the Town’s wastewater system.

### 3.3.1. Modeling Scenarios

The conceptual wastewater collection system is designed and analyzed based on the following:

1. **Peak Hourly Wet Weather Flow (PHWWF) scenario** – This scenario checks for the maximum flow in the wastewater collection system and includes infiltration into the system from groundwater and rainfall.

## 3.4. CONCEPTUAL WASTEWATER SYSTEM

The proposed wastewater network for the Castle ASP was developed based on the review of existing wastewater infrastructure, consideration of future servicing needs, and alignment with the Town’s servicing standards and requirements.

### 3.4.1. Wastewater Generation

The population projections provided in [Section 1.4](#) were used to determine the sanitary flows for Castle ASP. [Table 15](#) provides a summary of the total wastewater flows for each land use, based on the design criteria.

*Table 15: Wastewater Flows Per Land Use*

Type	Area (ha)	Average Dry Weather Flow (ADWF) (L/s)	Peak Dry Weather Flow (PDWF) (L/s)	Inflow & Infiltration (I&I) (L/s)	Peak Wet Weather Flow (PWWF) (L/s)
Low-Density Residential	72.0	8.4	30.5	13.7	44.2
Medium-Density Residential	23.3	6.4	23.9	10.5	34.3
Country Residential	31.5	0.2	0.8	0.3	1.1
Commercial	6.5	1.5	7.5	0.7	8.2
Road	26.2	0.0	0.0	3.0	3.0
<b>TOTAL =</b>	<b>159.5</b>	<b>16.6</b>	<b>62.7</b>	<b>28.2</b>	<b>90.8</b>

### 3.4.2. Town of Claresholm – Existing Wastewater System

[Figure 3.1](#) shows the existing wastewater system along 8<sup>th</sup> Street W and the north trunk main. McElhanney incorporated the information provided by AE on the wastewater network and peak wet weather flows during existing conditions to verify the results obtained were the same as the IMP under



existing conditions. The model matched the results of the IMP with the results shown in [Figure 3.2](#). As per the IMP and the model, the review identified existing capacity constraints as follows:

- Wastewater flow exceeds pipe capacity along 8<sup>th</sup> Street W, between 53<sup>rd</sup> Ave W and 51<sup>st</sup> Ave W
- Wastewater flow exceeds the design criteria of 86% of the pipe flowing full but does not exceed pipe capacity for two sections of main along 8<sup>th</sup> Street W: between 53<sup>rd</sup> Ave W and 54<sup>th</sup> Ave W as well as immediately south of 43<sup>rd</sup> Ave W.

### 3.4.3. Town of Claresholm – Future Wastewater System

The Town's full-buildout conditions (which includes the existing system, the North Point ASP, the Prairie Shores ASP, and the Evolution ASP) were considered in the IMP with the exclusion of the Castle ASP. Based on future flow projections provided by AE, the model was run to confirm that model results aligned with the IMP, which was verified. As per [Figure 3.3](#) the majority of wastewater mains along 8 St W, from 59<sup>th</sup> Ave W to 43<sup>rd</sup> Ave W, are expected to operate at or above capacity under full buildout conditions. The IMP identified a capital improvement program to replace the wastewater mains as development proceeded to allow future growth.

### 3.4.4. Castle ASP – Conceptual Wastewater System

Due to capacity constraints due to future development along 8<sup>th</sup> Street W and to ensure efficient, cost-effective servicing of Castle ASP, an independent wastewater system was proposed. The only proposed connection to 8<sup>th</sup> Street W for the Castle Development is the medium-density land area on the southeast side of the ASP where the wastewater main will connect to the existing wastewater main on 8<sup>th</sup> Street W at Westlyn Spur.

