Appendix G

Associated Engineering

REPORT

Carpere Valley Development Corp.

Carpere Valley View
Mixed-Use Development Concept
Infrastructure Servicing Plan

MARCH 2022

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

Associated Engineering was engaged by Carpere Valley Development Corp. to complete an Infrastructure Servicing Plan in support of the proposed Carpere Valley View Concept Plan prepared by Wallace Insights. The Concept Plan has a total developable area of approximately 49 hectares (121 acres) and overlooks the Moose Jaw River in southeast Moose Jaw. The location of the proposed Carpere Valley Development (Site) is shown in Figure 1-1. This report provides a review of the existing City infrastructure services adjacent to the development and a conceptual-level servicing strategy for the potable water distribution, wastewater collection, and stormwater management.

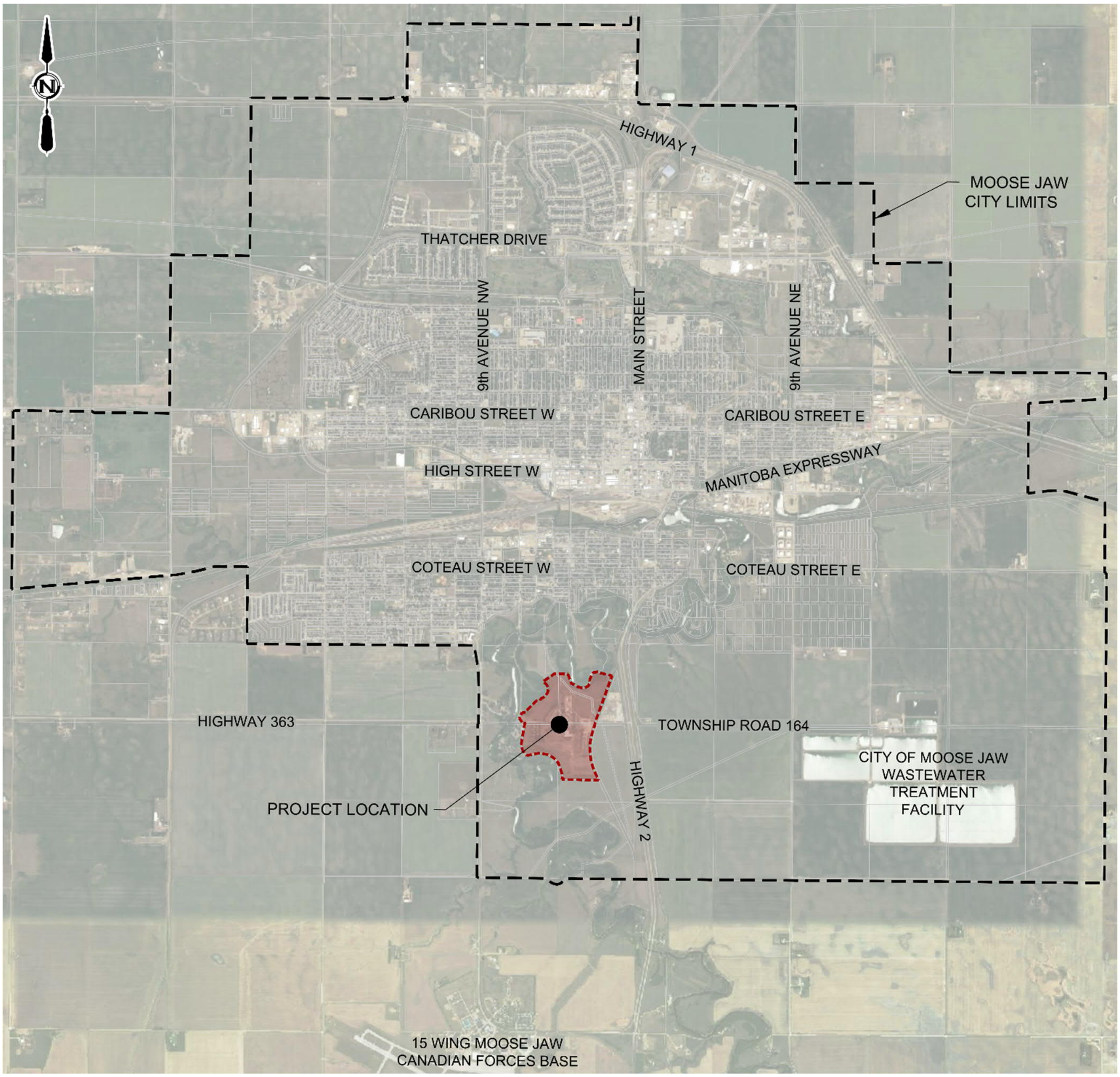


Figure 1-1
Location Plan

1.1 Background Information

1.1.1 Available Reports and Reference Information

The following is a summary of the available background information that was provided to Associated Engineering and was considered in this review:

- *Carpere Valley Development Corp. - Assessment of Existing Site Servicing Infrastructure* Report, dated June 2021, prepared by Associated Engineering
- City of Regina Storm*water Design Standard*, dated January 2021
- City of Regina *Wastewater Design Standard*, dated January 2021
- City of Regina *Water Design Standard*, dated January 2021
- *Moose Jaw Utility Master Plan Final Report*, dated April 2016, prepared by ISL Engineering and Land Services Ltd.
- *Churchill and Valley View Optimization* report, dated March 2021, prepared by Associated Engineering for the City of Moose Jaw
- Water Security Agency and Saskatchewan Ministry of Environment *Guidelines for Sewage Works Design, EPB 203*, dated April 2014
- Water Security Agency *Stormwater Guidelines, EPB 322*, dated June 2015
- Water Security Agency *Waterworks Design Standard, EPB 501*, dated November 15, 2012
- *Wellesley Park Lift Station* memo, dated December 8, 2021, prepared by Associated Engineering for the City of Moose Jaw

1.1.2 Preliminary Geotechnical Investigation

A preliminary geotechnical investigation report for the Site was prepared by Thurber Engineering Ltd., with the field portion of the investigation being conducted between November 29 and December 3, 2021.

The Site investigation included the drilling of 24 test holes across the Site and the installation of eleven standpipe piezometers. The investigation found that the subsurface soil conditions on Site generally consist of a thin layer of topsoil, underlain by high plastic clay that extended to depths of about 8 to 12 metres. This high plastic clay was followed by glacial clay till containing cobbles, boulders, and variable lenses and layers of wet sand. Groundwater seepage and sloughing soils were encountered within the discontinuous intertill sand. Short term groundwater levels across the Site generally ranged between 13 and 19 metres below ground surface. However, groundwater was measured at a depth of 4.4 metres in one test hole.

During the investigation, it was observed that there are numerous areas along the crest of the valley slopes which show evidence of recent and currently active slope movement, as well as evidence of historical movements. The Moose Jaw River is typically located at or near the toe of the valley slopes. The surrounding valley slopes on the north, northwest and southwest portions of the Site are typically quite steep with slopes typically ranging from 30 to 45 degrees. However, steeper slopes were observed, with some sections that are near vertical.

This investigation confirmed that the Site is conducive to redevelopment; however, given the subsurface conditions and slope stability factors, some special consideration will need to be given to the design and construction. This is particularly important along the Moose Jaw River Valley, where consideration must be given to help mitigate potential impacts on the existing and future slope instability.

2 PROPOSED DEVELOPMENT

2.1 Land Use Plan and Design Population

The Carpere Valley View Land-Use Concept Plan prepared by Wallace Insights is presented in Figure 2-1. This infill redevelopment proposes a diverse mix of land uses that include residential, commercial, employment, institutional, recreation, tourism, and a large amount of open spaces. To support the subdivision and servicing of this new mixed-use community in the City of Moose Jaw, new municipal rights-of-way, utility parcels and urban parks are proposed. The land use areas and design populations are shown in Table 2-1 below. The projected total population for the development area is 1478 residents.

Table 2-1
Carpere Valley Development – Land Use Areas and Design Population

Land Use	Area	Units[1]	People/Unit[1]	Est. Pop.[2]
Residential – Estate Lots	6.8 ha (16.8 ac)	60	2.2	133
Residential – Standard Large Lot	4.1 ha (10.2 ac)	78	3.0	235
Residential – Standard Seniors Bungalow Lots	5.0 ha (12.3 ac)	111	1.8	199
Residential – Multi Family	5.5 ha (13.7 ac)	480	1.9	911
Subtotal – Residential	**21.4 ha (53.0 ac)**	**729**		**1478**
Commercial	3.1 ha (7.7 ac)			
Employment	2.9 ha (7.2 ac)			
Institutional	3.4 ha (8.3 ac)			
Recreation/Tourism	4.1 ha (10.2 ac)			
Utility	1.1 ha (2.7 ac)			
Urban Park	4.7 ha (11.7 ac)			
Roads	8.2 ha (20.2 ac)			
Subtotal – Non-Residential	**27.5 ha (68.0 ac)**			
Total Concept Plan Developable Area[3]	**48.9 ha (121 ac)**			

[1] Provided by Wallace Insights
[2] From *Carpere Moose Jaw Valley View Development Concept* prepared by Wallace Insights, dated January 6, 2022
[3] Excludes Naturalized Open Space

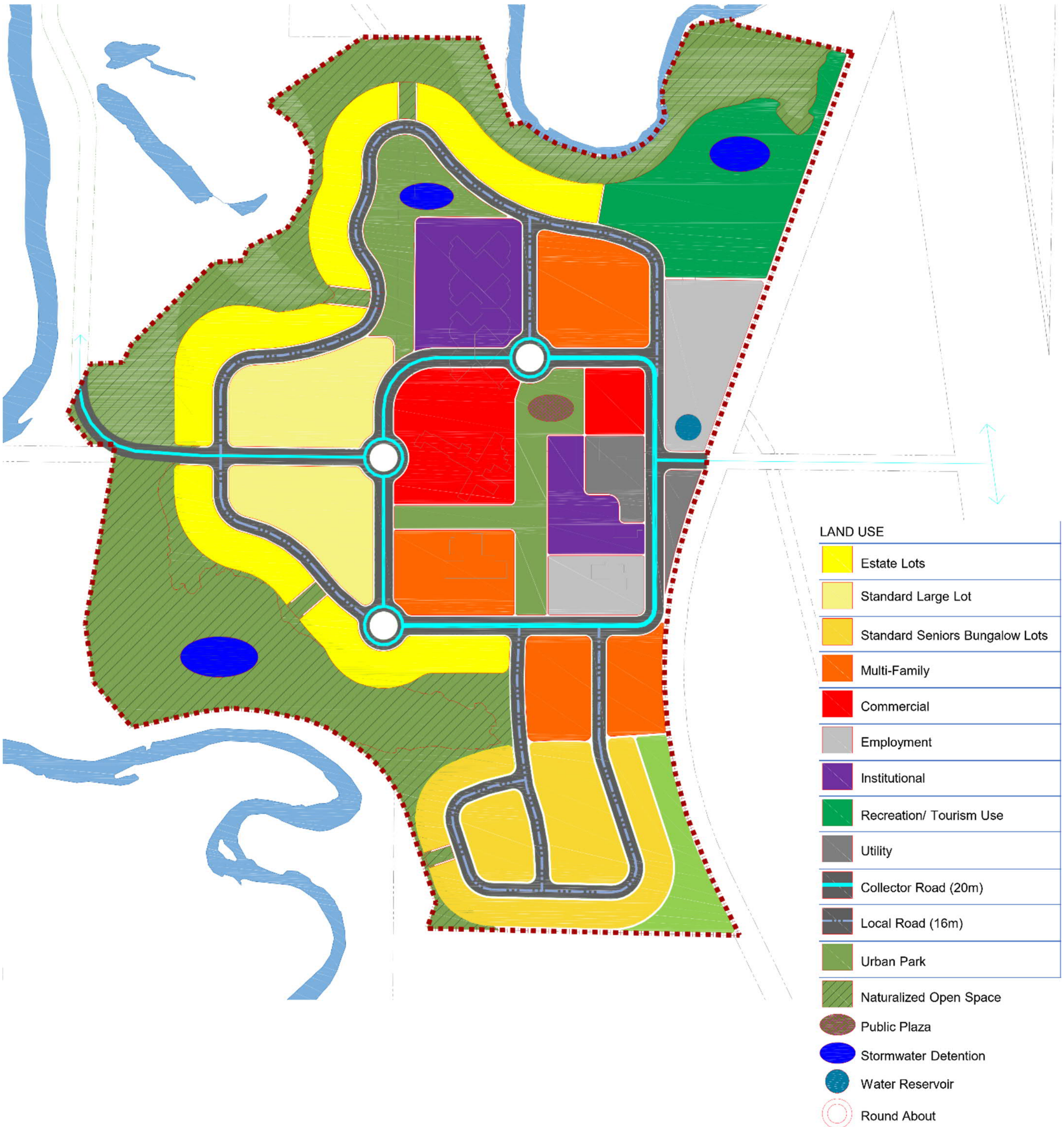


Figure 2-1
Carpere Valley Development – Land-Use Concept Plan[4]

[4] Figure is based on the *Carpere Valley View Land Use Plan* prepared by Wallace Insights, dated January 6, 2022

3 WATER

Refer to Figure 3-1, which shows the proposed connections to the City's existing potable water distribution system and conceptual-level sizing of the water mains proposed to service the Carpere Valley development.

3.1 Existing Water Infrastructure

In June 2021, Associated Engineering completed condition assessment and capacity analysis of the existing water infrastructure servicing the Site, including a desktop review of the on-site and off-site water mains as well as a site inspection of the water pump station and reservoir. The findings and recommendations of this study are included in the *Assessment of Existing Site Infrastructure* (AE, 2021) report in Appendix A.

3.1.1 Water Pump Station and Reservoir

The potable water pump station and reservoir was built in the 1950s and is currently not in operation. The June 2021 condition assessment completed by Associated Engineering took into account the various components, including structural, building and process mechanical, electrical, instruments, and controls. This assessment confirmed that the existing facility is suitable for servicing the Carpere Valley development, provided some upgrades and repairs are made to restore the pump station and reservoir to an acceptable level of service.

These recommended improvements are summarized as follows:

- Repair concrete walls within the reservoir and the east wall within the pump station.
- Confirm the condition and wall thickness of the interior piping and replace as required. Clean and recoat the interior of the pipe and paint the exterior.
- Confirm the operation of valves and replace as required.
- Confirm the operation and capacity of each distribution pump and repair as required.
- Replace the fire pump to meet the Fire Flow requirements of 250 L/s for the Concept Plan area, the Fire Flow requirement will need to be confirmed during later stages of design development.
- Upgrade the electrical, including the replacement of starters, panels, lights and electrical outlets.
- Upgrade the building mechanical, including replacement of the furnace, louvers, and fans.
- Upgrade instrumentation and controls, including the replacement and upgrade of instruments to SCADA compatible systems.
- The expansion of the reservoir will likely be required to service the full Concept Plan area; however, this should be confirmed during later stages of design development.

