



**Municipality of Crowsnest Pass
Water Distribution System Master
Plan**

FINAL REPORT

January, 2008

Executive Summary

Stantec Consulting Ltd. was retained by the Municipality of Crowsnest Pass to complete a comprehensive Master Plan for the water distribution system. The objectives of this master plan include assessing the performance of the existing system, identify system deficiencies, and develop a long-term system growth strategy and 20-year Capital Improvement Program (CIP) for the sustainable growth and development of the Municipality of Crowsnest Pass.

A hydraulic model was developed to analyze the performance of the distribution system network. The model was developed using existing GIS databases, as-built drawings, data extracted from older distribution system models, and field measurements. Although the model does not represent the exact physical characteristics of the water distribution system, it provides a conceptual representation the actual system that adequately meets the analysis needs of a master planning study.

The existing distribution system was analyzed using the hydraulic model to measure the performance of the water distribution system under various scenarios, including, average day, maximum day, peak hourly and fire flow conditions in order to develop a list of system deficiencies.

System performance was also tested for the future system under similar scenarios including demands from proposed future growth areas. The model was then used to evaluate improvement options for the various deficiencies and to develop servicing strategies for the future growth areas.

The findings of the existing and future system assessments suggest several projects for inclusion within the capital improvement plan. The intent of these plans is to outline construction priorities based upon the present and future needs of the utility and the Municipality as a whole.

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A specific list of prioritized capital projects including their cost and the triggers that will determine the timing of implementation are provided in Section 6. The short-term capital improvement plan to address existing system deficiencies include several projects as follows (listed in order of importance):

- Blairmore Coleman Interconnect: Estimated Capital Cost = \$2,630,000
- Blairmore Transmission Main Improvement Estimated Capital Cost = \$3,360,000
- Blairmore Reservoir Looping Improvement Estimated Capital Cost = \$1,390,000
- Coleman - Connection to New Pressure Zone (A) Estimated Capital Cost = \$680,000
- Coleman - Connection to New Pressure Zone (B) Estimated Capital Cost = \$270,000
- Coleman Distribution System Improvement: Estimated Capital Cost = \$1,610,000
- Bellevue Distribution System Improvements Estimated Capital Cost = \$2,570,000
- Upgraded Bellevue Pump Station Estimated Capital Cost = \$240,000
- Blairmore Frank Interconnect Estimated Capital Cost = \$1,840,000

Total Estimated Capital Cost (Short-Term Capital Plan) = \$14,590,000

The long-term capital plan to accommodate future development with existing and new infrastructure includes improvements in the existing system, and new infrastructure as future development is anticipated:

Water Supply and Pumping

- Sentinel Reservoirs: Estimated Capital Cost = \$6,850,000
- Coleman Reservoir: Estimated Capital Cost = \$3,450,000
- Blairmore Reservoir: Estimated Capital Cost = \$3,840,000

Distribution System

- Hillcrest – Bellevue Interconnections Estimated Capital Cost = \$1,570,000

Total Estimated Capital Cost (Growth Related Capital Improvement Plan) = \$15,710,000

In addition to these improvements to the existing system, future development will also require significant infrastructure investment to support this growth. A conceptual growth servicing

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strategy is provided for future growth areas, noting the approximate costs to provide these integral services. Unit costs are calculated for each growth area in order to provide information in determining an approximate offsite funding requirement in each area. The total projected cost to construct infrastructure to support the development of the proposed 1,800 ha of developable area within the Municipality of Crowsnest Pass is \$52,960,000. This equates to approximately \$30,000 per hectare of developable land.

The individual area offsite costs (on a per hectare basis) are summarized as follows:

Area Description	Area (ha)	Cost per hectare
Sentinel Growth Area	854	\$26,000
Coleman-Blairmore Growth Area	757	\$34,000
Bellevue Growth Area	100	\$22,000
Hillcrest Growth Area	50	\$53,000
Total	1,761	\$30,000

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1.0 Introduction

1.1 STUDY BACKGROUND

Stantec Consulting Ltd. was retained by the Municipality of Crowsnest Pass to complete a comprehensive Master Plan for the water distribution system. The objectives of this master plan include assessing the performance of the existing system, identify system deficiencies, and develop a long-term system growth strategy and 20-year Capital Improvement Program (CIP) for the sustainable growth and development of the Municipality of Crowsnest Pass.

The Water Distribution System Master Plan includes an assessment of the water distribution system and distribution pumping systems for the communities of Coleman, Blairmore, Belleview, Hillcrest, Frank and Sentinel. The scope of this study does not include an assessment or identify any existing deficiencies at the supply wells or raw water pump. An assessment of these facilities should be completed as a separate activity.

1.2 METHODOLOGY

The Water Master Plan for the Municipality of Crowsnest Pass consisted of 5 tasks, and these are documented as sections within this report.

1.2.1 Data Collection and Review

The following data was collected and assembled into a Geographic Information System (GIS) where applicable during the data collection task:

- Collection and Review of reports and studies
- SCADA flow / pressure data for all facilities as were available
- Recent Census Data and Population Projection Data
- Base mapping and topographic elevation data
- GIS files and databases including – recent utility system layers, land use zoning layers, legal parcel mapping, census tract boundaries, digital aerials / orthophotos, future land use mapping, etc.
- New infrastructure as-built drawings
- Fire Hydrant Testing (collected as part of this study)

Geographical Information System (GIS) databases and base mapping were prepared for use throughout the study to graphically display hydraulic model results and other data requiring visual presentation.

1.2.2 Model Update

A hydraulic model was updated for use in analyzing the performance of the existing collection system network. The model was developed using existing GIS databases, as-built drawings (where available), data extracted from the previous models. The model was then calibrated using data collected in the fire hydrant testing program.

1.2.3 Existing System Evaluation

The existing system was analyzed using the hydraulic model to measure the performance of the water distribution system under various conditions. The existing system performance was tested under average day, maximum day and peak hour conditions.

1.2.4 Future System Evaluation

The existing system was analyzed using the hydraulic model to measure the performance of the water system under future conditions. The existing system performance was tested under average day, maximum day and peak hour conditions with the additional demand loading from proposed future growth areas.

The model was then used to evaluate improvement options and water servicing strategies for the study areas.

1.2.5 Capital Improvement Plan Development

The findings of the existing and future system assessments will suggest projects for inclusion within the City's capital improvement plans. The intent of these plans is to outline construction priorities based upon the present and future needs of the utility and the City as a whole.

A specific list of prioritized capital projects including their cost and the triggers that will determine the timing of implementation are provided.

2.0 Data Collection

2.1 SYSTEM PERFORMANCE DATA COLLECTION

2.1.1 Hydrant Testing Program

In order to calibrate the existing system WaterCAD model, a total of thirteen hydrant tests were performed around the Municipality of Crowsnest Pass. For each test performed, a selected hydrant was measured for static pressure using a pressure gauge. A second hydrant close by was then opened and measured for flow using a pitot gauge.



Figure 2-1 shows the locations where hydrant tests were carried out. **Figure 2-2** shows a sample of the data collection form used in the hydrant testing program. The test locations are listed in **Table 2-1**.

Table 2-1 Hydrant Test Locations

Community	Test Number	Date:	Time:	Pressure Hydrant:	Flow Hydrant 1:	Flow Hydrant 2:
Coleman	1	Aug 04/06	9:00	C-H66	C-H62	C-H63
Coleman	2	Aug 04/06	10:00	C-H40	C-H37	C-H36
Coleman	3	Aug 04/06	10:30	C-H52	Not in GIS	-
Coleman	4	Aug 04/06	11:00	C-H16	C-H15	-
Coleman	5	Aug 04/06	12:00	C-H7	Not in GIS	-
Blairmore	6	Aug 08/06	11:00	BL-H68	BL-H67	BL-H66
Blairmore	7	Aug 08/06	11:30	BL-H40	BL-H53	BL-H52
Blairmore	8	Aug 08/06	11:45	BL-H24	BL-H23	BL-H22
Blairmore	9	Aug 08/06	12:00	BL-H21	BL-H20	-
Frank	10	Aug 08/06	12:15	FR-H10	FR-H8	FR-H9
Bellevue	11	Aug 08/06	2:00	BE-H21	BE-H22	BE-H20
Hillcrest	12	Aug 08/06	2:30	H-H23	H-H22	H-H14
Hillcrest	13	Aug 08/06	3:00	H-H14	H-H2	-

Residual pressure was measured from the first hydrant while the second hydrant was opened. Each hydrant test was then simulated in the WaterCAD model by placing the measured hydrant flow as a nodal demand, and then comparing the measured residual pressure to the model nodal pressure.

The test results are summarized in **Table 2-2**.

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Table 2-2 Hydrant Test Results

Test Number	Static Pressure	Hydrant Flow 1	Residual Pressure 1	Hydrant Flow 2	Residual Pressure 2
1	65	63.2	55	63.23	
2	70	49.99	50	31.62	45
3	110	70.70	65		
4	110	44.71	25		
5	75	46.89	45		
6	65	61.63	56	54.76	57
7	84	80.61	76	70.70	66
8	90	70.70	73	63.23	51
9	85	67.07	63		
10	90	61.63	47	49.99	24
11	86	54.76	36	42.42	21
12	83	42.42	27	39.99	13
13	99	42.42	67		

2.1.2 Blairmore Golf Course Flow Estimation

The Crowsnest Pass Golf & Country Club, located in Blairmore, uses treated municipal water to irrigate the golf course. In order to calculate demand scenarios to be used in the existing system water model an estimate of the water demand by the Crowsnest Golf & Country Club was required. Information about the existing irrigation system was gathered at the golf course including; system configuration, operating schedule, pump information, flow rates, distribution network attributes such as pipe diameter, material and elevations.

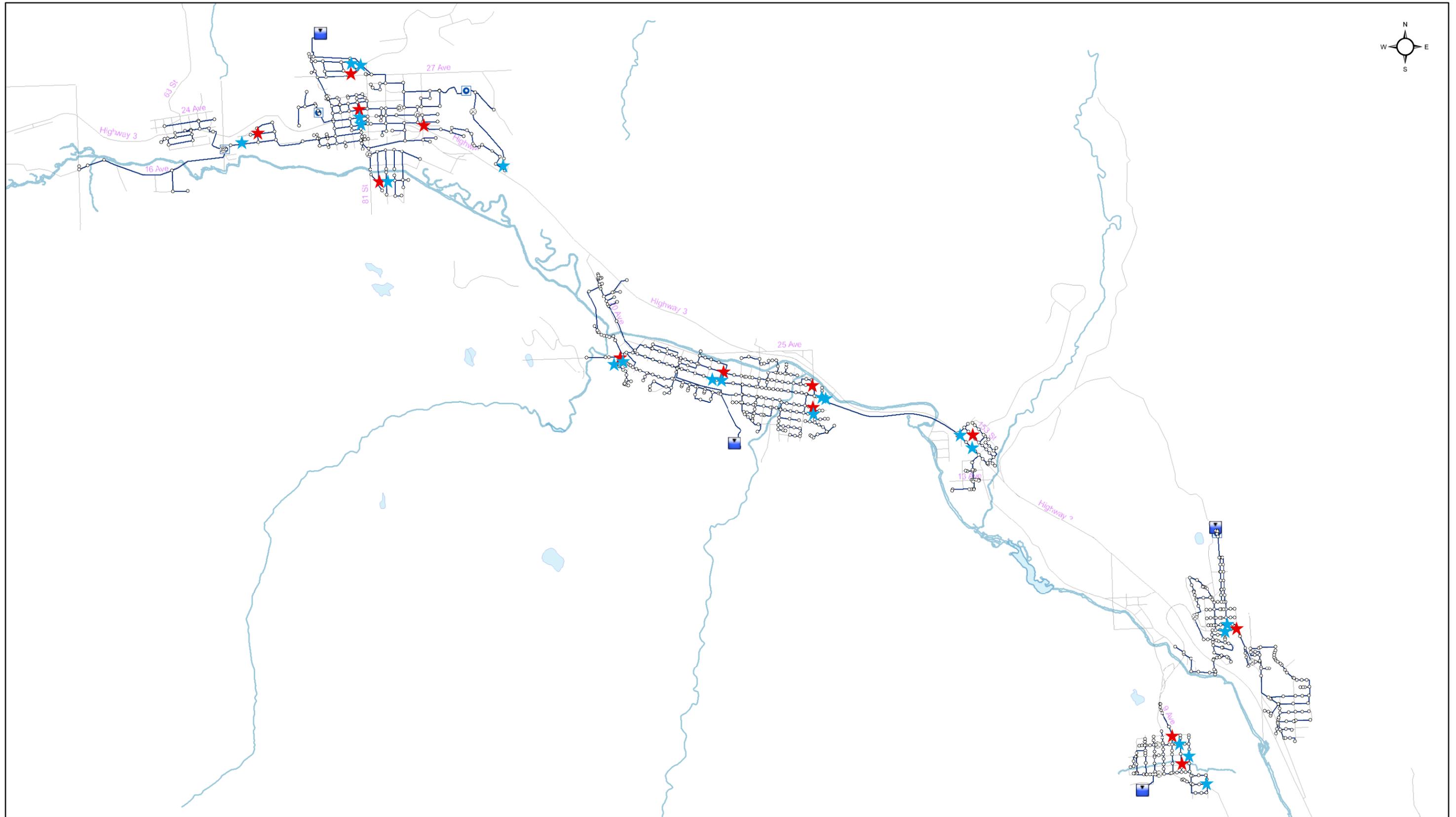
The total demand for the golf course was estimated to be 55,000,000 liters per year. This is an average daily flow of approximately 150,000 liters per day. This value was subtracted from the maximum day demand condition for Blairmore, which was calculated from the Blairmore water treatment plant records.

Note: Conversations with the Golf course superintendent state that the golf course is drilling groundwater wells to irrigate the course, to be operational in spring 2007. When the wells become operational, the only municipal water demand from the golf course will be for the clubhouse.

2.2 LIST OF FIGURES FOR SECTION 2.0

Figure 2-1 Hydrant Test Locations

Figure 2-2 Hydrant Test Data Collection Form



Stantec Consulting Ltd.
 290 - 220 4th Street South
 Lethbridge, AB T1J 4J7
 Ph: (403) 329-3344
 Fx: (403) 328-0664
 www.stantec.com

Legend

-  Flow Hydrant
-  Static Pressure Hydrant

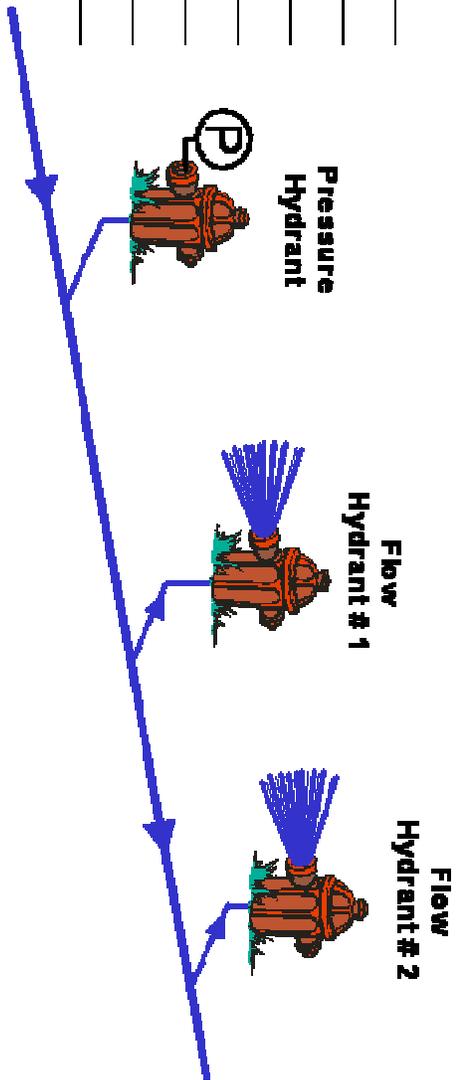
Client/Project
 Municipality of Crowsnest Pass
 Water Distribution Master Plan
 Figure No.
 2-1
 Title
 Municipality of Crowsnest Pass
 Fire Hydrant Test Locations



Dynamic Flow / Pressure Test



Loop ID: _____
 Date: _____
 Time: _____
 Operator: _____
 Pressure Hydrant: _____
 Flow Hydrant # 1: _____
 Flow Hydrant # 2: _____



Instructions:

- Record Static Pressure at Pressure Hydrant
- Open Flow Hydrant -F1- Measure Flow and Pressure
- Open Flow Hydrant -F2- Measure Both Flow and Pressure

	Before	After
Static Pressure =	<input type="text"/>	<input type="text"/>
F1 Flow =	<input type="text"/>	<input type="text"/>
Pressure 1 =	<input type="text"/>	<input type="text"/>
F1 Flow =	<input type="text"/>	<input type="text"/>
F2 Flow =	<input type="text"/>	<input type="text"/>
Pressure 2 =	<input type="text"/>	<input type="text"/>

Client/Project

Municipality of Crowsnest Pass
Water Distribution System Master Plan

Figure No.
2-2

Title

Example Data Collection Form

Legend



Stantec

3.0 Model Development

3.1 MODEL SELECTION

The software package WaterCAD V8 by Bentley (formerly Haested Methods) was used for the development of the water distribution model for the Crowsnest Pass Water Master Plan.

The WaterCAD model is used for analysis of complex pressurized pipe networks, such as municipal water distribution systems. WaterCAD can be used to perform a variety of functions, including steady-state and extended-period simulations of pressure networks with pumps, tanks, control valves, and more.

3.2 WATER MODEL UPDATE

The existing WaterCAD model that was previously developed for the Municipality of Crowsnest Pass was updated to include infrastructure that was not included in previous versions of the model.

Each of the hydraulic models that were developed during previous planning efforts were combined for use in this study. One model for the entire Municipality of Crowsnest Pass allows for testing of scenarios that are not possible with separate hydraulic models.

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3.2.1 Water Model Demands

Historical water demands for the Municipality of Crowsnest Pass were reviewed for use in the updated water model. 2005 water demands were used for the analysis of the existing water distribution system. **Table 3-1** summarizes the overall water use for the Municipality of Crowsnest Pass.

Table 3-1 2005 Water Demands

	Coleman (m³/day)	Blairmore (m³/day)	Bellevue (m³/day)	Hillcrest (m³/day)	Total MCNP (m³/day)
AVG. of Average Day Demand (ADD)	1,719	5,103	848	591	8,261
MAX. of Average Day Demand (ADD)	2,378	6,380	1,394	893	11,045
AVG. of Maximum Day Demand (MDD)	2,744	7,105	1,252	852	11,954
MAX. of Maximum Day Demand (MDD)	4,084	10,153	2,509	1,495	18,241
Multiplier (Avg of ADD to Avg of MDD)	1.60	1.39	1.48	1.44	1.37
Multiplier (Avg of ADD to Max of MDD)	2.38	1.99	2.96	2.53	2.21
Peak Hour Demand (PHD) [2 x MDD]	8,168	20,306	5,018	2,990	36,482

Table 3-2 summarizes the per capita water uses fro each community in the Municipality of Crowsnest Pass.

Table 3-2 Per Capita Water Use

	Coleman (l/cap/day)	Blairmore (l/cap/day)	Bellevue (l/cap/day)	Hillcrest (l/cap/day)	Total MCNP (l/cap/day)
Population (2001), UMA	<i>2,565</i>	<i>2,411</i>	<i>1,009</i>	<i>802</i>	6,787
ADD per Capita	670	2,117	840	736	1,217
MDD Per Capita	1,070	2,947	1,241	1,063	1,761
PHD Per Capita	3,184	8,422	4,973	3,728	5,375

3.2.2 Water Model Calibration

The water distribution system hydraulic model was calibrated using flow and pressure measurements from the data collection program.

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3.2.2.1 Calibration Results

Figure 3-1 is a map of the locations of calibration points in the model. Each corresponds to a point in the model where pressure measurements were taken.

Figure 3-2 and **Figure 3-3** show static and residual calibration results for each of the calibration points.

Table 3-3 is a summary of the calibration results for the existing system static pressure measurements. The demand during the test period was assumed to be the current Maximum Day Demand.

Table 3-3 Static Calibration Results Summary

	Model Node	Test ID	Measured Hydrant Flow	Measured Static Pressure	Modeled Static Pressure	Difference	
Coleman	CM-N-4	Test 1	0	60	57.2	2.8	5%
	CM-J-59	Test 2	0	70	74.7	-4.7	-7%
	CM-J-94	Test 3	0	110	110.5	-0.5	0%
	CM-J-132	Test 4	0	110	103.5	6.5	6%
	CM-J-28	Test 5	0	80	80.2	-0.2	0%
Blairmore	BL-N-113	Test 6	0	60	53.9	6.1	10%
	BL-N-135	Test 7	0	84	78.5	5.5	7%
	BL-N-140	Test 8	0	90	84.4	5.6	6%
	BL-N-178	Test 9	0	85	81.0	4.0	5%
Frank	F-N-17	Test 10	0	90	79.4	10.6	12%
Bellevue	BE-J-18	Test 11	0	86	78.2	7.8	9%
Hillcrest	H-N-55	Test 12	0	83	86.3	-3.3	-4%
	H-N-63	Test 13	0	99	96.0	3.0	3%

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Table 3-4 is a summary of the calibration results for the existing system residual pressure measurements. The demand during the test period was assumed to be the current Maximum Day Demand.

Table 3-4 Residual Pressure Calibration Results Summary

	Model Node	Test ID	Measured Hydrant Flow	Measured Static Pressure	Modeled Static Pressure	Difference	
Coleman	CM-N-4	Test 1	63	55	47.5	7.5	14%
	CM-J-59	Test 2	50	54	70.6	-16.6	-31%
	CM-J-94	Test 3	71	65	69.3	-4.3	-7%
	CM-J-132	Test 4	45	25	65.3	-40.3	-161%
	CM-J-28	Test 5	47	45	62.5	-17.5	-39%
Blairmore	BL-N-113	Test 6	62	56	48.0	8.0	14%
	BL-N-135	Test 7	81	76	62.3	13.7	18%
	BL-N-140	Test 8	71	73	55.0	18.0	25%
	BL-N-178	Test 9	67	63	49.0	14.0	22%
Frank	F-N-17	Test 10	62	47	16.4	30.6	65%
Bellevue	BE-J-18	Test 11	55	36	26.0	10.0	28%
Hillcrest	H-N-55	Test 12	42	27	51.2	-24.2	-90%
	H-N-63	Test 13	42	67	24.7	42.4	63%

In general, the model is providing a reasonable representation of pressures in the water distribution system. Much of the error is due to a lack of overall system data during testing periods.

