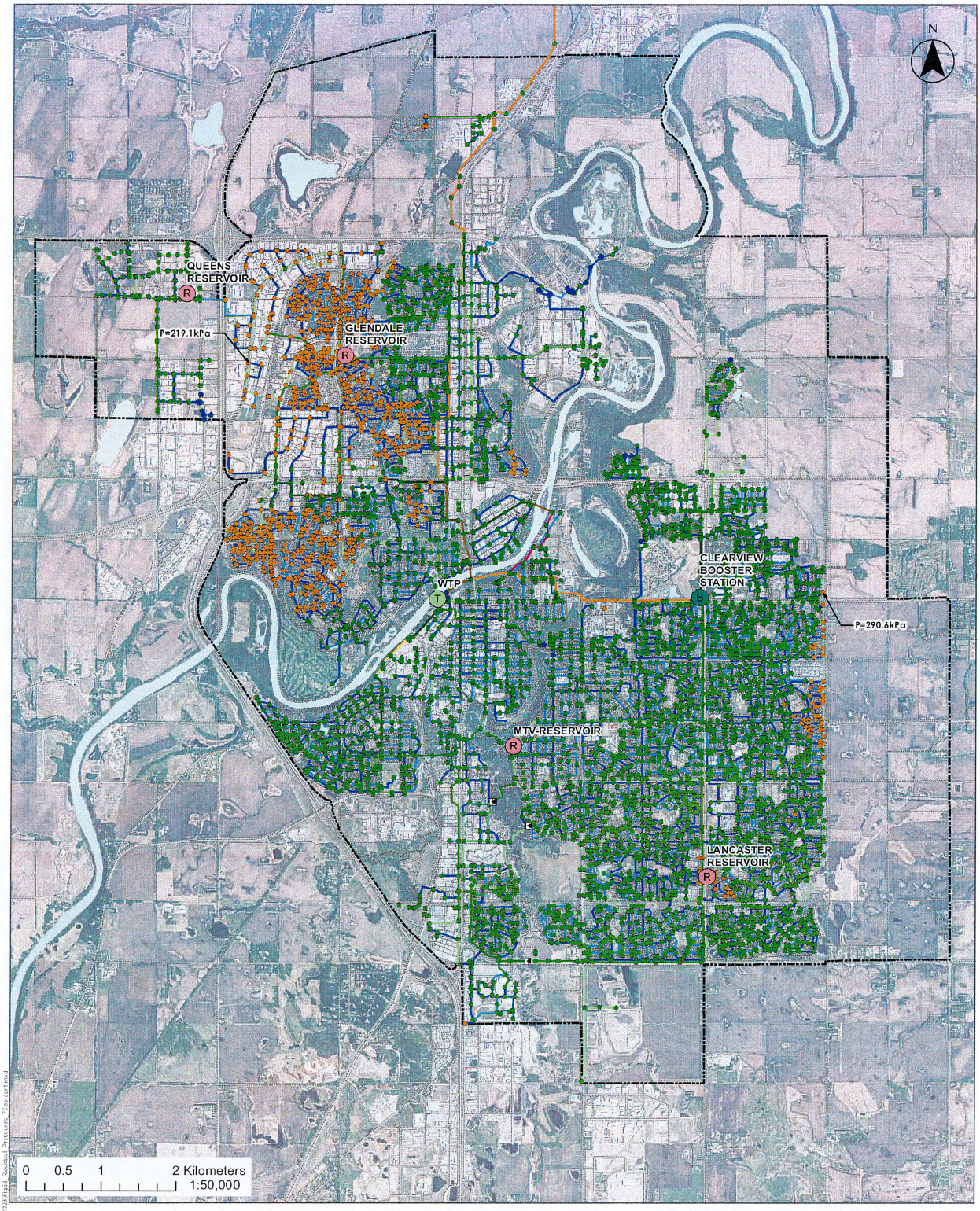

Reservoirs
- Booster Station
- Reservoir
- Water Treatment Plant

Pressure (kPa)
- < 140 kPa
- 140-300 kPa
- 300-600 kPa
- > 600 kPa

- Red Deer City Limits
- Existing PRV

Existing Water Pipes (mm)
- 100
- 150
- 200
- 250
- 300
- 350
- 400
- 450
- 500
- 600
- 750
- 900
- 1050
- 1200
- 2000

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Figure 5-8: Residual Pressures at 32 nd Hour In The 75% Full Scenario Without Regional Demands - 900mm Trunk Analysis

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5.2.2 900 mm Trunk Analysis Conclusions and Recommendations

Based on the hydraulic simulation conditions and results presented in the **Section 5.2.1**, the following summarizes the conclusions of the 900 mm Trunk Analysis:

- When the 900 mm diameter discharge trunk from the WTP was taken offline, the modeled hydraulic performance indicated that the minimum residual pressures in water distribution mains during the 48-hour simulation were lower than the current standard (300 kPa) but were not lower than the emergency LOS (140 kPa or 20 PSI).
- When the shut-off valve in the NRD regional line is not closed, the PSV might shut off the regional flow when the residual pressure drops below 586kPa.
- Relying on the WTP as much as possible as a water source rather than the pumping stations with water storage allowed for longer period of downtime for the 900 mm diameter trunk. This was achieved by delaying the operation of pumping stations with reservoirs until pressure in the discharge line dropped below 300 kPa.
- Pressures within the East Hill Pressure Zone dropped below 300 kPa due to the Lancaster reservoir depletion, but the zone did not fail the emergency LOS (i.e. pressures below 140 kPa) throughout the entire analysis.
- With continuous filling, the Mountview and Queens reservoirs did not deplete.
- When the NRD Regional line was shut off and the reservoirs were all full, Glendale reservoir had the longest depletion time (42 hours). When the NRD regional was not shut off, the Glendale reservoir lasted for 19 hours. However, shutting of the NRD Regional flow did not have significant impacts on the depletion time in other reservoirs.
- When the reservoirs began at 75% full, there was not a significant difference in their depletion time with or without shutting of the NRD regional line.
- The highest velocity in the 500 mm diameter WTP high lift pump station discharge steel trunk is 5.2 m/s with the regional demand. It is assumed that the existing 500 mm steel trunk can withstand this high flow velocity.