The estimated costs to bring the facility to an acceptable level of service is between $1.5M to $2.25M, including reservoir expansion. It is anticipated that these improvements will restore the water pump station and reservoir to a condition acceptable to the City so it can be maintained and operated as a municipal facility by the City. During the initial design phases for the development, the extents of the upgrades required for the pump station and reservoir, as well as reservoir sizing, will need to be confirmed.

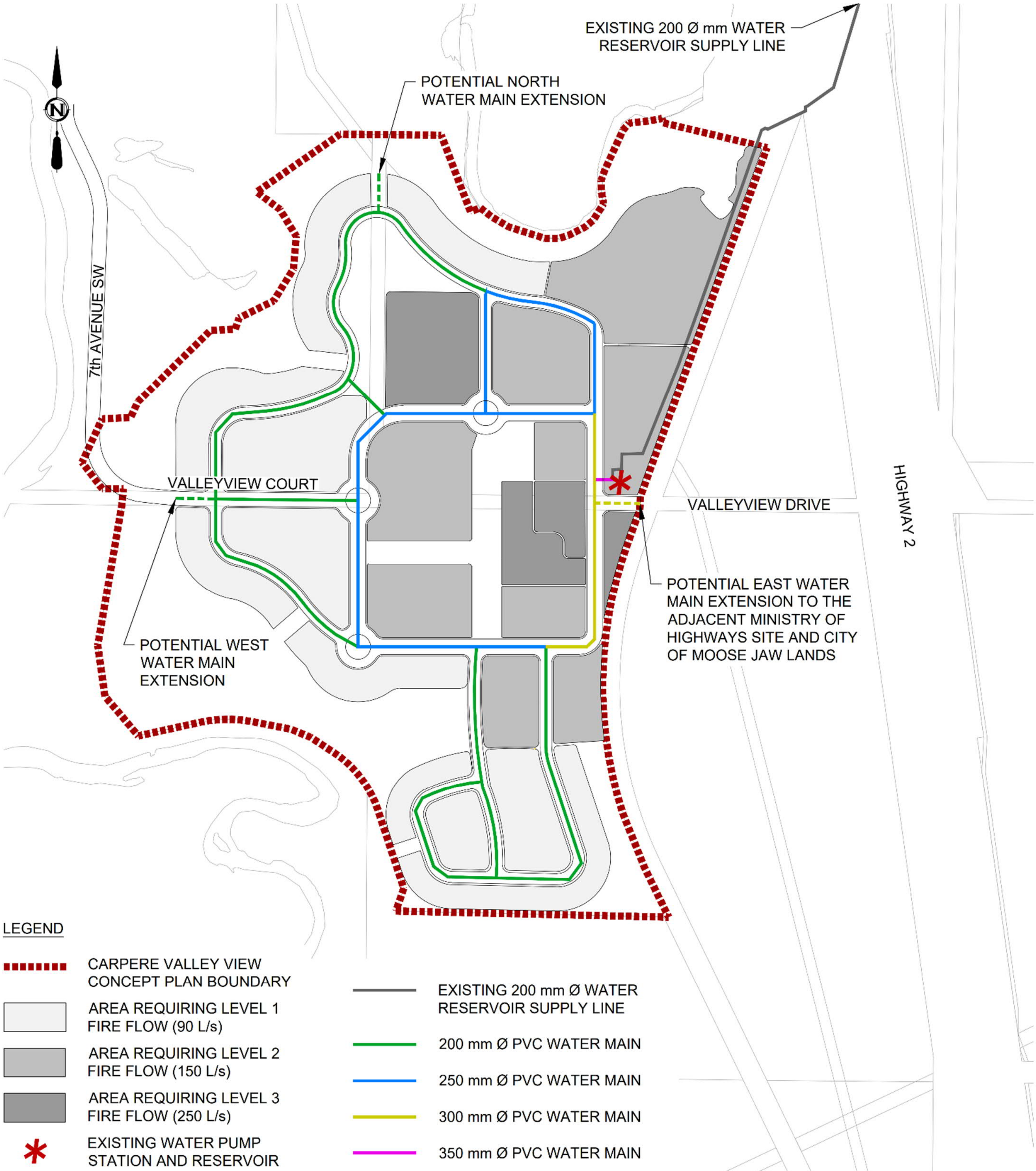


Figure 3-1
Carpere Valley Development – Proposed Water Distribution Network

3.1.2 Reservoir Supply Line

The reservoir for the Site was supplied by a 200 mm diameter water main from the north, where it crosses Highway 2 and the Moose Jaw River. Currently this line is out of service due to a main break at the crossing over the Moose Jaw River. As noted in the *Assessment of Existing Site Infrastructure* (AE, 2021) report, it is anticipated that the reservoir supply line will require replacement based on its age and the pipe material. Additional field investigations are required to confirm the condition and capacity of this supply line and determine the scope of improvements required to restore service to the Site.

3.1.3 On-Site Water Distribution Services

The Site contains various private water distribution services from the pump station and reservoir that extend throughout the site to various existing facilities. These services included asbestos cement (AC) water main pipe that was installed in 1952 and PVC water main pipe that was installed in 1985. Based on the material and age of the AC mains, it is assumed that this pipe is at the end of its useful life and would not be suitable for re-use. While the PVC mains likely have remaining useful life, based on the size and alignment of the mains there is a high potential that extensive upgrades will be required to provide a municipal distribution network that is capable of meeting minimum Fire Flow requirements. Additionally, the alignment of the existing mains is incompatible with the Concept Plan and unsuitable for adoption into a public municipal distribution system, where mains are typically aligned within public road rights-of-way. It is proposed these existing services be removed and/or abandoned in-place in conjunction with the construction of the new public water distribution network.

3.2 Proposed Water Servicing Strategy

3.2.1 Design Criteria

For calculating the water demand estimate for the Carpere Valley development, the design criteria developed in the *Moose Jaw Utility Master Plan Final Report*, dated April 2016 [2016 UMP] prepared by ISL Engineering and Land Services was utilized. The *2016 UMP* proposes future average day water demands for the various land uses, which are based on the City's current water consumption rates and other industry standards. The *2016 UMP* also proposes the use of the Maximum Day Demand and Peak Hour Demand Peaking factors taken from the City of Regina's Municipal Standards, 2010. The average day demands, and peaking factors are summarized in Table 3-1.

Table 3-1
Water Design Peaking Factors

Description	Value
Future Residential Average Day Demand	320 L/capita/day
Future Commercial & Institutional Average Day Demand	18.6 m^3/ha/day
Future Industrial Average Day Demand	6.0 m^3/ha/day
Peak Day Demand	2.1 x Average Day Demand
Peak Hour Demand	3.2 x Average Day Demand

The *2016 UMP* proposes future fire flow requirements based on the City of Regina Municipal Standards, the required fire flows for each land use designation are summarized in Table 3-2.

Table 3-2
Required Fire Flow

Concept Plan Land Use Designation	Fire Flow Requirements Designation	Requirement Minimum Fire Flow
Residential - Estate Lots Residential - Standard Large Lot Residential - Standard Seniors Bungalow Lots	Level 1	90 L/s
Residential - Multi-Family Commercial Employment Recreation/Tourism	Level 2	150 L/s
Institutional Utility	Level 3	250 L/s

Typically, the City of Moose Jaw utilizes the City of Regina Design Standards for development within the City. The Design Standards list several system performance criteria to be evaluated during the design of the water distribution network. These criteria are summarized in Table 3-3. Typically, the limiting criterion for a water distribution network is that the maximum pipe velocity cannot exceed 3.2 m/s while supplying Peak Day Demand plus Fire Flow at any point in the system. This is the criterion that will be used in order to complete the conceptual sizing of the mains for the water distribution network.

Table 3-3
System Performance Criteria

Description	Criteria
Peak Hour Demand maximum allowable pressure drop	≤ 27.6 kPa
Peak Hour Demand minimum allowable pressure corrected to proposed ground elevation	≥ 269.4 kPa
Peak Day Demand minimum allowable residual pressure within 500 m of fire site under Fire Flow condition corrected to proposed ground elevation	≥ 140 kPa
Maximum Pipe velocity at Peak Hour Demand	≤ 1.5 m/s
Maximum Pipe velocity at Peak Day Demand + Fire Flow	≤ 3.2 m/s

3.2.2 Water Demands

Table 3-4 summarizes the water demand calculations used to develop the conceptual water demand estimate for the Carpere Valley development.

Table 3-4
Carpere Valley Development – Estimated Water Demands

Land Use Area	Area	Estimated Residential Population	Average Day Demand	Peak Day Demand[5]	Peak Hour Demand[6]
Residential	21.4 ha	1478	5.47 L/s	11.49 L/s	17.50 L/s
Commercial/Institutional[7]	13.5 ha		2.91 L/s	6.11 L/s	9.31 L/s
Industrial[8]	1.1 ha		0.08 L/s	0.17 L/s	0.26 L/s
Roadways	8.2 ha				
Total	**44.2 ha**		**8.46 L/s**	**17.77 L/s**	**27.07 L/s**

3.2.3 Connection Points

The proposed internal water distribution network for the Site ties into the existing potable water pump station on the east side of the Site. This connection point is shown on Figure 3-1.

3.2.4 Pipe Sizing

The conceptual water main pipe sizing has been completed for the Carpere Valley development to limit the maximum pipe velocity to 3.2 m/s while supplying Peak Day Demand plus Fire Flow at any point in the system. This criterion was chosen because this is typically the limiting criterion for water distribution networks. WaterCAD modelling should be completed to check all criteria noted above and pipe sizes should be confirmed during the preliminary stages of design development. Figure 3-1 illustrates the conceptual pipe sizing for the Carpere Valley development.

3.2.5 Water Reservoir Sizing

The Water Security Agency *Waterworks Design Standard EPB 501* states that the minimum storage capacity shall be equal to or greater than twice the average daily consumption for systems where fire protection is required. Utilizing this criterion in conjunction with the Average Day Demand for the Carpere Valley development calculated above, a minimum reservoir storage volume of 1,462 m^3 is proposed. The required reservoir storage volume should be confirmed during the preliminary design stages.

It should be noted that the minimum reservoir storage volume proposed above is for the full build-out of the development. The existing reservoir should be sufficient in volume to accommodate approximately 75% of the development proposed in the Concept Plan and capacity can be expanded as required.

3.2.6 Water Pump Station Capacity

In order to meet the design criteria noted above, the water distribution pumping must be upgraded to meet the anticipated fire flow requirements for the Carpere Valley Development. The distribution pumping should be capable of supplying Peak Day Demand plus Fire Flow for the development. Utilizing the anticipated land use designations in the

[5] Peak Day Demand is the product of Average Day Demand multiplied by the Peak Day Peaking Factor of 2.1
[6] Peak Hour Demand is the product of Average Day Demand multiplied by the Peak Hour Peaking Factor of 3.2
[7] Includes all Commercial, Employment, Institutional, Recreation/Tourism areas in the Carpere Valley Concept Plan
[8] Includes all Utility areas in the Carpere Valley Concept Plan

concept plan and the Peak Day Demand calculated above, the water pump station should be capable of providing a flow of 267.77 L/s (17.77 L/s + 250 L/s). The pumping capacity should be confirmed during the initial stages of design, based on the finalized concept plan and updated demands for the development.

3.2.7 Proposed Water Distribution Network

The proposed conceptual water distribution network for the Carpere Valley development is shown in Figure 3-1.

With the proposed improvements and upgrades to the existing water pump station and reservoir and the installation of a new water distribution system, there is the opportunity to extend new municipal water services beyond the Site to service existing and future areas of development. Potential water service extensions to the north, west, and east are shown on Figure 3-1.

4 WASTEWATER

Refer to Figure 4-1, which shows the proposed connections to the City's existing wastewater collection system and conceptual-level sizing of the wastewater mains proposed to service the Carpere Valley development.

4.1 Existing Wastewater Infrastructure

The June 2021 *Assessment of Existing Site Infrastructure* report (refer to Appendix A), included a desktop condition assessment and capacity analysis of the existing wastewater infrastructure servicing the Site.

4.1.1 Off-Site Wastewater Main

The Site is currently serviced by a 375 mm diameter wastewater gravity main that runs off-site to the north, crossing Highway 2 and the Moose Jaw River, which historically discharged to the Valley View Lift Station. This off-site wastewater main consists primarily of VCT pipe that was installed in 1952, with a short section of PVC pipe that was installed in 1990 to replace some of the existing VCT pipe. Based on the desktop assessment, there is high potential that this main will have adequate capacity to service the full Concept Plan area. There is also potential that the existing pipe, or portions thereof, could be re-used or rehabilitated, however more information would be needed to verify this. During the initial design phases for the development, the extents of the upgrades required along the existing sewer main and manholes will need to be confirmed. Field investigations including CCTV inspection will be required to confirm the current condition, pipe slopes, and capacity of the main and verify the potential for re-use or rehabilitation. Based on an estimated minimum pipe slope of 0.15% and conservative Manning's roughness coefficient of 0.017, it is expected the existing 375 mm diameter wastewater gravity main will have a full flow conveyance capacity beyond 50 L/s.

4.1.2 Wellesley Park Lift Station

The Wellesley Park Lift Station, which is currently under construction adjacent to the existing Valley View Lift Station, will replace the existing Valley View and Churchill Lift Stations. This replacement lift station and new 150 mm diameter HDPE DR11 force main will have a pumping capacity between 15 and 22 L/s depending on the pump and force main condition. The incoming average day and peak wet weather flows into the new lift station is estimated at 0.23 L/s and 3.5 L/s, respectively, which excludes flow from the Valley View lands. The excess capacity in the new lift station can be allocated to support the proposed Carpere Valley Development. Based on the pumping capacity range noted above, a residual capacity between 11.5 to 18.5 L/s is estimated.

4.1.3 On-Site Wastewater Services

Following our review of the available information for the on-site wastewater mains, it is believed that these private services consist of approximately 1,740 metres of VCT pipe (installed in 1952) ranging in size from 200 mm to 375 mm, and approximately 250 metres of 100 mm and 150 mm VCT pipes that provide service to the existing buildings. Additionally, there is approximately 180 metres of PVC pipe that was installed in 1996 and 1997 to replace some of the existing VCT pipe on Site. While portions of the on-site wastewater mains have some potential to be re-used or rehabilitated based on their material and age, the configuration, location, depth, and size is incompatible with the Concept Plan, prohibiting their re-use for servicing the redevelopment. It is proposed these existing services be removed and/or abandoned in-place in conjunction with the construction of the new municipal wastewater collection system.