Note that if initial phasing of the ASP proceeds adjacent to 8<sup>th</sup> Street W near the north end of the ASP, a permanent or temporary connection to 8<sup>th</sup> Street W and 51<sup>st</sup> Ave W junction may be requested. A separate technical memo to support the proposed development area and confirm capacity of the wastewater system would be provided at the time of subdivision. In discussion with the developer, this initial phasing includes a mix of low-density and medium-density residential areas, totaling approximately 29.7 ha of land area. Should development proceed in these areas, an upgrade of approximately 370 m of 300 mm sanitary sewer main along 8<sup>th</sup> Street W, starting from 51<sup>st</sup> Ave W and extending south towards 48<sup>th</sup> Ave W, may be required. However, it is recommended that flow monitoring be conducted in this area to confirm whether sufficient capacity exists, as design standards often produce conservative results, with actual monitored flows typically being lower.

The conceptual design includes wastewater mains varying in size from 250mm to 375mm diameter. The wastewater system discharges the majority of flows to two proposed connection points along the existing north wastewater trunk main, located directly south of Castle ASP boundary. The entire system has been reviewed to confirm pipe sizes and slopes meet the Town's design criteria.

The conceptual sanitary system is shown in [Figure 3.4](#). As this is mostly an independent wastewater system, the performance of the Town's wastewater system remains unchanged as shown in [Figure 3.5](#)



under the Town’s existing conditions. The same wastewater main constraints identified in [Section 3.4.2](#) remain with no additional capacity constraints occurring as a result of the Castle ASP wastewater flows.

Similarly, as shown in [Figure 3.5](#), the performance of the Town’s wastewater system remains unchanged under the Town’s future conditions. The same wastewater main constraints identified in [Section 3.4.3](#) remain with no additional capacity constraints occurring as a result of the Castle ASP wastewater flows.

### 3.4.5. Castle ASP – Alternative Conceptual Sanitary System

Given the significant capacity constraints along 8<sup>th</sup> Street W under future conditions, servicing for the Castle ASP reviewed the potential to re-allocate flows from the Prairie Shores ASP (to the north of the Castle ASP) through the proposed wastewater mains in the Castle ASP. If feasible, this option would eliminate a significant portion of upgrades to the 8<sup>th</sup> Street W wastewater main, saving significant capital investment for the Town.

The Prairie Shores wastewater flows were diverted through the Castle ASP and the model was run. To accommodate additional flows from Prairie Shores ASP, several wastewater mains within Castle ASP conceptual wastewater system would require upsizing. [Table 16](#) summarizes the wastewater main modifications required and their corresponding lengths under this alternative conceptual wastewater system.

*Table 16: Wastewater Main Modifications*

Pipe Size (mm)		
Proposed Wastewater Mains - Wastewater Flows from Castle ASP only	Proposed Alternative Wastewater Mains - Wastewater Flows from Castle ASP and Prairie Shore ASP	Total Length (m)
250	300	797.4
250	375	359.9
300	375	295.7
375	450	1,135.3
<b>TOTAL =</b>		2,588.3

[Figure 3.7](#) shows the alternative conceptual wastewater system, with wastewater mains that were modified, shown in yellow highlight. This model results of re-routing the Prairie Shores wastewater flows to within Castle ASP are shown in [Figure 3.8](#). The alternative wastewater concept shows that by re-routing the wastewater flows from the Prairie Shores ASP through the Castle ASP, the only capacity constraints along 8<sup>th</sup> Street W are the same as the constraints identified in [Section 3.4.2](#).

## 3.5. SUMMARY

The Castle ASP’s proposed wastewater system is provided as concept for the purpose of this study. The following provides a summary of the wastewater modeling and wastewater generation for the Castle ASP and the Town’s wastewater system capacities.