Although these model simulation results indicated that the distribution system can be operated without the 900 mm trunk and meet the emergency LOS (pressure higher than 140 kPa) within the 48 hours of simulation, operating the system at lower pressure for such a long time would cause low pressure complaints from the users within the City. Furthermore, there is not much available fire fighting capacity throughout the City due to the low residual pressure and low water volume stored in the local reservoirs (the Glendale and Lancaster reservoirs were depleted). It is recommended the distribution operations team coordinate with the fire department on the emergency planning for the 900 mm trunk off-line scenario.

Note that the modeling results presented in this report are from the simulations with the settings and conditions as described in **Section 5.2.1**. The City can change the following in the WaterCAD model to explore different emergency operation options in emergency planning:

- The timing of the 900mm diameter off-line which can be adjusted by changing the "Start Time" of the "Calculation Times" in the "Calculation Options".
- The system demand was set to MDD. The system demand can be adjusted by changing the "Multiply" values in the "Active Demand Adjustment" of the "Calculation Options".
- The filling start levels of the Queens and Mountview reservoirs can be adjusted by resetting the filling conditions in the "Controls" in "Condition" tab under "Components" Ribbon.
- The filling rates to Queens and Mountview reservoirs can be adjusted by changing the FCV flow rates in the "Action" tab under the "Components" Ribbon.

5.3 Fire Pump Analysis

An onsite private fire pump is installed in the Olymel facility located at 7550 40 Avenue, intended to deliver the required fire fighting flow and head to the fire fighting system within the facility. The pump is connected directly to the City's water system with no water storage on-site. As such, operating that pump may have a negative impact on the pressures and velocities within the City's water system. In this section, this impact is evaluated using the calibrated WaterCAD model.

As discussed earlier in **Section 2.5.3**, the fire fighting flows in Alberta are determined based on land use type and typical standard values, which are in accordance with the Water Supply for Public Fire Protection published by Fire Underwriters Survey (FUS 1999). The required fire fighting flow for industrial land uses is 233 L/s according to FUS 1999 (see **Table 2-6**). However, the fire fighting flow for a particular facility should be determined considering the architectural design elements.

The fire flow for the Olymel Plant is dictated by the performance curve of the onsite fire pump, which was obtained and presented in Figure 5-9. As per the pump curve, the pump has a rated capacity of 4,000 gpm (i.e., 252.4 L/s), which is slightly higher than the fire fighting flow required by FUS 1999. The fire pump's performance curve was simulated in the WaterCAD hydraulic model to determine the maximum fire flow that the Olymel fire pump is allowed to operate at without negatively impacting the City's water system (i.e., lowering the residual pressures below 20 psi [140 kPa]).