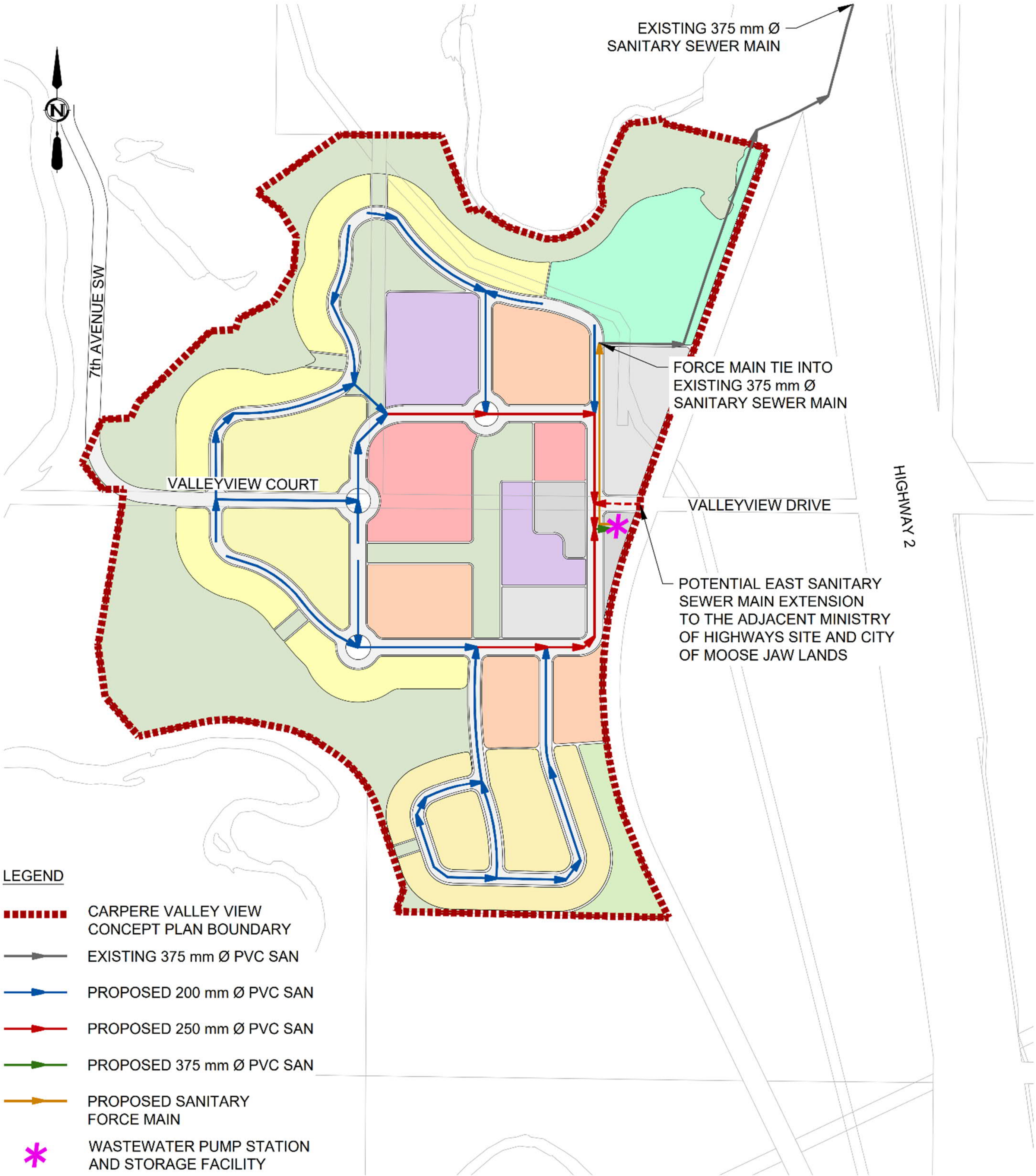


Figure 4-1
Carpere Valley Development – Proposed Wastewater Collection Network

4.2 Proposed Wastewater Servicing Strategy

4.2.1 Design Criteria

For calculating the wastewater generation estimate for the Carpere Valley Development, the design criteria developed in the *2016 UMP* was utilized. The *2016 UMP* provides the average daily wastewater flows, peaking factors, and infiltration flow allowances, which are summarized in Table 4-1.

Table 4-1
Estimated Wastewater Flow Design Criteria

Description	Value
Average Daily Wastewater Generation Rate	300 L/cap/day for Residential Areas 15.5 m^3/ha/day for Commercial and Institutional Areas 3 m^3/ha/day for In Industrial Areas
Residential Peaking Factor – Harmon's Formula	1 + 14 / (4 + √P), where P = Population in Thousands
Infiltration Rate, where weeping tile in the development is excluded from the wastewater system	0.127 L/s/ha

These values are then used to derive a wastewater flow using the following Wastewater Flow Formula:

$$Q = \frac{FDMA}{K} + I$$

where, Q = Peak Wastewater Flow (L/s), F = Average Daily Flow per Capita, D = Population Density (persons/ha), M = Harmon Peaking Formula (unitless), A = Area (ha), K = Constant (86,400), and I = Infiltration (L/s)

4.2.2 Estimated Wastewater Flows

Table 4-2 summarizes the conceptual wastewater flow estimate for the Carpere Valley Development.

Table 4-2
Carpere Valley Development – Estimated Wastewater Flows

Land Use Area	Area	Estimated Residential Population	Average Wastewater Generation	Residential Peaking Factor	Infiltration Rate	Estimated Peak Flow
Residential	21.4 ha	1478	5.13 L/s	3.68	2.72 L/s	21.6 L/s
Commercial/Institutional[9]	13.5 ha		2.42 L/s		1.72 L/s	4.14 L/s
Industrial[10]	1.1 ha		0.40 L/s		0.14 L/s	0.54 L/s
Roadways	8.2 ha				1.04 L/s	1.04 L/s
Total	**44.2 ha**		**7.95 L/s**		**5.62 L/s**	**27.3 L/s**

[9] Includes all Commercial, Employment, Institutional, Recreation/Tourism areas in the Carpere Valley Concept Plan
[10] Includes all Utility areas in the Carpere Valley Concept Plan

4.2.3 Proposed Wastewater Collection System

The proposed conceptual wastewater collection system for the Carpere Valley Development is shown in Figure 4-1. This system would utilize a series of new municipal gravity sewer mains installed along the proposed public road rights-of-way to convey flows to a new municipal wastewater pump station and storage facility. The pump station will be required due to the limited depth of the existing 375 mm wastewater main that services the Site. The pump station will allow for additional depth in the proposed gravity network, permitting services to be extended throughout the entire development. The pump station will convey flows to the existing 375 mm wastewater main via a force main, from which point wastewater flows will continue via gravity be directed towards the City's municipal wastewater system.

With the installation of a proposed pump station, there is the opportunity to extend new municipal gravity services beyond the Site to service existing and future areas of development. A potential service is shown on Figure 4-1 that could be extended east along Valleyview Court to service the Ministry of Highways site and City of Moose Jaw lands.

4.2.3.1 Pipe Sizing

Figure 4-1 illustrates the conceptual wastewater pipe sizing for the Carpere Valley Development. During the initial design phases for the development, detailed design flow sheets will be prepared to establish the size, inverts, and slopes of the gravity pipe network. The sizing, layout, and slopes will be designed in accordance with the current editions of the Water Security Agency and Saskatchewan Ministry of Environment's *Guidelines for Sewage Works Design*, *EPB 203* as well as the City of Regina's *Wastewater Design Standard*. Based on best design practice, the new wastewater collection network will be designed to have hydraulic capacity such that the sewer is flowing at no more than 80% of the full depth when conveying the design peak flow rate. This corresponds in a flow rate of approximately 86% of the sewers' full flow capacity.

4.2.3.2 Downstream System Capacity Assessment and Wastewater Storage

An evaluation of the existing downstream system is required to determine the system's capacity to receive additional wastewater flows. Where capacity deficiencies are identified, the development may be required to provide storage to delay the release of wastewater until the downstream system has capacity. These storage elements are intended to mitigate the impact that the new development has on the performance of the existing system, so that the existing level of service in existing areas can be maintained.

Understanding that the Wellesley Park Lift Station will have residual pumping capacity between 11.5 and 18.5 L/s, a wastewater storage facility will be required for the Carpere Valley Development to mitigate any impact to the downstream system during peak wet weather events. This facility would temporarily store wastewater flows until capacity in the downstream system becomes available. For an initial estimate, the storage volume is projected to range between 400 m^3 to 1500 m^3 depending on the downstream receiving systems' available capacity and the duration of the wet weather event. While the estimated storage volume can be assessed at the Concept Planning stage, there are several factors that may affect the volume of storage required. During the initial design phases of development, the wastewater storage volume will need to be re-evaluated and refined to determine the required design storage for the facility. It is anticipated the wastewater storage can be incorporated into proposed new pump station on Site.

Pending field investigations, the existing off-site 375 mm diameter gravity main is anticipated to have adequate capacity to convey flows from the Carpere Valley Development to the Wellesley Park Lift Station.

5 STORMWATER

5.1 Existing Conditions

5.1.1 Overland Drainage

There is a ridge running east-west through the middle of the Carpere Valley Development. Runoff on the north side of this ridge generally sheds north and west towards the Moose Jaw River, while runoff on the south side of this ridge generally sheds west to the Moose Jaw River. The grades across the Site are generally quite flat, with slopes typically in the range of 0.2 to 2.0% within the redevelopment area. The Site is bounded by the Moose Jaw River valley slopes on the north, west and southwest sides. These slopes are quite steep and typically range from 30 to 45 degrees; however, some sections are near vertical at the bottom of the valley slope. Figure 5-1 illustrates the existing site topography for the Carpere Valley Development.

5.1.2 Pre-Development Release Rate

The City of Regina *Stormwater Design Standard [COR SDS]* states that Rational Method hand calculations shall be used for design areas less than or equal to 65 ha. The *COR SDS* requires new developments to provide a stormwater management facility (SWMF) sized to accommodate a 1:100-year, 24-hour rainfall design event and states that the post-development runoff rates shall not exceed pre-development runoff rates. In order to determine the storage volume for the SWMF, the pre-development release rate is required. The pre-development release rate for the Carpere Valley development area was determined using the Rational Method for existing land conditions and the 1:100-year, 24-hour rainfall intensity in the for the Moose Jaw Airport.

The subsurface soil conditions for this land generally consist of high plastic clay based on the preliminary geotechnical report by Thurber Engineering Ltd. The existing Valley View lands contain a mix of developed and undeveloped land. Based on the soil type, land use, and the general slope of the terrain, runoff coefficients from several sources were evaluated.

Table 5-1
Pre-Development Runoff Coefficients

Reference	Runoff Coefficient C Value
Water Security Agency *Stormwater Guidelines, EPB 322*	0.1 – 0.3 for Unimproved Areas 0.25 – 0.4 for Suburban Areas
Saskatchewan Ministry of Highways *Hydraulic Manual*	0.2 – 0.4 for Cultivated Fields 0.4 for Flat Residential Areas
City of Regina *Stormwater Design Standard*	0.10 based on 0% impervious area 0.185 based on 10% impervious area 0.525 based on 50% impervious area

After a review of the runoff coefficients, a value of 0.2 is recommended to determine a pre-develop runoff rate for the Site. Due to the previously developed areas within the Site, it is likely that the existing runoff coefficient for the Site is higher than 0.2. However, best practice dictates that major stormwater systems should be sized to accommodate a 1:100-year design event utilizing a runoff coefficient that reflects the pre-development conditions of the Site.

For application of the Rational Method to extreme rainfall events, an additional factor should be applied. As per the *COR SDS*, the runoff coefficient should be increased by 25% for a 1:100-year return period rainfall event, resulting in a runoff coefficient of 0.25. The 1:100-year, 24-hour rainfall intensity for Moose Jaw is 3.4 mm/hr[11]. Applying these values to the Rational Method:

$$\frac{Q}{A} = 0.00278\ x\ C\ x\ I$$

$$\frac{Q}{A} = 0.00278\ x\ 0.25\ x\ 3.4\frac{mm}{hr}$$

This yields a pre-development release rate of 2.36 L/s/ha. It is recognized that the pre-development release rate of 1.378 L/s/ha is recommended in the *2016 UMP (Section 5.2.3)*; however, it is believed that the value determined above is more representative of the location conditions of the Carpere Valley Development area and therefore recommend that it be used as the pre-development release rate for the Site.

[11] from the Short Duration Rainfall Intensity-Duration-Frequency Data from the *Environment and Climate Change Canada*, dated March 26, 2021 for Moose Jaw CS.

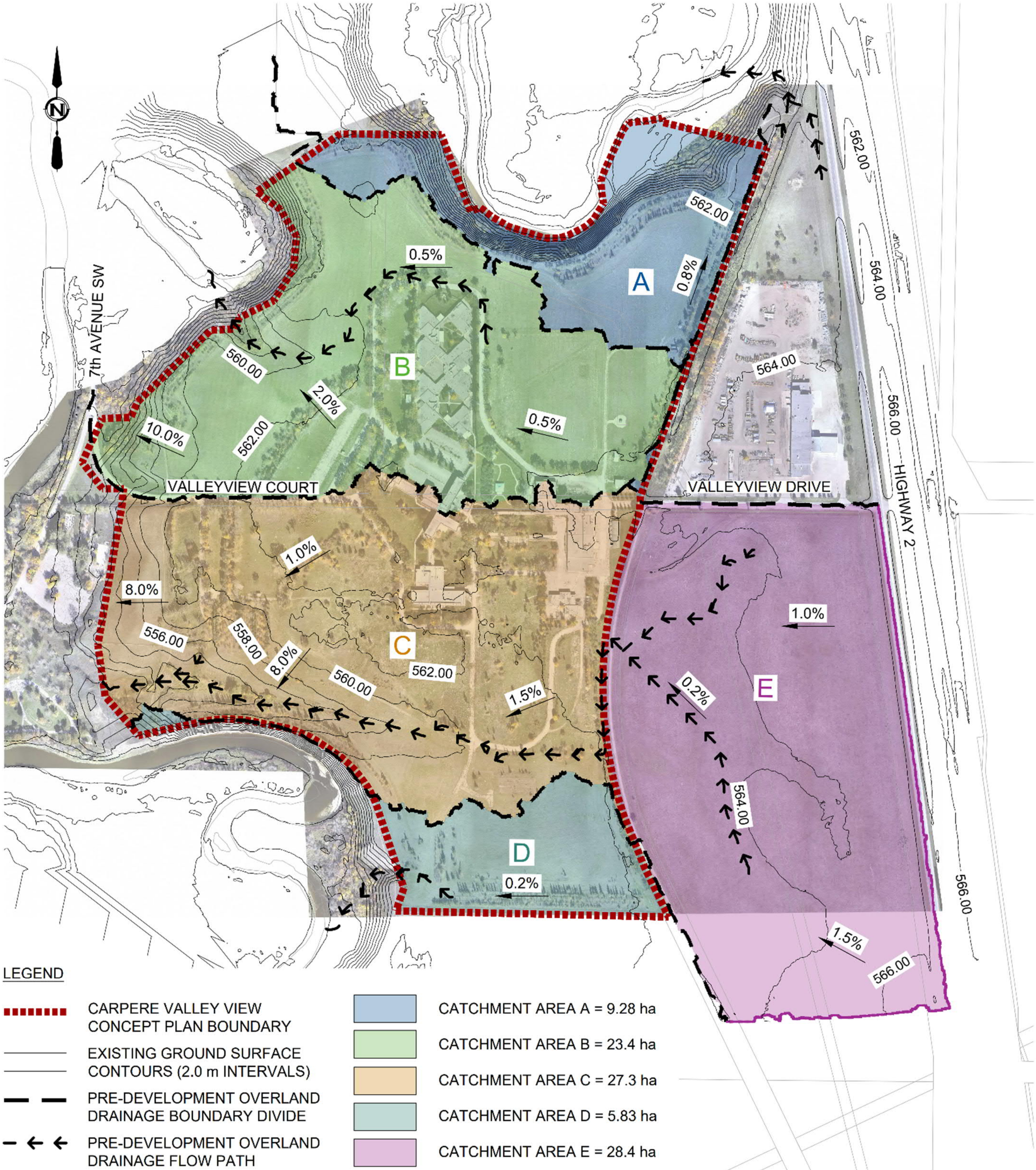


Figure 5-1
Existing Site Topography

Figure 5-2
Carpere Valley Development –Proposed Stormwater Management Plan

5.2 Proposed Stormwater Management Strategy

The conceptual stormwater management plan for the Carpere Valley Development is shown in Figure 5-2.