- Based on Table 5-6 in the IMP, the Town's wastewater lagoon can service a population of between 4,312 to 6,126, depending on whether evaporation is considered. The IMP's 20-year logarithmic projected population in 2041 is about 4,302 people, leaving a remaining serviceable population of approximately 1,824 for Castle ASP, assuming evaporation is accounted for. At Castle ASP's full buildout, the total ASP population is expected to reach about 3,255 people. Therefore, an upgrade to the lagoon will ultimately be required as the Town's population approaches 6,126. However, in the interim, there is sufficient capacity to accommodate partial development of the Castle ASP without immediately triggering the lagoon's upgrade.
- Based on Section 5.4.1 in the IMP, the Town's Main lift station has a capacity of 178 L/s at 15.6m of head, which can service a population of about 4,302 people in 2041. As noted, both pumps will likely need to operate simultaneously to meet future peak flow demands beyond 4,302 people. With both pumps operating, the Main Lift Station has capacity to accommodate up to approximately 6,126 people, which is limited by the lagoon capacity. An upgrade will be required at the full buildout of Castle ASP. However, in the interim, there is sufficient capacity in the existing system to service approximately 1,824 people from Castle ASP based on the information provided in the IMP.
- The Town's wastewater mains along 8<sup>th</sup> Street W have several sections of wastewater main that exceed capacity under existing conditions, without any flows from the Castle ASP. Upgrades are likely to be required, and it is recommended the Town undertake flow monitoring to determine the actual flows experienced in these sections of main. It is common to have the design criteria be conservative with actual flows being somewhat less, allowing for additional development before replacement or upgrades.
- The Town's wastewater mains along 8<sup>th</sup> Street W have the majority of the wastewater main that exceed capacity under future conditions, without any flows from the Castle ASP. Upgrades will be required if the Prairie Shores ASP wastewater flows to 8<sup>th</sup> Street W as per the IMP.
- The alternate concept alignment for the Prairie Shores ASP wastewater flowing through the Castle ASP lands can be accommodated with an increase in pipe diameters with an approximate length 2.6km of wastewater main. Note that the costs for the 8<sup>th</sup> Street W upgrades in the IMP identified project SG5 with a cost of \$1,047,000 and project SG6 with a cost of \$2,151,000 based on 2021 dollars.



## 4. Stormwater Management System – Master Drainage Plan (MDP)

The stormwater analysis and conceptual level design have been completed in accordance with applicable regional and provincial stormwater management requirements. The MDP encompasses an assessment of the pre-developed and post-developed drainage conditions, design considerations, applied design criteria, analysis, and the proposed drainage management strategy.

The MDP is based on the information available at the time of its completion and remains subject to revision should any conditions change during the detailed design phase of this project.

As a high-level drainage assessment, the MDP addresses large drainage areas, typically those served by a single outfall, which are delineated by natural watershed boundaries rather than property lines to ensure effective stormwater management that aligns with natural flow patterns. This MDP was prepared to support the Area Structure Plan (ASP) and provide guidance for the subsequent detailed design of the subdivision. As a conceptual and intermediate planning level between broader watershed plans and detailed site plans, the MDP provides an overall framework for stormwater management.

The MDP process involves the following primary phases:

- Context Review and Study Area Definition:
  - Define the study area based on natural hydrological boundaries, including both upstream and downstream catchments, rather than relying solely on property lines
  - Review relevant background material, including design drawings, previous reports and studies, regulatory documentation, and communication between relevant parties
  - Collect and analyze site-specific information such as topography, existing drainage infrastructure, land uses, and the environmentally sensitive features
- Drainage System Concept Development:
  - Analyze pre-development drainage conditions to establish baseline hydrologic conditions to confirm drainage boundaries
  - Establish post-development runoff rate and volume targets in accordance with local and provincial regulatory standards
  - Identify water quality and habitat protection requirements for the study area
  - Assess the capacity of existing downstream drainage infrastructure to receive post-development flows
  - Develop high-level stormwater servicing concepts that integrate Best Management Practices (BMPs) and Source Control Practices (SCPs)

- Determine preliminary criteria for individual sub-catchments to support consistent and equitable discharge control.
- Technical Hydrologic and Hydraulic Analysis:
  - Conduct post-development rainfall-runoff analysis to assess runoff characteristics and determine retention requirements.
  - Evaluate overland drainage performance during a 1:100-year design storm event based on both local and provincial regulations, with a focus on flood risk mitigation and flow conveyance
  - Consider Low Impact Development (LID) to manage runoff at the source and preliminarily size the stormwater ponds to control post-development runoff volumes
  - Approximate major and minor stormwater conveyance alignments, sizing, and preliminary invert elevations to verify servicing layout feasibility.