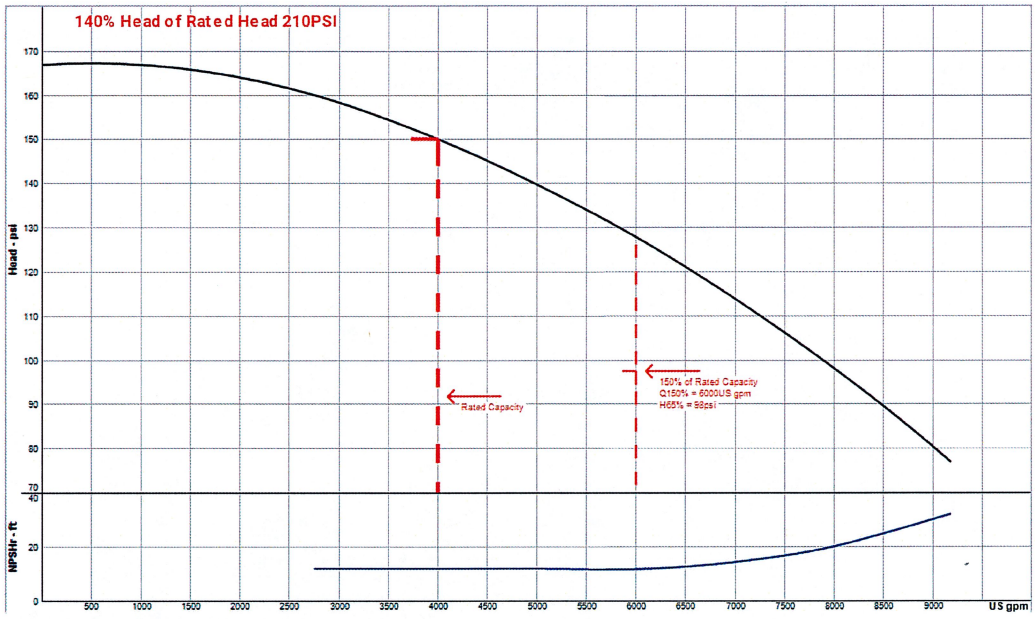


Figure 5-9: Pump Performance Curve of the Fire Pump at the Olymel Plant

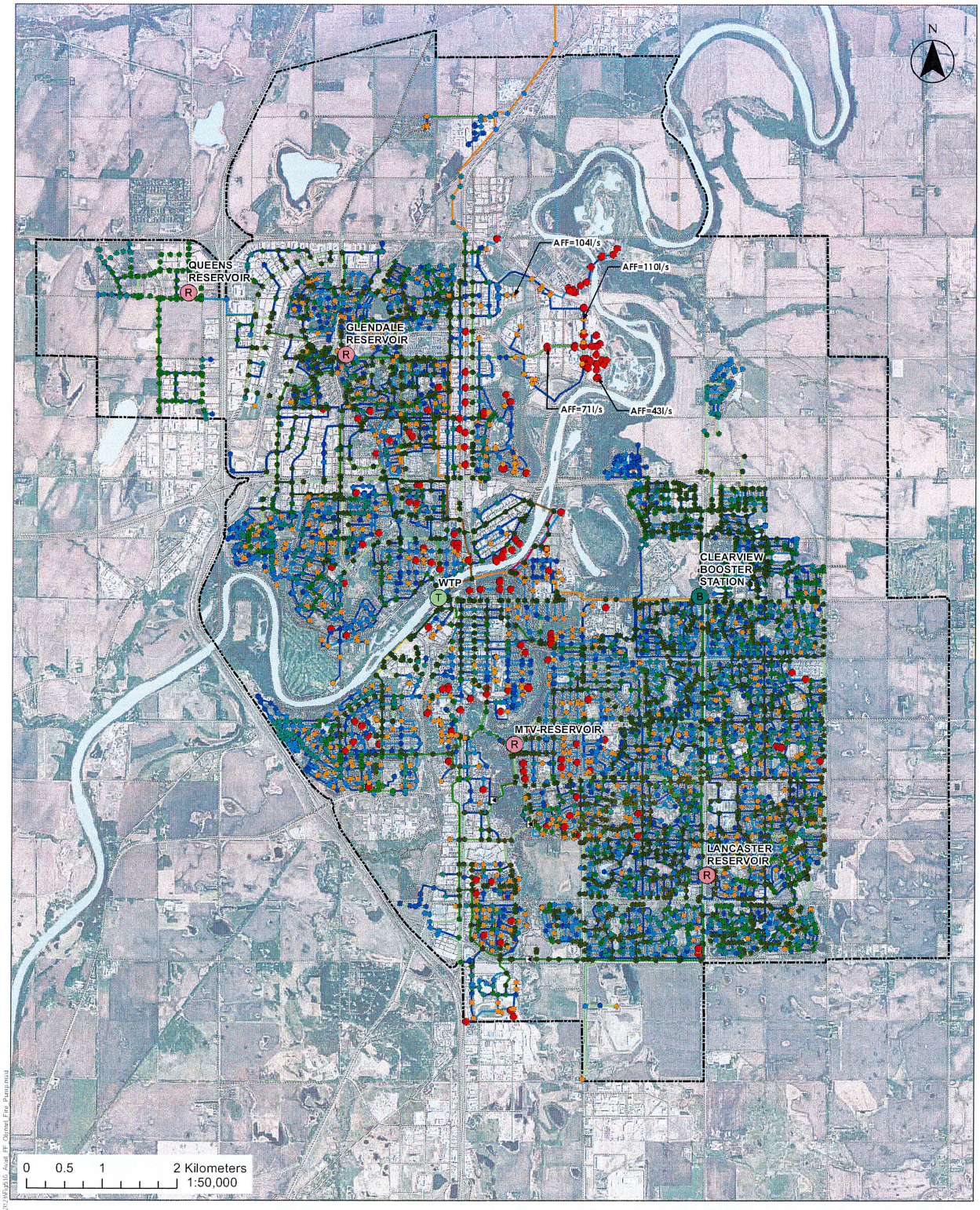
5.3.1 Fire Pump Operation Impacts

The WaterCAD model of the City's existing water distribution system was utilized to calculate the available fire flows during maximum day demands in the system. The available fire flow was determined to be 281.7 L/s (4,465 gpm) in the Olymel Plant site without compromising the pressure constraint of 20 PSI. At 4,000 gpm (i.e., 252.4 L/s), the minimum pressure observed was 156 kPa (i.e., 22.6 psi). As such, the City should instruct the Olymel Plant to control the fire flow so it does not exceed this limit, otherwise the pressures within the City's water system may drop below 20 psi. This can be achieved by installing a pressure gauge on the suction pipe of the pump to ensure that pressure would not drop below 20 psi.

It should be noted that at a fire flow of 4,000 gpm (i.e., 252.4 L/s), flow velocities in the watermains feeding the Olymel Plant reach 3.88 m/s. However, as discussed earlier in **Section 2.5.5**, it is recommended to disregard the velocity constraints when evaluating the fire flows in the existing system. The velocity constraint should apply to the new pipes for the long-term planning of the watermains.

5.3.2 Fire Flows at Other Locations

When the Olymel fire pump is running, the available flow for fire fighting at other locations in vicinity will be reduced. The water model simulation indicated that the available fire flows will drop below 75 l/s in the Olymel neighborhood as presented in **Figure 5-10**. These results imply that there will not be sufficient flow in the area when two fire events happen in the area. However, there are negligible drop in available fire flows in areas further away from the Olymel facility.



Reservoirs

- Booster Station
- Reservoir
- Water Treatment Plant
- Existing PRV
- Red Deer City Limits

Available Fire Flow

- <75 l/s
- 75 - 135 l/s
- 135 - 180 l/s
- 180 - 233 l/s
- 233 - 300 l/s
- 300 - 400 l/s
- >400 l/s

Existing Water Pipes (mm)

- 100
- 150
- 200
- 250
- 300
- 350
- 400
- 450
- 500
- 600
- 750
- 900
- 1050
- 1200
- 2000

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Figure 5-10: Existing System Available Fire Flows with Olymel Fire Pump Running

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6 Growth Scenario Analysis

Future development is expected in the Northwest Area of the City and this task includes developing sequencing scenarios to determine how much land can be developed in the North growth area before costly major upgrades are required. The objective of the analysis is to develop a sound engineering staging plan to postpone the costly major infrastructure upgrades. Due to this, extending the existing infrastructure service capacity to meet the future growth demands based on the various growth scenarios will be a high priority, and the basis for this analysis.