The level of calibration is sufficient for master planning purposes. As the system is upgraded and SCADA capabilities are expanded additional data should be collected. The data should include:

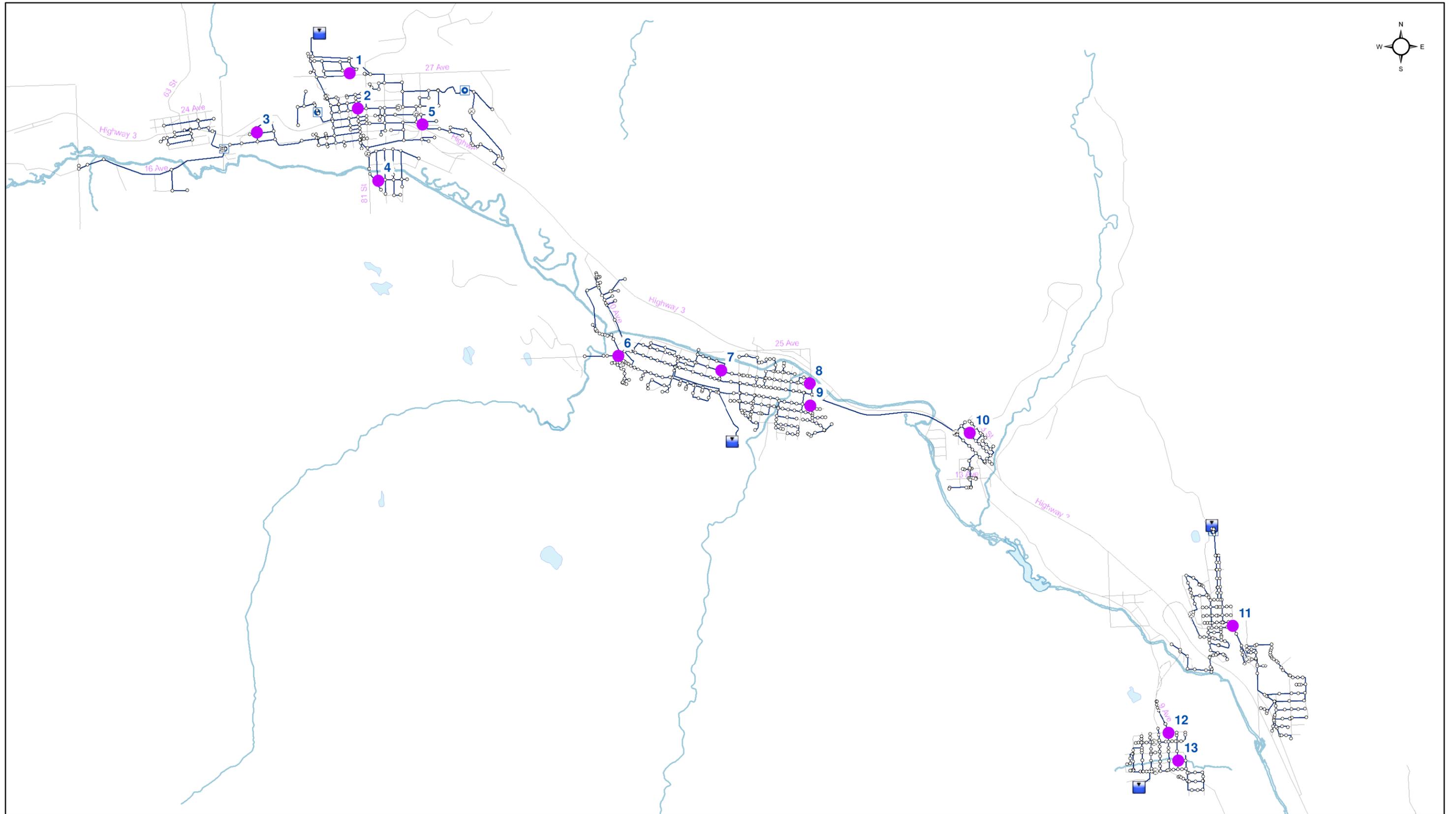
- Data collection at 5 min intervals (10 – 15 minutes may be used to minimize data storage requirements)
- Pressures, flows at pumps
- Levels, inflows and outflows at reservoirs

3.3 LIST OF FIGURES FOR SECTION 3.0

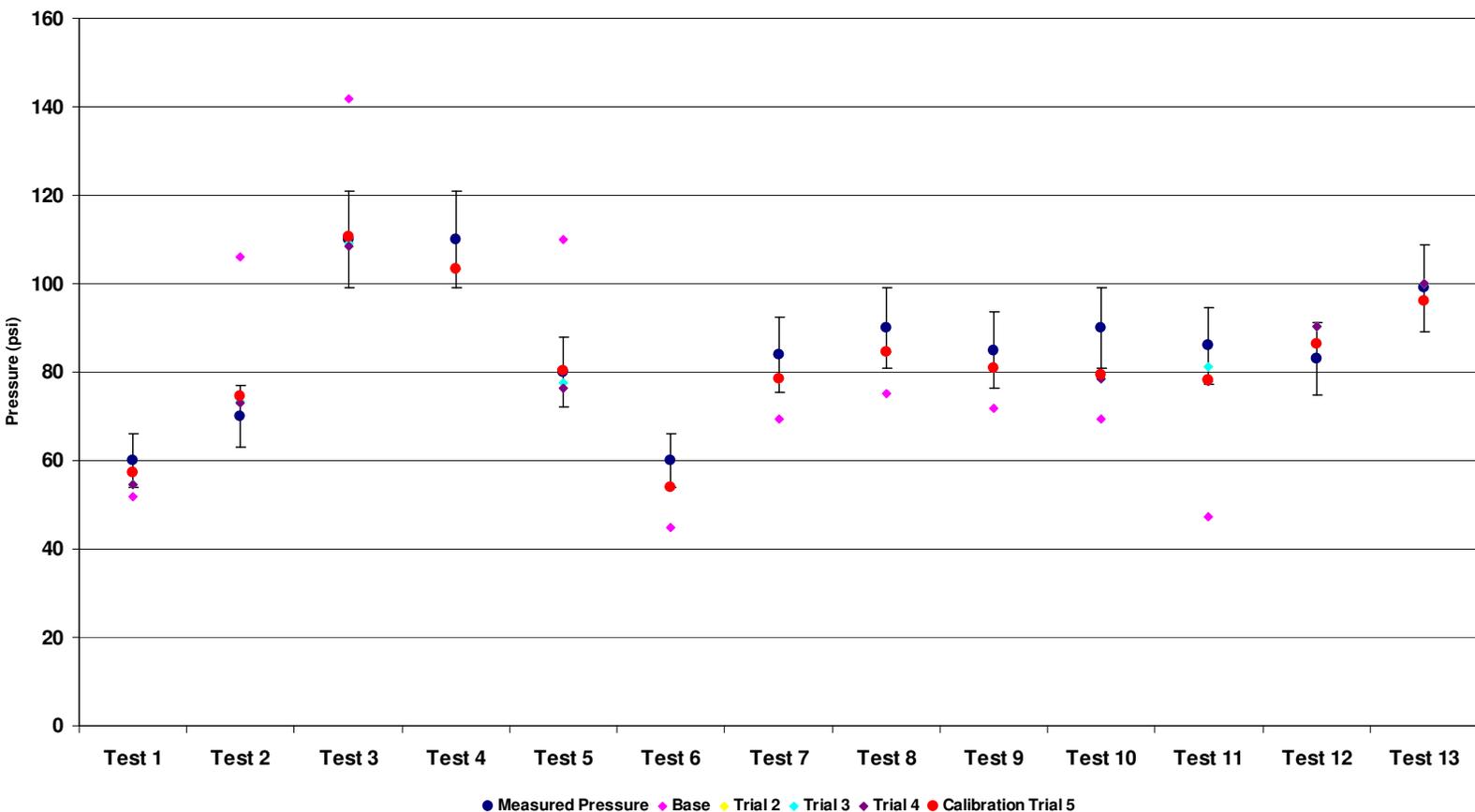
Figure 3-1 Calibration Test Locations

Figure 3-2 Water Distribution System Model Static Calibration

Figure 3-3 Water Distribution System Model Residual Calibration



Static Pressure Test



Legend



Client/Project

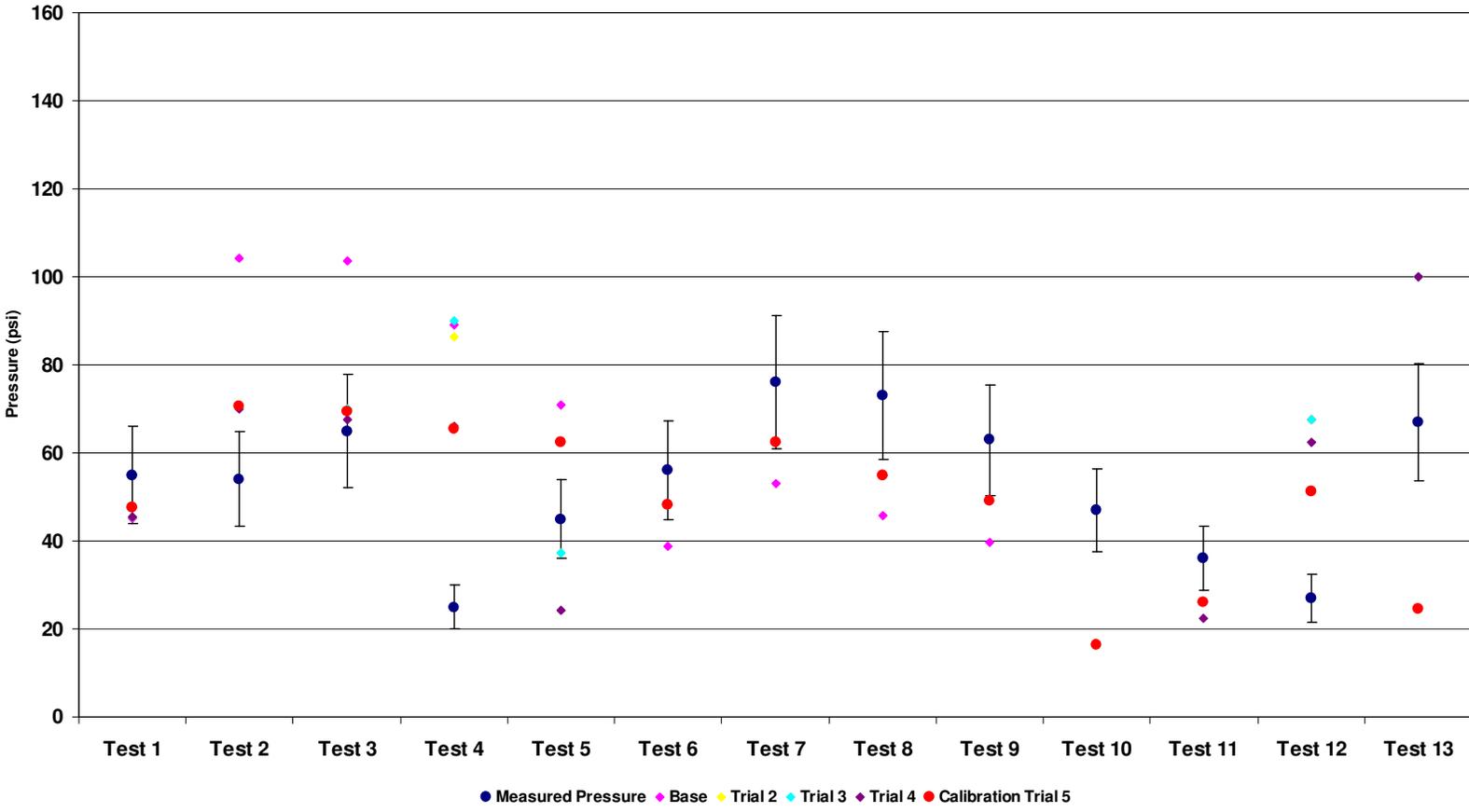
Municipality of Crowsnest Pass
Water Distribution System Master Plan

Figure No.
3-2

Title

Water Distribution System Model
Static Calibration

Residual Pressure Test



Legend



Client/Project

Municipality of Crowsnest Pass
Water Distribution System Master Plan

Figure No.
3-3

Title

Water Distribution System Model
Residual Calibration

4.0 Existing System Evaluation

4.1 EXISTING SYSTEM CHARACTERIZATION

The existing Municipality of Crowsnest Pass Water Distribution System provides service to approximately 6,000 customers. The water system is divided by each of the individual communities in the Municipality of Crowsnest Pass. Each of the individual communities is serviced by a separate distribution system. The one exception is the connection from Blairmore to Frank. **Figure 4-1** shows the general arrangement of the water distribution system of the Municipality of Crowsnest Pass.

4.1.1 Distribution System Piping

4.1.1.1 Pipe Diameters

There are pipe diameters that are present in the Crowsnest Pass water distribution system. The following table outlines the pipe diameters and its percentage of the total make up of the Crowsnest Pass system. **Table 4-1** summarizes the pipe diameter breakdown in the water distribution system

Table 4-1 Pipe Diameter Breakdown

Diameter	Bellevue	Blairmore	Coleman	Frank	Hillcrest	MCNP	%
100	1,379	1,596	4,687	89		7,750	17.7%
150	9,109	11,690	15,124	2,394	5,467	43,786	60.0%
200	2,082	6,751	3,119	343	325	12,620	17.3%
250	34	968	5,342		235	6,579	9.0%
300		558		21		579	0.8%
350			361			361	0.5%
400		1,333				1,333	1.8%
Total	12,605	22,897	28,633	2,847	6,028	73,009	100.0%

More than 75% of the pipe currently installed in the Municipality of Crowsnest Pass is less than 200 mm diameter pipe. **Figure 4-2** shows the location and distribution of pipe diameters in the Municipality of Crowsnest Pass.

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4.1.1.2 Pipe Materials

There are pipe materials that are present in the Crowsnest Pass water distribution system. **Table 4-2** outlines the pipe material and it's percentage of the total make up of the Crowsnest Pass system.

Table 4-2 Pipe Material Breakdown

Material	Bellevue	Blairmore	Coleman	Frank	Hillcrest	MCNP	%
Cast Iron		11,675	2,749			14,424	19.8%
Ductile Iron	10,506	7,159	15,809	2,594	5,276	41,343	56.6%
Galvanized Iron		87				87	0.1%
PE			34			34	0.0%
PVC	2,099	3,484	10,041	253	752	16,630	22.8%
Steel		492				492	0.7%
Total	12,605	22,897	28,633	2,847	6,028	73,009	100.0%

Ductile and Cast Iron compose more than 75% of the pipe currently installed in the Municipality of Crowsnest Pass. **Figure 4-3** shows the location and distribution of pipe material in the Municipality of Crowsnest Pass.

4.1.1.3 Facilities

Figure 4-4 shows the location of facilities in the existing distribution system

4.1.1.3.1 Reservoirs

The Municipality of Crowsnest Pass water distribution system includes four reservoir storage sites. **Table 4-3** provides a summary of the available potable storage in the existing water distribution system.

Table 4-3 Potable Storage Summary

	Current Available Storage		Elevation
	Imperial Gallons	Cubic Meters	Meters
Coleman Reservoir	2,000,000	9,092	
Blairmore Reservoir	3,000,000	13,638	
Hillcrest Reservoir	500,000	2,273	
Bellevue Reservoir and Pump Station	3,000,000	13,638	
Frank Fire Protection Reservoir*	10,000	45	n/a

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4.1.1.3.2 Pump Stations

Pump station locations are shown on **Figure 4-4** .

4.1.1.3.3 Pressure Reducing Stations

The remaining elements of the water distribution system include the wide variety of valves, service connections, hydrants, and other miscellaneous appurtenances and fittings.

There are 11 pressure reducing valves (PRV) in the system. **Table 4-4** lists the valve names and pressure set points used in the hydraulic modeling of the system. PRV locations are shown on **Figure 4-4**.

Table 4-4 PRV Model Data

Model Label	Community	Elevation (m)	HGL (m)	Pressure Setting (psi)
PRV-15	Bellevue	1,292.80	1,363.22	100
PRV-19	Bellevue	1,295.00	1,365.42	100
PRV-1	Coleman	1,322.00	1,392.42	100
PRV-2	Coleman	1,346.00	1,391.78	65
PRV-4	Coleman	1,349.00	1,394.78	65
PRV-5	Coleman	1,310.00	1,380.42	100
PRV-19	Coleman	1,351.00	1,396.78	65
PRV-17	Coleman	1,361.00	1,431.42	100
PRV-14	Frank	1,284.50	1,354.92	100
PRV-16	Hillcrest	1,300.80	1,371.22	100
PRV-18	Hillcrest	1,299.70	1,370.12	100

Based on GIS and CAD mapping the Municipality of Crowsnest Pass currently has 215 fire hydrants in its system. A typical fire hydrant can effectively service an area within a radius of 75 m or a linear hydrant spacing of 150 m as illustrated on **Figure 4-5**. There are significant areas throughout the Municipality of Crowsnest Pass that are not protected by the service of fire hydrants.

4.2 PERFORMANCE MEASURES

4.2.1 Node Pressure

Node pressures in the hydraulic model are simulated at the elevation of the main. In order to provide reasonable service to adjacent properties a minimum main pressure of 40 psi is required. **Table 4-5** shows the legend information for the node pressure performance measure.

Table 4-5 Node Pressures

Pressure	Map Color	Comments
< 40 psi (< 275 kPa)	●	Pressures less than 40 psi provide an unacceptable level of service.
40 - 50 psi (275 – 345 kPa)	●	Pressures between 40 and 50 psi provide the minimum acceptable level of service.
50 - 70 psi (345 – 480 kPa)	●	Good level of service
70 - 90 psi (480 – 620 kPa)	●	Good level of service
> 90 psi (> 620 kPa)	●	Pressures above 90 psi create special requirements for building plumbing systems.

4.2.2 Available Fire Flow

The model is used to calculate the total available fire flow available at the main. The model uses a minimum zone pressure of 150 kPa (22 psi) to determine the available flow.

The hydraulic model completes a series of calculations that iterate the total available fire flow at a node until such a time that the minimum pressure within that zone reaches 150 kPa. This ensures that backflow conditions do not occur within the distribution system putting customers at risk.

The model was not used to simulate the expected flow from a fire hydrant. There are specific hydraulic losses that occur at a hydrant that depend on:

- The length, material, diameter and condition of the lead;
- The diameter, type and condition of the branch valve, and;
- The type, brand and condition of the fire hydrant.

Because of this the total available fire flow that is calculated by the model is used as an indicator of the performance of the system. The available flow at a specific fire hydrant should be tested and verified in the field.

Table 4-6 shows the legend information for the node pressure performance measure.

Table 4-6 Available Fire Flow

Available Fire Flow	Map Color	Comments
< 3,000 l/min (800 gpm)	●	Unacceptable level of service.
3,000 – 4,500 l/min (800 – 1,200 gpm)	●	Marginal level of service.
4,500 – 9,000 l/min (1,200 – 2,400 gpm)	●	
9,000 – 15,000 l/min (2,500 – 4,000 gpm)	●	
15,000 – 18,000 l/min (> 4,000 gpm)	●	Level of service preferred for institutional sites / industry etc.

4.3 EXISTING SYSTEM CAPACITY

4.3.1 Water Supply

The existing system storage was assessed based on the following criteria.

Required Fire Storage (V_{fire})

$$V_{fire} = Q_{fire} \times T$$

Q_{fire} = Required Fire Flow

T = Required Fire Flow Duration

Equalization Storage (V_{eq})

$$V_{eq} = Q_{ADD} \times 50\%$$

Q_{ADD} Average Day Demand

Emergency Storage (V_{emerg})

$$V_{emerg} = Q_{MDD} \times 25\%$$

Q_{MDD} Maximum Day Demand

Total ($V_{required}$)

$$V_{required} = V_{fire} + V_{eq} + V_{emerg}$$

Storage Surplus (Deficiency)

$$Deficiency = V_{available} - V_{required}$$

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Table 4-7 provides a summary of the current and required storage by community for the Municipality of Crowsnest Pass. The community of Hillcrest has a storage deficiency of 1,000 m³ (264,000 gal). The only other deficiency is the total available fire storage in Frank. This deficiency is offset by a water connection to Blairmore. There is more than enough storage throughout the rest of the system.

Table 4-7 Existing System Storage

	Current Available Storage		Required Fire Storage	Equalization Storage	Emergency Storage	Total	Storage Surplus (Deficiency)
	Imperial Gallons	Cubic Meters					
Coleman Reservoir	2,000,000	9,092	2,455	1,189	1,021	4,665	4,427
Blairmore Reservoir	3,000,000	13,638	2,455	3,190	2,500	8,145	5,493
Hillcrest Reservoir	500,000	2,273	2,455	447	374	3,275	(1,002)
Bellevue Reservoir	3,000,000	13,638	2,455	697	627	3,779	9,859
Frank Fire Protection Reservoir*	10,000	45	2,455			2,455	(2,409)
<i>Sentinel Reservoir</i>	<i>50,000</i>	<i>227</i>					

*The Frank storage reservoir is available for fire storage only.

4.3.2 Distribution System

The computer hydraulic model was run to analyze the performance of the existing water distribution system under different demand scenarios. The performance of the system was analyzed to determine the existing level of service throughout the Municipality of Crowsnest Pass.

4.3.2.1 Average Day Demand

Table 4-8 shows the distribution of various pressures throughout the Communities of the Municipality of Crowsnest Pass. Under average day demand conditions there are 6 nodes with pressures of less than 40 psi. There are over 413 nodes with pressures over 90 psi.

Figure 4-6 show the distribution of node pressures throughout the Municipality of Crowsnest Pass.

Table 4-8 Average Day Demand Node Pressure

		MCNP	Coleman	Blairmore	Frank	Bellevue	Hillcrest
< 40 psi	●	6	3	0	0	3	0
40 - 50 psi	●	14	4	8	0	2	0
50 - 70 psi	●	131	50	54	0	6	21
70 - 90 psi	●	313	58	170	9	38	38
> 90 psi	●	413	98	72	45	156	42

4.3.2.2 Maximum Day Demand

Table 4-9 shows the distribution of various pressures throughout the Communities of the Municipality of Crowsnest Pass. Under maximum day demand conditions there are 12 nodes with pressures of less than 40 psi. There are 265 nodes with pressures over 90 psi.

Figure 4-7 show the distribution of node pressures throughout the Municipality of Crowsnest Pass.

Table 4-9 Maximum Day Demand Node Pressure

		MCNP	Coleman	Blairmore	Frank	Bellevue	Hillcrest
< 40 psi	●	12	3	4	0	5	0
40 - 50 psi	●	23	8	15	0	0	0
50 - 70 psi	●	142	51	60	0	9	22
70 - 90 psi	●	435	63	214	34	75	49
> 90 psi	●	265	88	11	20	116	30

4.3.2.3 Maximum Day Demand with Fire Flow

Table 4-10 shows the distribution of available fire flow throughout the Communities of the Municipality of Crowsnest Pass. Under maximum day demand conditions there are 268 nodes with available fire flows less than 50 l/s (or . There are 265 nodes with pressures over 90 psi.

Figure 4-8 show the distribution of available fire flow throughout the Municipality of Crowsnest Pass.

Table 4-10 Maximum Day Demand Available Fire Flow

		MCNP	Coleman	Blairmore	Frank	Bellevue	Hillcrest
< 3,000 l/min	●	268	61	44	49	70	44
3,000 – 4,500 l/min	●	268	44	37	4	137	46
4,500 – 9,000 l/min	●	223	69	141	1	1	11
9,000 – 15,000 l/min	●	95	41	53	0	1	0
15,000 – 18,000 l/min	●	31	7	23	0	0	1

4.3.2.4 Peak Hour Demand

Table 4-11 shows the distribution of various pressures throughout the Communities of the Municipality of Crowsnest Pass. Under peak hour demand conditions there are 34 nodes with pressures of less than 40 psi. There are 131 nodes with pressures over 90 psi.

Figure 4-9 show the distribution of node pressures throughout the Municipality of Crowsnest Pass.

Table 4-11 Peak Hour Demand Node Pressure

		MCNP	Coleman	Blairmore	Frank	Bellevue	Hillcrest
< 40 psi	●	34	8	21	0	5	0
40 - 50 psi	●	64	18	35	5	5	1
50 - 70 psi	●	392	55	206	48	59	24
70 - 90 psi	●	256	52	42	1	100	61
> 90 psi	●	131	80	0	0	36	15

4.3.3 Distribution System Facilities

The Bellevue Pump station located adjacent to the reservoir and pump station has insufficient capacity to meet the predicted range of flows that are expected in the community. **Table 4-12** provides a summary of the water distribution system demands for the Bellevue pump station. **Figure 4-10** shows the pump curves from the hydraulic model along with the Bellevue water demands.

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Table 4-12 Demand Scenarios

Demand Scenario	Flow
Average Day Demand (ADD)	14.1 l/s
Maximum Day Demand (MDD)	28.1 l/s
Peak Hour Demand (PHD)	56.2 l/s
Required Fire Flow (FF)	83.3 l/s (<i>5000 l/min Residential FF</i>)
MDD + FF	111.4 l/s

The pump station has sufficient capacity to provide up to the peak hour demand while providing an acceptable level of service. The pump station is unable to meet the maximum day demand fire flow requirements.

4.4 EXISTING SYSTEM DEFICIENCIES

- Areas of Low Pressure

There is approximately 33.7 ha of serviced land throughout the Municipality of Crownsnest Pass that experiences pressures at peak hour demands of less than 40 psi. These areas are generally at higher elevations.

These low pressures areas will experience unacceptable levels of service particularly during high demand periods.

A combination of pipe capacity improvements and water supply improvements will raise the level of service in these areas.

- Areas of High Pressure

There is approximately 189.8 ha of serviced land throughout the Municipality of Crownsnest Pass that experiences pressures at average day demands greater than 90 psi.

High pressures may result in damage to private plumbing and will increase the chance of leaks in aging pipes.

- Fire Hydrant Coverage

Fire hydrants should generally be spaced at 150 m in most areas (maximum distance from a fire hydrant of 75m). Requirements for hydrant spacing increases in land use districts with higher value development.

Based on the fire hydrant inventory that was provided by the Municipality of Crownsnest Pass there is 238 ha of serviced land that is not within 75 m of a municipal fire hydrant.

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- Available Fire Flow

Throughout the Municipality of Crowsnest Pass there are issues with a lack of total available fire flow at the main. The required fire flow that was previously defined in the Sentinel Servicing report is 225 l/s or 13,500 l/min. For developed areas comprised of single family residential development the required fire flow may be somewhat less depending on the building form.

The lack of available fire flow is caused by a number of issues in the distribution system. The principal cause within the Municipality of Crowsnest Pass is a lack of pipe capacity. Throughout the pass a combination of aging pipes (roughness) and total capacity (diameter) create high energy losses during extreme flows (fire flow events). As a result the total fire flow available is lowered.

In other areas within the Municipality of Crowsnest Pass the lack of fire flow availability is due to the lack of looping within the water distribution system.

- System Data

Detailed analysis of the water distribution system is impacted by a lack of system operational data. As the SCADA system for the Municipality of Crowsnest Pass is expanded the data collection should be enhanced to include:

- Pressures and flows for pumps
- Levels, inflows and outflows for reservoirs.
- Data should be collected, summarized and stored at 5 – 15 min intervals, depending on data storage and archiving capabilities.