## 4.1. EXISTING STORMWATER SYSTEM

The pre-developed condition of the region includes the 182.6-hectares (ha) area, which was primarily used for agricultural purposes, including as horse pasture and for highway advertising since 2003. Topographically, the land surface gently slopes from the northwest toward the southeast, with elevations ranging from 1,045 to 1,038 metres (m). This slope is almost consistent across the area, creating a uniform and manageable landscape with a low potential for flood hazards, as no wetlands or standing water were identified through desktop review or historical imagery.

### 4.1.1. Major System Components

The site is generally split in the middle of the quarter sections from north to south, and slopes towards the southeast and southwest corners. The site can be characterized as having shallow slopes with average overland slopes ranging from about 0.5 – 1%. *Figure 4.1* shows the existing condition of the site, showing the overland flow direction, local depression areas, existing ditches, and existing culverts. **The development site occupies the following quarter sections:**

- N.E. 1/4 SEC.27-12-27-4 (Site A),
- S.E. 1/4 SEC.27-12-27-4 (Site B),
- N.E. 1/4 SEC.22-12-27-4 (Site C)

Site boundaries generally consist of roadways and elevation breaks as follows:

- Eastern boundary: The site is delineated to the east by the existing 8<sup>th</sup> Street ditch, which conveys flow from north to south through a series of culverts. The ditch is also receiving flow from northern and western portions of the Town.
- Northern boundary: The site is bounded to the north by 8<sup>th</sup> St access road. There is an ASP for development to the north of 8<sup>th</sup> St access road; therefore, no upstream drainage contribution is anticipated from that area.



- Western boundary: The site is adjacent to undeveloped land to the west. A small portion of N.W.1/4 SEC. 27-12-27-4 (Figure 4.1) drains toward Site A. Portions of sites (A and B), and C direct sheet flows to S.W1/4 SEC.27-12-27-4 and S.W1/4 SEC.22-12-27-4, respectively.
- Southern boundary: The site is bounded by an access road, a ditch, and the municipal boundary. Site B and site C are separated by 43 Avenue W. (HWY 520).

A significant portion of the pre-development drainage area will discharge southeast towards the Frog Creek Stormwater Management Facility (SWMF), except for the southwest section of sites B and C, which slopes to the southwest. All runoff eventually discharges to overland channels and ditches, which ultimately discharge into the Willow Creek.

According to the Alberta Soil Information Finder (SIFT), the site's subsurface conditions are expected to consist primarily of silty clay, which aligns with typical soil profiles observed across the region.

## 4.2. ASSUMPTIONS AND DESIGN CRITERIA

Area developments lead to stormwater runoff increases primarily due to an expansion of impervious surfaces (e.g. roads, paved surfaces, roofs) that is referred to as the post-development condition. Discharge rates and volumes increase, relative to pre-development conditions, necessitating an assessment to control stormwater flows and mitigate the post-development impacts on the downstream systems.

### 4.2.1. Assumptions

The following assumptions supplement data gaps in the provided background data.

- The conceptual stormwater system for the Castle Area Structure Plan (ASP) was developed based on design criteria adopted from the Infrastructure Master Plan (IMP). In cases where there is conflicting information between the IMP and the Servicing Standards, the IMP takes precedence. Where the IMP does not provide specific guidance, the Servicing Standards are used to supplement the design.
- It is understood that the ASP, located on the east side of the Town, will offer land to accommodate commercial and residential development. The ASP will consist of approximately 72 ha of Low-Density Residential, 23.3 ha of Medium-Density Residential, 31.5 ha of Country Residential, 6.5 ha of Neighbourhood Commercial areas, 26.2 ha of road rights of way, and 23.1 ha of Open Space/Stormwater Pond, for a combined developable land area of 182.6 ha, as shown in [Figure 4.2](#).
- In the post-development condition, runoff from the site is assumed to be managed to accommodate Frog Creek SWMF. Hence, the ponds should be sized to accommodate any additional area that is not originally discharging toward Frog Creek, to meet the established maximum allowable release rate of 2.5 L/s/ha.



- Without the benefit of a detailed grading plan, the elevation of conceptual stormwater infrastructure is based on the existing LiDAR data and adjusted assuming future may be is +/- 1m of OG to suit the needs of the drainage system.
- Low-Impact Development (LID) modelling was not completed.