The future growth scenario analysis was conducted using the calibrated model on the existing system. The following three overall growth sections were analyzed as follows:

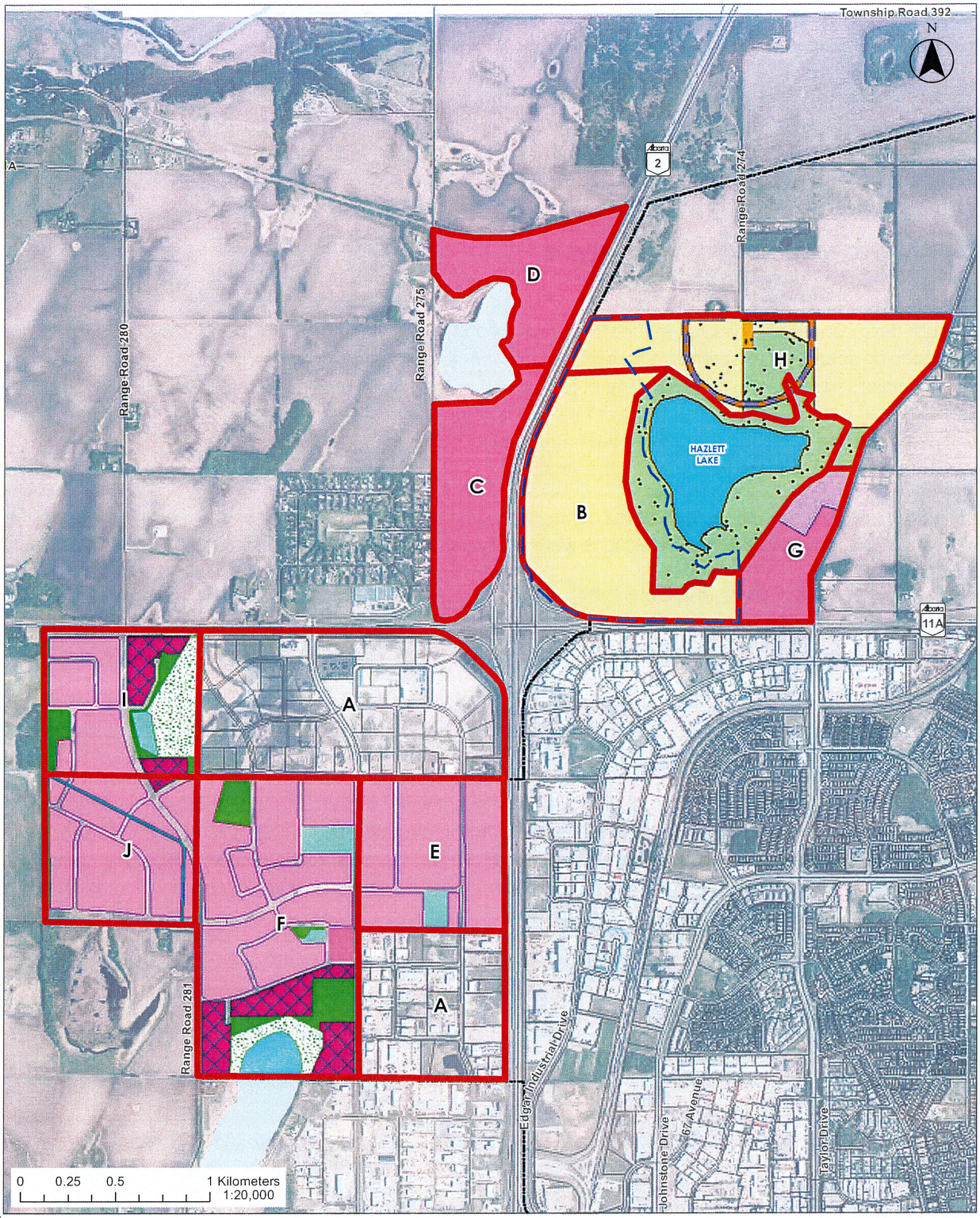
- Section #1 (Queens Business Park)
- Section #2 (Lands NE of Hwy 2 / 11A)
- Section #3 (Lands NW of Hwy 2 / 11A)

The Queens Business Park Servicing Study Report (WSP, 2016), the North of Highway 11A Servicing Study Report (AE, 2016) and the preliminary Hazlett West Water Service Plan Report (Stantec 2021) describe the water system network and servicing strategies for the three areas with emphasis on the full build of those areas. The servicing plans require significant water infrastructure upgrades, including building a new North Reservoir and Pump Station, dedicated transmission fill lines to the new North Reservoir and existing Queens Business Park Reservoir, and local distribution mains. Under the current economic conditions, it is expected that the three areas will be developed at a slow pace which adds another complexity if major upgrades are needed.

The City and Stantec have held workshops to define the smaller growth areas or service areas and form a development staging plan. The three sections noted above are further broken down into 10 service areas based on possible development sequencing.

Figure 6-1 presents the land use type and the service area codes (A – J) within the three growth sections of interest.

As discussed in **Section 2.5.8**, to maximize the use of the existing infrastructure capacity, some relaxations or deviations of the design criteria can be applied. **Table 2-8** summarizes the key design criteria and the proposed deviations for providing adequate service levels to the new developments for the near-term future.