4.5 LIST OF FIGURES FOR SECTION 4.0

Figure 4-1 Municipality of Crowsnest Pass Water Distribution System

Figure 4-2 Water Distribution System Pipe Diameters

Figure 4-3 Water Distribution System Pipe Materials

Figure 4-4 Water Distribution System Facilities

Figure 4-5 Fire Hydrant Coverage

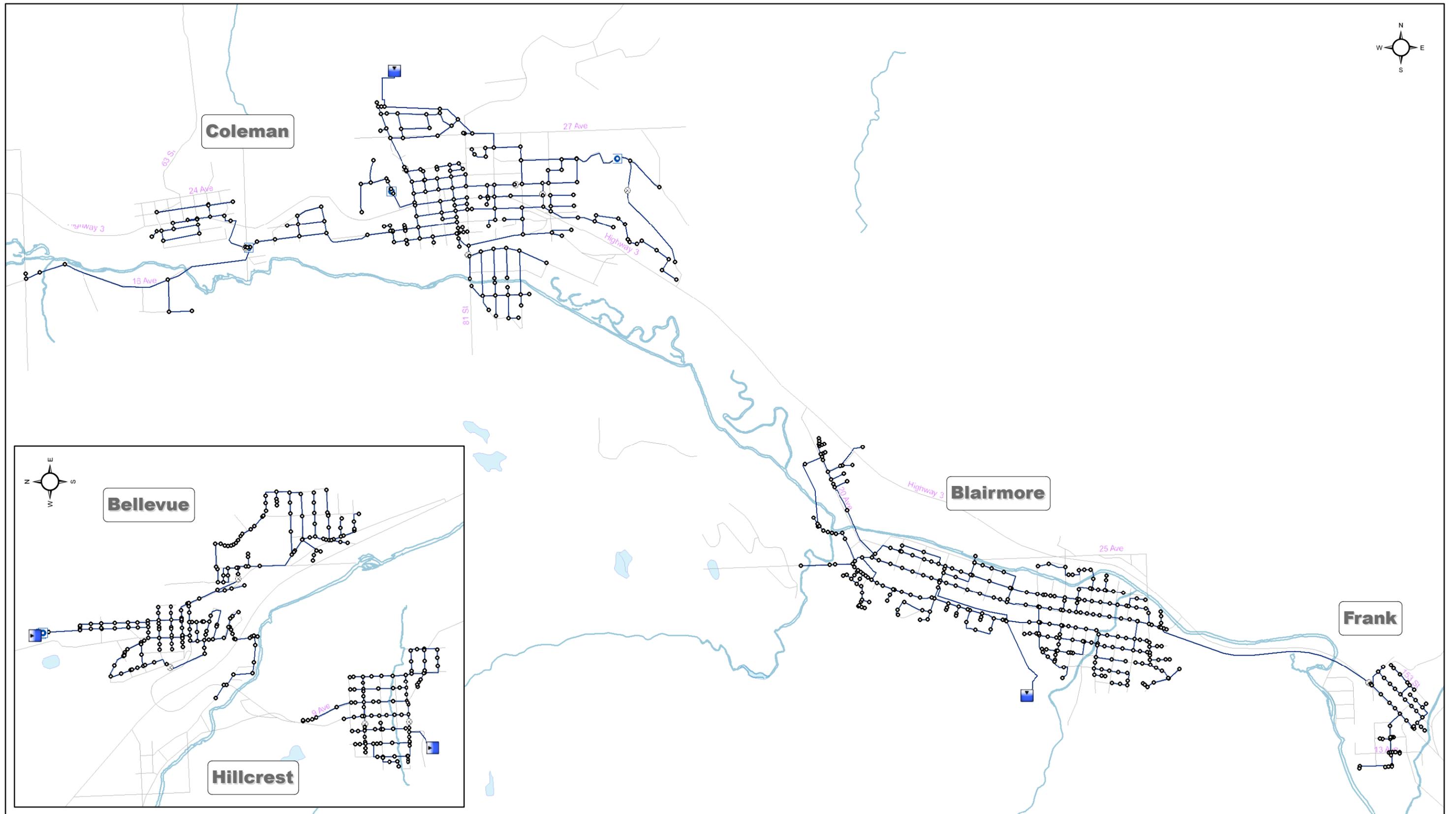
Figure 4-6 Average Day Demand – Node Pressure

Figure 4-7 Maximum Day Demand – Node Pressure

Figure 4-8 Maximum Day Demand – Available Fire Flow

Figure 4-9 Peak Hour Demand – Node Pressure

Figure 4-10 Bellevue Pump Station Capacity

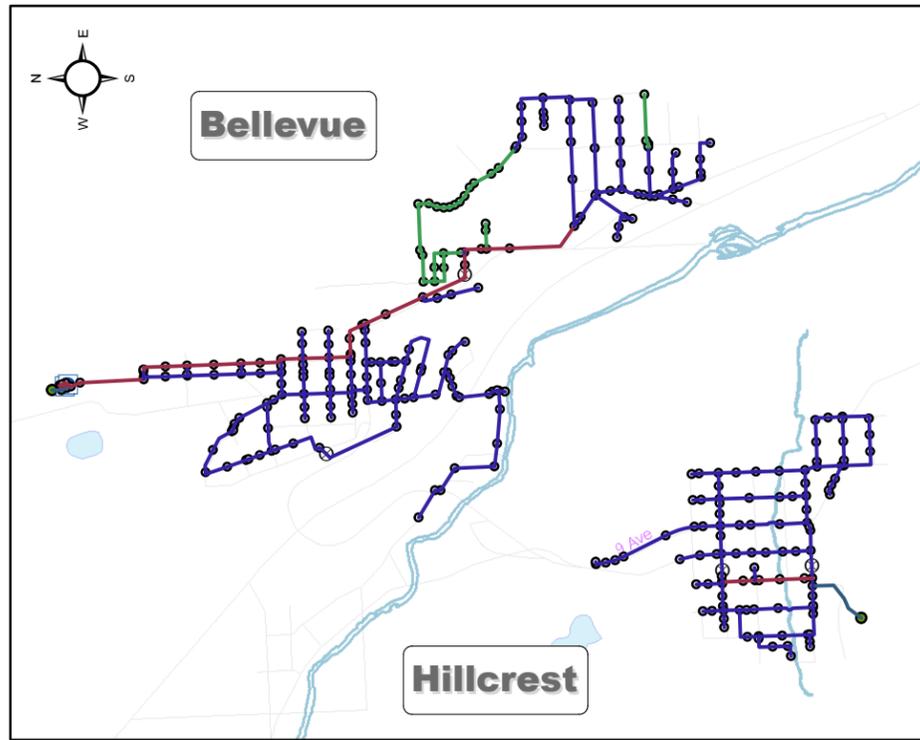
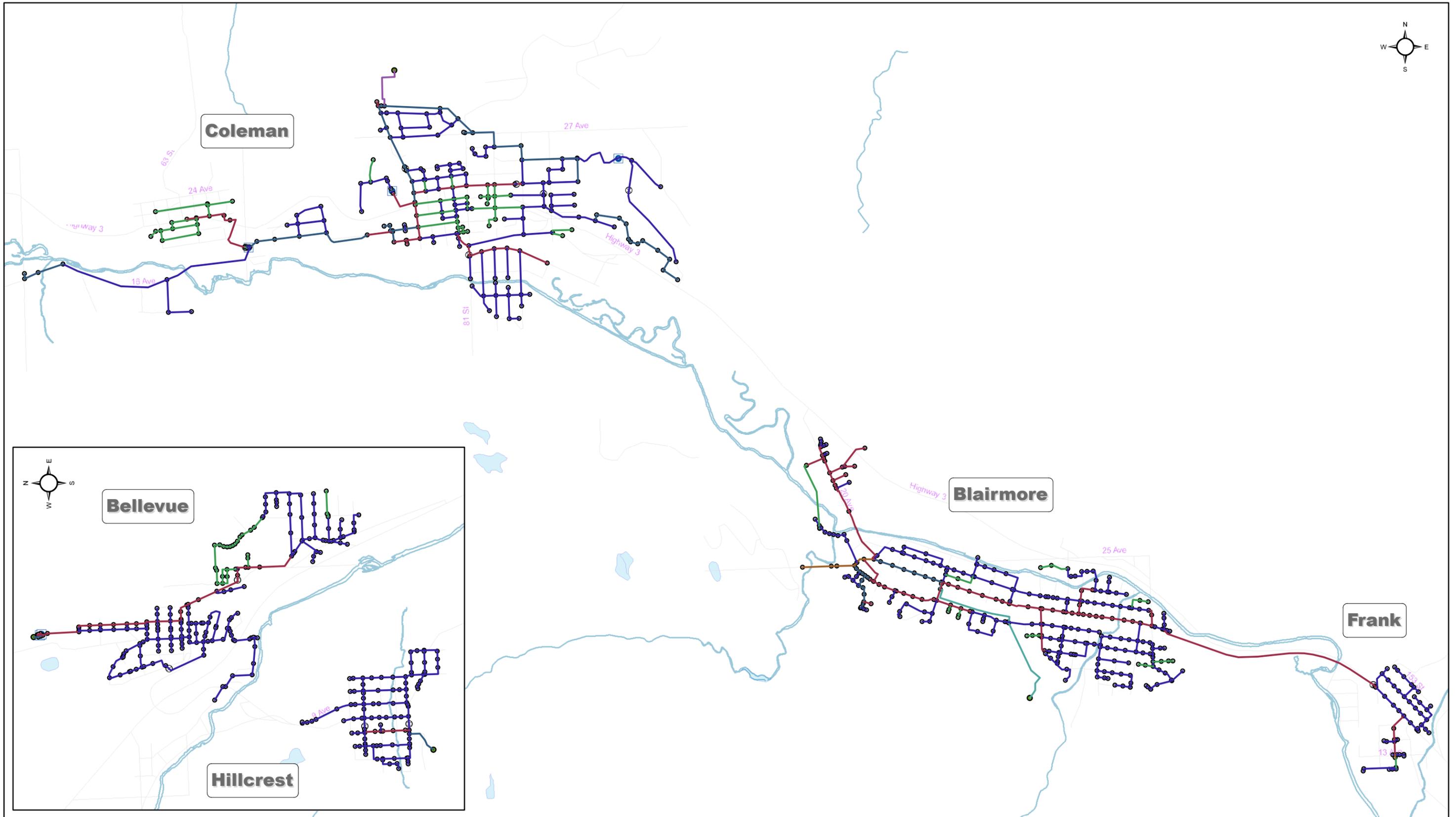
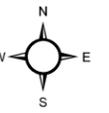


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 Water Distribution Master Plan
 Figure No.
 4-1
 Title
 Municipality of Crowsnest Pass
 Water Distribution System





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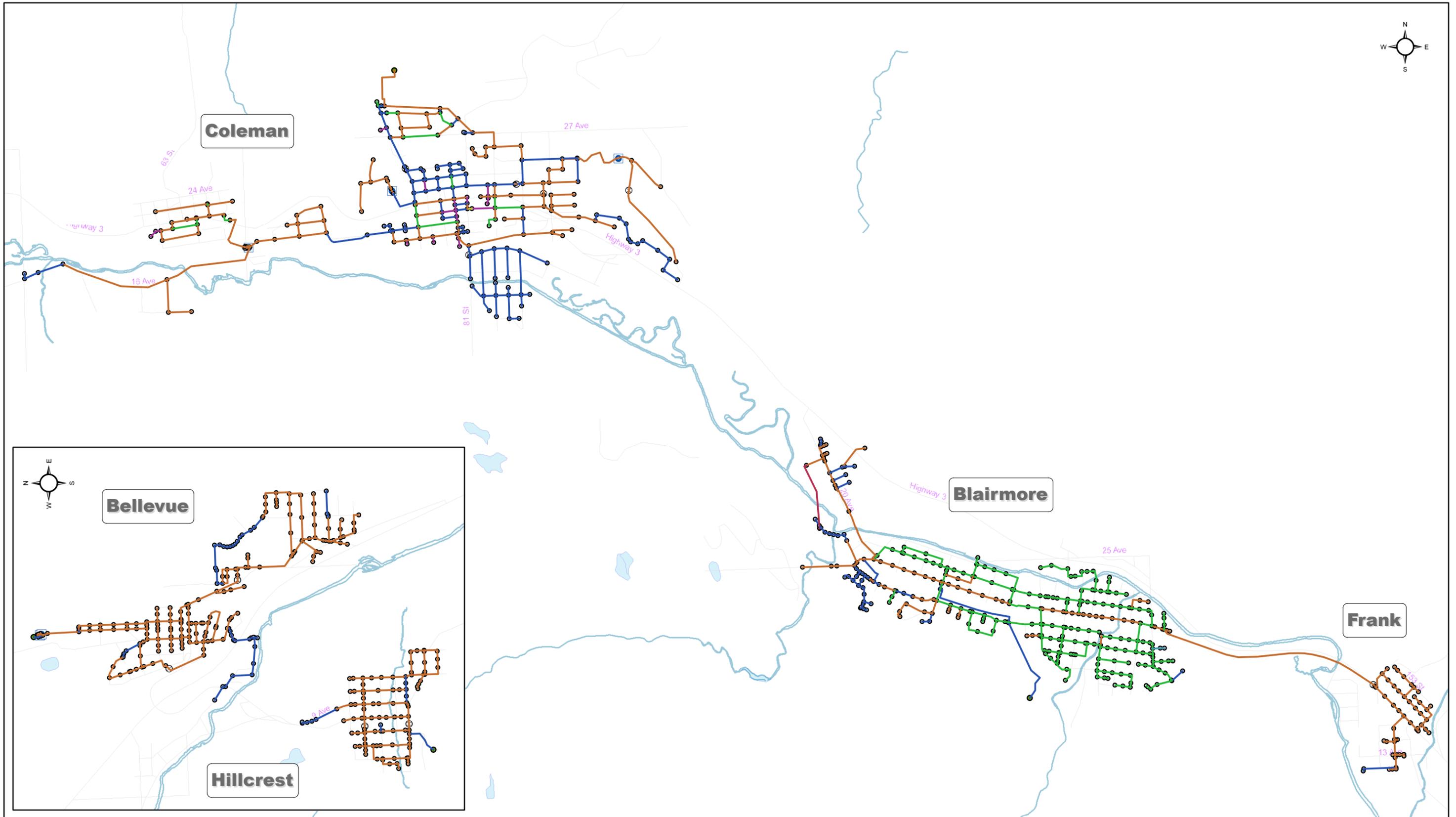
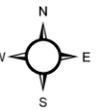
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Legend

	100		250
	150		300
	200		350
			400

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 Title
 Municipality of Crowsnest Pass
 Pipe Diameters





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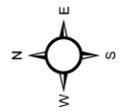
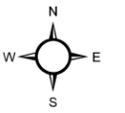
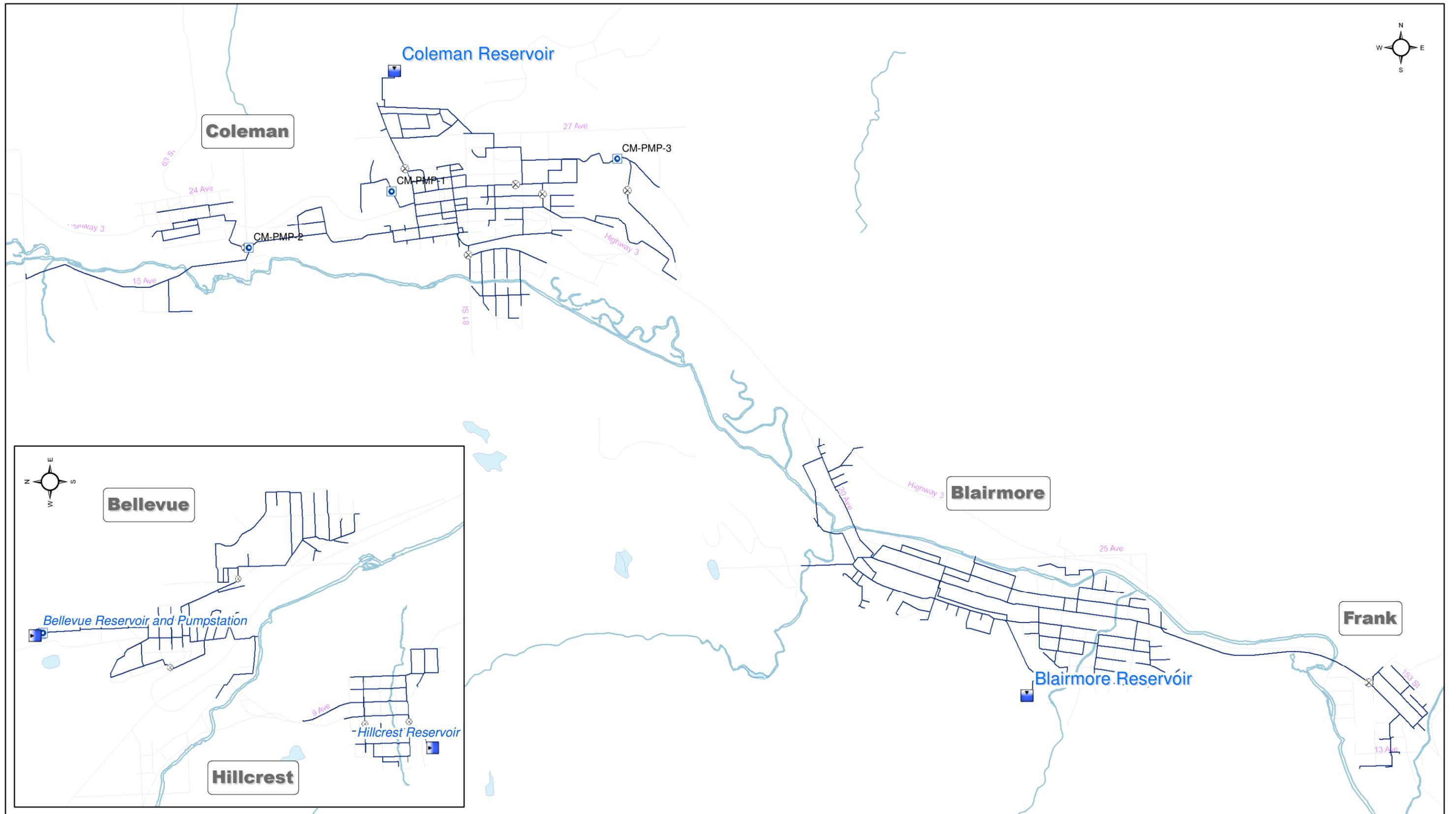
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Pipe Material		Galvanized iron	
	CI		PE
	Cast iron		PVC
	Ductile Iron		Steel

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 Figure No.
 4-3
 Title
 Municipality of Crowstest Pass
 Water Distribution Pipe Materials





Legend

- Reservoir
- Pump
- PRV

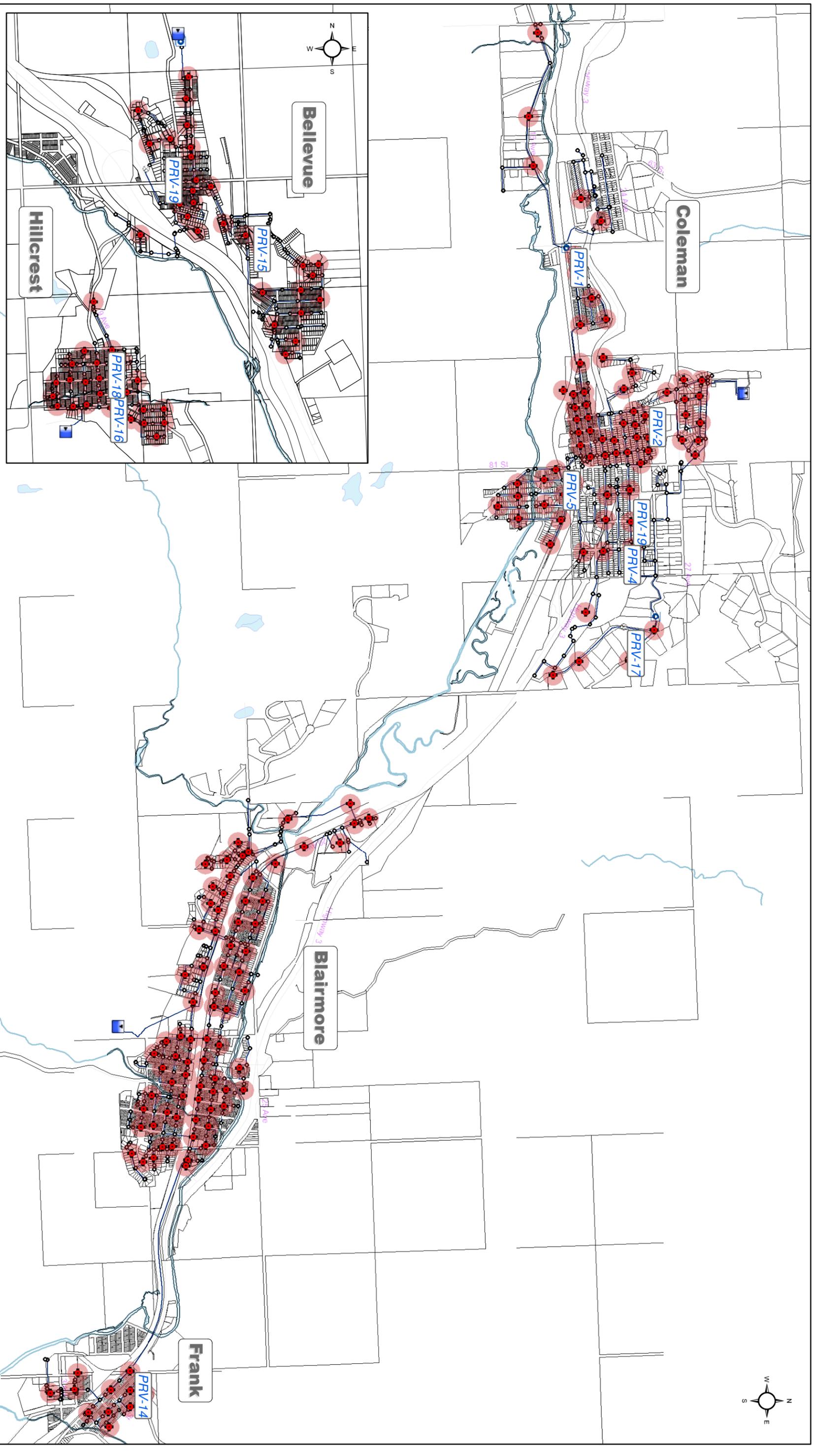


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 Title
 Municipality of Crowsnest Pass
 Water Distribution System Facilities





Legend

-  hydrant
-  zoning
-  transformer

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Water Distribution Master Plan

Figure No.
4-5

Title

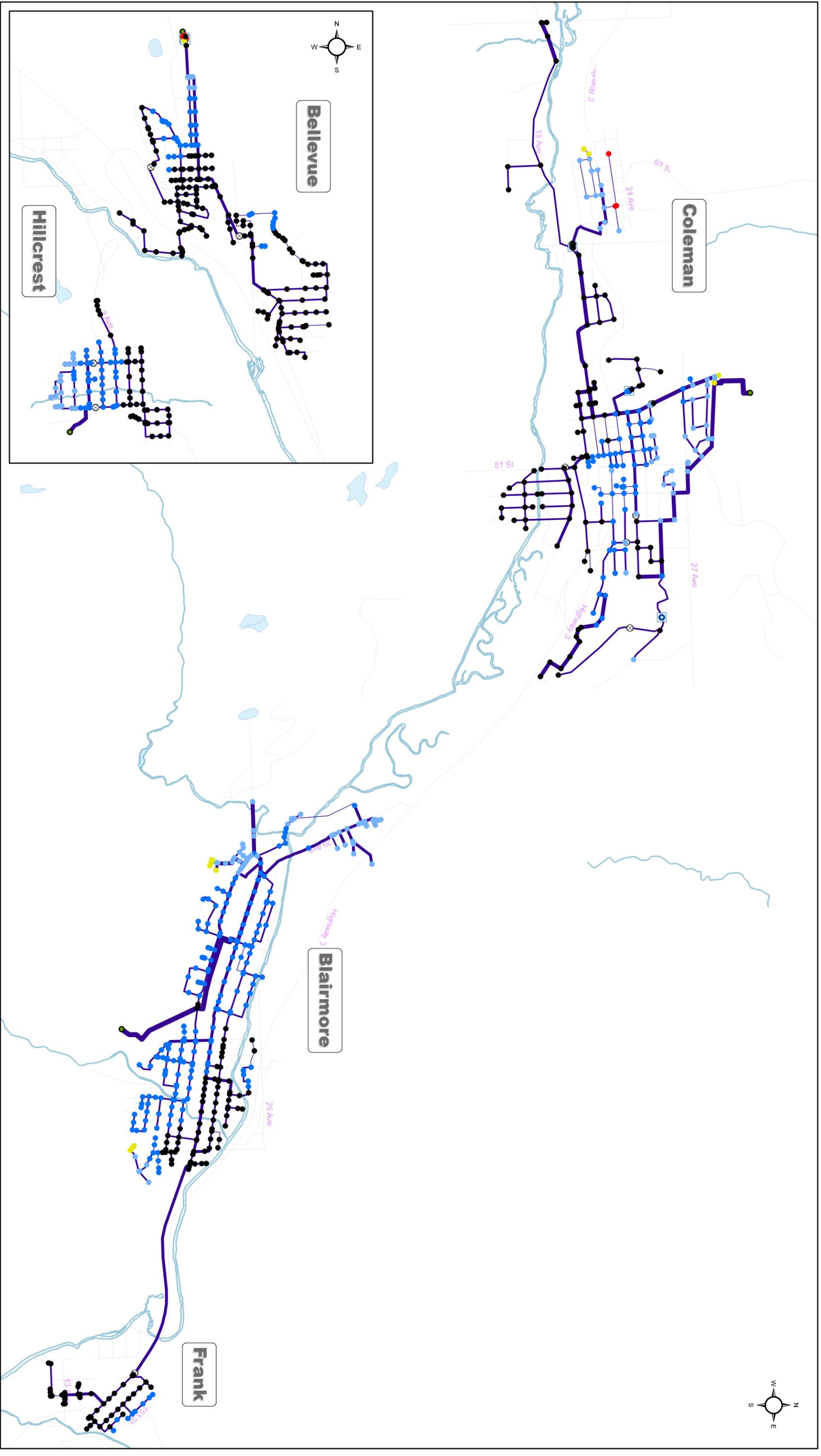
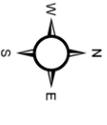
Municipality of Crownsnest Pass
Fire Flow Coverage



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Bellevue

Hillcrest

Coleman

Blairmore

Frank

Legend

- | | | |
|---|--|---|
| <ul style="list-style-type: none"> ● < 40 psi ● 40 - 50 psi ● 50 - 70 psi ● 70 - 90 psi ● > 90 psi | <ul style="list-style-type: none"> ⊗ PRV ⊕ Pump ⊙ Reservoir | <ul style="list-style-type: none"> — Pipe Diameter — Less than 100 mm — 100 mm - 150 mm — 150 mm - 200 mm — 200 mm - 300 mm — 300 mm - 400 mm |
|---|--|---|