5.2.1 Design Criteria

The *COR SDS* requires new developments to provide a minor drainage system capable of conveying flows for a 1:5-year return event and a major overland system sized to handle runoff from a 1:100-year return event. The minor drainage system is defined as a network of underground sewers, inlets, swales, and street gutters to rapidly convey storm runoff from minor return events, which provide an improved level of service in urban development areas. The major drainage system is comprised of overland flow routes, ditches, roadways, watercourse, storage facilities, and outfalls into storage facilities or watercourses. All runoff in excess of the minor system capacity is considered part of the major drainage system.

5.2.1.1 Minor Drainage System

The minor system will be divided into separate pipe networks for each overland drainage catchment within the Site. These networks will be sized to convey post-development runoff from a 1:5-year event and convey them into the corresponding SWMF for each catchment. Flow from each SWMF will be restricted to the pre-development release rate for that catchment area through the use of a manhole structure with an orifice plate. In events where incoming flows exceed the release rate, stormwater will surcharge into the SWMF for temporary detention. During the initial design stages of the Carpere Valley Development, the minor system will be established to include all sewers, service connections, manholes, and catch basin structures within the roadways, lanes, and municipal open spaces. A detailed storm system design flow sheet will be prepared to determine specific pipe sizes following the establishment of the grading plan.

5.2.1.2 Major Drainage System

In events where the minor system is at capacity, the major drainage system for the Carpere Valley Development will direct runoff overland along road rights-of-way, drainage easements, and municipal open spaces.

5.2.1.3 Stormwater Management Facilities

The SWMFs will be sized to provide storage for a 1:100-year, 24-hour return event, based on a release rate no greater than the pre-development rate established for each catchment area. The preliminary geotechnical report prepared by Thurber Engineering Ltd. outlines a number of risks and challenges associated with the construction of a wet pond at this Site. Based on this report, it is recommended that dry-bottom detention facilities be utilized to provide storage for the Site. These detention facilities should be constructed in accordance with the design guidelines outlined in Water Security Agency *Stormwater Guidelines*, *EPB 322* and *COR SDS*.

5.2.1.4 Safe Overflow Route

In the event that the capacity of one of the SWMF is surpassed, a safe overflow route has been defined to convey flows from the SWMF into a receiving body. During the detailed design of the Carpere Valley Development, safe building grades will be defined to ensure that floor levels are set a minimum of 0.35 m above the maximum water surface elevation of the SWMF and any surface ponding/tipping point elevations along the major drainage system.

5.2.2 Post-Development Catchments

The post-development catchment areas shown in Figure 5-2 generally align with the pre-development catchments and overland drainage boundaries for the Site.

Catchment A, covering the proposed recreation/tourism parcel, would function independent from the rest of the Site. It is anticipated this parcel could direct runoff north towards the Moose Jaw River and construct internal, private stormwater services as required that restricts flow off-site to the pre-development rate. Type of site development proposed within this area will dictate the type of private SWMF required.

Catchment B encompasses the majority of runoff within the north half of the Site and is proposed to convey runoff northwest to a municipal SWMF located within the internal urban park parcel. An outlet would be constructed from this facility to convey flows toward the Moose Jaw River utilizing the pre-development overland drainage route for this catchment.

Catchment C would function similar to Catchment B, collecting the majority of runoff within the south half of the Site. A municipal SWMF is proposed within the southwest naturalized open space area, which would have a controlled outlet to release flow toward the Moose Jaw River along the same pre-development overland drainage route for this catchment. The minor storm system for Catchment C would need to be sized to convey pre-development runoff from the Catchment E (City of Moose Jaw lands). In the event this upstream catchment area is developed in the future, it will require its own SWMF to manage post-development runoff.

Catchment D would be limited to the back-of-lot runoff from the proposed senior bungalow lots and strip of urban park space at the southeast corner of the site. Since this catchment area would be reduced following redevelopment of the Site, it is anticipated that the post-development runoff would not exceed pre-development rates. Therefore, a SWMF may not be required for this area. During future states of design for this area, it can be confirmed if any SWMF are required to provide post-development stormwater storage.

5.2.3 Post-Development Runoff

A post-development release rate is required to determine the storage volume of the SWMF. This post-development release rate can be determined utilizing the same Rational Method calculation as shown in Section 5.1.2, but with a post-development runoff coefficient utilized in place of the pre-development coefficient.

5.2.3.1 Post-Development Runoff Coefficients

The average post-development runoff coefficient for the Carpere Valley Development was determined using *Table 1: Percent Impervious Ratios* in the *COR SDS* for the various land use types and is summarized in Table 5-2. In instances where the different potential land uses could result in a different value, the more stringent impervious value was assumed.

Table 5-2
Post-Development Runoff Coefficients

Land Use		Area	Est. Percent Impervious	Runoff Coefficient
Catchment A	**Total**	**4.1 ha (10.2 ac)**		
Recreation/Tourism Use		4.1 ha (10.2 ac)	50%	0.525
Catchment A Average Runoff Coefficient, C_A				**0.525**
Catchment B	**Total**	**21.8 ha (54.0 ac)**		
Residential – Estate Lots		4.3 ha (10.7 ac)	50%	0.525
Residential – Standard Large Lot		2.2 ha (5.4 ac)	50%	0.525
Residential – Multi-Family		1.9 ha (4.7 ac)	75%	0.738
Commercial		3.1 ha (7.7 ac)	95%	0.908
Employment		2.0 ha (4.9 ac)	95%	0.908
Institutional		2.2 ha (5.5 ac)	95%	0.908
Roads		3.8 ha (9.3 ac)	100%	0.950
Urban Park		2.3 ha (5.8 ac)	10%	0.185
Catchment B Average Runoff Coefficient, C_B				**0.710**
Catchment C	**Total**	**21.1 ha (51.7 ac)**		
Residential – Estate Lots		2.5 ha (6.1 ac)	50%	0.525
Residential – Standard Large Lot		2.0 ha (4.8 ac)	50%	0.525
Residential – Multi-Family		3.7 ha (9.0 ac)	75%	0.738
Residential – Standard Seniors Bungalow Lots		4.0 ha (9.9 ac)	50%	0.525
Employment		0.9 ha (2.3 ac)	95%	0.908
Institutional		1.2 ha (2.8 ac)	95%	0.908
Roads		4.4 ha (10.9 ac)	100%	0.950
Urban Park		1.3 ha (3.2 ac)	10%	0.185
Utility		1.1 ha (2.7 ac)	95%	0.908
Catchment C Average Runoff Coefficient, C_C				**0.688**
Catchment D	**Total**	**2.1 ha (5.1 ac)**		
Residential – Standard Seniors Bungalow Lots		1.0 ha (2.4 ac)	50%	0.525
Urban Park		1.1 ha (2.7 ac)	10%	0.185
Catchment D Average Runoff Coefficient, C_D				**0.347**
	Total Redevelopment Area	**48.9 ha (121 ac)**		
	Average Runoff Coefficient			**0.670**

5.2.3.2 Post-Development Storage Required

The post-development runoff for the Carpere Valley Development was calculated for various return periods using the Rational Method and the average post-development runoff coefficients determined in Table 5-2. The storage required for the SWMF was then determined based on the net accumulation over a 24-hour storm event less the estimated site storage volume. The results are summarized in Table 5-3.

Table 5-3
SWMF Storage Volume Required using the Rational Method

	Catchment A (Private) SWMF	Catchment B (Municipal) SWMF	Catchment C (Municipal) SWMF	Catchment D (Municipal) SWMF
1:100-year 24-hour Average Rainfall Intensity, i_{24hr}	3.4 mm/hr			
Redevelopment Catchment Area, A_{Post}	4.1 ha	21.8 ha	21.1 ha	2.1 ha
Post-Development Average Runoff Coefficient, C_{Post}	0.525	0.710	0.688	0.347
Post-Development 1:100-year Runoff Coefficient[12], $C_{Post\text{-}1:100yr}$	0.656	0.888	0.860	0.434
Post-Development 1:100-year Runoff Rate, Q_{Post}	0.025 m³/s	0.183 m³/s	0.172 m³/s	0.009 m³/s
Pre-Development Release Rate[13], $Q_{Release\ Rate}$	0.010 m³/s	0.052 m³/s	0.050 m³/s	0.005 m³/s
Net Runoff Accumulation, $Q_{Post} - Q_{Release\ Rate}$	0.015 m³/s	0.131 m³/s	0.122 m³/s	0.004 m³/s
Estimated 24-hour SWMF Storage Required, V_{24hr}	**1,300 m³**	**11,320 m³**	**10,540 m³**	**350 m³**

[12] Runoff Coefficient increase by 25% for 1:100 year return period provided in Table 4 in the *COR SDS*
[13] Based on the Redevelopment Catchment Area, A_{Post} times the 2.36 L/s/ha Pre-Development Release Rate established in Section 5.1.2

6 DEVELOPMENT PHASING

The anticipated phasing of development for the Carpere Valley Development is shown in Figure 6-1. The projected development is segmented into five phases. It is expected that these phasing boundaries will be adjusted as the extent of servicing and focus of development will be driven by market conditions. Phases may be staged in a manner to facilitate a more rapid uptake of demand with either the residential, commercial, tourism or other markets.

6.1 Initial Phase

The initial phase of the Carpere Valley Development will most likely include the recreation/tourism use area in the northeast of the Site, the residential areas on the west side of the Site and a commercial area which is centrally located. The anticipated infrastructure improvements required to facilitate this initial phase of development would include:

Water Services

- Water pump station upgrades to meet fire flow requirements
- Water reservoir upgrades and expansion to meet full build-out requirements
- Extension of new water main distribution system, as required to service Phase 1 areas

Wastewater Services

- Construction of a wastewater pump station and force main
- Construction of a wastewater storage facility
- Extension of new wastewater collection system from the proposed pump station, as required to service Phase 1 areas

Stormwater and Drainage Services

- Construction of the municipal SWMF located within the internal urban park parcel to service the majority of the north half of the development
- Construction of a minor stormwater system to service the Phase 1 areas and the municipal SWMF, complete with storm outlet/outfall

Rough Grading and Earthworks

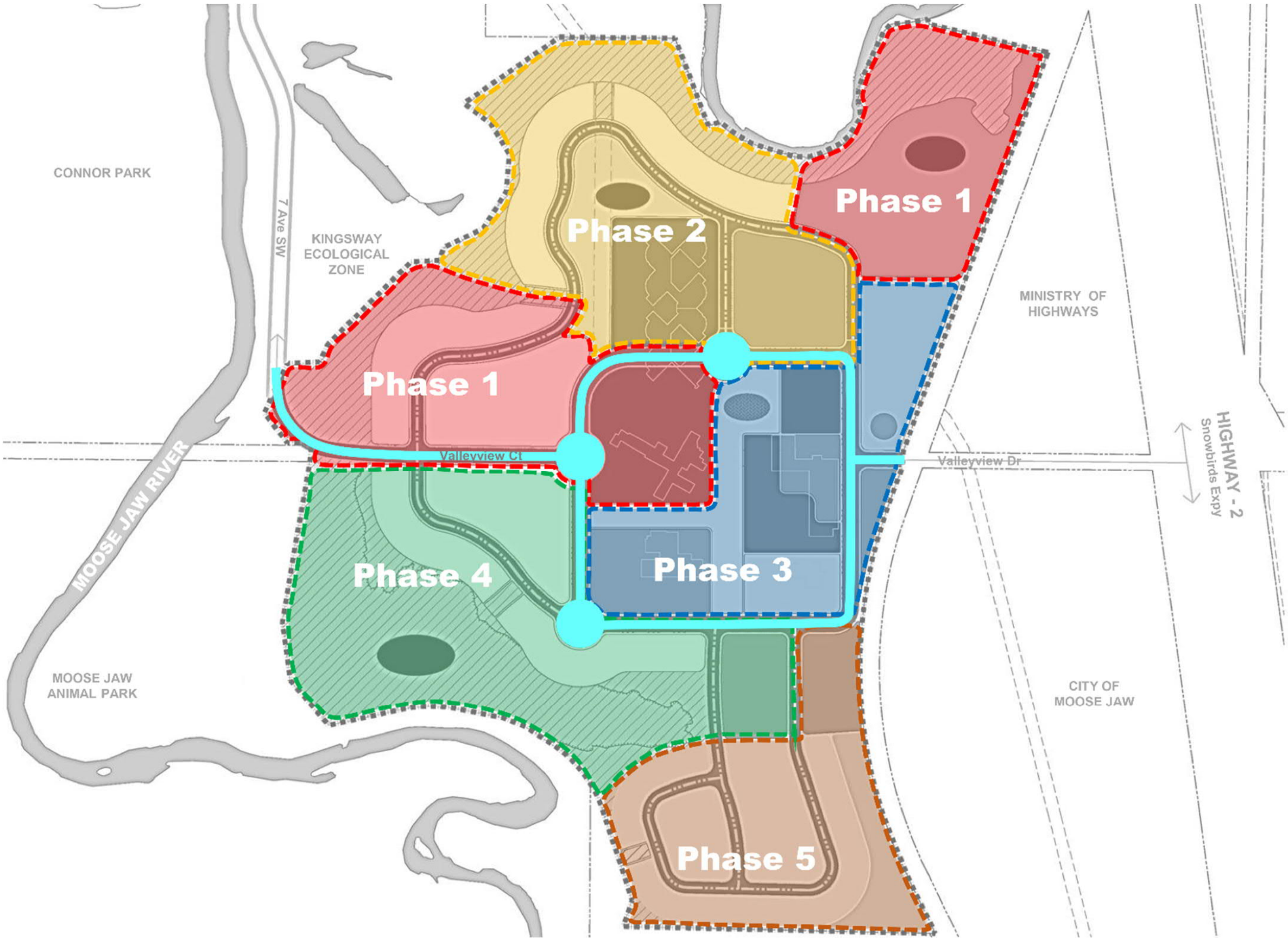
- Completion of pre-grading within the entire north half of the development
- Completion of excavation and pre-grading for the municipal SWMF located within the internal urban park parcel to service the majority of the north half of the development (Catchment Area B)

Surfacing

- Construction of the proposed collector roadways including Valleyview Court, Valleyview Drive, and the north leg of the internal collector road loop
- Construction of the local roads to service the Phase 1 areas
- Depending on the extent and timing of initial and subsequent phases of development, interim turn-arounds may need to be constructed to provide proper access at temporary “dead-ends”

6.2 Subsequent Phases of Development

Once the initial water and wastewater services have been established within the development, there will be considerable flexibility for extending services throughout the remainder of the Site. Initial development within the south half of the site will require the construction of the municipal SWMF within Catchment C.