Land Use Areas

- NASP Boundary
- Landfill Setback
- Utility Lot
- Municipal Reserve
- Eco Industrial Park
- Industrial and Business Service
- Environmental Reserve
- Public Utility Lot
- Water
- Landfill
- Commercial
- Major Park
- Mixed Residential/Commercial
- Residential
- Growth Area Boundary
- Cadastral

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Figure 6.1:
Land Use for the City of Red Deer Growth Areas
City of Red Deer Water Model Update
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6.1 Development and Review of Existing Water Servicing Plans

6.1.1 Land Use Types and Areas

As indicated in **Figure 6-1**, the ten (10) service areas of interest consist of various land use types. Derived from the three previous servicing studies, the areas of the land use type breakdowns are presented in the following table.

Table 6-1: Land Use Statistics for the City of Red Deer Growth Areas

Growth Area (ha.)	A	B	C	D	E	F	G	H	I	J	Subtotal
Gross Area	183.3	81.7	44.3	39.8	62.4	137.0	27.0	83.7	63.4	63.0	785.4
Utility Lot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	1.9
Municipal Reserve	0.0	0.0	0.0	0.0	0.0	12.8	0.0	0.0	6.8	1.2	20.7
Eco Industrial Park	0.0	0.0	0.0	0.0	0.0	19.6	0.0	0.0	8.5	0.7	28.7
Industrial and Business Service	183.3[1]	0.0	0.0	0.0	54.8	65.2	0.0	0.0	23.3	47.0	373.6
Environmental Reserve	0.0	0.0	0.0	0.0	0.0	6.9	0.0	0.0	11.7	0.0	18.6
Public Utility Lot	0.0	0.0	0.0	0.0	2.7	5.3	0.0	0.0	2.0	0.4	10.4
Water	0.0	0.0	0.0	0.0	0.0	6.3	0.0	0.0	0.0	0.0	6.3
Landfill	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8[2]	0.0	0.0	0.8
Commercial	0.0	0.0	44.3	39.8	0.0	2.4	20.0	0.0	0.0	0.0	106.4
Community Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.2	0.0	0.0	18.2
Major Park	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.6	0.0	0.0	17.6
Mixed Residential/ Commercial	0.0	0.0	0.0	0.0	0.0	4.6	7.0	0.0	0.0	0.0	11.6
Residential	0.0	81.7	0.0	0.0	0.0	0.0	0.0	47.1[3]	0.0	0.0	128.8
Total Area	183.3	81.7	44.3	39.8	57.5[3]	122.9[3]	27.0	83.7	52.2[3]	51.1[3]	743.3

Notes:

1. *Existing developed area in the Queens Business Park.*
2. *It is assumed that the historical land fill site can be remediated and reclaimed. The 0.8 Ha of land where the landfill is located will be covered with trees. The land fill set back area can be developed as residential area.*
3. *The area occupied by the planned local traffic roads are not included in the total Area in areas E, F,I and J.*

6.1.2 Short Term Servicing Strategy to Defer Major Capital Upgrades

The water servicing strategy for the three sections of land have been previously developed in the past servicing reports as well as in the 2013 Water Master Plan (Stantec, 2013), which are summarized in the following paragraphs:

In the existing Queens Business Park area (Section #1) that includes Areas A, E, F, I and J, the existing Queens Business Park Reservoir will continue to service these areas with an operational HGL of 955 m as indicated in the Queens Business Park Servicing Study Report (WSP, 2016).

Areas B, G and H are in the Hazlett Lake development area. The Hazlett Lake development area locates in the NE quadrant of Hwy 2 and 11A (Section #2) which is most suitable to reside in the new North Pressure Zone (NPZ) with a HGL of 930 m as indicated in the 2013 Water Master Plan and the 2016 North of Highway 11A Servicing Study. Water to these areas should be delivered from the proposed North Reservoir and Pump Station which requires a 900 mm diameter dedicated fill line from the WTPZ. However, due to the required high capital investment on the proposed North Reservoir and Pump Station and the 900 mm fill line, City would like to find another source to service Areas B, G and H and postponed the construction of the North Reservoir and the 900 mm fill line.

In the 2013 Water Master Plan, the proposed North Reservoir will have a 750 mm diameter discharge line along Hwy 11A to deliver water to the Stage 2 future reservoirs West of Hwy 2. The 750 mm fill line would then branch off to the existing Queens Reservoir with a 600 mm line. The other branch from the 750 mm fill line is proposed to be a 500 mm transmission main going to the area north of Hwy 11A. To defer the major capital upgrades, sections of proposed 600 mm and 500 mm fill lines can be constructed now to connect the Hazlett Lake development area and the Queens Business Park Reservoir transmission main. With a design operation 955 m HGL, the Queens Business Park Reservoir can service the Hazlett Lake development area with a Pressure Reducing Valve (PRV) installed in the transmission main connecting the Queens Park Pressure Zone and the Hazlett Lake development area. This will eliminate the need for a new North Reservoir in the short term until such a time development requires the North Reservoir.

Section #3 includes Areas C and D, locating in the NW quadrant area of Hwy 2 and 11A. The Hazlett West Water Service Plan Report (Stantec 2021) proposes that the Areas C and D be serviced by the Queens Business Park Reservoir with a 955 m HGL.

In summary, with an operational HGL of 955 m, it is possible to utilize the Queens Business Park Reservoir and Pump Station to service the proposed Areas A to J without the construction of the proposed North Reservoir and the dedicated 900 mm fill line to the North Reservoir. A hydraulic analysis was conducted to ensure the level of service can be met with this servicing strategy. The details on the hydraulic analysis and results are presented in the following sections.