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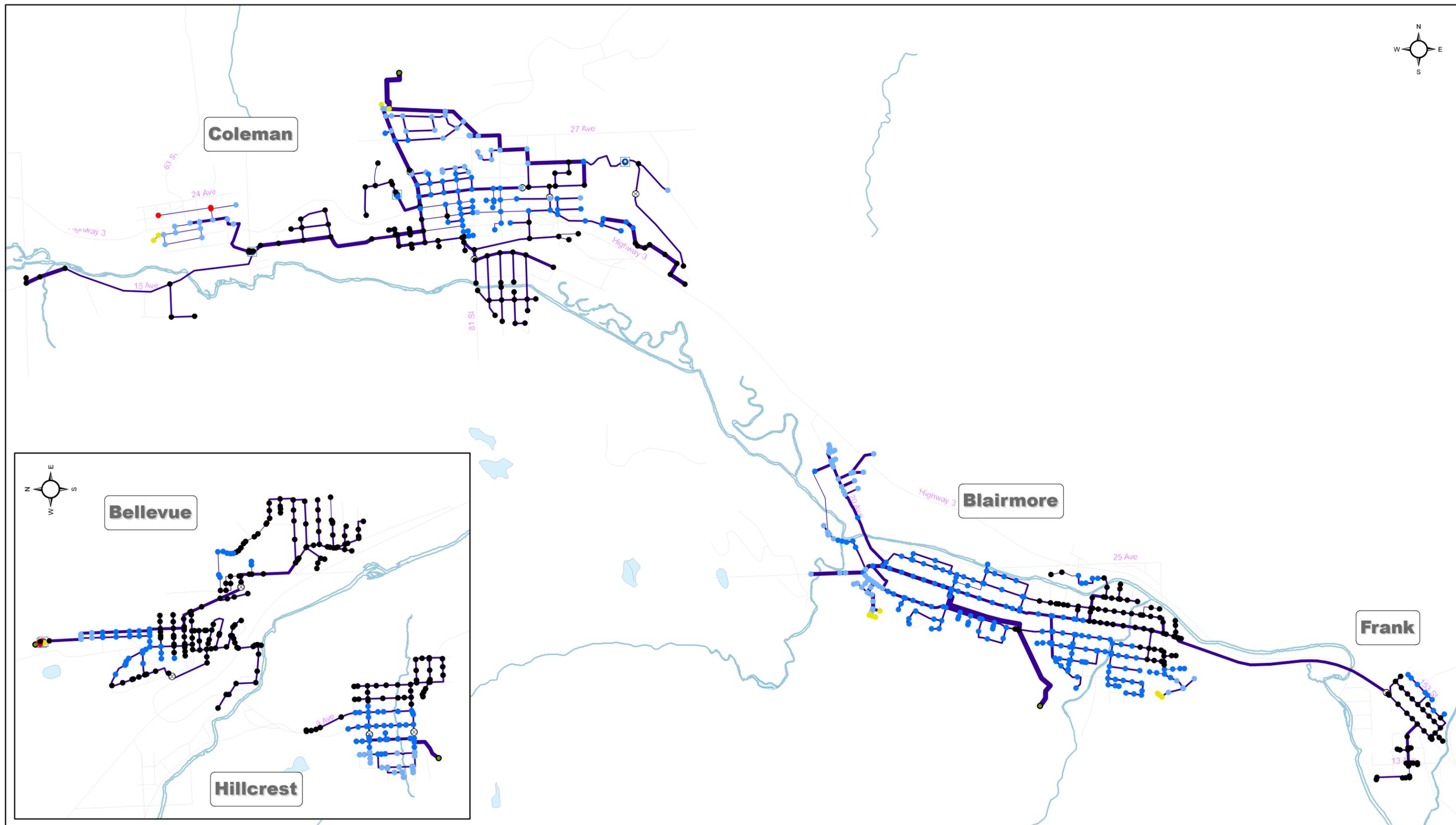
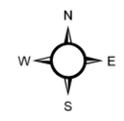
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Municipality of Crownsnest Pass
 Water Distribution Master Plan

Figure No.
 4-6

Title
 Existing Water Distribution System
 Average Day Demand Node Pressure





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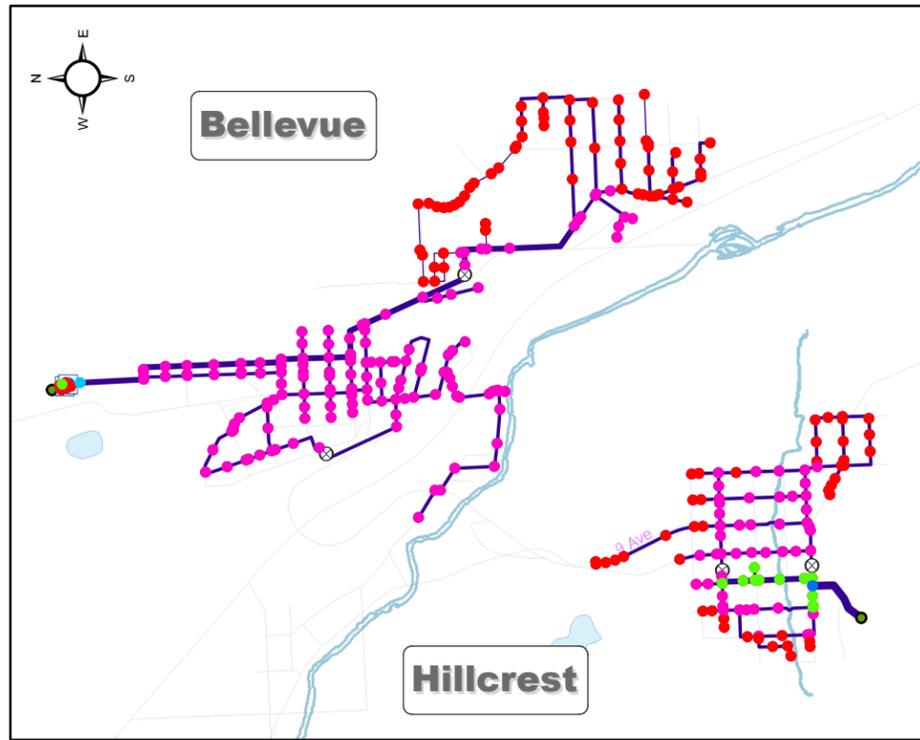
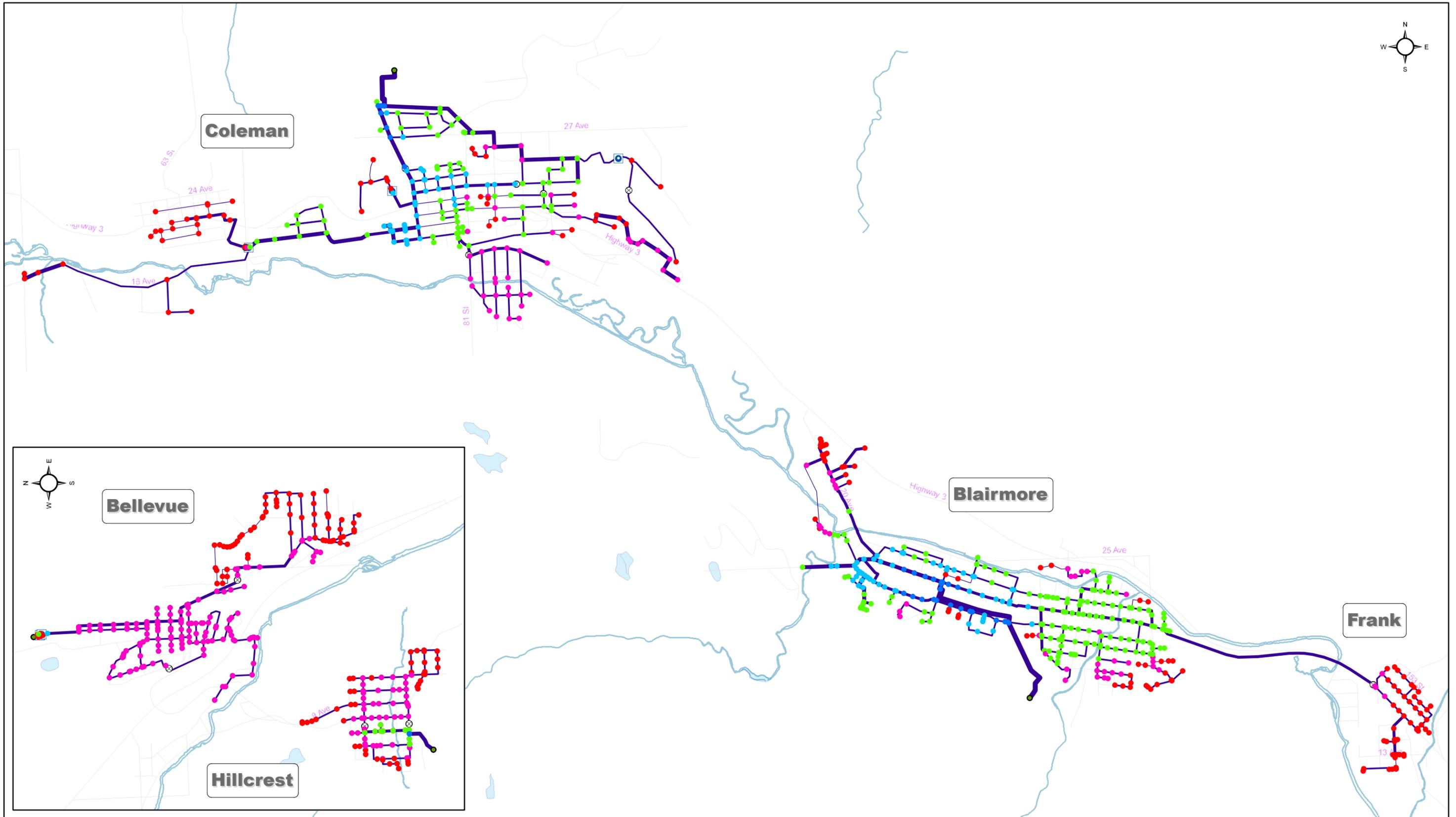
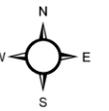
Node Pressure	⊗ PRV	Pipe Diameter
● < 40 psi	⊕ Pump	— Less than 100 mm
● 40 - 50 psi	● Reservoir	— 100 mm - 150 mm
● 50 - 70 psi		— 150 mm - 200 mm
● 70 - 90 psi		— 200 mm - 300 mm
● > 90 psi		— 300 mm - 400 mm

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Water Distribution Master Plan

Figure No.
4-7

Title
Existing Water Distribution System
Maximum Day Demand Node Pressure





Legend

Available Fire Flow	⊗ PRV
● Less than 50 l/s	⊕ Pump
● 50 to 75 l/s	● Reservoir
● 75 to 150 l/s	
● 150 - 250 l/s	
● 250 - 300 l/s	



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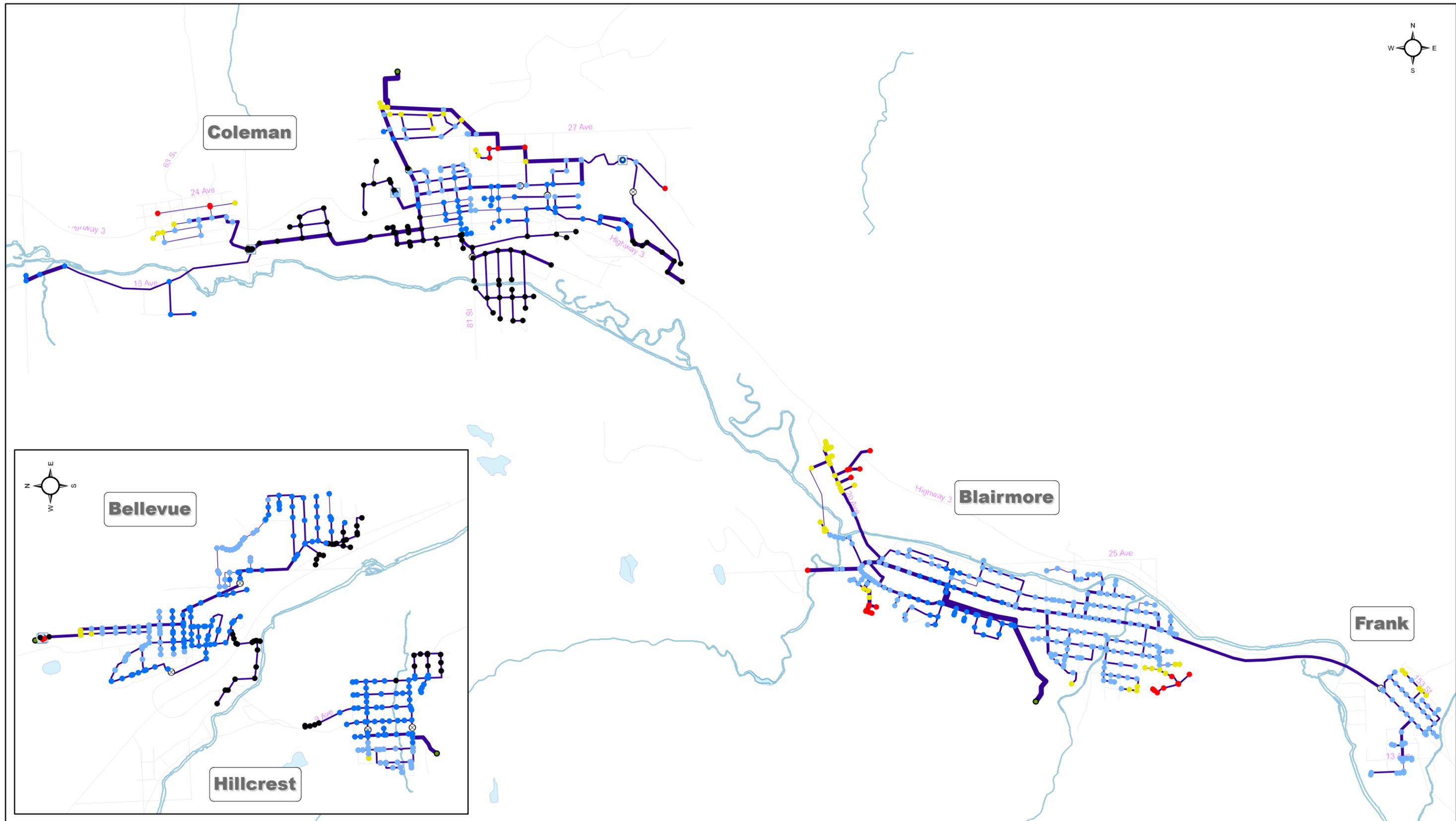
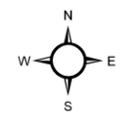
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Title
 Existing Water Distribution System
 Maximum Day Demand Available Fire Flow





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Node Pressure		PRV	Pump	Reservoir	Pipe Diameter	
●	< 40 psi	⊗	⊠	●	—	Less than 100 mm
●	40 - 50 psi				—	100 mm - 150 mm
●	50 - 70 psi				—	150 mm - 200 mm
●	70 - 90 psi				—	200 mm - 300 mm
●	> 90 psi				—	300 mm - 400 mm

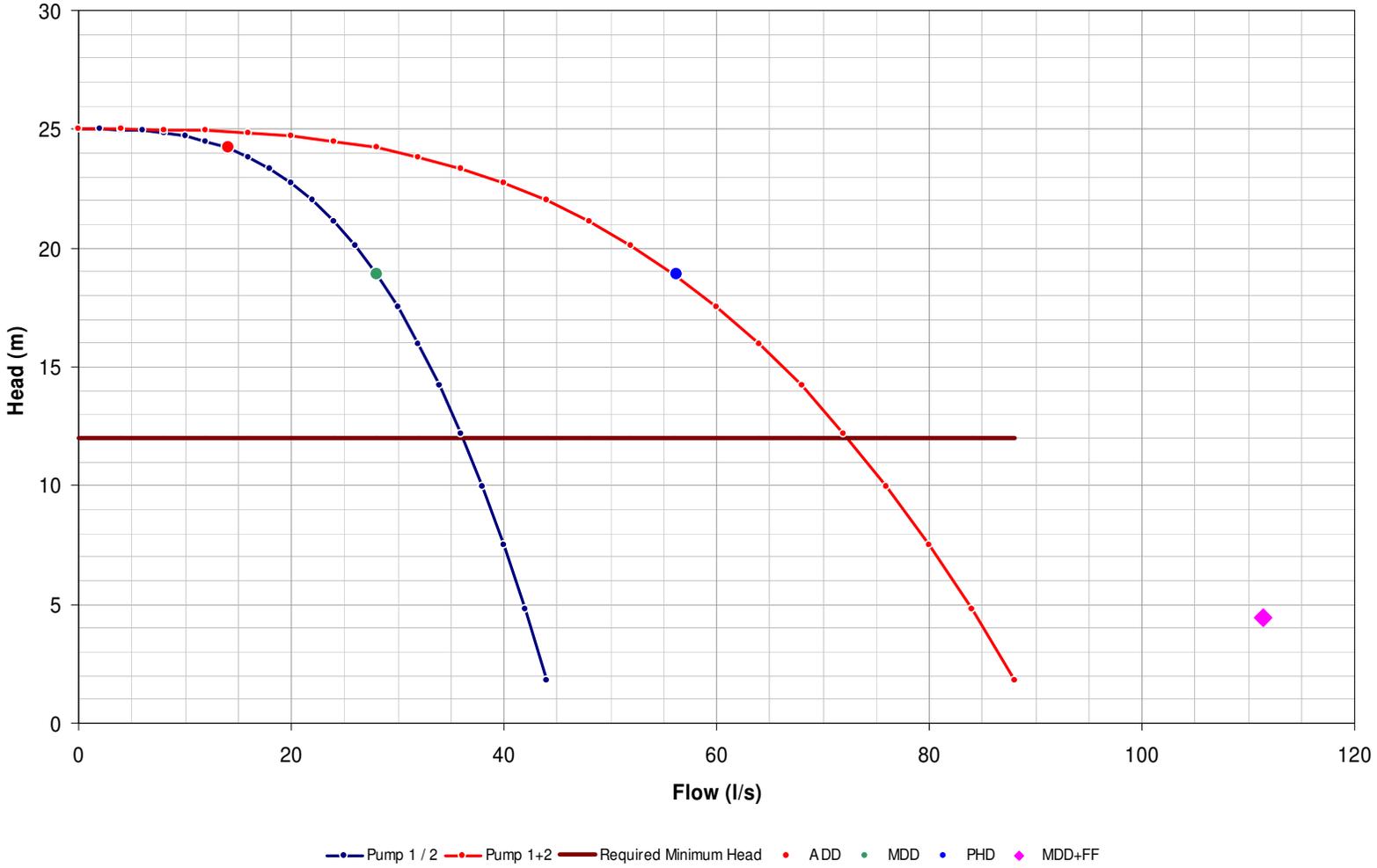
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Figure No.
 4-9

Title
 Existing Water Distribution System
 Peak Hour Demand Node Pressure



Bellevue Pump Station Capacity Analysis



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Municipality of Crowsnest Pass
Water Distribution System Master Plan

Figure No.

4-10

Title

Bellevue Pump Station Capacity

5.0 Future System Evaluation

5.1 FUTURE GROWTH AREAS

The proposed future development area used in the Municipality of Crowsnest Pass Preliminary Design For Water and Sanitary Sewer Servicing Sentinel / Crowsnest Mountain Resort report was used as the basis of this master plan. The future growth scenario also includes areas in Coleman, Blairmore, Bellevue and Hillcrest.

Figure 5-1 shows the proposed future development areas. The total proposed developable area is 1741 ha.

5.2 FUTURE WATER DEMAND SCENARIOS

Table 5-1 provides the design criteria that were used to develop peak water demands flows. The criteria included in this table are taken from the Sentinel Servicing Study.

Table 5-1 Water Demand Design Criteria

Densities:			
	Low	40	Lots per 1/4section
	Medium	100	Lots per 1/4section
	High	150	Lots per 1/4section
	Pop Density	2.5	People/lot
Water Consumption			
	ADD Residential	400	L/capita/day
	ADD Residential	0.40	m ³ /capita/day
	ADD Commercial	30	m ³ /ha/day
	ADD Industrial	40	m ³ /ha/day
	MDD / ADD Multiplier	2	
	PHD / ADD Multiplier	4	
Fire Flow Requirements			
	Required Fire Flow	225	l/s
	Duration	3	Hours

From: Sentinel Servicing Report Design Criteria.

Table 5-2 shows the overall breakdown of land uses and estimated populations assumed for each land use type. The projected peak hour demand from the future growth areas is 604.4 l/s.

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Table 5-2 Total Future Water Demands Flows

Land Use	Area (ha)	Population	ADD (l/s)	MDD (l/s)	PHD (l/s)
Residential	1,482.10	5,725	26.50	53.01	106.02
Industrial	140.6		48.82	97.63	195.27
Commercial	81.8		37.86	75.71	151.42
Crowsnest Mountain Resort	22.5	1,400	6.48	12.96	25.93
Bridgegate Resort Village	9	3,750	17.36	34.72	69.44
River Run	25	3,040	14.07	28.15	56.30
Total	1,761.10	13,915	151.09	302.19	604.38

Figure 5-2 shows the Sentinel growth areas and demands from each area. **Table 5-3** shows the overall breakdown of land uses and estimated populations assumed in for the Sentinel growth area. The projected peak hour demand from the Sentinel growth areas is 443.5 l/s.

Table 5-3 Sentinel Future Water Demands

Land Use	Area (ha)	Population	ADD (l/s)	MDD (l/s)	PHD (l/s)
Residential	623.0	2,407	11.14	22.29	44.57
Industrial	140.6		48.82	97.63	195.27
Commercial	58.5		27.07	54.15	108.29
Crowsnest Mountain Resort	22.5	1,400	6.48	12.96	25.93
Bridgegate Resort Village	9.0	3,750	17.36	34.72	69.44
Total	853.5	7,557	110.88	221.75	443.51

Figure 5-3 shows the Coleman / Blairmore growth areas and water demands from each area. **Table 5-4** shows the overall breakdown of land uses and estimated populations assumed in for the Blairmore / Coleman growth area. The projected peak hour demand flow from the Blairmore / Coleman growth areas is 150.2 l/s.

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Table 5-4 Blairmore / Coleman Future Water Demands

Land Use	Area (ha)	Population	ADD (l/s)	MDD (l/s)	PHD (l/s)
Residential	709.1	2743	12.70	25.40	50.80
Commercial	23.3		10.78	21.56	43.13
River Run	25.0	3,040	14.07	28.15	56.30
Total	757.4	5783	37.56	75.11	150.22

Figure 5-4 shows the Bellevue / Hillcrest growth areas and water demands from each area.

Table 5-5 shows the overall breakdown of land uses and estimated populations assumed in for the Bellevue / Hillcrest growth area. The projected peak hour demand from the Bellevue / Hillcrest growth areas is 10.7 l/s.

Table 5-5 Bellevue / Hillcrest Future Water Demands

Land Use	Area (ha)	Population	ADD (l/s)	MDD (l/s)	PHD (l/s)
Residential	150.0	575	2.66	5.32	10.65
Total	150.0	575	2.66	5.32	10.65

5.3 IMPROVEMENTS REQUIRED FOR FUTURE SYSTEM

5.3.1 Water Supply and Pumping

5.3.1.1 Sentinel Water Supply and Pumping Requirements

The Sentinel Growth Area requires additional reservoirs to provide service pressures, fire storage and operational storage. **Figure 5-5** shows the two proposed storage reservoirs.

Table 5-6 Sentinel Growth Area Storage Requirements

	Required Storage	Required Hydraulic Grade Line
Sentinel Reservoir A	7,600 m ³ (2,010,000 gal)	1455 m
	Fill Rate	90 l/s
	<i>Distribution System Connection</i>	<i>1000 m of 450 mm PVC</i>
Sentinel Reservoir B	7,600 m ³ (2,010,000 gal)	1450 m
	Fill Rate	135 l/s
	<i>Distribution System Connection</i>	<i>500 m of 450 mm PVC</i>

5.3.1.2 Coleman Water Supply and Pumping Requirements

Much of the Coleman growth areas are located at elevations higher than the existing reservoir. There are two options for servicing areas above the current reservoir:

- New Pump Station

A new pump station constructed at the site of the existing reservoir storage would provide service to the entire Coleman Service area. The pump station will be sized for the entire range of projected flows.

Figure 5-6 shows the location of the proposed pump station upgrade.

Table 5-7 Coleman Pump Station Upgrade Requirements

	Design Flow	Required Hydraulic Grade Line
ADD	39.5 l/s	1560 m * Maximum Pressure Zone
MDD	79.0 l/s	1560 m * Maximum Pressure Zone
PHD	158.0 l/s	1560 m * Maximum Pressure Zone
FIRE FLOW	200 l/s (Fire Pump)	1560 m * Maximum Pressure Zone

- New Reservoir

A new reservoir will be constructed at an elevation with a sufficient hydraulic grade line to provide service pressures to the higher Coleman service areas. A pump station will be constructed at the site of the existing reservoir to fill the new facility.

Figure 5-7 shows the location of the proposed reservoir upgrade.

Table 5-8 Coleman Reservoir Upgrade Requirements

	Required Storage	Required Hydraulic Grade Line
New Coleman Reservoir	3,000 m ³ (800,000 gal)	1560 m
Fill Rate	5 l/s	

5.3.1.3 Blairmore Water Supply and Pumping Requirements

Portions of the Blairmore growth areas are located at elevations higher than the existing reservoir. There are two options for servicing areas above the current reservoir:

- New Pump Station

A new pump station constructed at the site of the existing reservoir storage would provide service to the Blairmore Service area. The pump station will be sized for the entire range of projected flows.

Figure 5-8 shows the location of the proposed pump station upgrade.

Table 5-9 Blairmore Pump Station Upgrade Requirements

	Design Flow	Required Hydraulic Grade Line
ADD	4.6 l/s	1460 m
MDD	9.2 l/s	1460 m
PHD	18.4 l/s	1460 m
FIRE FLOW	200 l/s (Fire Pump)	1460 m

- New Reservoir

A new reservoir will be constructed at an elevation with a sufficient hydraulic grade line to provide service pressures to the higher Blairmore service areas. A pump station will be constructed at the site of the existing reservoir to fill the new facility.

Figure 5-9 shows the location of the proposed reservoir upgrade.

Table 5-10 Blairmore Reservoir Upgrade Requirements

	Required Storage	Required Hydraulic Grade Line
New Blairmore Reservoir	3,000 m ³ (800,000 gal)	1460 m
Required Fill Rate	10 l/s	

5.3.1.4 Bellevue Water Supply and Pumping Requirements

- Upgraded Pump Station

The existing Bellevue pump station can not provide the full range of required flows. The pump station will be upgraded to provide the required level of service for current and future service areas.

Figure 5-10 shows the location of the proposed pump station upgrade.