Phase 1 +/- 29.6 Acre	Estate Lots; Standard Lots; Commercial Centre1; Local Roadway; Collector Roadway; Roundabouts (2); Tourism/Recreational Use; Naturalized Greenspace.
Phase 2 +/- 26.3 Acre	Estate Lots; Institutional; Multi-Unit Site1; Local Roadway; Park; Stormwater Pond; Naturalized Greenspace and Linkages.
Phase 3 +/- 23.9 Acre	Multi-Unit Site2; Commercial Centre2; Park Space; Public Plaza; Institutional; Employment and Utility Sites.
Phase 4 +/- 19.1 Acre	Estate Lots; Standard Lots; Multi-Unit Site; Naturalized Greenspace; Stormwater Pond; Local Roadway; Collector Roadway and Roundabout.
Phase 5 +/- 20.9 Acre	Multi-Unit Site; Senior Bungalow sites; Park; Local Roadway

Note:
Acres refer to developable acres only, and does not include naturalized area

TOTAL DEVELOPABLE LAND	**Approx. 120 ACRE**
TOTAL LAND SIZE	**Approx. 160 ACRE**

Figure 6-1
Carpere Valley Development –Proposed Phasing Plan[14]

[14] Figure is based on the *Carpere Valley View Phasing Plan* prepared by Wallace Insights, dated January 6, 2022

CLOSURE

This report was prepared for the Carpere Valley Development Corp. to provide a review of the existing City infrastructure services adjacent to the development and a conceptual-level servicing strategy for the potable water distribution, wastewater collection, and stormwater management.

The services provided by Associated Engineering (Sask.) Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
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APPENDIX A - ASSESSMENT OF EXISTING SITE SERVICING INFRASTRUCTURE REPORT

REPORT

Carpere Valley Development Corp.

Assessment of Existing Site Servicing Infrastructure

JUNE 2021

A Carbon Neutral Company

BEST MANAGED COMPANIES Platinum member

EXECUTIVE SUMMARY

Off-Site Wastewater Mains

- The off-site wastewater mains consist primarily of VCT pipe that was installed in 1952, with a short section of PVC pipe that was installed in 1990 to replace some of the existing VCT pipe. Based on our evaluation, there is high potential that the mains will have adequate capacity to service the full Concept Plan area. There is also potential that the existing pipe, or portions thereof, could be re-used or rehabilitated, however more information would be needed to verify this.
- Following our review, it is recommended that additional topographic survey be completed to collect pipe invert information, sewer main depth information, and manhole location data throughout the wastewater collection system. If the topographic survey data indicates that there is sufficient capacity within the system, then we would recommend completing CCTV inspection of the mains to determine their condition and verify their potential for re-use or rehabilitation.
- At this stage, we estimate the costs for the off-site wastewater mains between $420k - $1.2M, depending on the extent of pipe that can be repaired, versus the extent that will have to be replaced with new pipe.

Off-Site Water Mains

- The off-site water mains consist primarily of asbestos concrete (AC) and cast-iron pipe that was installed in 1952, with a short section of PVC pipe that was installed in 1990 to replace some of the aging AC pipe. Based on the material and age of the AC and cast-iron water mains, we assume that the pipe is at the end of its useful life and would not be suitable for re-use. The short section of PVC pipe likely has some remaining useful life; however, given the relatively short overall length, and the challenges it may present during design and construction for alignment, tie-in and commissioning, it is assumed that this would not be re-used.
- Following our review, it is recommended that all of the off-site water mains be replaced with new PVC pipe. During later stages of design development, the re-use of the PVC pipe installed in 1990 could be investigated.
- At this time, we estimate the costs for the full replacement of the off-site water mains as $850k.

On-Site Wastewater Mains

- The on-site wastewater mains consist primarily of VCT pipe installed in 1952, with some PVC pipe that was installed in 1996 and 1997 to replace some of the aging VCT pipe. Portions of the mains have some potential to be re-used or rehabilitated based on their material and age; however, it is likely that the location, depth, or size will prohibit re-use of the majority of the mains.
- Following our review, it is recommended that additional topographic survey be completed to collect pipe invert information, sewer main depth information, and manhole location data throughout the wastewater collection system. If the topographic survey data indicates that the wastewater mains, or portions thereof, have potential for re-use or rehabilitation, then we would suggest completing CCTV inspection of those segments of the mains to determine the condition of the existing sewer and verify their potential for re-use or rehabilitation.
- At this stage, we estimate the costs of the on-site wastewater mains between $800k - $1.5M, depending on the extent of pipe that can be repaired, versus the extent that will have to be replaced with new pipe.

On-Site Water Mains

- The on-site water mains consist of AC pipe, which was installed in 1952 and PVC pipe that was installed in 1985. Based on the material and age of the AC mains, we assume that this pipe is at the end of its useful life and would not be suitable for re-use. The PVC mains likely have remaining useful life; however, based on their size and alignment there is high potential that extensive upgrades would be required to provide a network capable of meeting minimum Fire Flow requirements. Additionally, the existing mains are largely incompatible with the Concept Plan.
- Following our review, it is recommended that the all of the on-site water mains be replaced with new PVC pipe. During later stages of design development, the re-use of certain segments of the mains, where alignment and sizing of the mains are acceptable, can be evaluated.
- At this time, we estimate the costs for the full replacement of the on-site water mains as $3.1M.

On-Site Stormwater Mains

- The on-site stormwater mains consist of VCT pipe, corrugated iron pipe, and concrete pipe, which was installed in 1952. Portions of the mains may have potential for re-use or rehabilitation based on their material and age; however, it is likely that the location, depth, or size will prohibit re-use or rehabilitation of the majority of the mains.
- Following our review, it is recommended that additional topographic survey be completed to collect pipe invert information, sewer main depth information, and manhole location data throughout the stormwater collection system. If the topographic survey data indicates that the stormwater mains, or portions thereof, have potential for re-use or rehabilitation, then we would suggest completing CCTV inspection of those segments of the mains to determine the condition of the existing sewer mains and verify their potential for re-use or rehabilitation.
- At this stage, we estimate the costs of the on-site stormwater mains between $950k - $1.2M, depending on the extent of pipe that can be repaired, versus the extent that will have to be replaced.

Water Pump Station and Reservoir

- The water pump station and reservoir were built in the 1950's. At the time of this evaluation, the pump station was not operating and had previously been abandoned; the reservoir was understood to be empty. The water pump station and reservoir will require additional inspection to confirm the operation and condition of various components; they will also require a number of repairs and upgrades. These upgrades will restore the pump station and reservoir to an acceptable level of service. Upgrades will include the expansion of the reservoir, so that it has adequate capacity to service the Concept Plan area.
- Following our review, we recommend completing additional inspections and all necessary upgrades required to restore the pump station and reservoir to an acceptable level of service and complete the expansion of the reservoir.
- At this stage, we estimate the costs to upgrade the water pump station and reservoir to an acceptable level of service, including the expansion of the reservoir, between $1.5M - $2.25M.

TABLE OF CONTENTS

LIST OF TABLES

1 BACKGROUND

The Carpere Valley Project Site (Site) is an approximately 66-hectare property that overlooks the Moose Jaw River in southeast Moose Jaw. The land, acquired by Carpere, includes approximately 30,000 sq.m of brick buildings, which have been sitting vacant since December 2019 and were decommissioned in March 2020. Carpere hopes to repurpose the buildings for adaptive reuse for a mixed-use development.

2 PURPOSE

The purpose of this report is to understand the condition, remaining lifespan, and capacity of the existing water and sewer infrastructure to the Site. This includes an evaluation of the off-site mains, on-site water pump station and reservoir, and on-site linear infrastructure.

2.1 Condition

The condition of the infrastructure was evaluated using information available from existing drawings and reports. Where specific reference to the condition of an asset was not available, relative data such as material and age were used to provide a general estimate of expected remaining useful service life of that asset.

Significant variation can occur amongst an asset group in terms of how it deteriorates over time, given variables such as initial design, installation, operation and maintenance, soil and ground water conditions, and other environmental factors. However, this evaluation was used to understand potential viability of the existing infrastructure and inform recommendations regarding potential functionality and value in conducting more detailed investigations.

2.2 Demand

Population and demands were developed based on the land uses and areas identified in the Concept Plan provided. Using an estimated population of 2000 persons, the following conceptual water demands, and wastewater generation rates were calculated:

- Estimated Water Demands of:
  - Average Day Demand: 9.0 L/s
  - Peak Day Demand: 16.3 L/s
  - Peak Hour Demand: 26.2 L/s
- Estimated Peak Wet-Weather Wastewater Generation Rate of 57.0 L/s.

3 ASSESSMENT OF OFF-SITE WATER AND WASTEWATER MAINS

3.1 Off-Site Wastewater Mains

The off-site wastewater mains run from the property line at the northeast end of the property to Wellesley Street, this line crosses both the Snowbird Expressway and the Moose Jaw River. We do not have adequate detail for the crossings of the Snowbird Expressway and Moose Jaw River and have assumed that the highway crossing utilizes a deep sewer and that the river crossing utilizes an inverted siphon. Following our review of the available information for the off-site wastewater mains, it is believed that the off-site mains consist of approximately 610 metres of 375 mm diameter vitrified clay tile (VCT) pipe, which was installed in 1952. There is also approximately 120 metres of 375 mm diameter polyvinyl chloride (PVC) pipe, which was installed in 1990 to replace some of the existing VCT pipe. Figure 4555-00-C-7001 in Appendix A shows the existing wastewater mains. The Carpere Valley Development Boundary illustrated in the Figure defines the boundary between on-site and off-site infrastructure.

3.1.1 Condition Assessment

The VCT pipe that has been installed has an expected maximum lifespan in the range of 80 to 100 years; therefore, we would estimate that the remaining lifespan is in the range of 10 to 30 years. Experience with VCT pipe within the expansive clay soils in Saskatchewan has shown that the condition of this type of pipe is highly variable from location to location. As the failure mechanism for VCT pipe is relatively predictable, a visual inspection could be utilized to estimate the remaining life of the pipe.

It is expected that the PVC pipe that was installed in 1990 will have a remaining useful life of approximately 70 years, based on the estimated lifespan for PVC pipe of 100 years. A visual inspection of the pipe could be utilized to verify the condition of the pipe and assess any defects or deficiencies that may be present in the pipe.

For both the PVC and VCT segments of the off-site wastewater mains, completion of CCTV inspection would help to determine the condition of the existing sewer pipe. This type of inspection would help to verify the pipe materials currently in place, determine the general condition of the pipe, identify any structural issues, sags or other deficiencies that may be present in the pipe, and determine the potential of the mains for re-use or rehabilitation

3.1.2 Capacity Analysis

The capacity of gravity sewer pipes can be estimated using pipe diameter, slope, and material; however, because the slope data for this section of pipe is incomplete, it is difficult to accurately calculate the capacity of the sewer pipe. Based on the invert data that we have; slopes are highly variable along this section of the mains and range from 0.24% to 34.24%. There are large sections of the off-site wastewater mains where invert data is absent. If these sections have poor slope, they may create potential bottlenecks in the line. For the purposes of this high-level capacity check, we estimate available capacity of this main is between 50 – 70 L/s.

In comparing the estimated peak wet-weather wastewater flow for the full Concept Plan area, there is a high potential that the existing off-site wastewater mains will have adequate capacity for servicing the full development. However, additional field information would be required to confirm this. This evaluation is based a number of assumptions and additional information could greatly impact the results of this high-level capacity check if slopes and condition along these mains are found to be significantly different than is assumed.

3.1.3 Off-Site Wastewater Mains Recommendations

Following our review of the off-site wastewater mains, we provide the following recommendations:

- Complete additional topographic survey to collect pipe invert information, sewer main depth information and manhole location data throughout the wastewater collection system. Invert information collected for areas where no data is currently available will help to fill in gaps, while invert information collected from segments of the mains where data is available on as-built drawings will help to increase confidence in the as-built information provided. This information will provide for a more accurate and in-depth analysis of the capacity of the mains and verify the location and alignment of the mains.

- If the topographic survey data indicates that there is sufficient capacity within the mains, then we would recommend completing CCTV inspection of the wastewater mains to determine the condition of the existing sewer pipe. CCTV inspection will verify the material and approximate lengths of the mains currently in place. This inspection will also provide an assessment of the general condition of the pipe and identify any structural issues, sags or other deficiencies that may be present in the pipe.

These recommendations will allow us to better determine the condition of the mains and provide a more reliable indication of opportunities for rehabilitation or re-use. We expect that the mains will fall into one of the following classes:

- Good condition - If the mains are in good condition and we expect that there is a significant amount of useful life remaining, we would evaluate re-using the existing mains.
- Moderate condition - If the mains are in moderate condition with some minor to moderate defects, we could investigate cost-effective rehabilitation options such as cured-in-place pipe (CIPP).
- Poor condition - If the mains are poor condition, with major defects, then we would provide a recommendation for repair and replacement of the mains.

3.2 Off-Site Water Mains

The off-site water main runs northeast from the property line at the northeast end of the property to Wellesley Street. The water main follows the same general alignment as the wastewater main, also crossing the Snowbird Expressway and the Moose Jaw River. Based on our review of the available information for the off-site water mains, we have determined that there is approximately 250 metres of 200 mm diameter asphaltic concrete (AC) pipe and 400 metres of 200 mm diameter cast iron pipe that was installed in 1952, there is an additional 70 metres of PVC pipe that was installed in 1990 to replace some of the existing AC pipe.

There is also approximately 330 metres of 150 mm diameter PVC pipe which extends services to a Saskatchewan Ministry of Highways and Infrastructure (MHI) building from the water pump station. Figure 4555-00-C-7002 in Appendix A shows the existing water mains. The Carpere Valley Development Boundary illustrated in the Figure defines the boundary between on-site and off-site infrastructure.