6.1.3 Short Term Servicing Standards for New Growth Areas

As discussed in **Sections 2.5.1** to **2.5.7**, to maximize the use of the existing infrastructure capacity to service the proposed growth areas, some relaxations or deviations can be applied. The relaxations can increase the service limits of the Queens Business Park Reservoir and Pump Station to cover all the proposed growth areas. This will then allow the construction of the North Reservoir and the dedicated fill line to be deferred. The following table summarizes the key design criteria and the proposed deviations for providing adequate service levels to the proposed development in the three sections noted above.

Table 6-2: Design Criteria and Proposed Relaxations Summary

Parameter	Current Standard	Relaxed Standard	Unit	Note
Average Daily Demand (ADD) - Residential	375	300	Lpcd	Deviations are for short term servicing only
Maximum Daily Demand (MDD) - Residential	600	480	Lpcd	MDD/ADD=480/300= 1.6
Peak Hour Demand (PHD)- Residential	1200	870	Lpcd	PHD/ADD =870/300= 2.9
Non-Residential Unit ADD	0.15	0.10	L/s/ha	Deviation is for short-term planning without large water users
MDD to ADD peaking factor - non-Residential	2	2		
PHD to ADD peaking factor – Non-Residential	$10Q^{-0.45}$	$10Q^{-0.45}$		Q = ADD
Max. Velocity in Pipe at MDD+ fire	2.5*	No velocity constraint	m/s	The near future available fire flow will be calculated without velocity constraint
Max. Velocity in Pipe at PHD	1.5	3.0	m/s	3.0 m/s is the limit for the near future flow
Hazen-William C for PVC pipes	140	150	-	Deviation for short term servicing only
Minimum pressure during daily flows	300	250	kPa	
Minimum residual pressure in the system during fire flow	150	150	kPa	Critical safety value, no deviation is proposed
Design fire flow for single family area	75	75	L/s	No deviation proposed
Design fire flow for medium density residential area	150	150	L/s	No deviation proposed
Design fire flow for industrial/commercial area	233	233	L/s	No deviation proposed

Note: * City accepted 3.0 m/s as a relaxed standard in the Queens Business Park development servicing studies completed by WSP in 2016.

It should be noted that the criteria listed in Table 6-2 as relaxations or deviations are recommended only for the new water infrastructure required for the near future developments in the areas of interest in order to maximize the use of the existing infrastructure capacity. However, subdivision servicing planning and design should use the current standard design guideline values to size the local networks in these areas.

6.2 Demand Projections

Based on the development areas presented in Table 6-1 and the current standard and relaxed unit demands in Table 6-2, the demands in the growth areas of interest are projected. The projected demands in the growth areas of interest are presented in the following tables.

Table 6-3: Demand Projection for the Growth Areas – Current Standards

Demands	A	B	C	D	E	F	G	H	I	J	Total
ADD (m^3/d)	2,088.0	1,378.3	573.6	515.8	710.3	1,129.6	348.8	1,030.6	411.2	617.3	8,803.5
MDD (m^3/d)	3,960.0	2,205.2	1,147.2	1,031.6	1,420.7	2,259.2	697.5	1,743.1	822.4	1,234.6	16,521.6
PHD (m^3/d)	9,960.0	4,410.5	2,447.2	2,308.3	2,752.6	3,552.5	1,861.3	4,044.1	2,037.9	2,548.0	35,922.3
ADD (L/s)	24.2	16.0	6.6	6.0	8.2	13.1	4.0	11.9	4.8	7.1	101.9
MDD (L/s)	45.8	25.5	13.3	11.9	16.4	26.1	8.1	20.2	9.5	14.3	191.2
PHD (L/s)	115.3	51.0	28.3	26.7	31.9	41.1	21.5	46.8	23.6	29.5	415.8

Table 6-4: Demand Projection for the Growth Areas – Relaxed Standards

Demands	A	B	C	D	E	F	G	H	I	J	Total
ADD (m^3/d)	2,088.0	1,102.6	382.4	343.9	473.6	753.1	232.5	792.7	274.1	411.5	6,854.4
MDD (m^3/d)	3,960.0	1,764.2	764.8	687.7	947.1	1,506.1	465.0	1,331.1	548.3	823.0	1,2797.4
PHD (m^3/d)	9,960.0	3,197.6	1,958.0	1,846.9	2,202.4	2,842.4	1,489.2	3,043.4	1,630.5	2,038.7	30,209.2
ADD (L/s)	24.2	12.8	4.4	4.0	5.5	8.7	2.7	9.2	3.2	4.8	79.3
MDD (L/s)	45.8	20.4	8.9	8.0	11.0	17.4	5.4	15.4	6.3	9.5	148.1
PHD (L/s)	115.3	37.0	22.7	21.4	25.5	32.9	17.2	35.2	18.9	23.6	349.6

The demands in service area A are derived from the recorded flows in 2021 while the demands in other areas are projected values based on area, land use type and current and relaxed unit demand values.

6.3 Growth Scenario Model Analysis

6.3.1 Proposed Growth Scenarios

The City and Stantec collaborated to develop the growth scenarios in workshop meetings, and the following table outlines the scenarios that will be analyzed in the hydraulic model simulations.

Table 6-5 Growth Scenarios to be Modeled

Scenario No.	Service Area										Total New Area (ha)	Current Standard MDD (l/s)	Relaxed Standard MDD (l/s)
	A	B	C	D	E	F	G	H	I	J			
1	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	560.0	191.2	148.1
2	✔	✔	✔	✔	✔		✔				250.1	121.1	99.4
3	✔	✔	✔	✔			✔	✔			276.3	124.8	103.9
4	✔	✔	✔	✔							165.7	96.6	83.1
5	✔	✔	✔						✔		178.1	94.2	81.5
6	✔	✔	✔		✔						183.4	101.1	86.1

Note: The "✔" symbol implies that the area is included in the growth scenario. The total new area excludes the existing developed area in Area A.