Table 5-11 Bellevue Pump Station Upgrades

	Design Flow	Required Hydraulic Grade Line
ADD	11.3 l/s	1355 m
MDD	22.6 l/s	1355 m
PHD	45.2 l/s	1355 m
Fire Flow	200 l/s (Fire Pump)	1355 m

5.3.2 Distribution System

5.3.2.1 Coleman Water Distribution System Upgrades

- Connection to New Pressure Zone (A)

The pipe upgrade consists of 1,200 m of 200 mm pipe as shown in **Figure 5-11** will provide a connection from new pipe network to the existing pressure zone CM-5. This

arrangement will eliminate the booster pump that currently services this area. Service pressures and total available fire flow will be increased.

In addition to the interconnection mains in the immediate area will require pipe size upgrades to maximize the potential of the upgrade.

- Connection to New Pressure Zone (B)

The pipe upgrade consists of 150 m of 200 mm pipe as shown in **Figure 5-11** will provide a connection from new pipe network to the existing pressure zone CM-4. This arrangement will eliminate the booster pump that currently services this area. Service pressures and total available fire flow will be increased.

In addition to the interconnection mains in the immediate area will require pipe size upgrades to maximize the potential of the upgrade.

- Coleman Water Distribution System Improvement

The upgrade consists of 1,900 m of 250 mm pipe replacement or upgrade as shown in **Figure 5-11**. The previously planned upgrade increase the level of service to the existing Coleman service area and is required for portions of the future Coleman service areas.

5.3.2.2 Blairmore Water Distribution System Upgrades

- Blairmore Coleman Interconnect

The pipe upgrade as shown in **Figure 5-12** will provide a connection from Coleman to the existing Blairmore distribution system. This upgrade will increase the level of service to the area adjacent in the area of the connection point. Service pressures and total available fire flow will be increased during higher demand periods.

The upgrade consists of 2,100 m of 250 mm pipe.

- Blairmore Transmission Main Improvement

The upgrade consists of 3,200 m of 300 mm pipe installation as shown in **Figure 5-13**. This upgrade will increase the service pressures under high demand conditions to portions of Blairmore. More importantly the total available fire flow in areas within Blairmore will be increased.

- Blairmore Reservoir Looping Improvement

The upgrade consists of 1,350 m of 200 mm pipe installation as shown in **Figure 5-13**. This upgrade will increase the service pressures in a high elevation area. More importantly the total available fire flow will be increased.

5.3.2.3 Bellevue Water Distribution System Upgrades

- Bellevue Distribution System Improvements

The upgrade consists of 3,150 m of 250 mm pipe installation as shown in **Figure 5-14**. This upgrade will increase the service pressures under high demand conditions to portions of Bellevue. More importantly the total available fire flow in areas within Bellevue will be increased.

5.3.2.4 Hillcrest Water Distribution System Upgrades

- Hillcrest – Bellevue Interconnections

The upgrade consists of 675 m of 200 mm pipe installation as shown in **Figure 5-15**. This upgrade will fulfill the additional storage requirements for the Hillcrest Water Distribution system by leveraging the unallocated storage in the Bellevue Water Distribution System.

5.3.2.5 Frank Water Distribution System Upgrades

- Blairmore Frank Interconnect

The pipe upgrade will improve the existing connection from Frank to the existing Blairmore distribution system as shown in **Figure 5-16**. This upgrade will increase the level of service to the area adjacent in the area of the connection point. Service pressures and total available fire flow will be increased during higher demand periods.

The upgrade consists of 1,650 m of 300 mm pipe.

5.3.2.6 Other Miscellaneous Improvements

- Pressure Zone Adjustments

The Municipality of Crowsnest Pass should consider revising the current pressure zone arrangement to limit pressures to less than 620 kPa (90 psi). **Figure 5-17** shows the proposed boundaries for the pressure zones in areas serviced by the proposed future water distribution system.

- Replacement of Smaller Mains

As aging water mains are replaced in the distributions system pips should be sized to ensure that the system is designed to maximize looping and the availability of fire flows. **Figure 5-18** shows the pipe upgrades that should be carried out as cast and ductile iron mains are replaced.

- Fire Hydrant Coverage Improvements

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As the development and redevelopment of the overall water distribution system occurs, efforts should be made to install additional fire hydrants to maximize fire hydrant coverage within the distribution system.

Areas that required additional fire protection coverage are shown in **Figure 4-5**.

5.4 FUTURE LEVEL OF SERVICE

The future level of service for the water distribution system was analyzed using the proposed future water distribution system **Figure 5-19** shows the proposed future water distribution system.

5.4.1 Water Supply

Table 5-12 provides a summary of the ultimate storage requirements by community for the Municipality of Crownsnest Pass. The community of Hillcrest has a storage deficiency of 1,000 m³ (264,000 gal) that is supplemented by a pipe connection to the Bellevue Distribution System. The net result is a combined total storage of 15,911 m³ (3,500,000 gal). The interconnected Bellevue / Hillcrest water system requires total potable storage of 7,286 m³ (1,900,000 gal).

Table 5-12- Future Reservoir Storage Requirements

	Current Available Storage		Required Fire Storage	Equalization Storage	Emergency Storage	Total	Storage Surplus (Deficiency)
	Imperial Gallons	Cubic Meters					
Coleman Reservoir	2,000,000	9,092	2,455	1,189	1,021	4,665	4,427
Additional Storage Requirements		-		414	414	829	(829)
				Additional Storage Surplus (Requirement)			3,598
Blairmore Reservoir	3,000,000	13,638	2,455	3,190	2,500	8,145	5,493
Additional Storage Requirements		-		483	483	965	(965)
				Additional Storage Surplus (Requirement)			4,528
Hillcrest Reservoir	500,000	2,273	2,455	447	374	3,275	(1,002)
Additional Storage Requirements		-		38	38	77	(77)
				Additional Storage Surplus (Requirement)			(1,079)
Bellevue Reservoir	3,000,000	13,638	2,455	697	627	3,779	9,859
Additional Storage Requirements		-		78	78	155	(155)
				Additional Storage Surplus (Requirement)			9,704
Frank Fire Protection Reservoir	10,000	45	2,455			2,455	(2,409)
Sentinel	2,804,607	12,750	2,455	5,147	5,147	12,748	New Reservoirs
Reservoir 1			2,455	2,574	2,574	7,603	
Reservoir 2			2,455	2,574	2,574	7,603	

5.4.2 Distribution System

The computer hydraulic model was run to analyze the performance of the future water distribution system under different demand scenarios. The performance of the system was analyzed to determine the future level of service throughout the Municipality of Crowsnest Pass.

5.4.2.1 Average Day Demand

Table 5-13 shows the distribution of various pressures throughout the future water distribution system in the Municipality of Crowsnest Pass. Under average day demand conditions there are 11 nodes with pressures of less than 40 psi. There are 317 nodes with pressures over 90 psi.

Most of the low pressure areas are within future growth areas at higher elevations.

Figure 5-20 show the distribution of node pressures throughout the Municipality of Crowsnest Pass.

Table 5-13 Average Day Demand Node Pressure

		MCNP	Existing	Future
< 40 psi	●	11	3	8
40 - 50 psi	●	19	11	8
50 - 70 psi	●	204	180	24
70 - 90 psi	●	489	457	32
> 90 psi	●	317	222	95

5.4.2.2 Maximum Day Demand

Table 5-14 shows the distribution of various pressures throughout the future water distribution system in the Municipality of Crowsnest Pass. Under maximum day demand conditions there are 16 nodes with pressures of less than 40 psi. There are 275 nodes with pressures over 90 psi.

Most of the low pressure areas are within future growth areas at higher elevations.

Figure 5-21 show the distribution of node pressures throughout the Municipality of Crowsnest Pass.

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Table 5-14 Maximum Day Demand Node Pressure

		MCNP	Existing	Future
< 40 psi	●	16	6	10
40 - 50 psi	●	23	16	7
50 - 70 psi	●	211	188	23
70 - 90 psi	●	515	479	36
> 90 psi	●	275	184	91

5.4.2.3 Maximum Day Demand with Fire Flow

Table 5-15 shows the distribution of available fire flow throughout the future water distribution system in the Municipality of Crowsnest Pass. Under maximum day demand conditions there are 44 nodes with available fire flows less than 3,000 l/min. Further there are an additional 68 nodes that supply less than 4,500 l/min.

The majority of the fire flow problems are within the existing water distribution system and are the result of undersized (150 mm or less) mains.

Figure 5-22 shows the distribution of available fire flow throughout the Municipality of Crowsnest Pass.

Table 5-15 Maximum Day Demand Available Fire Flow (Future System)

		MCNP	Existing	Future
< 3,000 l/min	●	44	35	8
3,000 – 4,500 l/min	●	68	61	1
4,500 – 9,000 l/min	●	344	276	6
9,000 – 15,000 l/min	●	295	256	7
15,000 – 18,000 l/min	●	289	245	145

Table 5-16 shows the distribution of available fire flow throughout the future water distribution system after replacing undersized mains throughout the water distribution system. Under maximum day demand conditions there are 8 nodes with available fire flows less than 3,000 l/min. Further there are an additional 6 nodes that supply less than 4,500 l/min.

Figure 5-23 shows the distribution of available fire flow throughout the Municipality of Crowsnest Pass.

Table 5-16 Maximum Day Demand Available Fire Flow (Future System with Improvements)

		MCNP	Existing	Future
< 3,000 l/min	●	8	0	8
3,000 – 4,500 l/min	●	6	1	0
4,500 – 9,000 l/min	●	187	121	5
9,000 – 15,000 l/min	●	287	245	4
15,000 – 18,000 l/min	●	552	506	150

5.4.2.4 Peak Hour Demand

Table 5-17 shows the distribution of various pressures throughout the future water distribution system in the Municipality of Crownsnest Pass. Under peak hour demand conditions there are 23 nodes with pressures of less than 40 psi. There are 159 nodes with pressures over 90 psi.

Most of the low pressure areas are within future growth areas at higher elevations.

Figure 5-24 show the distribution of node pressures throughout the Municipality of Crownsnest Pass.

Table 5-17 Peak Hour Demand Node Pressure

		MCNP	Existing	Future
< 40 psi	●	23	11	12
40 - 50 psi	●	50	43	7
50 - 70 psi	●	257	225	32
70 - 90 psi	●	478	435	43
> 90 psi	●	232	159	73

5.5 DEVELOPMENT STANDARDS

5.5.1 Level of Service Guidelines

The following level of service guidelines should be considered during design of extensions to the water distribution system.

- Minimum Pressure: 40 psi (275 kPa)
- Maximum Pressures: 90 psi (620 kPa)
- Minimum Available Fire Flow: 4,500 l/min (75 l/s)

- a. The Available Fire Flow is the lower limit for residential development. Higher value land use will require higher standards for fire protection. Standards for higher value districts (multifamily, commercial, industrial) should be assessed on a case by case basis.

5.5.2 Design Requirements

5.5.2.1 Demands

Average Day Demand:

- Residential: 400 l/c/d
- Commercial
- Industrial

Maximum Day Demand: 2.0 x Average Day Demand

Peak Hour Demand: 4.0 x Average Day Demand

5.5.2.2 Water Mains

Extensions of the water distribution system should provide looped service wherever practical. If looping is not possible the system should be designed to maximize the available fire flow at dead ends in the water distribution system.

Sizing of water mains should be determined by computer hydraulic network analysis. The minimum sizes are defined by the following:

- Looped mains: 200 mm
- Dead end mains with length < 50 m: 150 mm
- Dead end mains with length > 50 m: 200 mm

Fire hydrant spacing should be a maximum of 150 m; higher value land use will require higher standards to ensure appropriate fire protection coverage.

LIST OF FIGURES FOR SECTION 5.0

Figure 5-1 Future Growth Areas

Figure 5-2 Sentinel Growth Areas

Figure 5-3 Coleman / Blairmore Growth Areas

Figure 5-4 Bellevue / Hillcrest Growth Areas

Figure 5-5 Sentinel Storage Reservoirs

Figure 5-6 Coleman Supply Upgrade – Pump Station

Figure 5-7 Coleman Supply Upgrade – New Reservoir

Figure 5-8 Blairmore Supply Upgrade – Pump Station

Figure 5-9 Blairmore Supply Upgrade – New Reservoir

Figure 5-10 Bellevue Supply Upgrade – Pump Station

Figure 5-11 Coleman Distribution System Upgrades

Figure 5-12 Blairmore - Coleman Interconnection

Figure 5-13 Blairmore Distribution System Upgrades

Figure 5-14 Bellevue Distribution System Upgrades

Figure 5-15 Hillcrest – Bellevue Interconnection

Figure 5-16 Blairmore – Frank Interconnection

Figure 5-17 Water Distribution System Pressure Zone Adjustments

Figure 5-18 Replacement of Smaller Distribution Mains

Figure 5-19 Municipality of Crowsnest Pass Future Water Distribution System

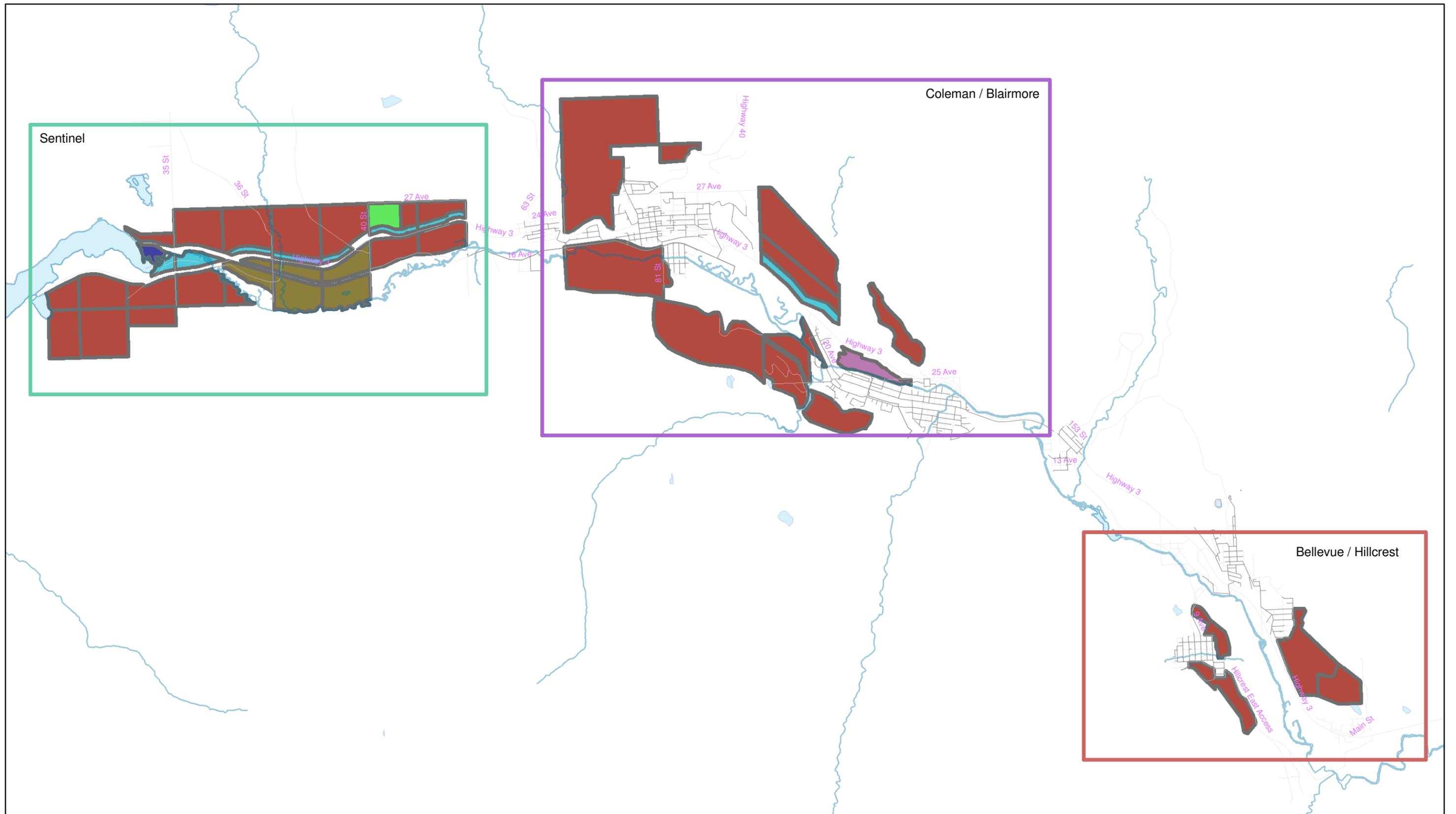
Figure 5-20 Average Day Demand – Node Pressure

Figure 5-21 Maximum Day Demand – Node Pressure

Figure 5-22 Maximum Day Demand – Available Fire Flow

Figure 5-23 Maximum Day Demand – Available Fire Flow (Ultimate Water System)

Figure 5-24 Peak Hour Demand – Node Pressure



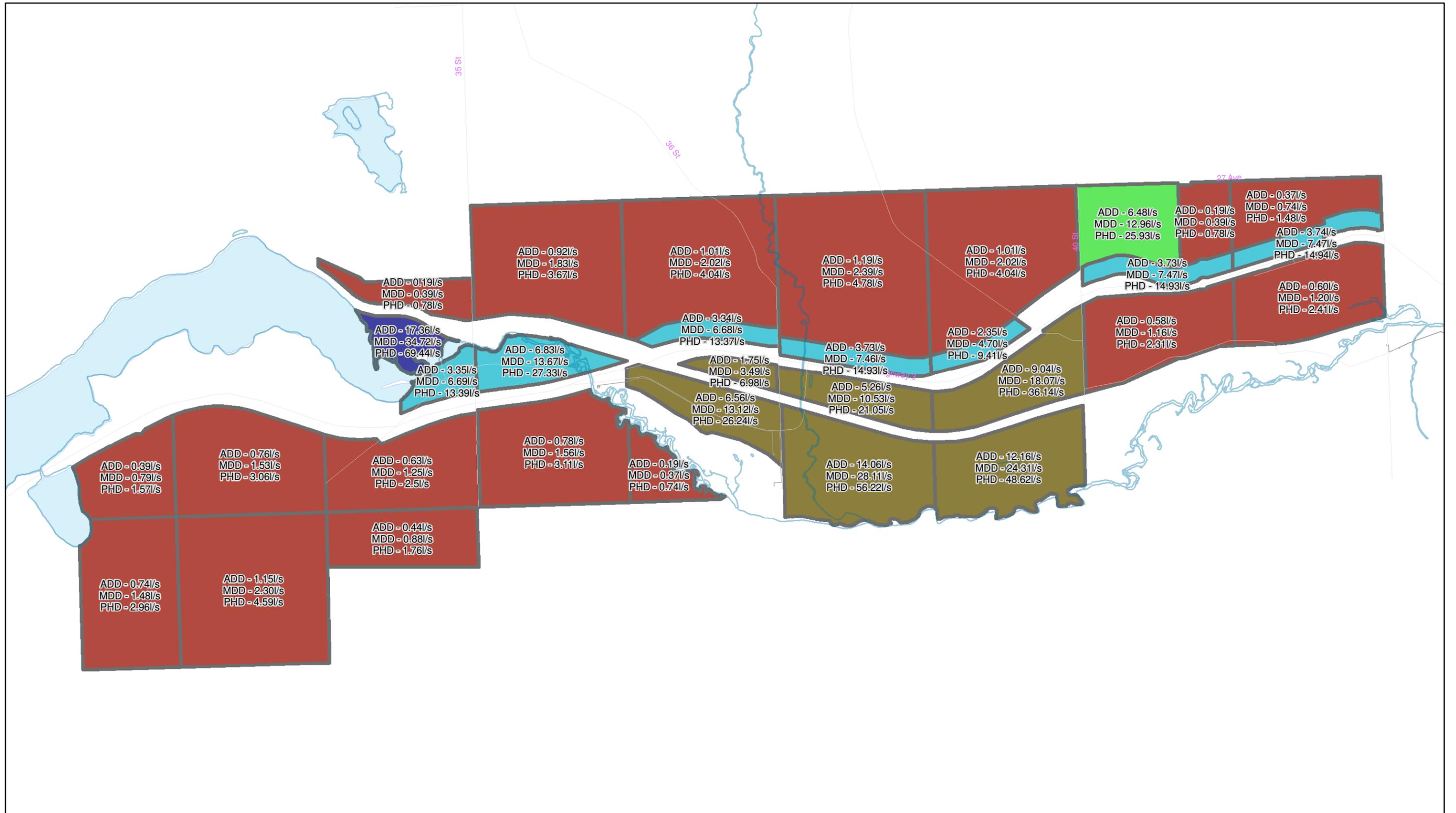
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 Fx: (403) 328-0664
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Legend

- | | | | |
|--|-------------------|--|-------------|
| | Bridgegate Resort | | Industrial |
| | Commercial | | Residential |
| | Crowsnest Resort | | River Run |

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 Municipality of Crowsnest Pass
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 Figure No.
 5-1
 Title
 Future Growth Areas





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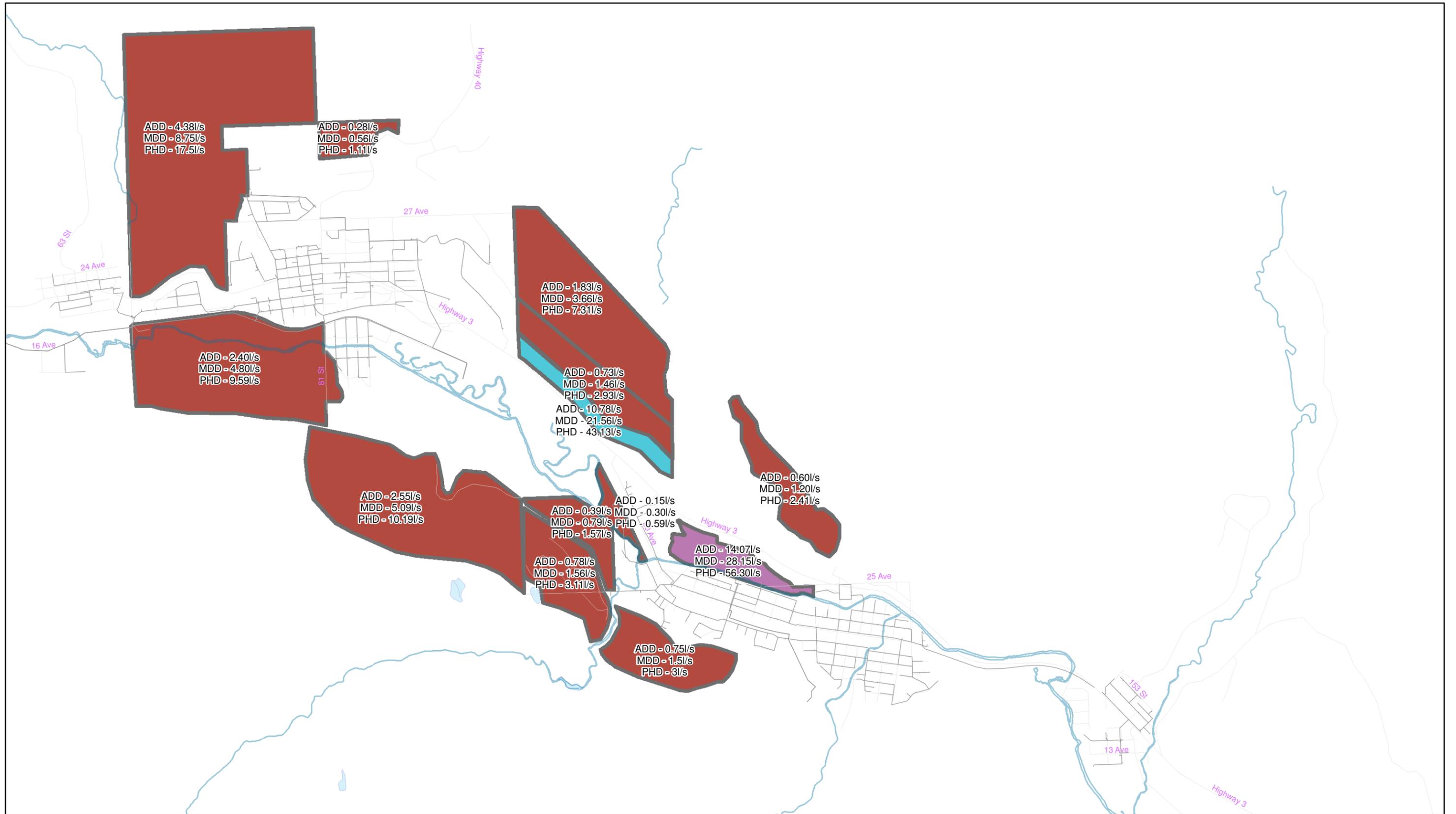
- Residential
- Commercial
- Industrial
- Bridgegate Resort
- Crowsnest Resort
- River Run