3.2.1 Condition Assessment

The AC pipe that was installed as part of the off-site water mains has an estimated lifespan of approximately 70 years; therefore, we would assume that this pipe is at the end of its useful life and would not be suitable for re-use. In the event that further investigation is requested to confirm our assumptions, testing could be completed to determine if there is any usable life left in the pipe.

The cast iron pipe that is part of the off-site water mains has also met or exceeded its expected design lifespan. In addition, the City of Moose Jaw currently experiences a large amount of structural and operation issues with its existing cast iron inventory and is unlikely to want to adopt any more into their system.

It is expected that the off-site PVC water mains should have a remaining useful life of approximately 70 years, this is based on an estimated lifespan for PVC of 100 years. Additional testing and inspection could be carried out to verify the presence and condition of the pipe. Given the relatively short overall length of the 200 mm diameter PVC section of the mains, and the challenges it may present during design and construction for alignment, tie-in and commissioning, it is conservatively assumed that this section would not be renewed or reused.

Due to the above-mentioned factors, we do not believe that the 200 mm diameter off-site water mains will be suitable for continued use and should conservatively be planned for full replacement.

Alternatively, the 150 mm diameter PVC water main that extends services to the MHI building has potential to be re-used. Additional inspection and testing of the of 150 mm diameter PVC water main that extends service to the MHI building could be utilized to verify the condition of the pipe.

3.2.2 Capacity Analysis

The 200 mm diameter off-site water mains supply the reservoir for the Site. Typically, a water supply line for a reservoir should be sized to supply Maximum Day Demand, while maintaining velocities between 0.6 m/s and 1.5 m/s. Based on this velocity criteria, the 200 mm diameter off-site water main, which consists of AC pipe, cast iron pipe, and PVC pipe is likely sufficient in size to provide Maximum Day Demand without exceeding 1.5 m/s. It should be noted that the actual flow available will be affected by the size and configuration of the mains and pressures at the tie-in location to the City's system.

The 150 mm diameter water main that supplies the MHI building will not be sufficient in size to meet Fire Flow requirements for the building. There is potential that a private fire suppression system could be utilized for this site; however, this is beyond the scope of this evaluation.

3.2.3 Off-Site Water Mains Recommendations

Following our review of the off-site water mains, we provide the following recommendations:

- Based on the age and material of the off-site water mains, it is recommended that the AC and cast-iron water mains be replaced with new PVC mains. The sizing of these mains will be determined during later stages of design development.
- During later stages of design development, we could investigate connecting to and re-using the existing segment of 200 mm diameter PVC pipe that was installed in 1990. However, due to the short length of pipe and possible difficulties or limitations with testing, constructability, and alignment, we do not recommend planning to re-use this pipe. At this stage, we would conservatively assume that this segment will need to be replaced.
- During later stages of design development, the re-use of the existing 150 mm diameter PVC pipe that extends service to the MHI building could be evaluated. However, we anticipate that this line would be the responsibility of the MHI to repair and replace, as required.

During the design process, the feasibility of rehabilitation, including CIPP or epoxy lining for the AC and cast-iron water mains could be investigated. However, these technologies would require approval by the City and may not result in cost savings that warrant their inclusion. In establishing high-level pricing within the scope of this evaluation, it is assumed that the entire length of off-site water mains will be replaced. This costing excludes the 150 mm main that extends service to the MHI building for the reasons noted above.

4 ASSESSMENT OF ON-SITE LINEAR INFRASTRUCTURE

4.1 On-Site Wastewater Mains

Following our review of the available information for the on-site wastewater mains, it is believed that the on-site mains consist of approximately 1,740 metres of VCT pipe (installed in 1952) ranging in size from 200 mm to 375 mm, and approximately 250 metres of 100 mm and 150 mm VCT pipes that provide service to the existing buildings. Additionally, there is approximately 180 metres of PVC pipe that was installed in 1996 and 1997 to replace some of the existing VCT pipe on Site. There were significant gaps in the pipe invert and pipe depth data for these segments of the mains. Figure 4555-00-C-7001 in Appendix A shows the existing wastewater mains. The Carpere Valley Development Boundary illustrated in the Figure defines the boundary between on-site and off-site infrastructure.

4.1.1 Condition Assessment

The VCT pipe that has been installed has an expected maximum lifespan in the range of 80 to 100 years; therefore, we would estimate the remaining lifespan is in the range of 10 to 30 years. Experience with VCT pipe within expansive clay soils in Saskatchewan has shown that the condition of this type of pipe is highly variable from location to location.

It is expected that the PVC pipe that was installed in 1996 and 1997 will have a remaining useful life of approximately 75 years, based on the estimated lifespan for PVC pipe of 100 years. A visual inspection of the pipe could be utilized to verify the condition of the pipe and assess any defects or deficiencies that may be present in the pipe.

For both the PVC and VCT segments of the off-site wastewater mains, completion of CCTV inspection would help to determine the condition of the existing sewer pipe. This type of inspection would help to verify the pipe materials currently in place, determine the general condition of the pipe, identify any structural issues, sags or other deficiencies that may be present in the pipe, and determine the potential of the mains for re-use or rehabilitation

4.1.2 Capacity Analysis

The capacity of sewer pipes can be estimated using pipe diameter, slope, and material; however, as we have very little data on the slope of the existing pipes, it makes it difficult to accurately calculate the capacity of the wastewater mains. Another issue with analyzing the capacity of the wastewater mains at this stage is that it is difficult to determine exactly how much flow will be directed to any given segment the sewer network, as this is highly dependent on the Concept Plan layout. At this time and with the information available, we are unable to complete a capacity analysis on the majority of the wastewater mains.

The one portion of the mains that we can complete a high-level capacity check for is the 375 mm diameter VCT pipe at the downstream end of the on-site mains. We estimate the available capacity of this main is between 50 – 70 L/s. In comparing the estimated peak wet-weather wastewater flow for the Concept Plan area, there is high potential that this main will have capacity. However, additional field information would be required to confirm this. This evaluation is based a number of assumptions and additional information could greatly impact the results of this high-level capacity check if slopes and condition along these mains are found to be significantly different than is assumed.

At this stage, we conservatively assume that there is not adequate capacity in the majority of the existing system, with the exception of the 375 mm diameter VCT portion of the mains mentioned above.

4.1.3 Alignment with Proposed Concept Plan

When comparing the Concept Plan with the current alignment of the on-site wastewater mains, it appears that a large portion of the mains may be outside of the existing roadways. This may create conflicts with Concept Plan and development alignments and render portions of the on-site network undesirable for re-use. The fit is not completely incompatible overall, and with strategic adjustments and establishment of utility easements may be manageable.

The lack of invert and sewer main depth information also creates uncertainty in the ability of the existing infrastructure to support expansion of servicing to new areas based on lack of data regarding available cover.

4.1.4 On-Site Wastewater Mains Recommendations

While portions of the on-site wastewater mains have some potential to be re-used or rehabilitated based on their material and age, likely the location, depth, or size of the majority of the mains will prohibit their re-use for servicing the Concept Plan area. We lack invert data to know if these mains can be extended to service the extents of the proposed Concept Plan area and we also lack condition data to know if they are suitable for re-use or rehabilitation. In establishing the high-level pricing within the scope of this evaluation it is assumed that the majority of the on-site wastewater services will need to be replaced to service the Concept Plan area and facilitate redevelopment of the site.

Our recommendation is to gather additional data for a more in-depth evaluation of the mains during the Concept Planning stage when developing the Servicing Strategy, including the following:

- Complete additional topographic survey to collect pipe invert information, sewer main depth information and manhole location data throughout the wastewater collection system. Invert information collected for areas where no data is currently available will help to fill in gaps, while invert information collected from segments of the mains where data is available on as-built drawings will help to increase confidence in the as-built information provided. This information will support a more accurate and in-depth analysis of the capacity of the mains and verify the locations of key features and alignment of the mains. The sewer main depth information will be used to understand the potential or limitations of extending sewer service to new areas.
- If the topographic survey data indicates that the wastewater mains, or portions thereof, have potential for re-use or rehabilitation, then we would suggest completing CCTV inspection of those segments of the mains to determine the condition of the existing sewer pipe. CCTV inspection would help to confirm the material of the mains currently in place and verify lengths of the mains. This inspection will determine the general condition of the pipe and identify any structural issues, sags or other deficiencies that may be present in the pipe.

These recommendations will support a better understanding and determination of the condition of the mains and provide a more reliable indication of opportunities for rehabilitation or re-use. We expect that the pipe will fall into one of the following classes:

- Good condition – If the mains are in good condition and we expect that there is a significant amount of useful life remaining, we would evaluate re-using the existing mains.
- Moderate condition – If the mains are in moderate condition, with some minor to moderate defects, we could investigate cost-effective rehabilitation options such as CIPP.
- Poor condition – If the mains are in poor condition, with major defects, we would provide a recommendation for repair and replacement of the mains.

4.2 On-Site Water Mains

Based on our review of the available information for the on-site water mains, we have determined that there is an existing 200 mm diameter AC water main, which was installed in 1952. This approximately 540 metre water main supplies flow from the northeast property line to the water pump station and reservoir that serves the Site. From the water pump station and reservoir, water is distributed throughout the Site via approximately 3,550 metres of PVC pipe. These PVC lines range in size from 100 mm to 200 mm in diameter and were installed in 1985. Figure 4555-00-C-7002 in Appendix A shows the existing water mains. The Carpere Valley Development Boundary illustrated in the Figure defines the boundary between on-site and off-site infrastructure.

4.2.1 Condition Assessment

The AC pipe that has been installed has an estimated lifespan of approximately 70 years; therefore, we would assume that this pipe is at the end of its life and would not be suitable for re-use. In the event that further investigation is requested, testing can be completed to determine if there is any useful life remaining in this pipe.

It is expected that the on-site PVC water mains should have a remaining useful life of approximately 60 years, this is based on an estimated lifespan for PVC pipe of 100 years. Additional testing and inspection could be carried out to verify the condition of the pipe.

In general, it appears that additional hydrants and valves will be required throughout the Site to meet current hydrant and valve spacing requirements. However, details of the number and location of valves and hydrants will need to be determined during later stages of design development as this spacing is dependent on the adjacent land-uses.

4.2.2 Capacity Analysis

Typically, a water supply line for a reservoir should be sized to supply Maximum Day Demand, while maintaining velocities between 0.6 m/s and 1.5 m/s. Based on this velocity criteria, the 200 mm diameter AC water line that provides flows to the water reservoir is likely sufficient in size to accommodate Maximum Day Demand; however, the actual flow will be affected by the size and configuration of the mains at the tie-in as well as the pressures at this location.

The City of Moose Jaw typically utilizes City of Regina Design Standards for development within the City. The Design Standards list several system performance criteria that need to be evaluated during the design of a water distribution network. Typically, the limiting criterion for a water distribution network is that the maximum pipe velocity cannot exceed 3.2 m/s while supplying Peak Day Demand plus Fire Flow to any point in the system. For the purposes of this analysis, this is the criterion that will be used to evaluate the capacity of the mains. The required minimum Fire Flows for the Site have been assigned based on anticipated land-uses shown in the Concept Plan, a summary of the required Fire Flows for each land use is shown in Table 4-1.

Table 4-1
Required Fire Flow

Land Use Designation	Fire Flow Requirement Designation	Required Minimum Fire Flow
Low Density Residential	Level 1	90 L/s
Medium Density Residential High Density Residential Commercial Office Area	Level 2	150 L/s
Large Market Commercial Institutional Light Industrial	Level 3	250 L/s
Heavy Industrial	Level 4	300 L/s

Based on the size of the on-site PVC water mains and the estimated Fire Flow requirements, it is anticipated that, in general, the mains will not be sufficient to meet Fire Flow requirements for the Site. Table 4-2 provides an approximation of typical water main sizes required to meet the various minimum Fire Flows. It should be noted that during later stages of design development the mains should be sized using water modelling.

Table 4-2
Approximation of Water Main Sizes Required to meet Fire Flow Requirements

Required Flow	Required Pipe Diameter for Single Line[1]	Required Pipe Diameter for Looped Line[1]
90 L/s	200 mm	150mm
150 L/s	250 mm	200 mm
250 L/s	350 mm	250 mm
300 L/s	350 mm	250 mm

[1]These pipe sizes are an approximation based solely on the pipe area and a velocity of 3.2 m/s, which is the maximum allowable pipe velocity during a Peak Day Demand plus Fire Flow scenario using City of Regina Design Standards. All pipe diameters should be determined using water modelling during later stages of design development.

It is possible that some of the mains could be re-used with the installation of additional mains or looping. However, this would require a more detailed evaluation as well as water modelling during later stages of design development. Incorporation of some of the existing water mains would also be dependent on the condition of the existing mains and if the routing is compatible with the layout of the Concept Plan.

4.2.3 Alignment with Proposed Concept Plan

When comparing the Concept Plan with the current alignment of the on-site water mains, it appears that a large portion of the mains may be outside of the existing roadways. This may create conflicts with Concept Plan and development alignments and render portions of the on-site network undesirable for re-use.

4.2.4 On-Site Water Mains Recommendations

Following our review of the on-site water mains, we provide the following recommendations:

- Based on the age of the AC water mains, it is recommended that the AC mains be replaced with new PVC mains. The sizing of these mains will be determined during later stages of design development.
- At this time, we recommend that it be assumed that all of the PVC mains will need to be replaced. The PVC mains have an estimated remaining useful life of approximately 60 years. However, based on the size and alignment of the mains, there is a high potential that extensive upgrades will be required to provide a network of mains that is capable of meeting minimum Fire Flow requirements. Additionally, the alignment of the existing mains is incompatible with the Concept Plan. Re-use of certain segments of the mains, where alignment and sizing of the mains are acceptable, can be evaluated during later stages of design development.

If it is determined that some of the pipe can be re-used during later stages of development, additional testing and inspection would be required to verify the integrity of the pipe. This would include:

- Hydro-vac work to do 'spot checks' along the existing water mains, hydrant leads, and service connections to improve our confidence in the pipe material that was installed and confirm the findings in the background information reviewed.
- Once the pipe materials have been confirmed, leakage testing should be completed to confirm that the system is holding pressure and does not have any major leakage issues. This testing could be completed on a section by section basis, so that only the mains with potential for re-use are tested.
- If leakage testing identifies any major issues, we would suggest completing a CCTV inspection of the water mains to identify any issues associated with installation methods such as ovaling of the pipe, bulging gaskets, over-inserted pipe, etc.

4.3 On-Site Stormwater Mains

The on-site stormwater mains consist of two separate systems of stormwater mains, both of which convey flows from the Site to the south and south-west. Based on our review of the available information for the on-site stormwater mains, we have determined that there is approximately 1100 metres of VCT pipe ranging in size from 150 mm to 450 mm diameter, 350 metres of corrugated iron pipe ranging in size from 600 mm to 900 mm diameter, and 180 metres of 600 mm diameter concrete pipe. All of this stormwater pipe appears to have been installed in 1952. Figure 4555-00-C-7003 in Appendix A shows the existing stormwater mains.