As indicated in Table 6-5, the total projected MDD of the 10 areas (Area A to J) is 191 l/s with the current design standard and 148 l/s with the relaxed standard. Currently, the Queens Business Park Reservoir is filled at 50 l/s. To catch up the demands in the areas in a growth scenario, it is recommended that the City increase the fill rate to match the MDDs in the scenario.

6.3.2 Growth Modeling Setups

The calibrated existing system hydraulic model was modified to analyze the hydraulic performance of the proposed distribution network extending to the areas noted in the six growth scenarios. The following factors were considered when setting up the hydraulic model.

1. Areas A to J can be serviced by the Queens Business Park Reservoir. Areas A, C, D, E, F, I and J are in the Queens Business Park pressure zone with a HGL 955 m. Areas B, G and H are in the North Pressure Zone with a HGL 930 m.

2. Other pressure zone HGL set points are set at their designed values (WTPZ 919 m, EPZ 940 m, South Pressure zone 930 m) and for the growth scenarios. The updated water system pressure zones map is enclosed in **Appendix D**.

3. The proposed local watermains in Areas A to J were input into the hydraulic model based on the alignments and sizes in the three servicing plans: the Queens Business Park Servicing Study Report (WSP, 2016), the North of Highway 11A Servicing Study Report (AE, 2016) and the Hazlett Lake West Water Servicing Plan Report (Stantec 2021). It should be noted that at the

time of preparation of this report, the Hazlett Lake West Water Servicing Plan Report (Stantec 2021) was considered preliminary in nature and the City had not agreed upon or accepted any pipe sizing. Once the lands (areas C and D) are annexed in the future, an official servicing study will be completed by the developer to refine the water servicing strategy. During preparation of the official servicing strategy, the City will evaluate an alternative pipe size layout with the 400 mm line following Range Road 275, and a subdivision internal loop 300 mm in size. This layout can provide an equivalent level of service to the neighbourhood.

4. The transmission main connecting the distribution network in Areas B, G and H to Queens Business Park Reservoir and Pump Station discharge main is the proposed Stage 2 600mm fill line from Queens Reservoir across Highway 2, and then a 500 mm main across Highway 11A to the PRV chamber. The pipe downstream of the PRV chamber to Area B is a 400mm main.

5. Areas C and D are connected to the Queens Business Park distribution system with a proposed 400mm main across Hwy 11A.

6. Although it might be desirable to connect Hazlett Lake West (Areas C and D) to the Hazlett Lake areas (Areas B, G and H) with a new watermain crossing Highway 2 and a PRV to form a loop for better reliability, the hydraulic model is setup without this loop to defer capital upgrades. Note that, without this second Highway 2 crossing, Areas B, G and H will rely on a single transmission main without a loop.

7. The local mains of the areas are activated in the model when the areas are included in the specific growth scenario, which leads to an un-looped main in some scenarios, e.g., the mains in Area B will be a network without a loop if Area H and G are not developed.

8. The projected demands in an area are evenly assigned to the 'nodes' in the hydraulic model. All new pipes are assumed to be PVC pipes with C value of 140 in the current standard and 150 in the relaxed standard.

9. In the model built for the relaxed standard, the available fire flow in the MDD condition were calculated without the velocity constraint but with the 150 kPa pressure constraint in the hydraulic model in the relaxed standard simulations. In the simulation for the current standard, the velocity constraint of 2.5 m/s was applied to the new pipes for the available fire flow calculation.

10. The residual pressures in the PHD condition were calculated for the six growth scenarios for the current standard and relaxed standard.

11. Since the Queens Business Park Pump Station is to service all the growth areas, the filling rate to the Queens Business Park Reservoir should match the MDD in the growth scenarios.

12. The filling simulations are carried out with the MDD condition and the night fill condition. In the MDD condition, it is assumed that all the pressure zones are delivering MDD to end users. In the night fill conditions, the end users' demands are 1/3 of the MDD. The satellite reservoirs Glendale, Mountview and Lancaster are filled at 200 L/s, 120 L/s and 150 L/s respectively.

13. The population in the communities connected to the NRDRWSC regional line is projected to have annual growth rate of 1.4% as per Alberta Treasury Board and Finance's population projection whitepaper. The NRDRWSC water demand might grow slightly faster than population growth. At a 2% annual growth rate, the NRDRWSC demand might increase by 21% in ten (10) years. The projected NRDRWSC MDD (filling flow to the reservoirs in the participating communities) will increase from 189.3 l/s to 222.5 l/s. If the demand increases at 1.4%, it will take 14 years to reach the same level of demand. The additional future demands have been accounted in the model.

14. Within the existing development area within the City, it is assumed that the demands will also grow by 21% which accounts for the infill developments, redevelopments, and new subdivisions in the northeast area (Timberland North, Timber Ridge, Evergreen, Garden Heights, Emerson etc). The model has accounted for the future demands.

15. The hydraulic simulations were in steady state.

6.3.3 Model Results – Current Standard

The hydraulic performance of the six growth scenarios were simulated with the current servicing standard in WaterCAD and the results are presented in **Figure 6-2** to **Figure 6-25** following the table. The deficiencies that are not meeting the City's current servicing standard in the growth scenarios under different demands are identified in **Table 6-6**.