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Figure No.
 5-2

Title
 Future Growth Areas - Sentinel





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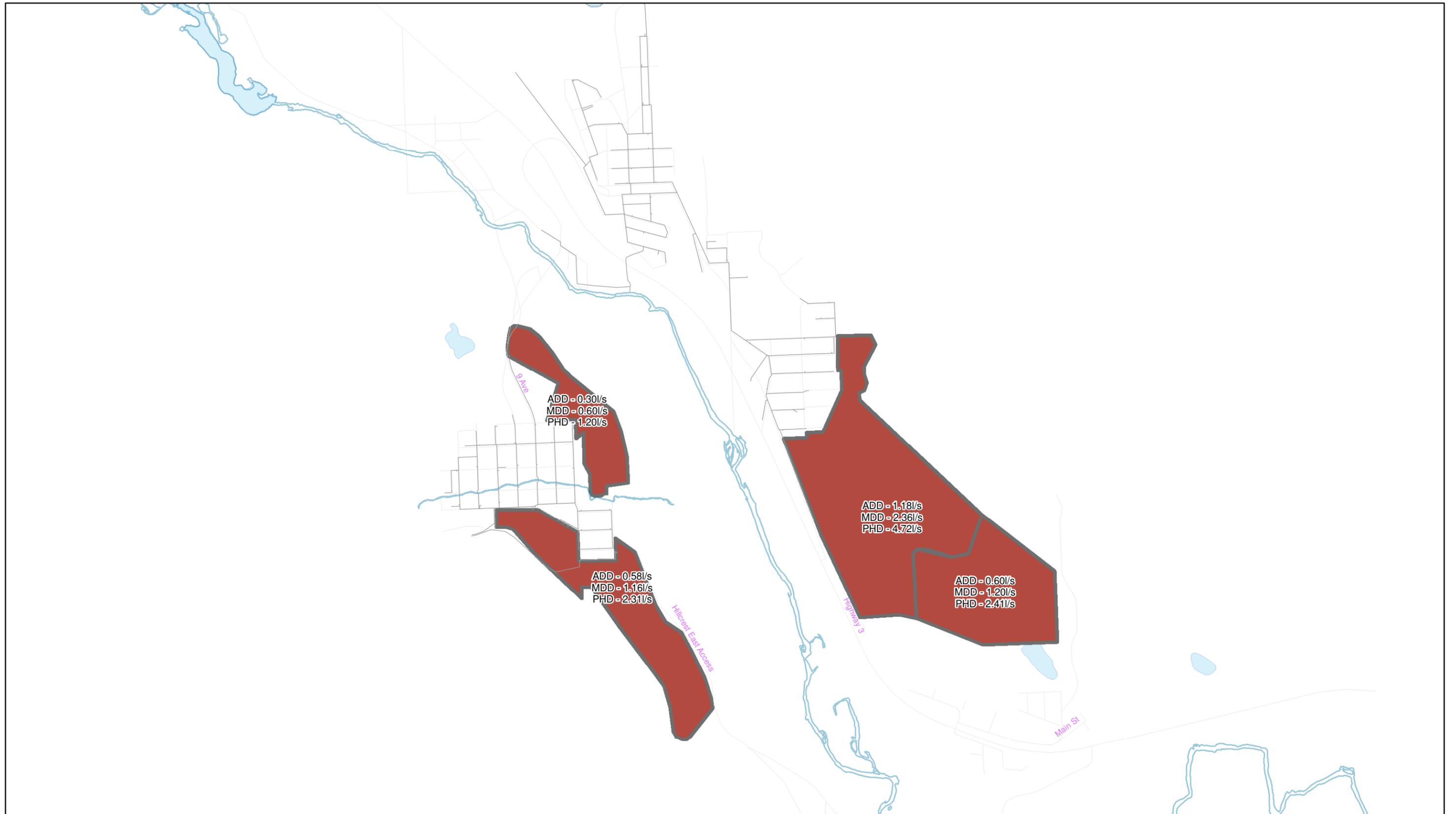
- | | | | |
|--|------------------|--|-------------|
| | Bridgeway Resort | | Industrial |
| | Commercial | | Residential |
| | Crowsnest Resort | | River Run |

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Figure No.
 5-3

Title
 Future Growth Areas
 Coleman / Blairmore





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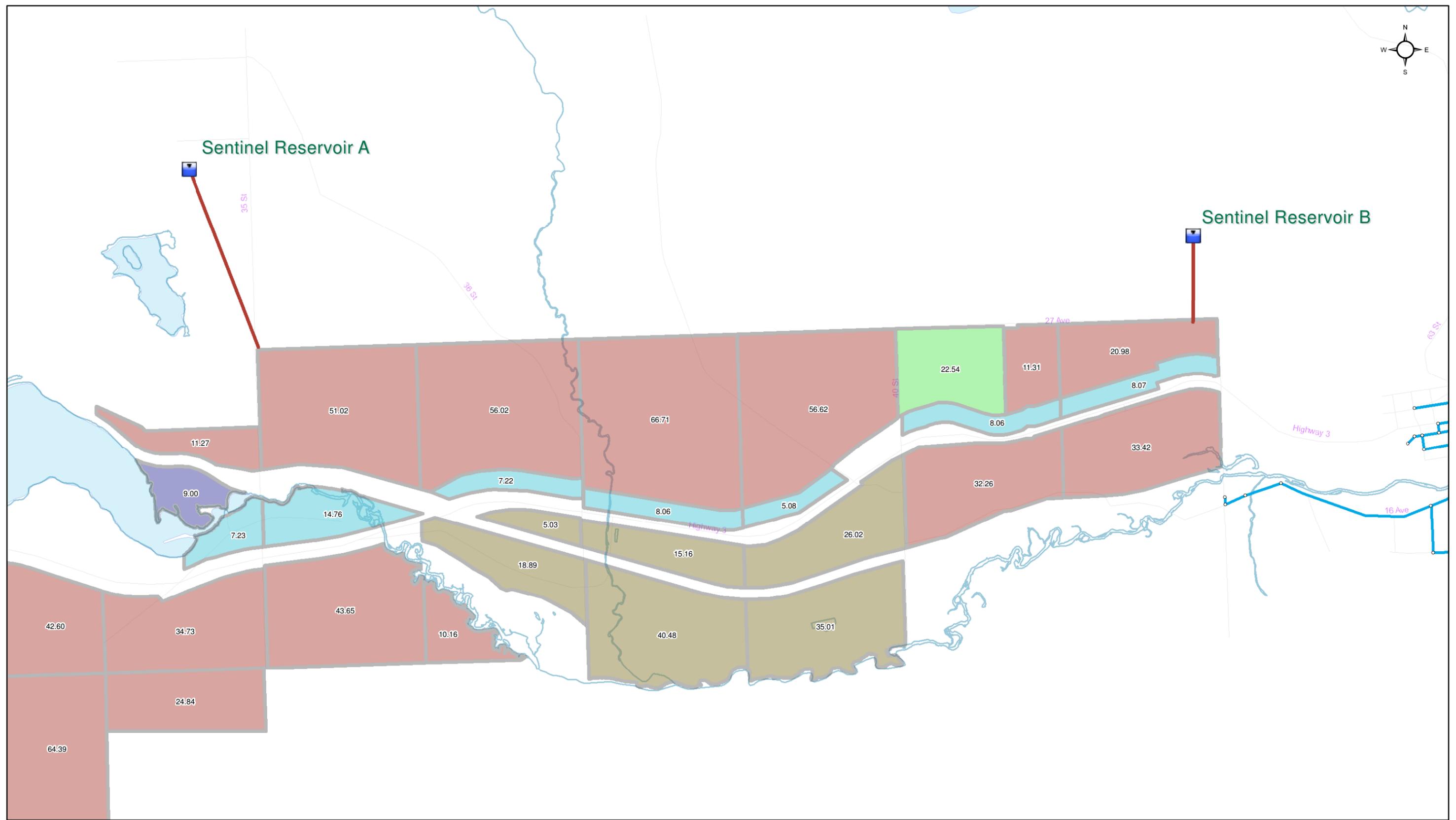
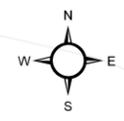
- | | |
|---|---|
|  Bridgegate Resort |  Industrial |
|  Commercial |  Residential |
|  Crowsnest Resort |  River Run |

Client/Project
 Municipality of Crowsnest Pass
 Water Distribution System Master Plan

Figure No.
 5-4

Title
 Future Growth Areas
 Bellevue / Hillcrest



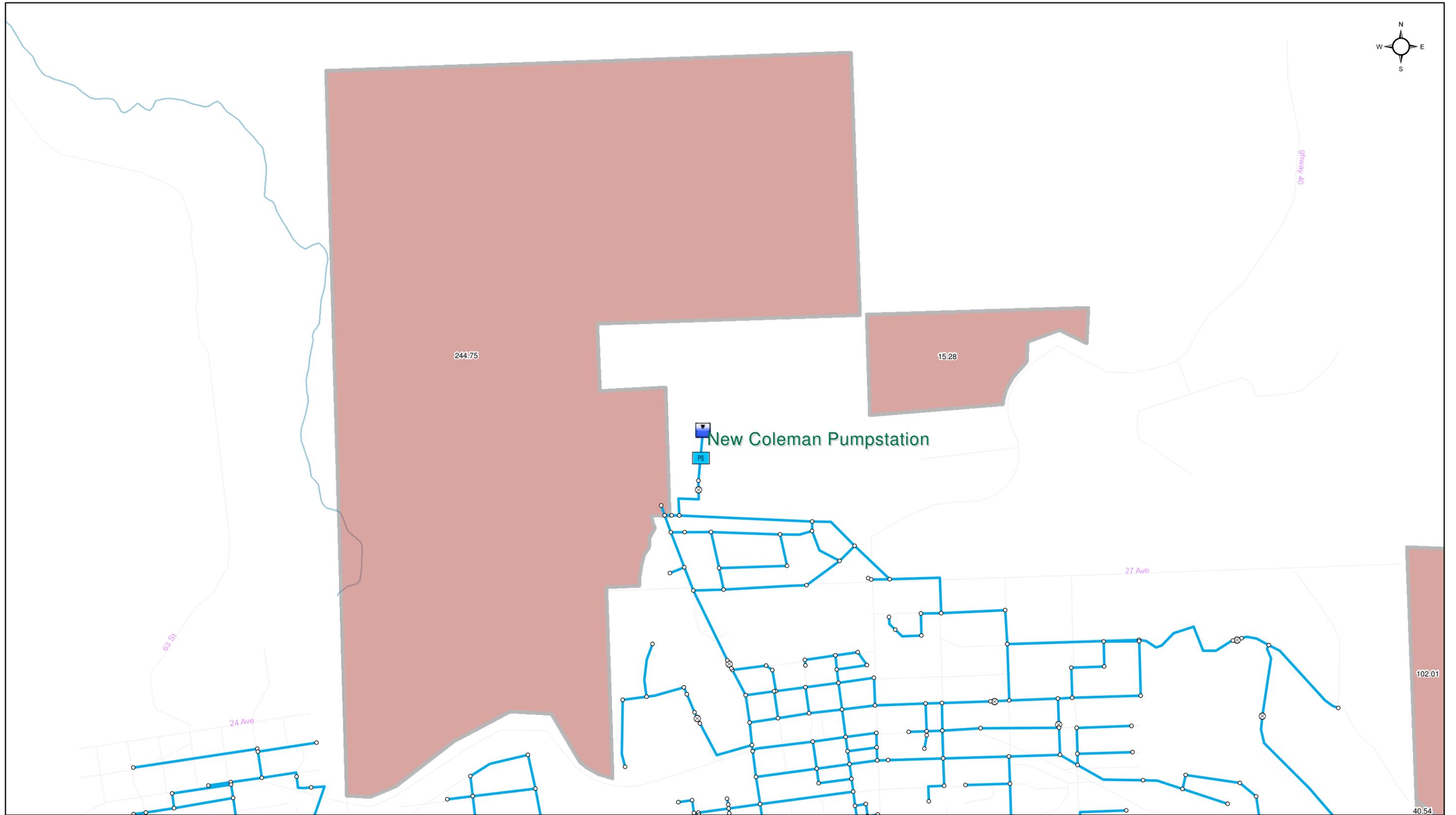
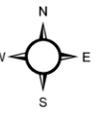


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- Legend**
-  Sentinel Reservoir A
 -  Sentinel Reservoir Connections
 -  Bridgegate Resort
 -  Commercial
 -  Crowsnest Resort
 -  Industrial
 -  Residential
 -  River Run
 -  Sentinel Reservoir B

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 Water Distribution Master Plan
 Figure No.
 5-5
 Title
 Water Distribution System Improvements
 Sentinel Growth Area Reservoirs





Legend

- New Coleman Pumpstation
- Bridgegate Resort
- Commercial
- Crowsnest Resort
- Industrial
- Residential
- River Run

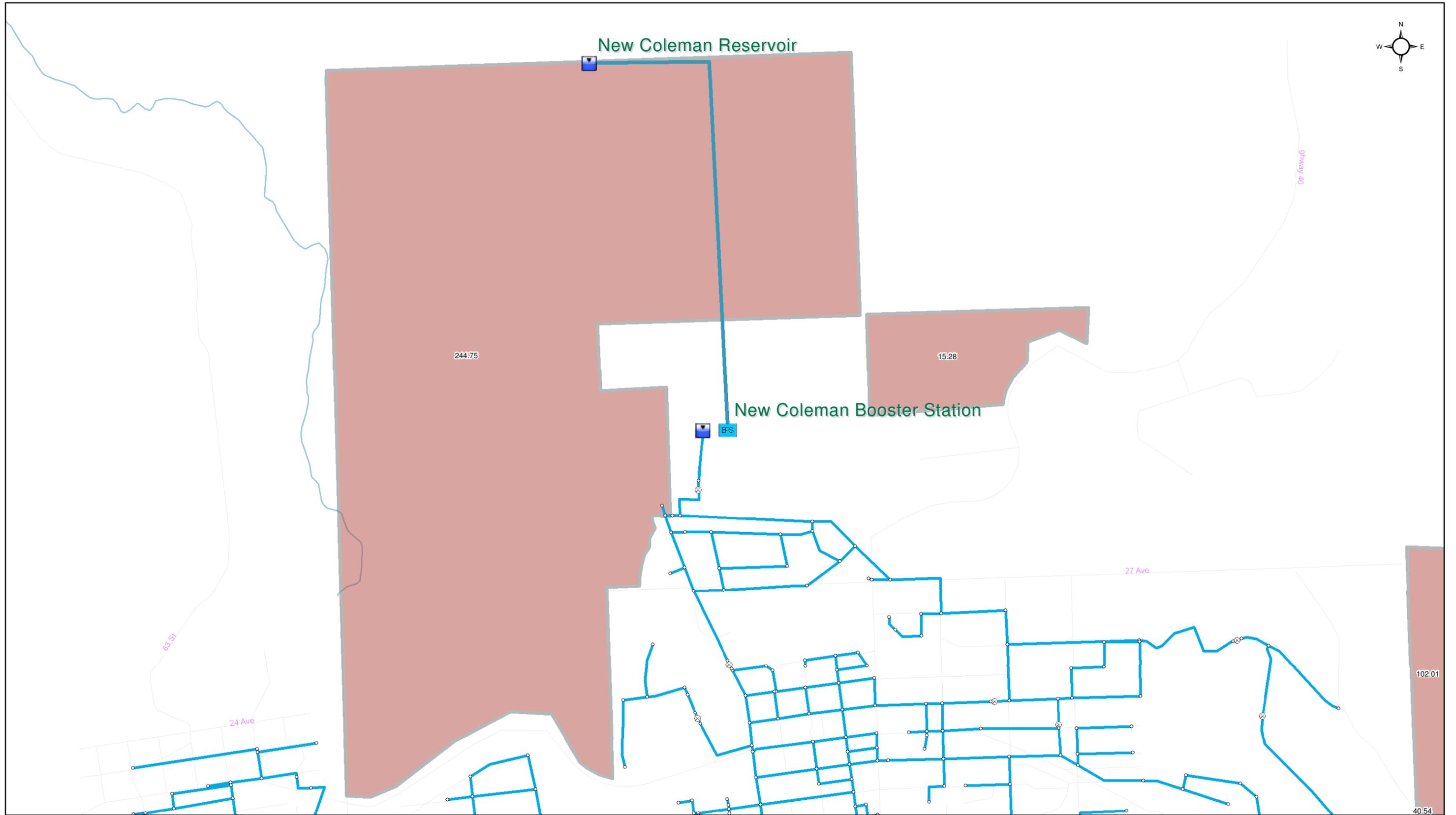


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 Figure No.
 5-6
 Title
 Water Distribution System Improvements
 Coleman Pump Station Upgrade

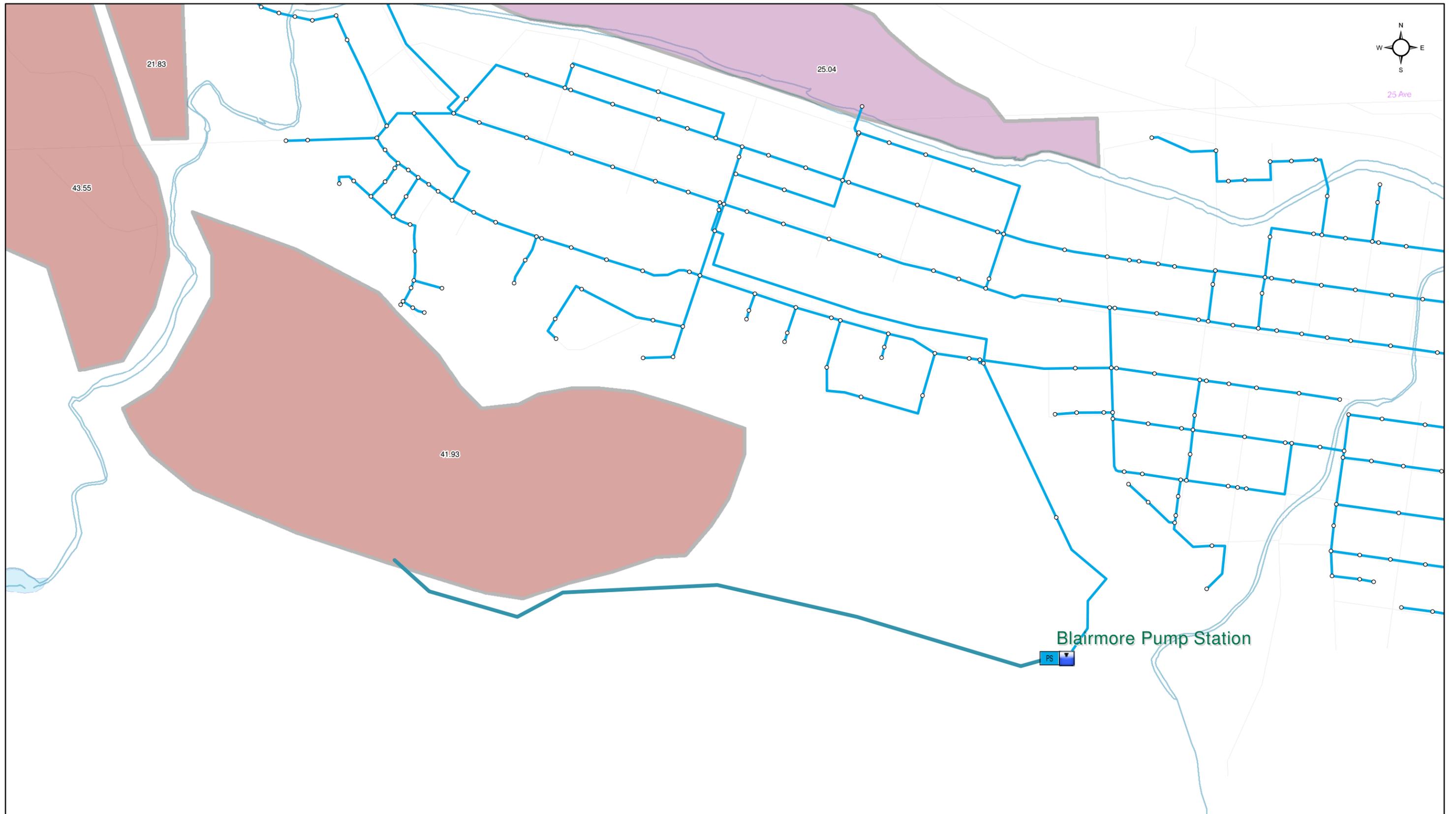




Legend

 New Coleman Reservoir	 New Reservoir Fill Main	 Bridgeway Resort
 New Coleman Booster Station	 Commercial	 Crowsnest Resort
	 Industrial	 Residential
	 River Run	





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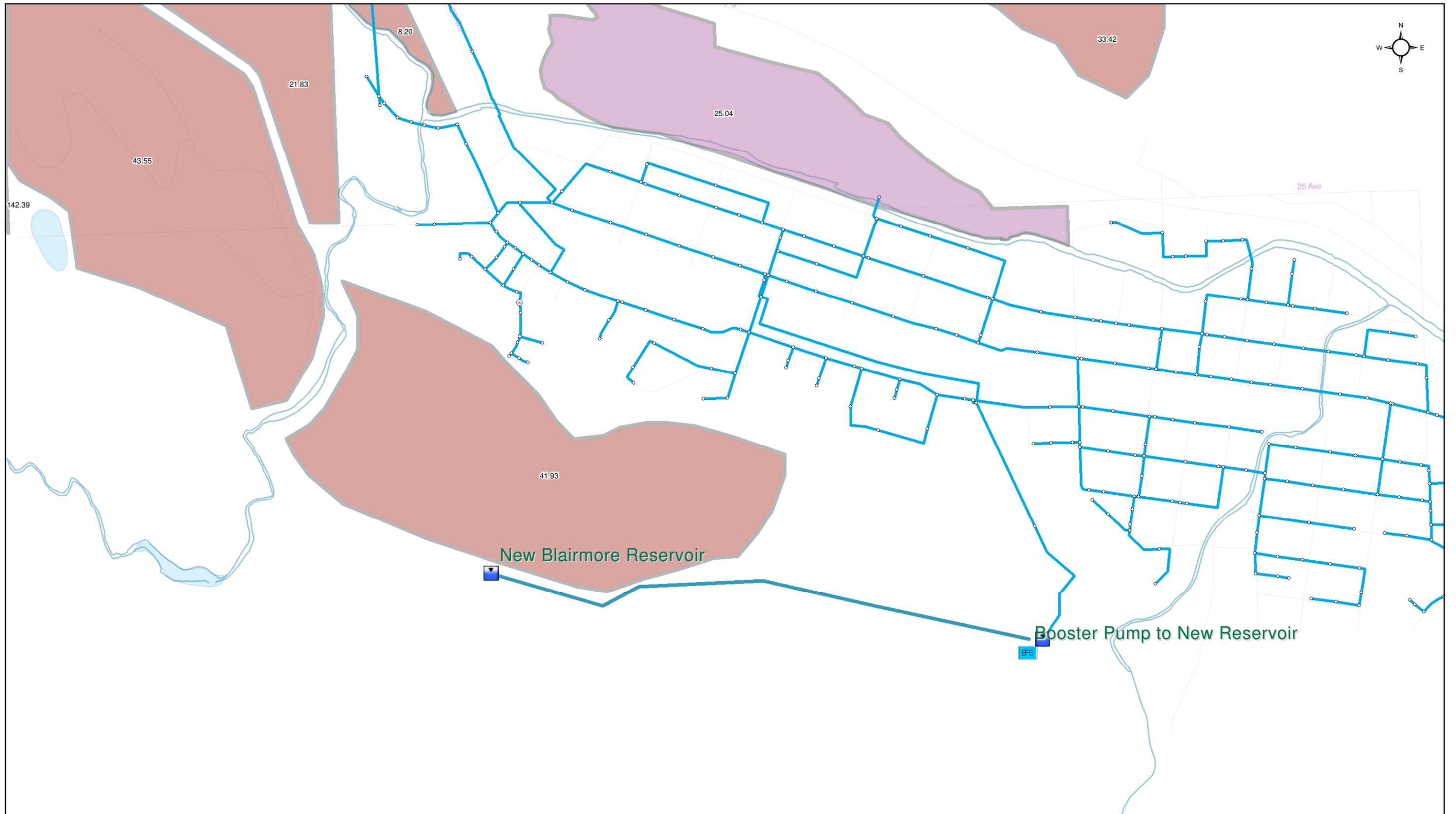
- Blairmore Pump Station
- New Transmission Main
- Bridgegate Resort
- Commercial
- Crowsnest Resort
- Industrial
- Residential
- River Run

Client/Project
 Municipality of Crowsnest Pass
 Water Distribution Master Plan

Figure No.
 5-8

Title
 Water Distribution System Improvements
 New Blairmore Pump Station Upgrade

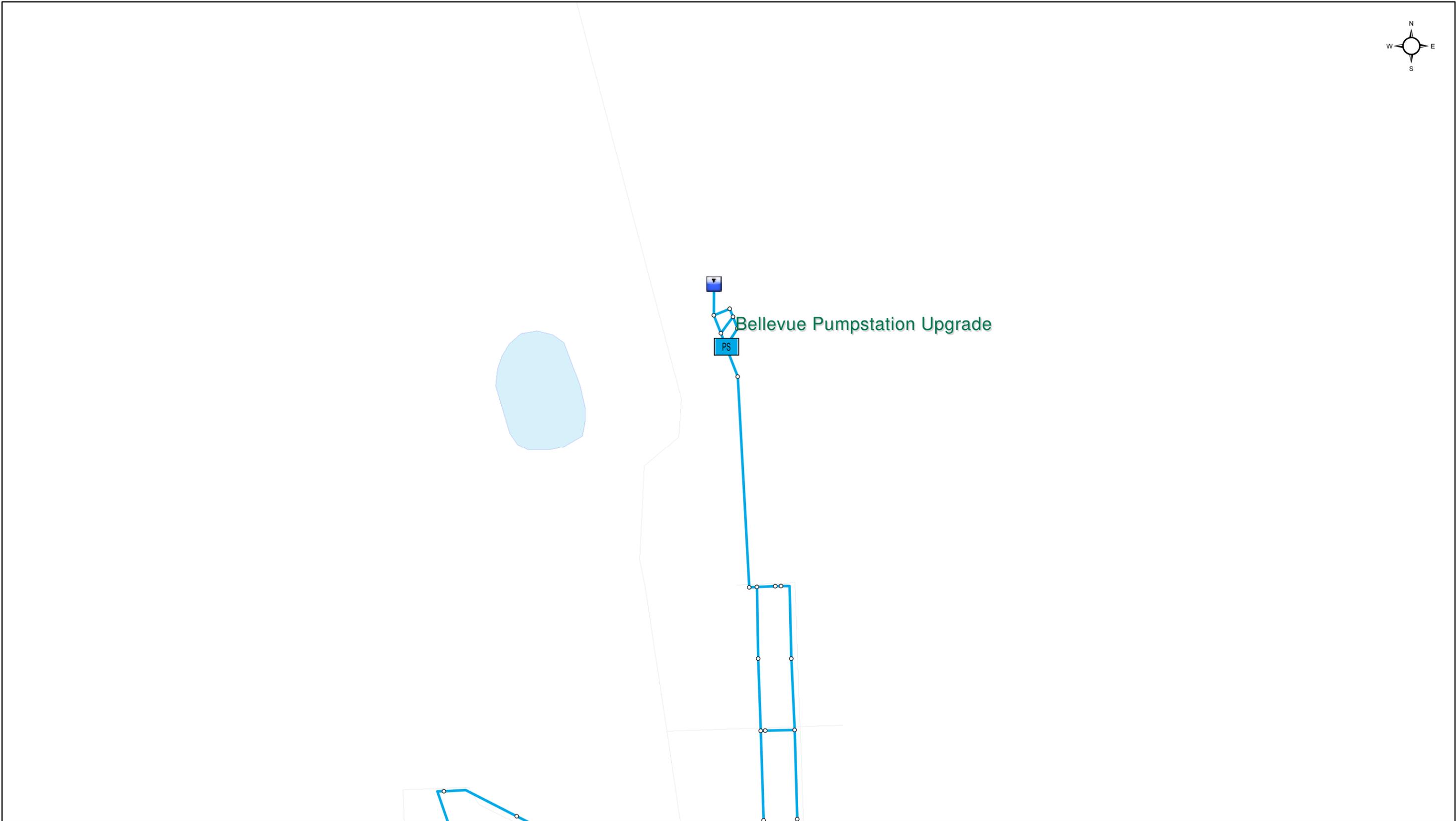
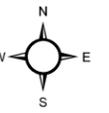