#### 4.2.2. Design Storms

The design storms are based on the Environment Canada Claresholm AB climate station (#3031640) Intensity-Duration-Frequency (IDF) curve as per the IMP. The climate station has 17 years of rainfall data from 2005 to 2021. The Chicago Distribution was used for the generation of the design of storm hyetograph for durations ranging from 1 to 24 hours with a peak ratio of 0.30, as per the Servicing Standards. For this analysis, the 5-year 4-hour, and 100-year 24-hour design storms were used for sizing the minor systems and major system/pond design, respectively. *Table 17* provides the total rainfall depths of each storm event.

*Table 17: Design Storms*

Return Period	Rainfall Depth (mm)				
	1-Hour	2-Hour	6-Hour	12-Hour	24-Hour
<b>5-Year</b>	24.6	27.4	37.8	50.3	62.9
<b>100-Year</b>	48.5	52.2	69	95.5	121.4

#### 4.2.3. Low Impact Development (LID) Source Controls

To offset the increase in runoff rate and volume in the country residential lots (equal to total 31.5 ha), it is proposed to utilize local source controls for 1:100 storm for each country residential lot. Furthermore, for the specified low density residential lots in the site C, LID is recommended as well due to grading constraints, shown in *Figure 4.2*. The exact placement for these features will be determined during the subdivision's detailed design phase. For the other lots, considering LID is recommended, however, LID has been excluded from the modeling.

Ditches may be considered for stormwater management, with the option for local widening to incorporate appropriate bioretention areas, during detailed design.

Lot-level source controls will be incorporated for required lots to address increased imperviousness based on the final lot layout. The placement, sizing, and detailed design of these controls are the responsibility of the individual lot owner/developer and must be documented in a Site-Specific Stormwater Implementation Plan (SSSIP) for country residential lots. The SSSIP will be prepared in accordance with the design criteria outlined in this report and must be submitted for review and approval as part of the Lot Development Permit process.



Source controls must be suitably sized and located during the detailed design phase and must comply with the following requirements:

- Water quality improvement should be considered and, at a minimum, should not deteriorate from pre-developed conditions
- Developers could refer to the Source Control Practice of Calgary Stormwater Source Control Practices Handbook, LID best management practices design guide, and LID development guidelines (Module 2).
- Any design details not specified in this report must be addressed by developers in their detailed design submissions
- Ditches could be utilized as a stormwater control practice and designed accordingly
- Integrating source controls into the stormwater design of individual lots should be considered to improve volumes and the quality of water prior to discharging downstream
- The directions of the upstream flows and subdivision catchment area boundaries should not be altered
- Culverts should be sized and located at the detailed design phase of the work.

#### 4.2.4. Minor Conveyance System

The proposed stormwater system is comprised of a combination of ditches and stormwater pipes. The design of these elements is summarized below and is based on the Guidelines and design standard.

- Lot services consideration:
  - Service connections should be disconnected from the minor system and discharged overland by pumping or be equipped with backflow preventers to prevent flooding.
- Storm Pipes
  - Minimum size of 300mm in diameter
  - Minimum slope based on minimum velocity of 0.60m/s when flowing full.
  - Minimum depth not shallower than 1.2m
  - Material: PVC and Concrete (for diameter ≥ 1200mm)
  - Manning's Roughness Coefficient: 0.013
- Culverts
  - Minimum size of 600mm
  - Assess capacity up to 100-year event.
- Swales / Ditches
  - Velocity and depth not to exceed the values provided in [Table 18](#)



- Minimum continuous grade of 2.00%: Based on site LiDAR, it may be difficult to achieve a minimum ditch grade of 2% with average site grades being only 0.5-1%. Therefore, the design of ditches will take into consideration a larger cross-sectional area to increase capacity and an evaluation of capacity for all design events up to the 100-year to such that they provide suitable conveyance at a minimum achievable slope of 0.1%.