As indicated in the **Table 6-6** and **Figure 6-2** to **Figure 6-25**, under the current servicing standard, the lower than 250 kPa residual pressures in Edgar, Johnstone Park and Glendale subdivisions might lead to user complaints during the night filling period (12 am to 6 am) in which the Glendale reservoir is filled, and the Glendale pump station is shut off. The lowest pressure is 226 kPa in Edgar Industrial area and 234 kPa in Johnstone Park Springfield Crossing Estates. Note that in the current night filling period, the residual pressure dropped to approximate 260 kPa in the Edgar, Glendale and Johnstone Park without triggering a user complaint. However, it does not mean future lower pressures will not trigger a user complaint. Since these areas are located far away from the WTP, these low pressures cannot be easily addressed without high capital cost water infrastructure projects, e.g., North Reservoir construction and the 900 mm dedicated fill line to North Reservoir as recommended in the 2013 Master Plan. The residual pressure 162 kPa in the fill line to the Queens reservoir is of no concern. At the North Red Deer Regional Water Service Commission valve chamber, the minimum upstream residual pressure to the PSV is 600 kPa, higher than the shut off set point of 586 kPa. The regional flow supply will not be interrupted.

The available fire flows in the industrial and commercial Areas C, I, J and G in Growth Scenarios 1, 2, 5 and 6 are lower than the desired 233 L/s mainly due to the 2.5 m/s velocity constraint. Note that in the 2016 service study, the available fire flows in Areas I and J are higher than 233 L/s as a 3.0 m/s velocity constraint was used in the fire flow calculations. The pipe sizes in the 2016 service study are considered sufficient. Following **Section 6.3.4** will present higher available fire flows which were calculated without a velocity constraint.

During the MDD and PHD demand, there are nodes with residual pressure lower than 300 kPa but higher than 250 kPa; Central Park, Edgar, Johnstone and Glendale areas, which are worse than the existing system's lowest pressure 280 kPa. Although using 250 kPa as the minimum pressure is considered acceptable in some communities, it might trigger low pressure complaints from users who are used to slightly higher residual pressures in these areas. To avoid high capital projects and address the low pressure issues, the City might consider having the building owners install inhouse booster pumps in some buildings that requires higher pressure. It is suggested the City install some pressure loggers in the watermains in these areas to monitor the pressure as the development advances. The low pressure in the Night fill period, 12 am to 6 am, and can also be addressed in the same way.

The results presented in this section is based on the current servicing standard. Compared to the relaxed standard, the current standard can supply higher level of services. The next **Section 6.3.4** presents the hydraulic performance analysis results based on the relaxed standard, which can be considered as a sensitivity analysis.

In the hydraulic simulation, the bigger pumps (2X150 HP) in the Queens Business Park pump station were turned on to deliver the high fire flows in all the scenarios, which imply that the existing firm capacity of the Queens pump station is not sufficient for the future growth scenarios. A 150 HP pump should be added to the pump station to increase its firm capacity.

Table 6-6: Hydraulic Performance Issues Under Current Standard

Growth Scenario	AFF In MDD	MDD (Filling to Queens to meet the growth area MDDs)	Night Fill (12AM-6AM)	PHD	Pump Operation
1	Figure 6-2 Less than 233 L/s in Areas I and J due to velocity constraint.	Figure 6-3 Central Park, Edgar and Glendale areas have lower than 300 kPa pressure nodes	Figure 6-4 Johnstone Park, Glendale and Edgar have less than 250 kPa pressure nodes	Figure 6-5 Central Park, Edgar, and Glendale have lower than 300kPa nodes	Queens Pump Station needs to run 2x150HP and 1X100 HP pumps, need a new 150 HP for backup Other pump stations are operating within firm capacity
2	Figure 6-6 Less than 233 L/s AFF in Area G commercial area due to unlooped water pipe	Figure 6-7 Central Park, Edgar and Glendale have lower than 300kPa nodes	Figure 6-8 Edgar and Johnstone Park have lower than 250 kPa nodes	Figure 6-9 Central Park, Edgar, Johnstone and Glendale have lower than 300kPa nodes	Queens Pump Station needs to run 2x150HP and 1X100 HP pumps, need a new 150 HP for backup Other pump stations are operating within firm capacity
3	Figure 6-10 No issues	Figure 6-11 Central Park, Edgar and Glendale have lower than 300kPa nodes	Figure 6-12 Edgar and Johnstone Park have lower than 250 kPa nodes	Figure 6-13 Central Park, Edgar, Johnstone and Glendale have lower than 300kPa nodes	Queens Pump Station needs to run 1X75 HP 2x150HP and 1X100 HP pumps, need a new 150 HP for backup Other pump stations are operating within firm capacity
4	Figure 6-14 No issues	Figure 6-15 Central Park, Edgar and Glendale have lower than 300kPa nodes	Figure 6-16 Central Park, Johnstone Park, Edgar and Glendale have lower than 300kPa nodes	Figure 6-17 Central Park, Edgar and Glendale have lower than 300kPa nodes	Queens Pump Station needs to run 2x150HP and 1X100 HP, need a new 150 HP for backup Other pump stations are operating within firm capacity
5	Figure 6-18 175 – 228 L/s fire flows in Areas C, I, J	Figure 6-19 Central Park, Edgar Johnstone and Glendale have lower than 300kPa nodes	Figure 6-20 Central Park, Johnstone Park, Edgar, Glendale and Pines have lower than 300kPa nodes	Figure 6-21 Central Park, Edgar and Glendale have lower than 300kPa nodes	Queens Pump Station needs to run 2x150HP and 1X100 HP, need a new 150 HP for backup Other pump stations are operating within firm capacity
6	Figure 6-22 Lower than 233 L/s fire flows in Area C	Figure 6-23 Central Park, Edgar and Glendale have lower than 300kPa nodes	Figure 6-24 Central Park, Johnstone Park, Edgar, Glendale and Pines have lower than 300kPa nodes	Figure 6-25 Central Park, Edgar, Johnstone and Glendale have lower than 300kPa nodes	Queens Pump Station needs to run 2x150HP and 1X100 HP, need a new 150 HP for backup Other pump stations are operating within firm capacity