Legend

- | | | |
|---|---|---|
|  New Blairmore Reservoir |  New Reservoir Fill Main |  Bridgegate Resort |
|  Booster Pump to New Reservoir | |  Commercial |
| | |  Crowsnest Resort |
| | |  Industrial |
| | |  Residential |
| | |  River Run |





Legend

- PS Bellevue Pumpstation Upgrade
- Bridgegate Resort
- Commercial
- Crowsnest Resort
- Industrial
- Residential
- River Run



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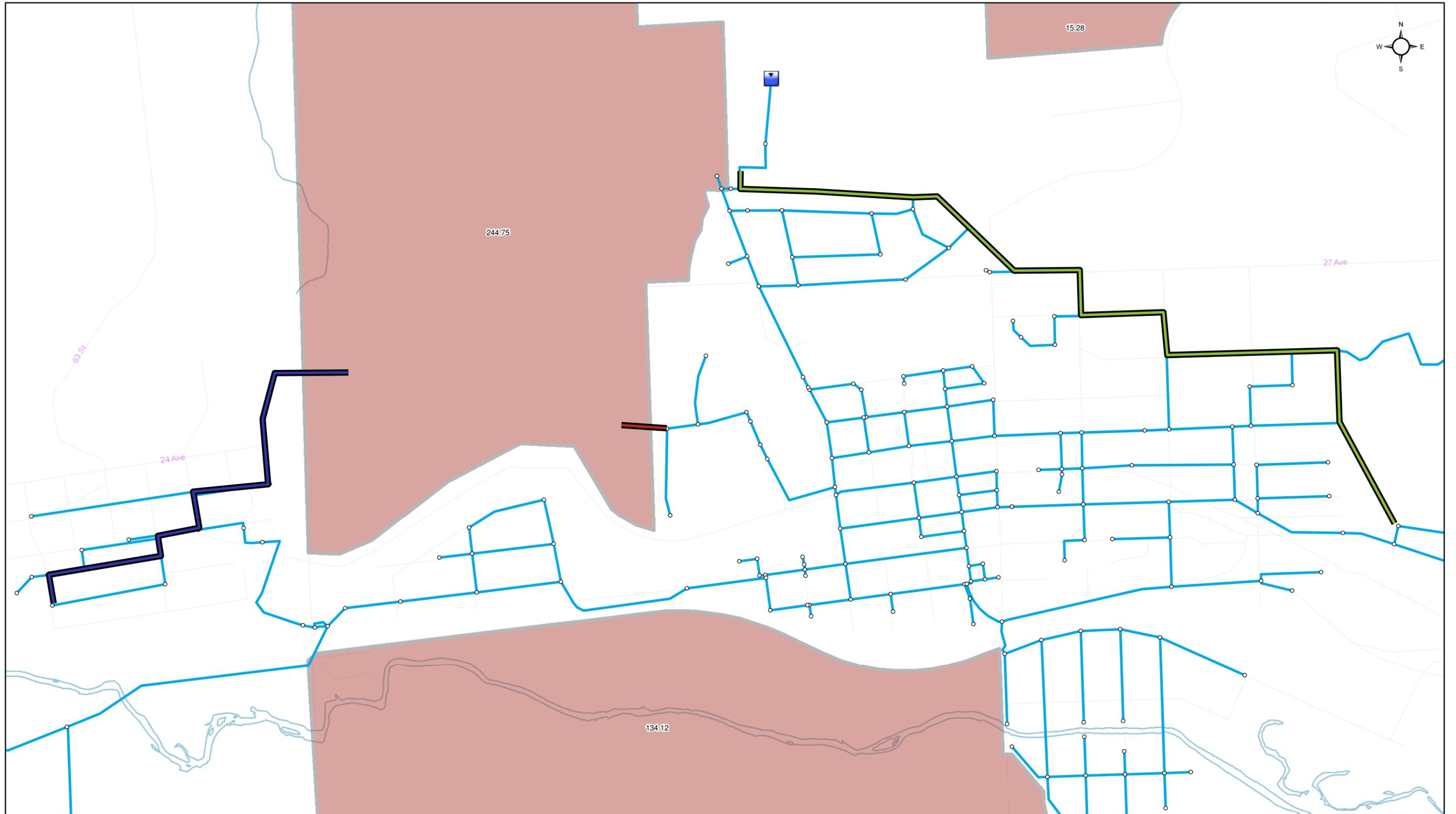
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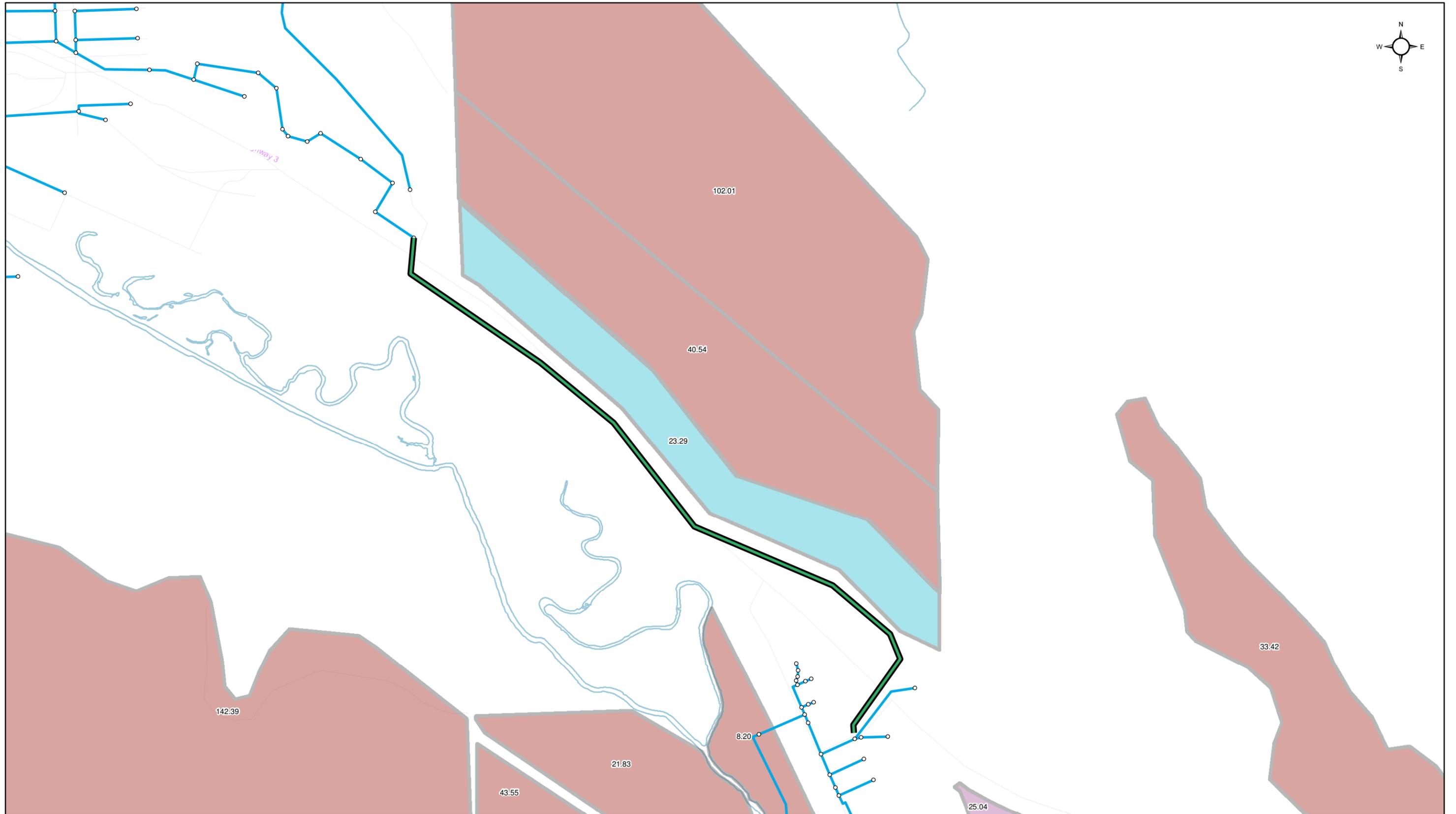
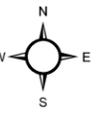
Client/Project
 Municipality of Crowsnest Pass
 Water Distribution Master Plan

Figure No.
 5-10

Title
 Water Distribution System Improvements
 Bellevue Pump Station Upgrade







Legend

-  Coleman - Blairmore Interconnect
-  Bridgegate Resort
-  Commercial
-  Crowsnest Resort
-  Industrial
-  Residential
-  River Run

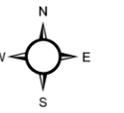
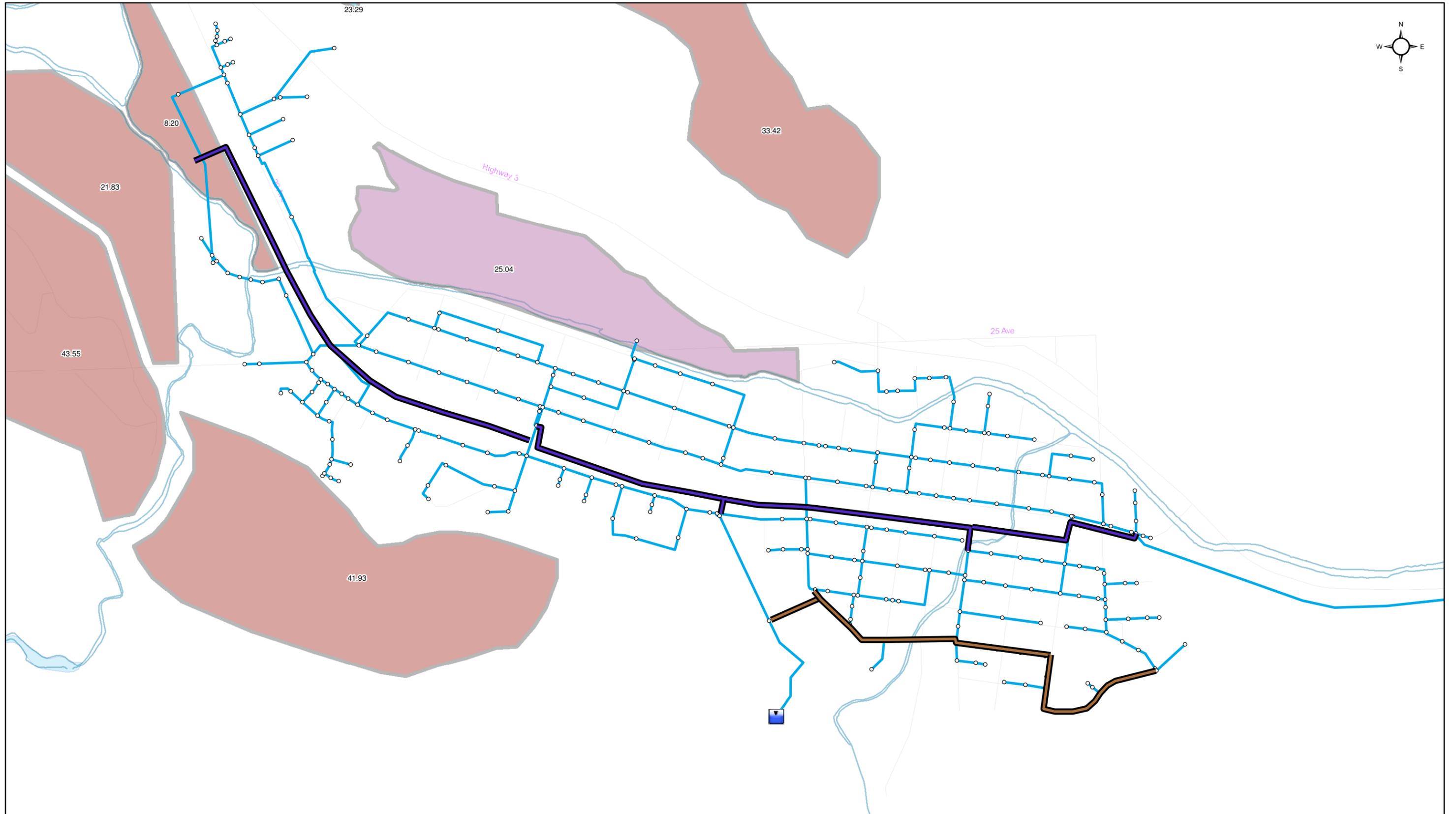


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 Water Distribution Master Plan
 Figure No.
 5-12
 Title
 Water Distribution System Improvements
 Coleman - Blairmore Interconnect





Legend

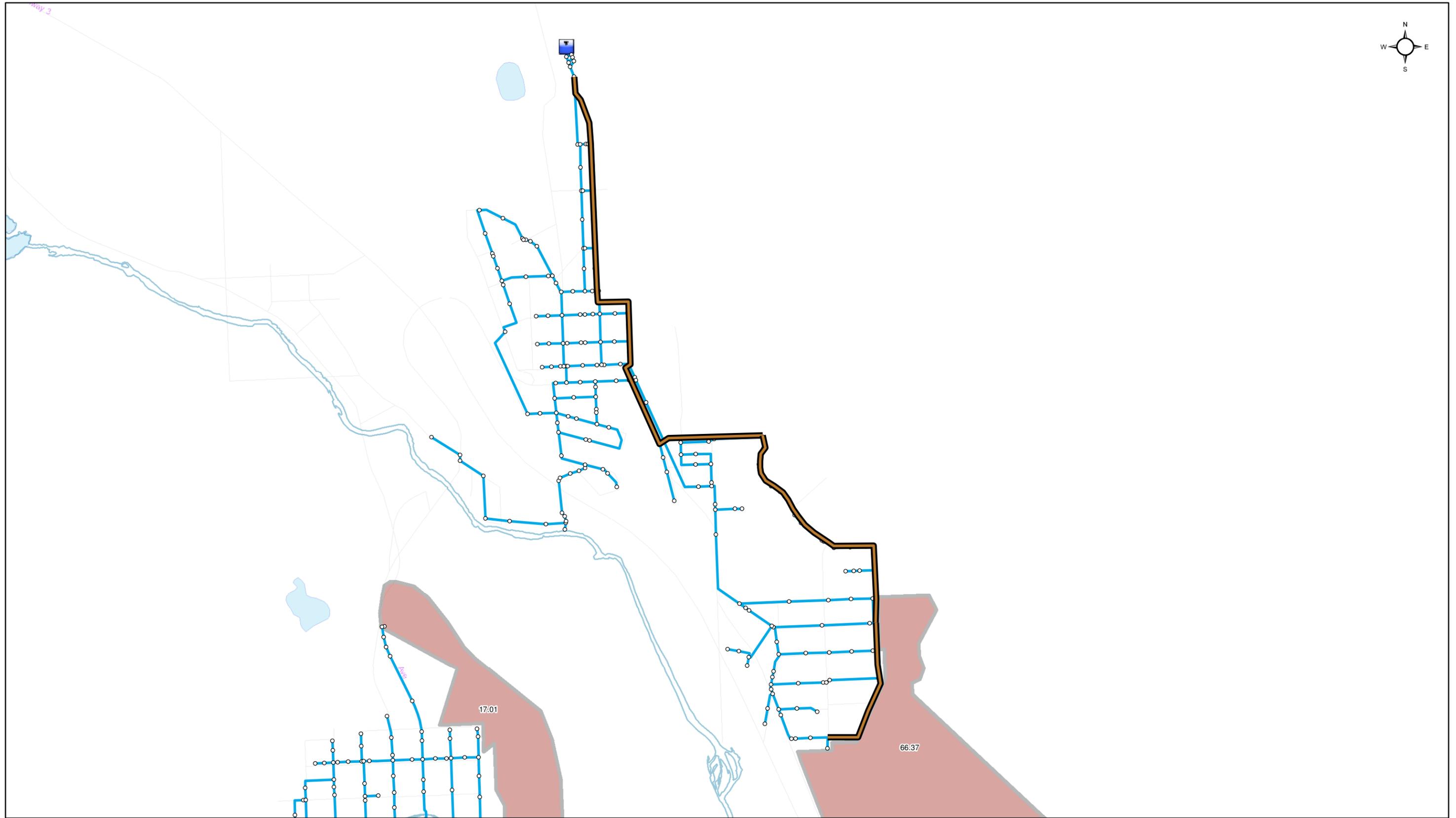
- Blairmore Transmission Main Improvement
- Blairmore Reservoir Looping Improvement
- Bridgeway Resort
- Commercial
- Crowsnest Resort
- Industrial
- Residential
- River Run



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 Water Distribution Master Plan
 Figure No.
 5-13
 Title
 Water Distribution System Improvements
 Blairmore Distribution System Upgrades





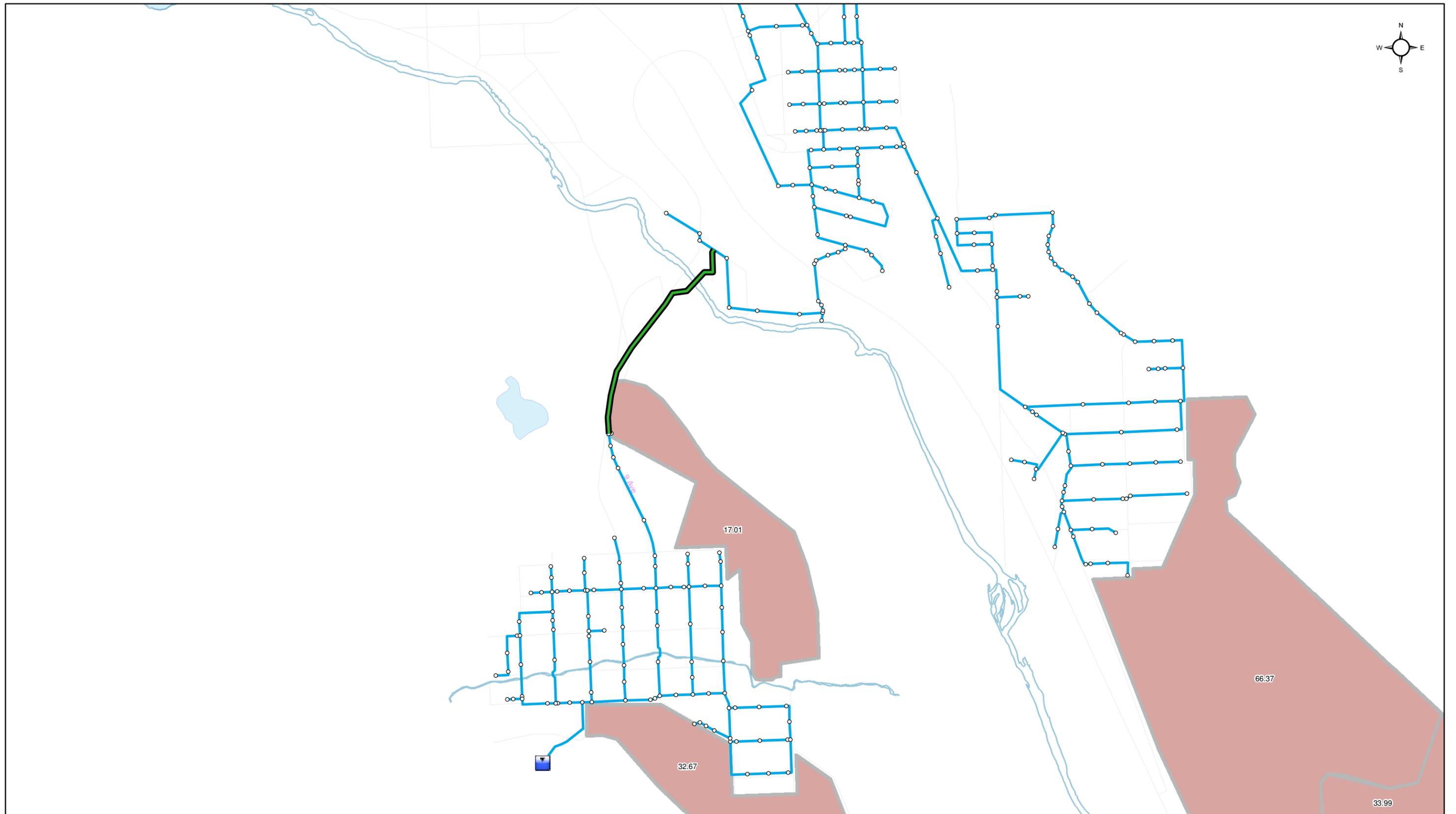
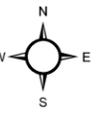
Legend

	Bellevue Looping Improvement		Bridgeway Resort
	Commercial		Crowsnest Resort
	Industrial		Residential
	River Run		

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 Water Distribution Master Plan
 Figure No.
 5-14
 Title
 Water Distribution System Improvements
 Bellevue Distribution System Upgrades





Legend

- Bellevue - Hillcrest Interconnection
- Bridgeway Resort
- Commercial
- Crowsnest Resort
- Industrial
- Residential
- River Run



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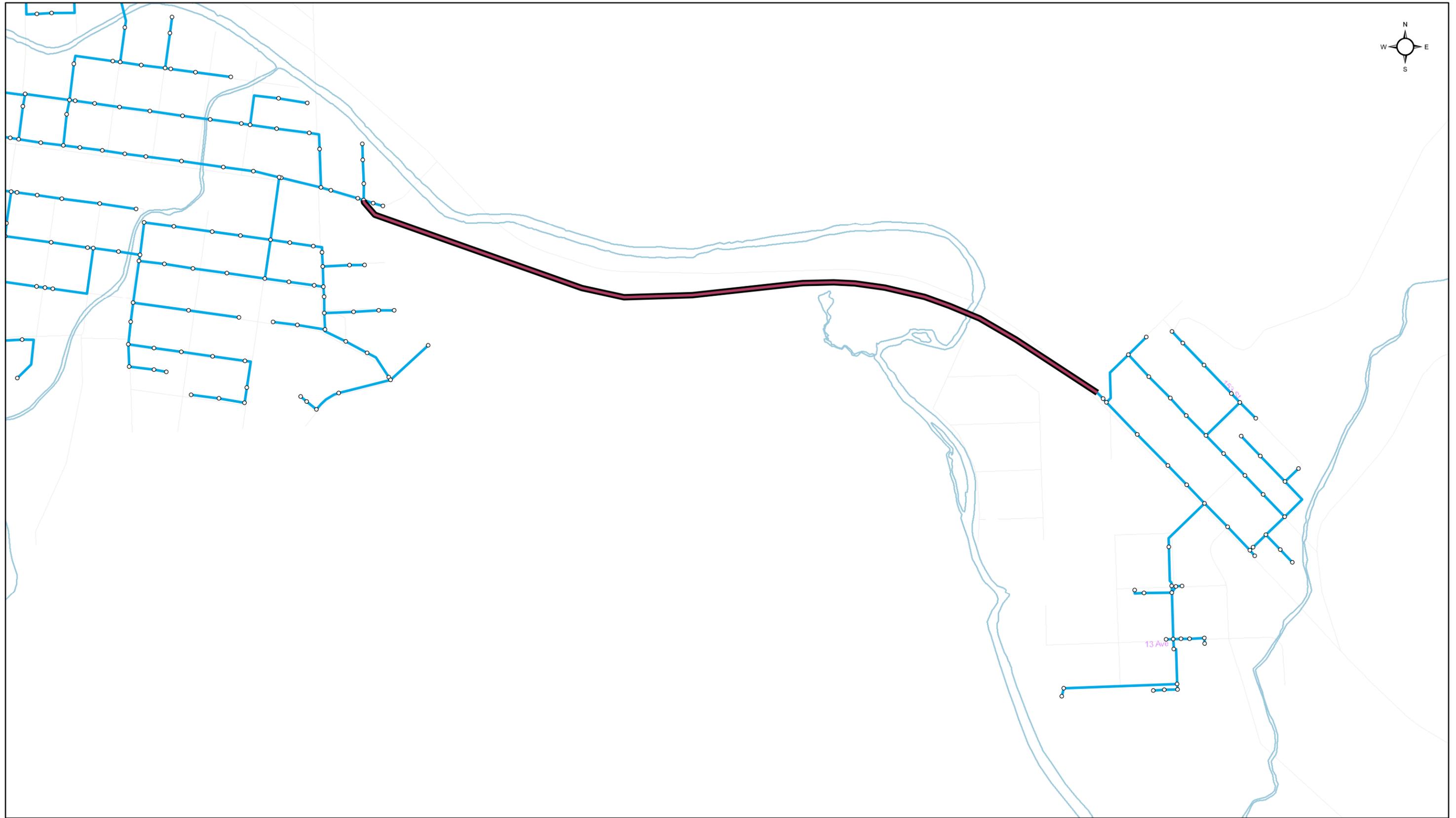
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 Municipality of Crowsnest Pass
 Water Distribution Master Plan