Table 18: Velocity vs Permissible Depth

Velocity (m/s)	Permissible Depth (m)
<b>0.5</b>	0.80
<b>1.0</b>	0.32
<b>2.0</b>	0.21
<b>3.0</b>	0.09

#### 4.2.5. Major Drainage System

- The major system must be designed to convey runoff from a 1:100-year 24hour storm event
- The ditch network can contain major flows without flooding, and the piped system has limited surcharge and flooding to prevent major ponding during the 100-year event.
- Ponding and overland flow shall be contained within public property.
- No building shall be inundated at its ground line.
- The depth of water at curbside should be less than 0.30m for all roadways.
- Properties zoned for non-residential use or for medium- and high-density multi-family residential use shall retain excess runoff volumes generated by the 1:5-year and 1:100-year storm events.
- Velocities in the conceptual overland channels are minimized, as per the Servicing Standards and the AEP Standards and Guidelines, as shown in Table 18.
- Climate change-scaled IDF curves for Claresholm should be used to assess the impact of climate change on the major stormwater system, and ditches and overland escape routes must be adequately sized to accommodate increased runoff volumes and intensities projected under future climate scenarios.
- During detailed design, ditch capacity must be sized to fully contain major year flows, including those increased by climate change impacts, without causing ponding, and must safely convey these flows to downstream discharge points. This ensures the system remains effective under projected future conditions and complies with municipal and provincial stormwater management standards.
- Rate control: Rate control for the development area will be achieved using detention systems, designed per the Servicing Standards and SWM Guidance. Relevant criteria used at the conceptual level of design, namely preliminary design dimensions for sizing, including:



- Wet Ponds
  - Minimum water surface area of 2.0 ha
  - Maximum side slopes of 5:1
  - Minimum permanent pool depth of 2.0m
  - Maximum 100-year active storage depth of 1.5m
  - Minimum freeboard of 0.6m between the lowest top of the footing and 100-year high water level where the emergency route is available.
- Pond sizing was designed based on a defined allowable release rate of 2.5 l/s/ha. The allowable release rate is for design storms of 1:100 year 24-hour event.
- Consideration may be given to scaling the size of a pond, in the location specified within the development concept of the Castle ASP, in order to size the pond appropriately for the phase(s) of development being undertaken, if full buildout of the pond is not warranted at that time and overland conveyance is possible without impeding future development phases. IMP recommended an approximate unit storage rate of 800 m<sup>3</sup>/ha for sizing the pond, which could be considered for sizing the temporary ponds.
- All lots should have controls provided on-site to limit discharge to the minor system at or below the established Lot-Level Rate Control Target.
  - This detention deferred to subdivision design reduces the size of downstream facilities and control targets. Pond locations were selected to limit the community detention system sizes across the development.
- Quality control:
  - a minimum of 85% of sediments of particles size 75 microns or greater should be removed as per AESRD Municipal Policies and Procedures Manual, utilizing pond forebays and LID. Erosion and sediment control must be in place as permanent features of development. These include grassed swales and runways to trap silt and ponds designed with dimensions and detention times promoting settling.
  - Wet ponds are cited to provide water quality treatment of urban pollutants.
  - Grassed swales/ditches also provide stormwater treatment through filtering and detention of runoff. The ditch section recommended includes a minimum slope and bottom width which provide a level of quality control.
  - Commercial developments may implement oil-grit separators or LID features to reduce pollutant loads to the piped system and downstream systems.

## 4.3. METHODOLOGY

### 4.3.1. Hydrologic/Hydraulic Modeling

The Castle ASP has a total area of approximately 182.6 ha. Therefore, a computer model was developed to determine design flows and sizing of the conceptual stormwater system. The hydrologic/hydraulic



model for the post-development stormwater systems were developed using PCSWMM (version 7.7), developed by Computational Hydraulics International (CHI). The software is an adaptation and enhancement of the well-known and widely used United States Environmental Protection Agency’s (EPA) Stormwater Management Model (SWMM) version 5.1.

### 4.3.2. Modeling Parameters

Table 19 summarizes the stormwater modeling parameters.