4.3.1 Condition Assessment

The VCT pipe that has been installed has an expected maximum lifespan in the range of 80 to 100 years; therefore, we would estimate that the remaining lifespan is in the range of 10 to 30 years. Experience with VCT pipe within the expansive clay soils in Saskatchewan has shown that the condition of this type of pipe is highly variable from location to location. As the failure mechanism for VCT pipe is relatively predictable, a visual inspection could be utilized to estimate the remaining life of the pipe.

The background information indicates that some of the on-site stormwater mains are corrugated iron, which is not a common type of pipe. Corrugated steel, however, has a typical lifespan of 35 years and it is expected that this group of pipe may have exceeded its expected design life. Some of the drawings also note that sections of the existing corrugated iron pipe have an asbestos bonded coating, which could potentially extend the lifespan of the pipe. Additional testing and inspection could be carried out to verify the condition of the pipe and determine if there is potential for rehabilitation. If the inspection indicates that the pipe still has remaining useful life or an adequate cross-section, then there would be the opportunity to potentially re-use or cost effectively rehabilitate the existing pipe.

Concrete pipe has an expected design lifespan in the range of 50 to 75 years; therefore, we would estimate that the pipe has met or exceeded its expected design lifespan. Additional testing and inspection could be carried out to verify the condition of the pipe. If inspection indicates that the pipe still has remaining useful life or an adequate cross-section, then there would be the opportunity to potentially re-use or cost effectively rehabilitate the existing pipe.

4.3.2 Capacity Analysis

The capacity of storm sewer pipes can be estimated using pipe diameter, slope, and material; however, as we have very little data on the slope of the existing pipes, it makes it difficult to accurately calculate the capacity of the stormwater mains. Another problem with analyzing the capacity of the stormwater mains at this stage is that it is difficult to determine exactly how much flow will be directed to any given segment the sewer network, as this is highly dependent on grading, surface treatment, and the number of outlets. At this time and with the information available, we are unable to complete a capacity analysis.

Based solely on the pipe sizes provided in the background information, there is some potential for re-use or rehabilitation of portions of the existing stormwater mains.

4.3.3 Alignment

The proposed drainage design for overland or piped systems is not known at this stage, therefore it is difficult to say with any level of certainty how the current storm sewer alignments will fit into the eventual drainage strategy.

4.3.4 On-site Stormwater Mains Recommendations

While some portions of the on-site stormwater mains have potential to be re-used or rehabilitated based on their material and age, it is likely that the location, depth, or size will prohibit re-use or rehabilitation of the majority of the mains. We lack invert data to know if these mains can be extended to service the extents of the proposed Concept Plan area and we also lack condition data to know if they are suitable for re-use or rehabilitation. In establishing the high-level pricing within the scope of this evaluation it is assumed that the majority of the on-site stormwater services will need to be replaced to service the Concept Plan area and facilitate redevelopment of the site.

Our recommendation is to gather additional data for a more in-depth evaluation of the mains during the Concept Planning stage when developing the Servicing Strategy, including the following:

- Complete additional topographic survey to collect pipe invert information, sewer main depth information, and manhole location data throughout the stormwater collection system. This information will provide a more accurate and in-depth analysis of the capacity of the mains and verify the locations of key features and alignment of the mains. The sewer main depth information will be used to understand the potential or limitations of extending storm sewer to new areas.
- If the topographic survey data indicates that the stormwater mains, or portions thereof, have potential for re-use or rehabilitation, then we would suggest completing CCTV inspection of those portions of the stormwater mains to determine the condition of the existing storm sewer pipe. CCTV inspection would help to verify the materials and treatments of the pipes and provide approximate lengths. The inspection would also help to determine the general condition of the pipe and identify any sags or other deficiencies that may be present in the pipe.

If our above-mentioned recommendations are followed, we will be better able to determine the condition of the mains and provide a more reliable indication of opportunities for rehabilitation or re-use. We expect that the pipe will fall into one of the following classes:

- Good condition – If the mains are in good condition and we expect that there is a significant amount of useful life remaining, we would evaluate re-using the mains.
- Moderate condition – If the mains are in moderate condition, with some minor to moderate defects, we could investigate cost-effective rehabilitation options such as CIPP lining.
- Poor condition – If the mains are in poor condition, with major defects, we would provide a recommendation for repair and replacement of the mains.

5 WATER PUMP STATION AND RESERVOIR

5.1 Condition Assessment

The potable water pump station and reservoir were built in the 1950's. At the time of this evaluation, the pump station was not operating and had previously been abandoned. The reservoir was understood to be empty and was not entered due to lack of safety equipment and personnel.

5.1.1 Structural

The reservoir is a partially buried square concrete structure, no visual inspection could be completed at the time of this evaluation. However, ATAP had previously cleaned and assessed the condition of the reservoir in September 2018. ATAP's 2018 report indicated that the overall condition of the reservoir was average to below average. The interior walls were spalled and were beginning to break down. Access was difficult as the rungs had significant corrosion and were missing sections. The floor, columns, beams, and ceiling appear to be in good condition as per the report photos. It also appears that the reservoir was built with potential for expansion.

The structure of the potable water pump station consists primarily of concrete with one masonry wall. The roof, floor, ceiling, and mezzanine are concrete and are in good condition. The concrete and masonry walls are also in good condition with the exception of the west wall. The pump station shares its east concrete wall with the reservoir, this wall shows some spalling including a section where the reinforcing has been exposed due to the deterioration.

The monorail appears in good condition; however, the hoist is rated for 3 ton, but the trolley is only rated for 1.5 ton and the rail is unrated.

5.1.2 Building Mechanical

The building mechanical consists of a natural gas heater on the pump room floor and a small ventilation fan. The heater on the pump room floor is a Carrier natural gas forced air furnace, the age of which is unknown, but appears to be approximately 10 to 15 years old. The thermostat is located on the north wall approximately 2.0 m above the floor and is set to keep the temperature around 10 degrees Celsius. The original brick chimney is still in place but has been relined with an aluminum chimney and appears in good condition. There is a small, 300 mm square exhaust fan on the south wall and intake louver on the north wall, the louvers are uninsulated. Operation of the furnace and fan was not evaluated.

5.1.3 Process Mechanical

The process mechanical consists of pipes, valves, pumps, air compressors and hydropneumatics tanks. Operation of the valves and pumps was not evaluated, as the system is not in operation.

Piping within the pump station is located on the lower level and is exposed or in trenches. The piping consists of painted ductile iron, steel, or copper with sizes ranging from 15 mm to 200 mm. Pipes are either flanged, grooved coupled or soldered. Overall condition of the pipe is fair with some surface rust. No thickness test or internal checks were completed

Valves within the pump station are located on the lower level and are exposed or in trenches. The types of valves within the pump station include gate valves, butterfly valves, ball valves, diaphragm valves, and check valves. The inlet valves appear to be new OS&Y gate valves; however, the diaphragm and check valve are much older. Valves on the pumps are gate valves, silent check valves, and butterfly valves and are all in average condition with the exception of the check valve for Pump 1, which is missing a part of the casting. The discharge and hydropneumatics valves appear to be OS&Y gate valves and appear to be in average condition. The remainder of the miscellaneous valves are ball valves, which are in average condition. Valves on the fire pump include OS&Y gate valves, butterfly valves, diaphragm valves and check valves, and appear to be in average condition.

There are four pumps, three distribution pumps and one fire pump, all of which are 208V/3ph/60 Hz pumps. The three distribution pumps are Aurora model 411-2.5x3x10B with 20 hp and 3500 rpm rotation. The fire pump is an Aurora 3-481-10 with 50 hp and 3500 rpm rotation. These pumps were understood to be operational before the facility was abandoned; however, the pumps have not run in one and a half years, which may cause deterioration of seals and bearings.

There are four air compressors, two on the main level and two on the lower level. On the main level the older air compressor has been disconnected and a new one has been installed. The new compressor is Ingersoll Rand model 2340 with 5 hp, 3500 rpm rotation and a 60-gal tank. Information for the two compressors on the lower level is unknown.

The hydropneumatics tanks appear to be in good condition.

There is a chemical tank with a chemical pump and spill containment located on the main floor, which appears to be fairly new and in operating order. This is likely a used for a chlorine boost, prior to distribution.

5.1.4 Electrical

Service to the building is 120/208V 3ph/60 Hz, the electrical equipment within the building is old, which may make replacement parts difficult to source.

The exterior lights have been upgraded to LED and are in excellent condition. The interior lights over the pumps however are the original fixtures, which may make replacement bulbs difficult to source.

5.1.5 Instruments and Controls

The majority of the instruments are pressure gauges and pressure switches. The starting and stopping of pumps is based on pressure within the distribution system. It is believed that the reservoir fill is controlled by an actuated valve, missing at the time of assessment.

5.2 Capacity Analysis

The reservoir has interior dimensions of approximately 14 m x 14 m, and a full-service level depth of approximately 5.75 m, for a total capacity of 1,127 m^3. This capacity is close to the stated capacity for the reservoir of 1,135 m^3 (Valley View Centre Moose Jaw Report, September 2012). Based on an estimated average daily water consumption for the Concept Plan area of 780 m^3/day and a storage requirement for twice the average daily consumption for systems requiring fire protection, the reservoir is undersized for a full build-out of the Concept Plan area. However, the capacity is likely sufficient for initial phases of development.

The current distribution pumps (DP1, 2 & 3) have a catalog Best Efficiency Point (BEP) of 22.7 L/s @ 36.6 m (360 USgpm @ 120 ft) and are constant speed pumps. With two pumps operating, and one pump on standby, the firm pumping capacity would be 45.4 L/s @ 36.6 m or 720 USgpm at 120 ft or 50 psi, which is sufficient to provide peak hour demand.

The current fire pump (FP1) has a catalog BEP of 31.5 L/s @ 67.1 m (500 USgpm @ 220 ft) and is connected to a Westinghouse FireGuard fire pump controller. This pump is not sufficient to meet the anticipated Fire Flow requirements for the Concept Plan area.

5.3 Water Pump Station and Reservoir Recommendations

Following our review of the water pump station and reservoir, we recommend the following upgrades and repairs, which are required to restore the pump station and reservoir to an acceptable level of service:

- Repair concrete walls within the reservoir and the east wall within the pump station.
- Confirm the condition and wall thickness of the interior pipe and replace pipe as required. Clean and recoat the interior of the pipe and paint the exterior.
- Confirm the operation of valves and replace as required.
- Confirm the operation and capacity of each distribution pump and repair as required.
- Replace the fire pump to meet the Fire Flow requirements of 250 L/s for the Concept Plan area, the Fire Flow requirement will need to be confirmed during later stages of design development.
- Upgrade the electrical, including the replacement of starters, panels, lights and electrical outlets.
- Upgrade the building mechanical, including replacement of the furnace, louvers, and fans.
- Upgrade instrumentation and controls, including the replacement and upgrade of instruments to SCADA compatible systems.
- The expansion of the reservoir will likely be required to service the full Concept Plan area; however, this should be confirmed during later stages of design development.

6 COST ESTIMATE

6.1 Off-Site Wastewater Mains Cost Estimate

The off-site wastewater mains have the potential to be re-used or rehabilitated; however, we lack adequate information to determine this. At this time, we estimate the costs for the off-site wastewater mains between $420k – $1.2M. The costs will vary depending on the extent of pipe that can be rehabilitated versus the extent that will have to be replaced with new pipe.

6.2 Off-Site Water Mains Cost Estimate

The off-site water mains will likely require full replacement, based on the materials, age, and alignment of the pipe. There is potential that the small section of PVC mains could be re-used; however, at this time we conservatively assume that this segment will need to be replaced also. The estimated costs for the full replacement of the off-site water mains is $850k. It should be noted that this cost does not include upgrades to the existing 150 mm diameter PVC pipe that extends service to the MHI building.

6.3 On-Site Wastewater Mains Cost Estimate

The on-site wastewater mains have some potential to be re-used or rehabilitated; however, we lack adequate information to determine this. At this time, we estimate the costs for the on-site wastewater mains between $800k – $1.5M. The costs will vary depending on the extent of pipe that can be rehabilitated versus the extent that will have to be replaced with new pipe. It should be noted that these estimates only include costs for the rehabilitation or replacement of the existing infrastructure that is currently on Site. The estimates do not include costs for the extension of the wastewater collection system to areas which are not currently serviced; these servicing costs can be prepared following the development of a preliminary wastewater servicing strategy for the Concept Plan during the next phase of the project.

6.4 On-Site Water Mains Cost Estimate

The on-site water mains will likely require full replacement, based on the materials, age, size, and alignment of the pipe. There is potential that some segments of the PVC mains could be re-used; however, at this time we conservatively assume that all of the pipe will need to be replaced. The estimated costs for the full replacement of the on-site water mains is $3.1M. It should be noted that these estimates only include costs for the replacement of the existing infrastructure that is currently on Site. The estimates do not include costs for the extension of the water distribution network to areas which aren't currently serviced; these servicing costs can be prepared following the development of a preliminary water servicing strategy for the Concept Plan during the next phase of the project.

6.5 On-Site Stormwater Mains Cost Estimate

The on-site stormwater mains have some potential to be re-used or rehabilitated; however, we lack adequate information to determine this. At this time, we estimate the costs for the on-site stormwater mains between $950k – $1.2M. The costs will vary depending on the extent of pipe that can be rehabilitated versus the extent that will have to be replaced with new pipe. It should be noted that these estimates only include costs for the rehabilitation or replacement of the existing infrastructure that is currently on Site. The estimates do not include costs for the extension of the stormwater collection system to areas which aren't currently serviced; these servicing costs can be prepared following the development of a preliminary stormwater servicing strategy for the Concept Plan during the next phase of the project.

6.6 Water Pump Station and Reservoir Cost Estimate

We estimate the costs to bring the water pump station and reservoir to an acceptable level of service between $1.5M – $2.25M. This includes the costs for the expansion of the reservoir, so that it will have sufficient capacity to accommodate the Concept Plan area.

6.7 Cost Estimate Summary

Table 6-1 summarizes the anticipated costs required to upgrade the existing off-site mains and on-site linear infrastructure to an acceptable level of service.

Table 6-1
Cost Estimate Summary

Required Upgrades	Cost
Existing Off-Site Wastewater Mains Upgrades	$420k – $1.2M
Existing Off-Site Water Mains Upgrades	$850k
Existing On-Site Wastewater Mains Upgrades	$800k – $1.5M
Existing On-Site Water Mains Upgrades	$3.1M
Existing On-Site Stormwater Mains Upgrades	$950k - $1.2M
Water Pump Station and Reservoir Upgrades (including reservoir expansion)	$1.5 – $2.25M
Total	**$7.62M – $10.1M**
High-End (+50%)	**$15.15M**
Low-End (-30%)	**$5.33M**

CERTIFICATION PAGE

This report presents our findings regarding the Carpere Valley Development Corp. Assessment of Existing Site Servicing Infrastructure .