Table 19: Stormwater Model Parameters

Parameter	Assumption	Notes
<b>Slopes</b>	1%	Estimate as per LiDAR DEM
<b>Flow Length</b>	the lesser of $[\frac{\sqrt{Area}}{2}]$ or 150] where, Area is in m <sup>2</sup> units	
<b>Impervious Manning’s N</b>	0.013	Manning’s roughness coefficient (N) for smooth asphalt, as per the SWMM Reference.
<b>Pervious Manning’s N</b>	0.25	Manning’s roughness coefficient (N) for short prairie grass, as per the SWMM Reference.
<b>Impervious Depression Storage</b>	1.6	As per the SWMM Reference.
<b>Pervious Depression Storage</b>	3.2	As per the SWMM Reference.
<b>Percent Impervious</b>	Low-density Res. = 55% Medium-density Res. = 65% Country Res. = 30% Neighbourhood Commercial = 85% Open space = 20% Undivided Arterial Road = 70.46% Collector Road = 72.9% Local Road = 74.25%	As per the SWMM Reference.
<b>Infiltration Method</b>	The SCS Runoff Curve Number Low-density Res. = 75% Medium-density Res. = 85% Country Res. = 65% Neighbourhood Commercial = 85% Open space = 60% Undivided Arterial Road = 83.6% Collector Road = 85.03% Local Road = 85.81%	Based on the geotechnical report.
<b>Conduit Roughness Coefficients</b>	CSP culverts = 0.024 Overland flow = 0.035 Stormwater mains = 0.013 Vegetated swales/ditches = 0.03	As per the SWMM Reference.

### 4.3.3. Modeling Scenarios

The proposed stormwater management approach for the ASP area utilized a traditional dual drainage system. This system incorporates both a minor (piped) system and a major (overland) system. The minor system is designed to handle more frequent, smaller runoff events, such as those up to a 1 in 5-year



return period. In contrast, the major system is configured to safely convey larger, less frequent events, specifically those up to a 1 in 100-year return period, by utilizing designed overland flow paths including roads, curbs, and other channels. This dual approach ensures comprehensive management of stormwater under varying conditions.

Therefore, the conceptual stormwater system was designed and analyzed based on the following modeling scenarios:

**1. 1:5-year 4-hour Single Storm Condition:**

- Establishes baseline results for the development.
- Includes proposed hydrology and hydraulics.
- Determines runoff rate and volume targets for the post-development condition.
- Used primarily for pipe sizing.

**2. 1:100-yr 24-hour Single Storm Condition:**

- Used to size stormwater management ponds and major system components.
- Ensures adequate storage and safe conveyance of extreme event runoff.

## 4.4. DISCUSSION

The concept stormwater system envisioned for the development is illustrated in [Figure 4.2](#). The Stormwater Concept Plan and results are summarized below.

### 4.4.1. CONVEYANCE (MINOR) SYSTEM

- In areas with challenging grades, drainage easements must be established to provide positive slope conveyance for ditches and storm pipes. These alignments also mimic the pre-development drainage patterns of ephemeral water bodies to maintain site hydrology.
- The concept pipe alignment to service the commercial areas is based on general flow directions and aligned both for proximity to connections to a larger amount of the development area, as well as upgrades to Highway 27, and elevation to prevent surcharge of the network from the proposed wet pond.
  - Pipe sizes range from 300mm to 1050mm in diameter, discharging to the main pond.

### 4.4.2. RATE CONTROL (DETENTION)

- Roadways, and the developed areas draining to the minor system will be ultimately conveyed to any of the stormwater management facilities.
- Pond sizes and configurations are listed in [Table 20](#) and displayed conceptually in [Figure 4.2](#). Detailed stormwater management plans are to be completed at the outline plan stage as per the requirements of the Town.



- Pond volumes and sizes are considered conceptual and may differ based on future stormwater planning and design. Presented values are based on modelling of the proposed concept ASP areas and assumptions discussed in [Section 4.3](#).

Table 20. Pond Parameters

Name	Type	Depth	Total Depth (m)	Pond Areas m <sup>2</sup>
North Pond	Wet pond	Active Storage = 1.5m Freeboard = 0.6m	5	Bottom = 12850 m <sup>2</sup> Active Storage (HWL) = 30405 m <sup>2</sup> Freeboard = 33185 m <sup>2</sup>
Middle Pond	Wet pond	Active Storage = 1.5m Freeboard = 0.6m	5	Bottom = 13065 m <sup>2</sup> Active Storage (HWL) = 29650 m <sup>2</sup> Freeboard = 32300 m <sup>2</sup>
South Pond	Wet pond	Active Storage = 1.5m Freeboard = 0.6m	5	Bottom = 4840 m <sup>2</sup> Active Storage (HWL) = 19190 m <sup>2</sup> Freeboard = 21660 m <sup>2</sup>

- Pond volume requirements and unit area storage are listed in [Table 21](#). Detailed stormwater management plans are to be completed at the outline plan stage as per the requirements of the Town.

Table 21. Pond Volumes

Name	Target	Drainage Area*	5-Year			100-Year		
		ha	m <sup>3</sup> /ha	Active storage m <sup>3</sup>	Total storage m <sup>3</sup>	m <sup>3</sup> /ha	Active storage m <sup>3</sup>	Total Storage m <sup>3</sup>
North Pond	100-year 24hr	36.49	214.3	7820	64130	838.9	30610	86920
Middle Pond	100-year 24hr	62.29	199.1	12400	68430	665.0	41420	97450
South Pond	100-year 24hr	36.80	215.5	7930	36540	790.5	29090	57700

\* The remaining 47.02 ha should be serviced by LID features (Additional areas may also require LID servicing due to grading constraints).

- The post-development drainage area for the north pond is completely within the pre-development catchment that discharges to the Frog Creek SWMF.
- The post-development drainage area for the middle pond is almost within the pre-development catchment (covering 62.11 of 62.29ha) that discharges to the Frog Creek SWMF, except for an additional 0.18ha that originally drained southwest. This minor area will be included in the proposed preliminary design for the middle pond.
- A large portion of the post-development drainage area (covering 26 of 36.8ha) for the south pond is within the pre-development catchment that discharges to the Frog Creek SWMF, and 10.73ha of drainage area, which originally discharged southwest, will be accommodated by the south pond. Therefore, the maximum release rate for the south pond was estimated based on 26 ha of drainage area.



### 4.4.3. MAJOR SYSTEM

- Pipe system capacity is designed to convey 1:5, 4hr storm, limit surcharge and ponding depths during major flows.
- Ponds discharging off-site provide major flow control for the 100-year event in the absence of suitable emergency overflow locations bounded by roadways.

## 4.5. IMPLEMENTATION

### 4.5.1. DESIGN CONSIDERATIONS

- Stormwater Master Plans, stormwater facility reports, and site-specific stormwater management plans are required before any development approvals to demonstrate stormwater requirements in the development area are met.
- Future grading and road elevations should be completed to promote positive drainage towards pipes, ditches, and pond systems to prevent uncontrolled offsite discharges.
- Lot-level detention systems are to be provided by developers to meet the targets established in this ASP. Downstream capacity and pond volumes provided are contingent on these targets being met based on the area of discharge.
- The maximum catchment area that contributes to the Frog Creek SWMF has been considered in the post-development runoff control to ensure no negative impact on the downstream storage facilities.
- Pond outlet structures have not been designed and will depend on pond elevations and finished grades during detailed design.
- Suitable grading and depth of cover for stormwater pipe systems must be achieved. Due to shallow grades across the site, large pipe diameters may be required to provide adequate conveyance for storm events.
- All ponds were designed with 600mm of freeboard based on assumed elevations. Future grading must ensure that, in the absence of a suitable emergency overflow, freeboard from the pond's high-water level to the lowest top of footing must be provided during detailed design phases.
- LID features were not assessed but may be implemented during detailed design phases to add additional rate control and water quality benefits. These features may also contribute to lot-level detention systems during detailed design.
- The design of the ASP's stormwater system shall be under the most up-to-date Olds Design Guidelines and Alberta Environment Guidelines at the time of the detailed engineering design.



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# APPENDIX A

Castle ASP Land Use



# APPENDIX B

Water Infrastructure Figures



# APPENDIX C

Wastewater Infrastructure Figures



# APPENDIX D

## Stormwater Infrastructure Figures



# APPENDIX E

## Water Demand Calculations



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