Respectfully submitted,
Associated Engineering (Sask.) Ltd.

Jared Faber, P.Eng.
Project Engineer

Mike Binns, P.Eng.
Asset Management / Technical Lead

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J.M. FABER
MEMBER 29743
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SASKATCHEWAN

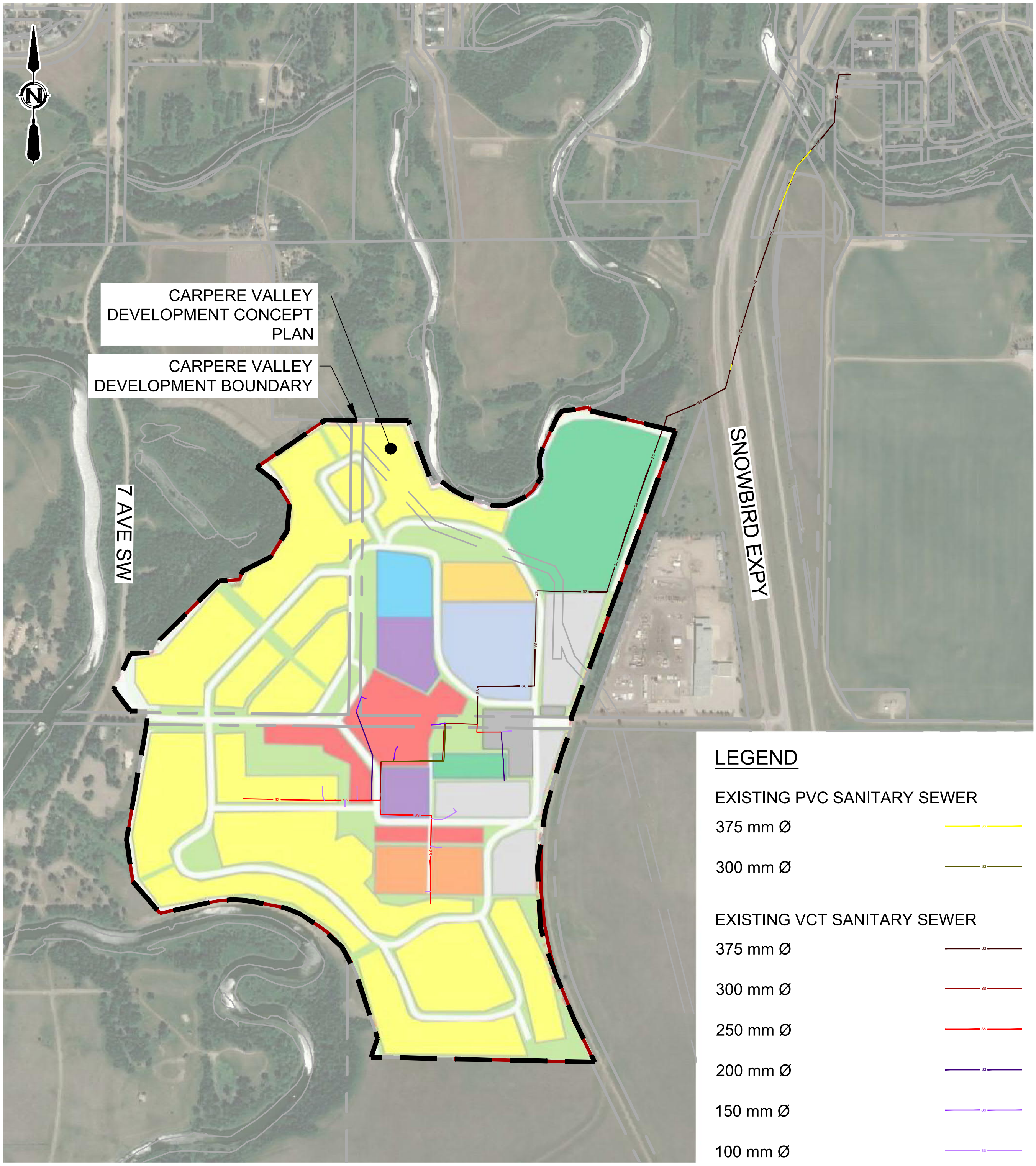
ASSOCIATION OF PROFESSIONAL ENGINEERS
AND GEOSCIENTISTS OF SASKATCHEWAN
CERTIFICATE OF AUTHORIZATION
ASSOCIATED ENGINEERING (SASK.) LTD.
NUMBER C116
PERMISSION TO CONSULT HELD BY:

DISCIPLINE	SASK. REG. No.	SIGNATURE
MUNICIPAL	12603	

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF
Signature:
Date: June 3, 2021

APPENDIX A - FIGURES

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR LETTER (8.5X11) SIZE DRAWINGS UNLESS NOTED OTHERWISE



LEGEND

EXISTING PVC SANITARY SEWER

375 mm Ø

300 mm Ø

EXISTING VCT SANITARY SEWER

375 mm Ø

300 mm Ø

250 mm Ø

200 mm Ø

150 mm Ø

100 mm Ø

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Associated Engineering

BEST MANAGED COMPANIES CANADA
Platinum member

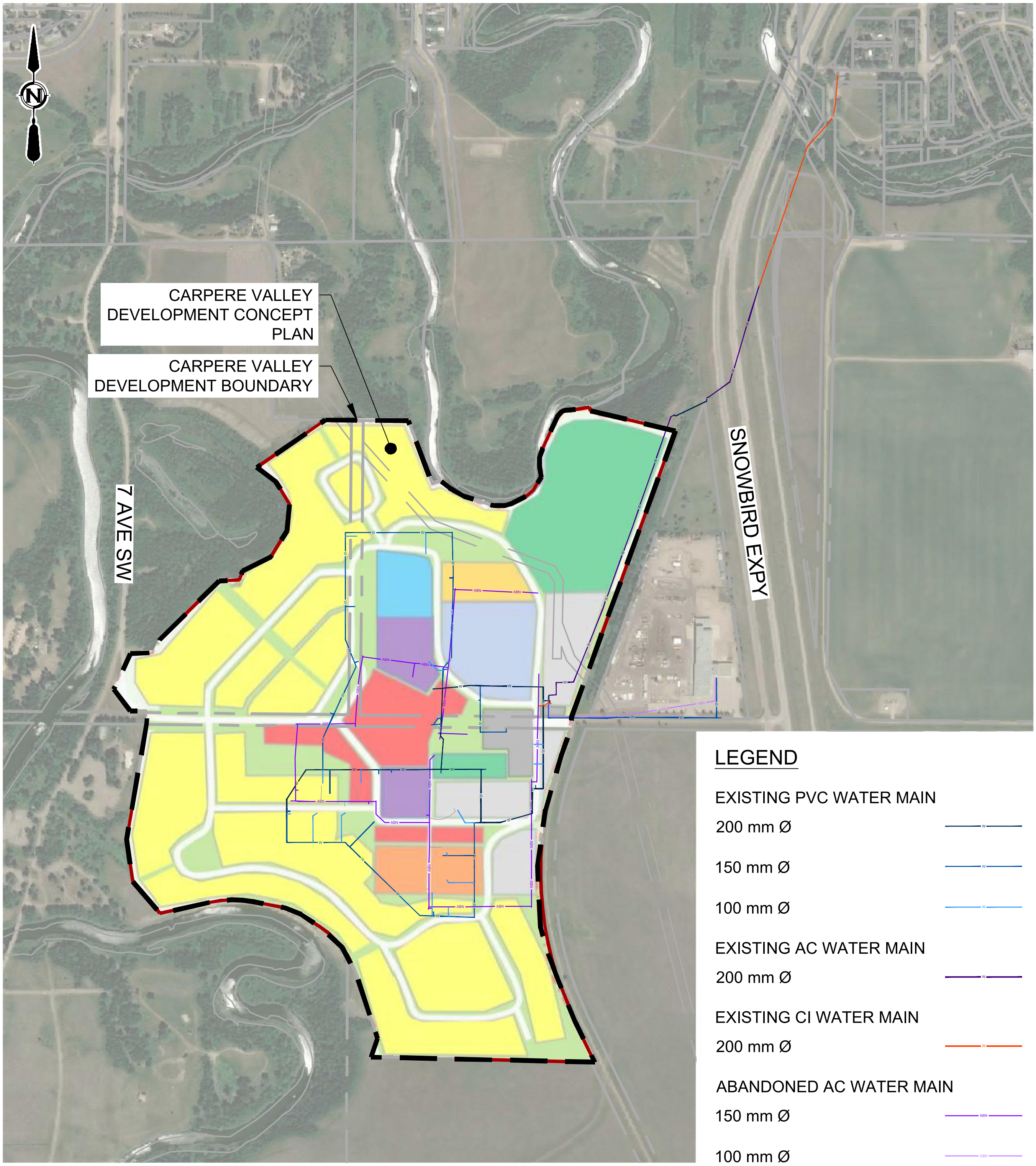
AE PROJECT No.	20214555-00
SCALE	1:10000
APPROVED	J. FABER
DATE	2021JUN01
REV	A
DESCRIPTION	ISSUED FOR REPORT

FIGURE 4555-00-C-7001

CARPERE VALLEY DEVELOPMENT CORP.

CIVIL
CARPERE VALLEY DEVELOPMENT PROJECT
EXISTING WASTEWATER

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR LETTER (8.5X11) SIZE DRAWINGS UNLESS NOTED OTHERWISE



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Associated Engineering

BEST MANAGED COMPANIES
Platinum member

AE PROJECT No.	20214555-00
SCALE	1:10000
APPROVED	J. FABER
DATE	2021JUN01
REV	A
DESCRIPTION	ISSUED FOR REPORT

FIGURE 4555-00-C-7002

CARPERE VALLEY DEVELOPMENT CORP.

CIVIL
CARPERE VALLEY DEVELOPMENT PROJECT
EXISTING WATER NETWORK

IF NOT 25 mm ADJUST SCALES
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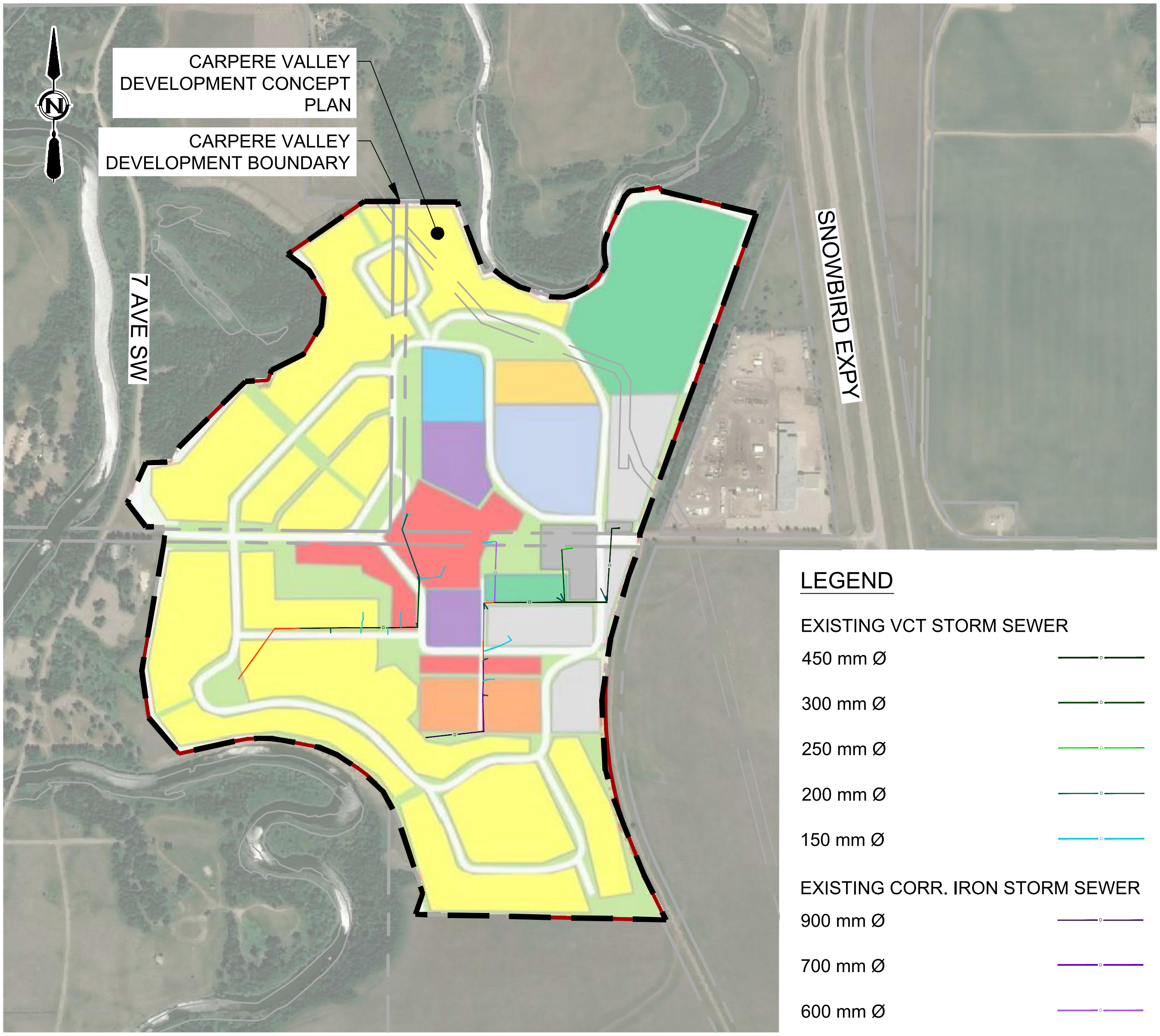
SCALE(S) SHOWN ARE INTENDED FOR LETTER (8.5X11) SIZE DRAWINGS UNLESS NOTED OTHERWISE



LEGEND

EXISTING VCT STORM SEWER
450 mm Ø
300 mm Ø
250 mm Ø
200 mm Ø
150 mm Ø

EXISTING CORR. IRON STORM SEWER
900 mm Ø
700 mm Ø
600 mm Ø

EXISTING CONCRETE STORM SEWER
600 mm Ø

PLOT DATE: 2021-06-01 10:06:01 AM
SAVE DATE: 2021-06-01 9:53:58 AM SAVED BY: KOTM
DWG PATH: q:\2021-4555-00\civil\model\4555-00-c-7003-stm.dwg

Associated Engineering

BEST MANAGED COMPANIES
Platinum member

AE PROJECT No.	20214555-00
SCALE	1:10000
APPROVED	J. FABER
DATE	2021JUN01
REV	A
DESCRIPTION	ISSUED FOR REPORT

FIGURE 4555-00-C-7003

CARPERE VALLEY DEVELOPMENT CORP.

CIVIL
CARPERE VALLEY DEVELOPMENT PROJECT
EXISTING STORM SEWER