Figure No.
 5-15

Title
 Water Distribution System Improvements
 Bellevue - Hillcrest Interconnection





Legend

-  Blairmore - Frank Interconnection
-  Bridgegate Resort
-  Commercial
-  Crowsnest Resort
-  Industrial
-  Residential
-  River Run



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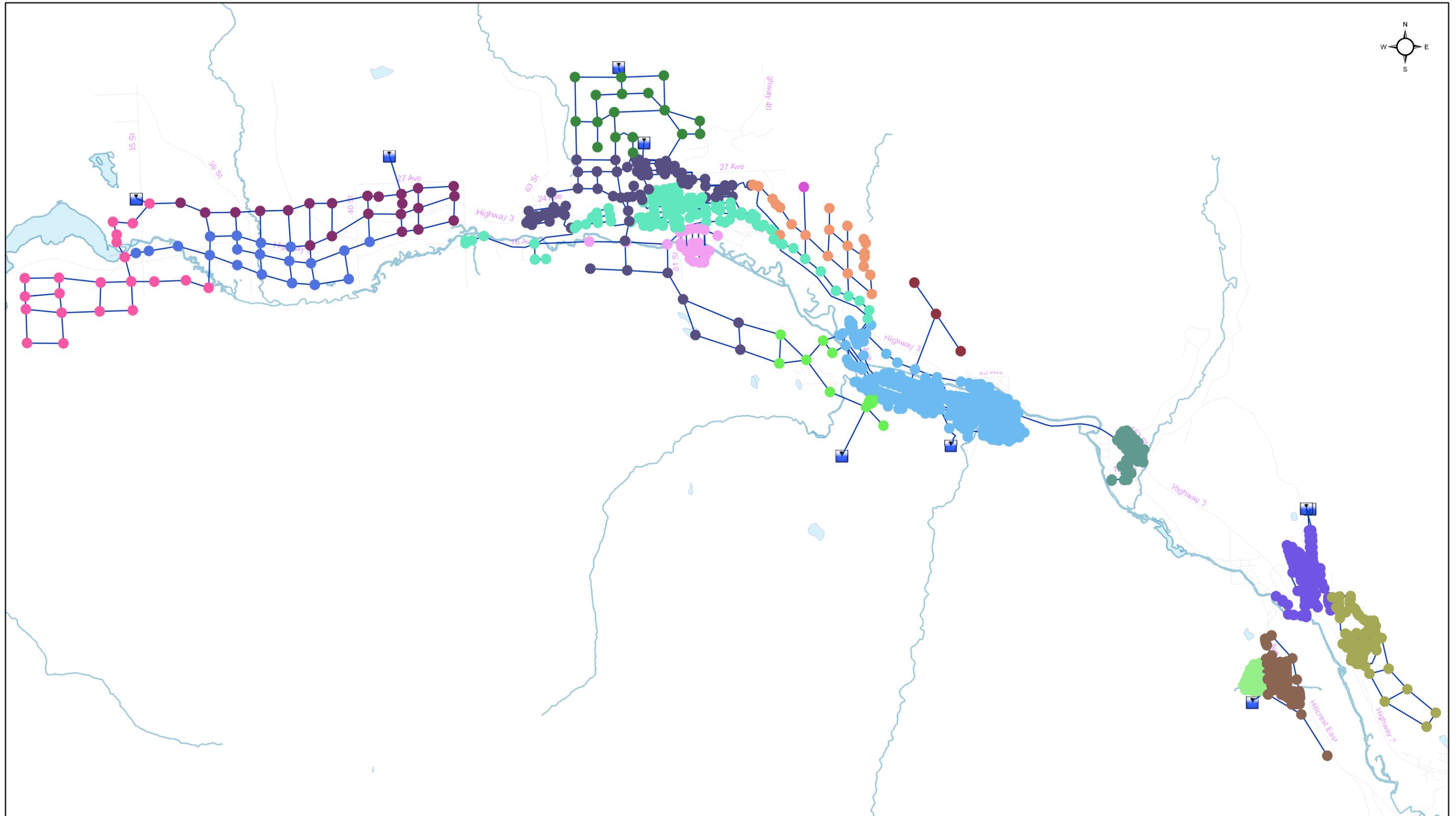
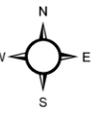
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 Water Distribution Master Plan

Figure No.
 5-16

Title
 Water Distribution System Improvements
 Blairmore - Frank Interconnection





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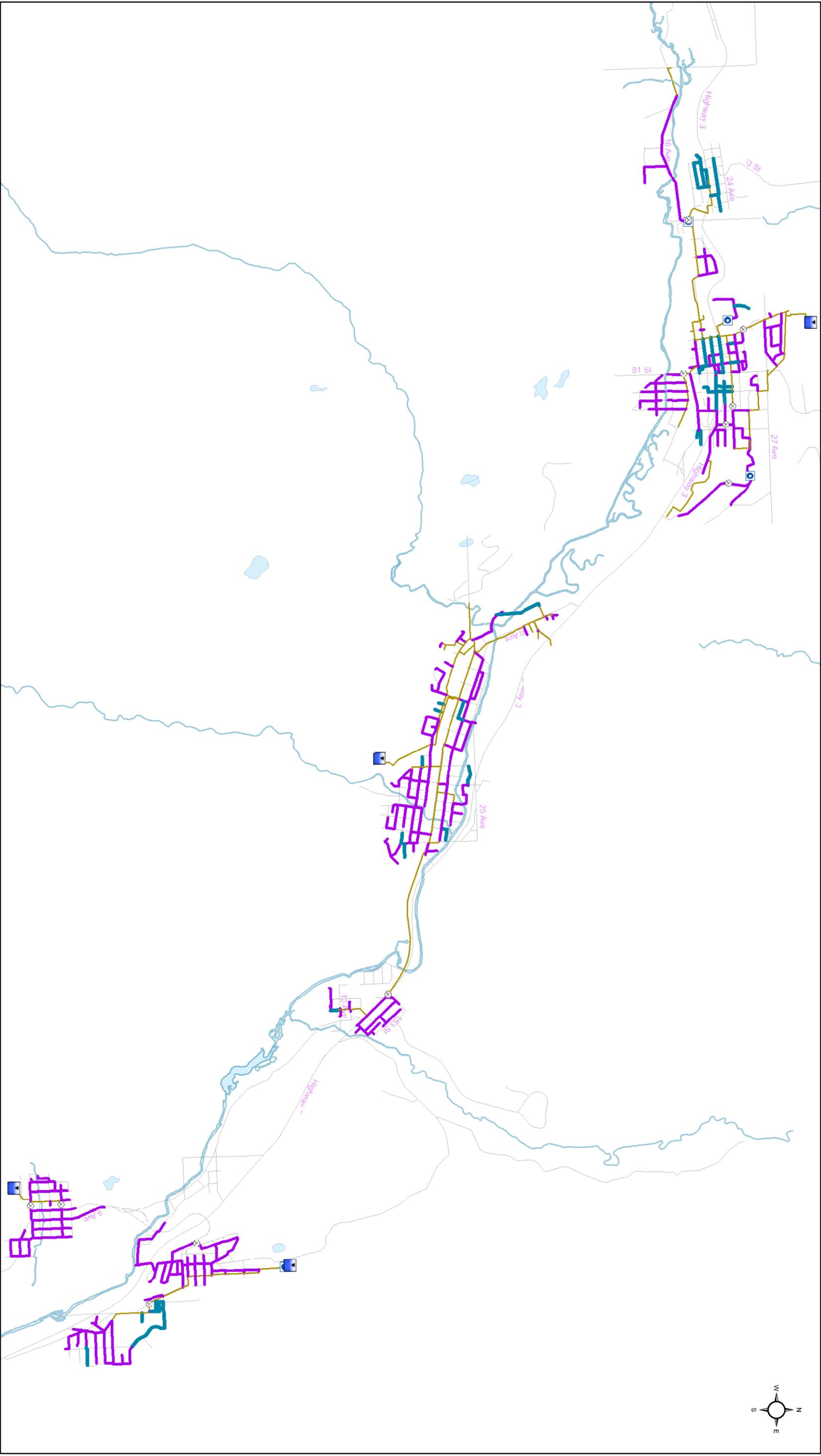
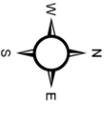
Pressure Zone Label	Blairmore - 1437 m	Coleman - 1440 m	Frank - 1345 m	Sentinel - 1450 m
Bellevue - 1340 m	Blairmore - 1460 m	Coleman - 1460 m	Hillcrest - 1350 m	Sentinel - 1455 m
Belleuve - 1355 m	Coleman - 1360 m	Coleman - 1535 m	Hillcrest - 1355 m	
Blairmore - 1345 m	Coleman - 1380 m	Coleman - 1560 m	Sentinel - 1400 m	

Client/Project
 Municipality of Crowsnest Pass
 Water Distribution Master Plan

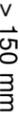
Figure No.
 5-17

Title
 Water Distribution System Improvements
 Sentinel Growth Area Reservoirs





Legend

-  > 150 mm
-  100 mm Mains
-  Reservoir
-  Pump
-  PRV
-  150 mm Mains

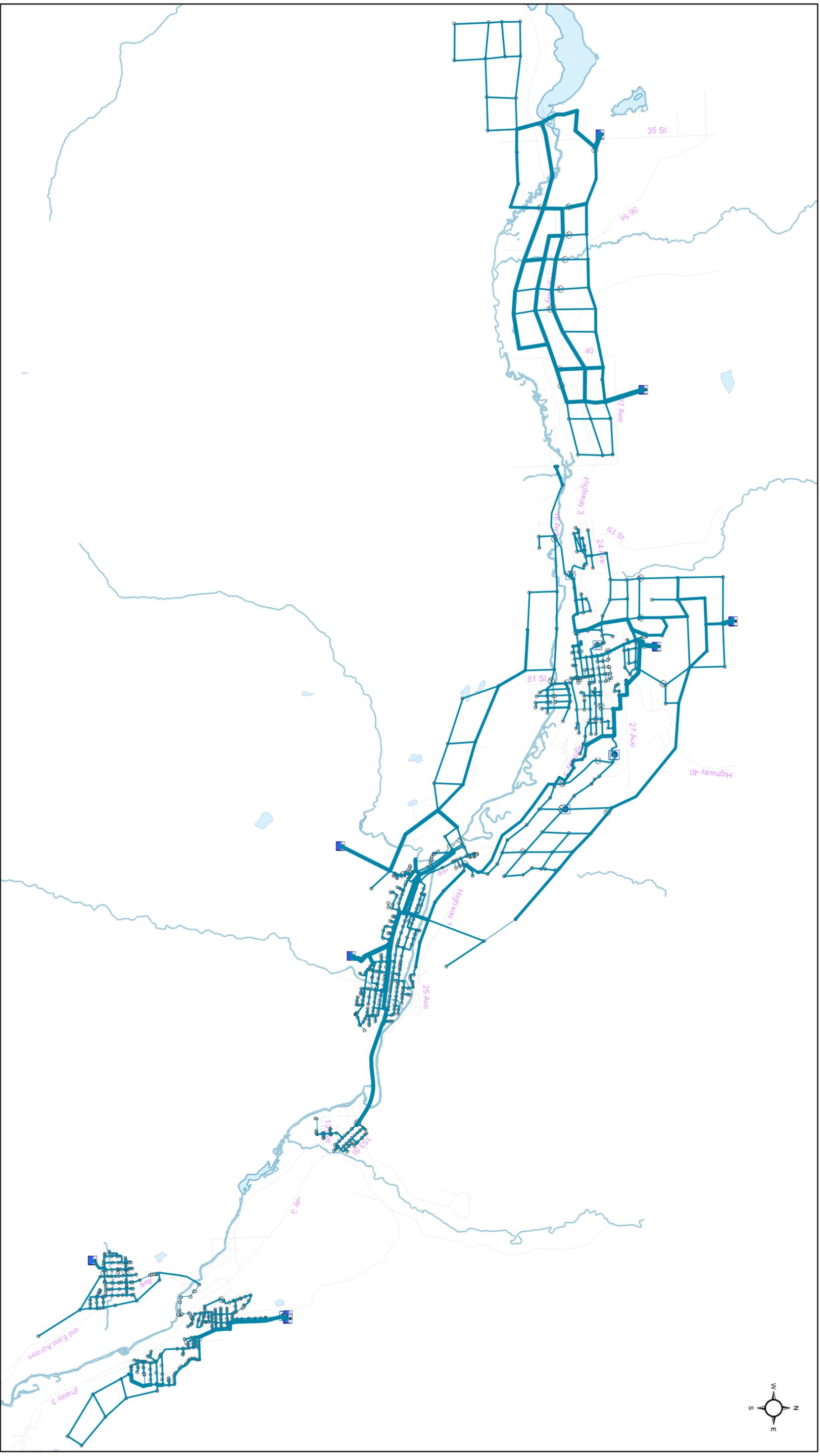
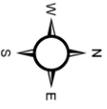


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Municipality of Crownsnest Pass
Water Distribution Master Plan
Figure No. 5-18
Title
Municipality of Crownsnest Pass
Replacement of Smaller Mains





Legend

- | | |
|---------------------------|----------------|
| ○ Nodes | — Diameter |
| ▣ Reservoir | — Up to 150 mm |
| ⊗ Pressure Reducing Valve | — 150 - 200 mm |
| ⊕ Pump | — 200 - 250 mm |
| | — 250 - 350 mm |
| | — 350 - 500 mm |



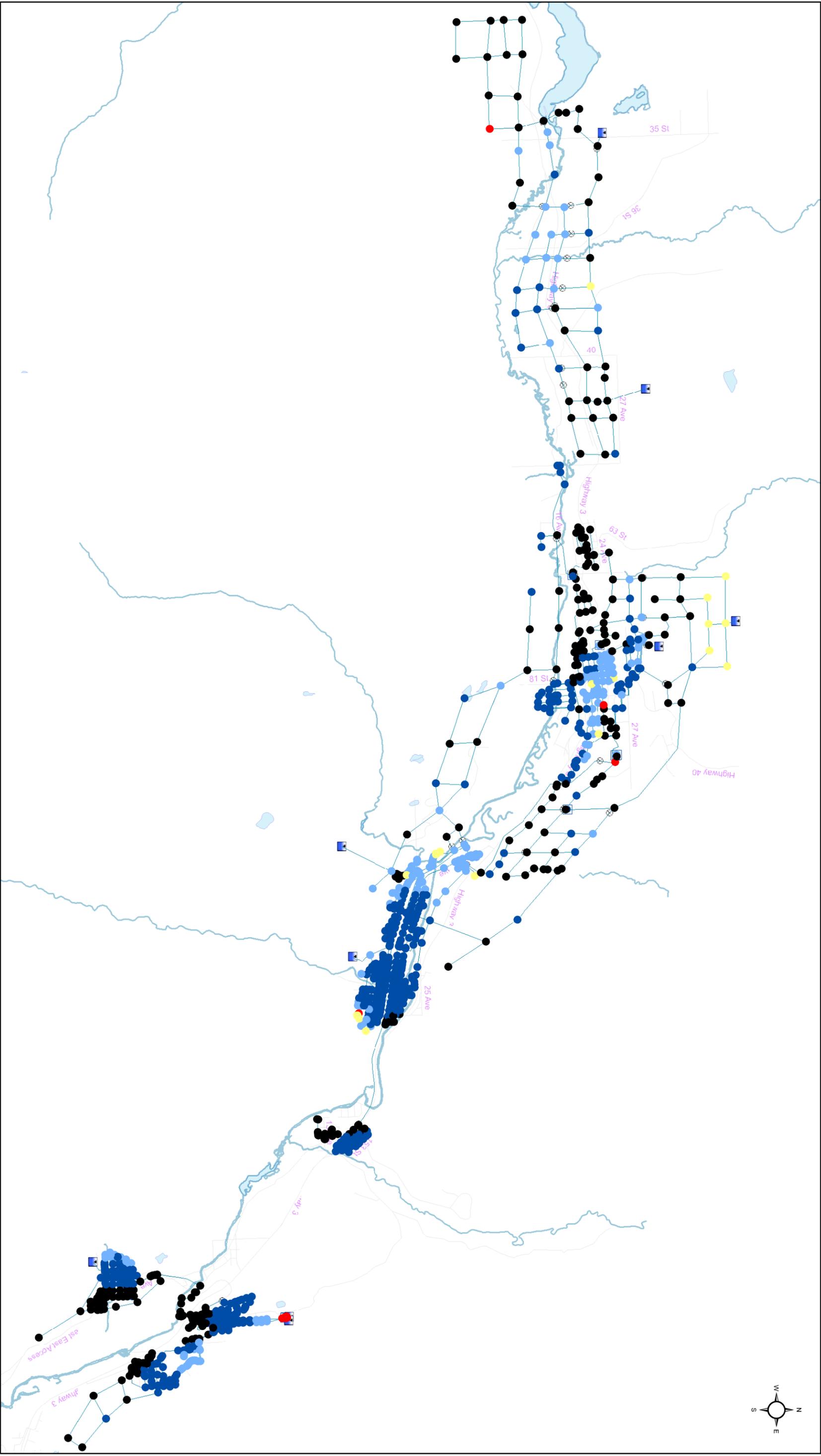
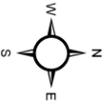
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Municipality of Crownsnest Pass
 Water Distribution Master Plan
 Figure No. 5-19
 Title Future Water Distribution System





Legend

- Pipe
- Reservoir
- Pressure Reducing Valve
- Pump

Node Pressure

- < 40 psi
- 40 - 50 psi
- 50 - 70 psi
- 70 - 90 psi
- > 90 psi



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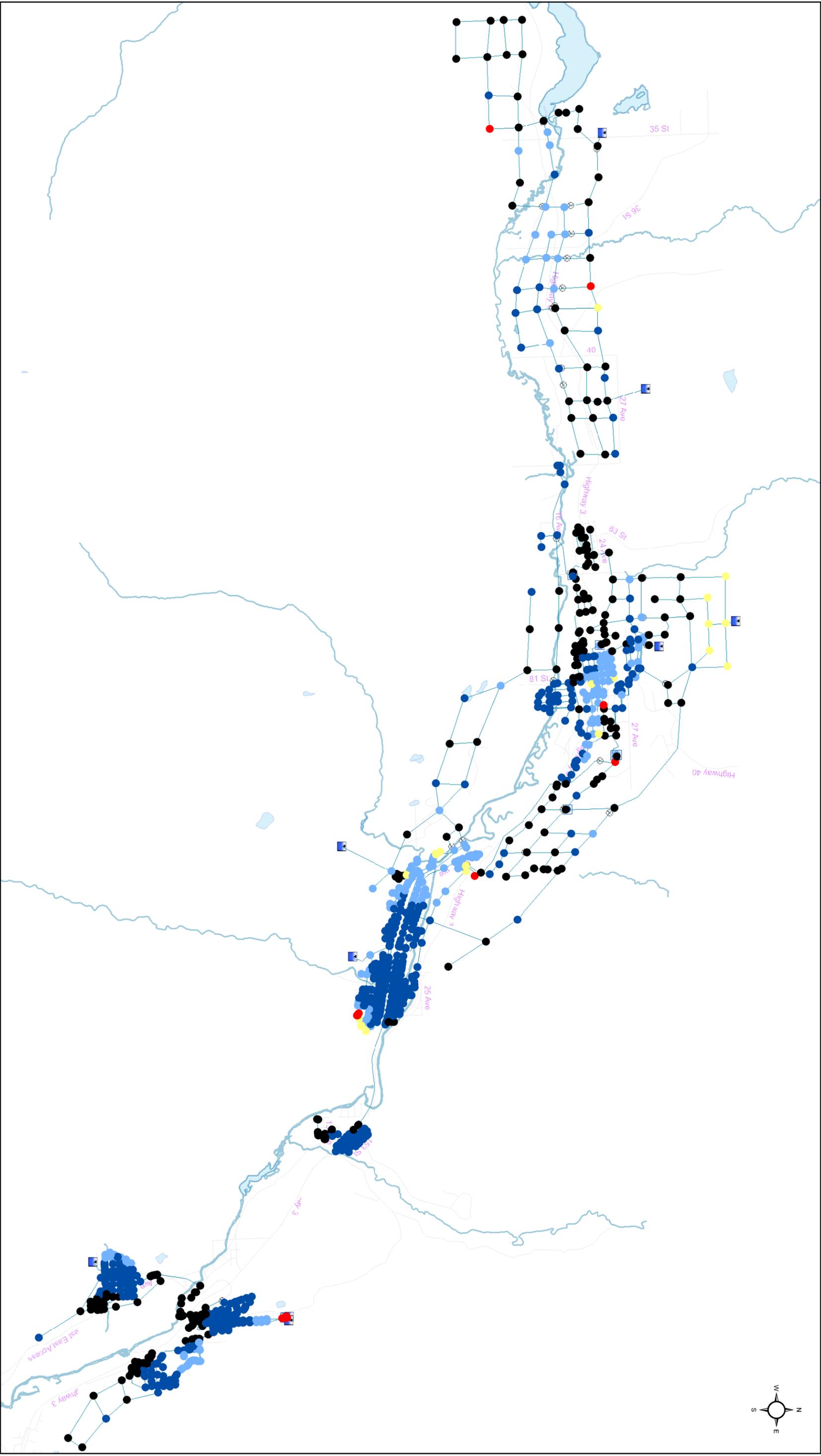
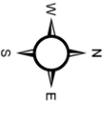
Figure No.

5-20

Title

Future Water Distribution System
 Average Day Demand Node Pressure





Legend

— Pipe

☐ Reservoir

⊗ Pressure Reducing Valve

⊕ Pump

Node Pressure

● < 40 psi

● 40 - 50 psi

● 50 - 70 psi

● 70 - 90 psi

● > 90 psi

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Municipality of Crownsnest Pass
Water Distribution Master Plan

Figure No.

5-21

Title

Future Water Distribution System
Maximum Day Demand Node Pressure



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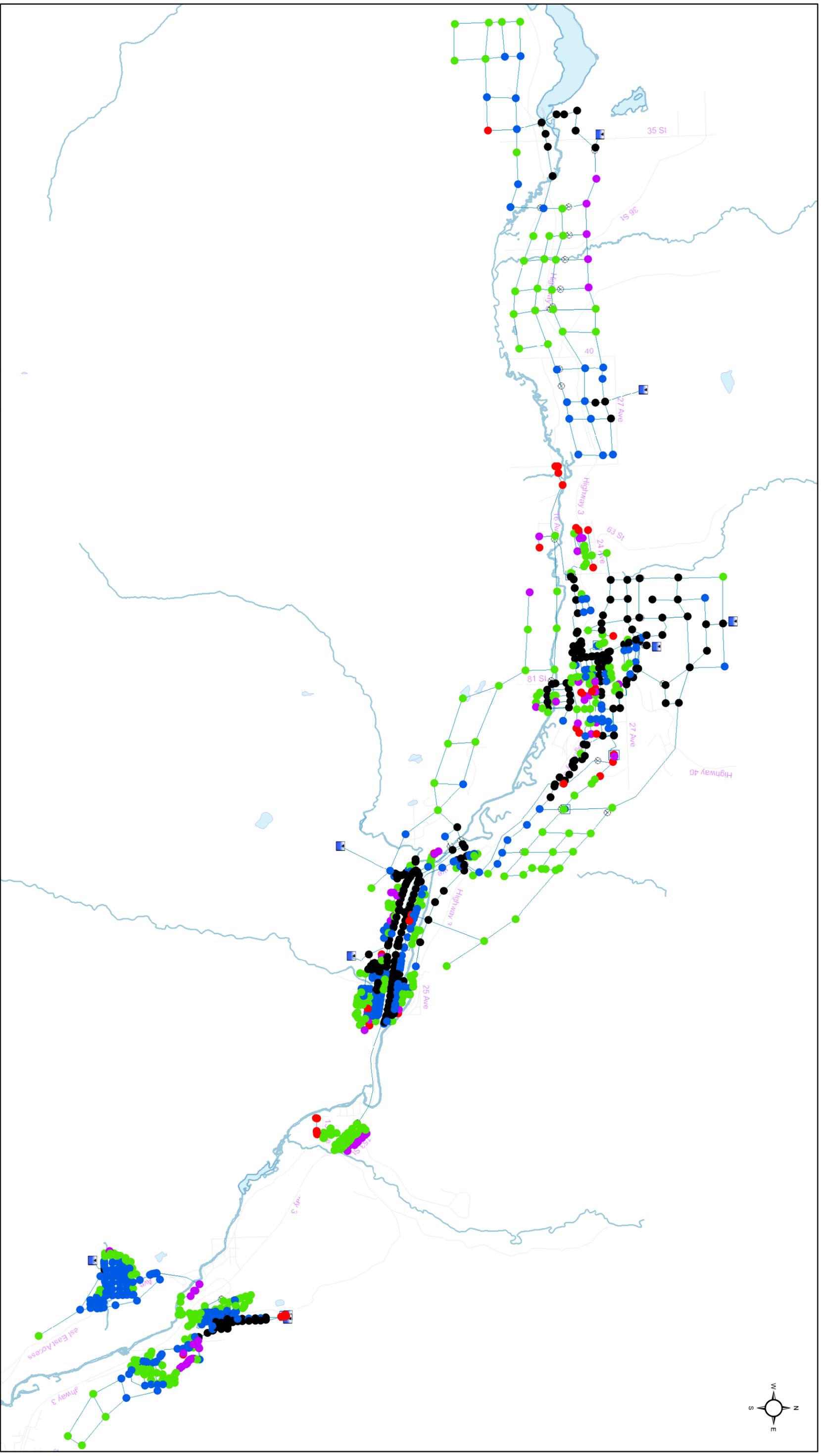
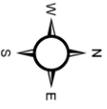
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Legend

- | | | | |
|--|-------------------------|--|-----------------------------------|
| | Pipe | | Available Fire Flow < 3,000 l/min |
| | Reservoir | | 3,000 - 4,500 l/min |
| | Pressure Reducing Valve | | 4,500 - 9,000 l/min |
| | Pump | | 9,000 - 15,000 l/min |
| | | | 15,000 - 18,000 l/min |

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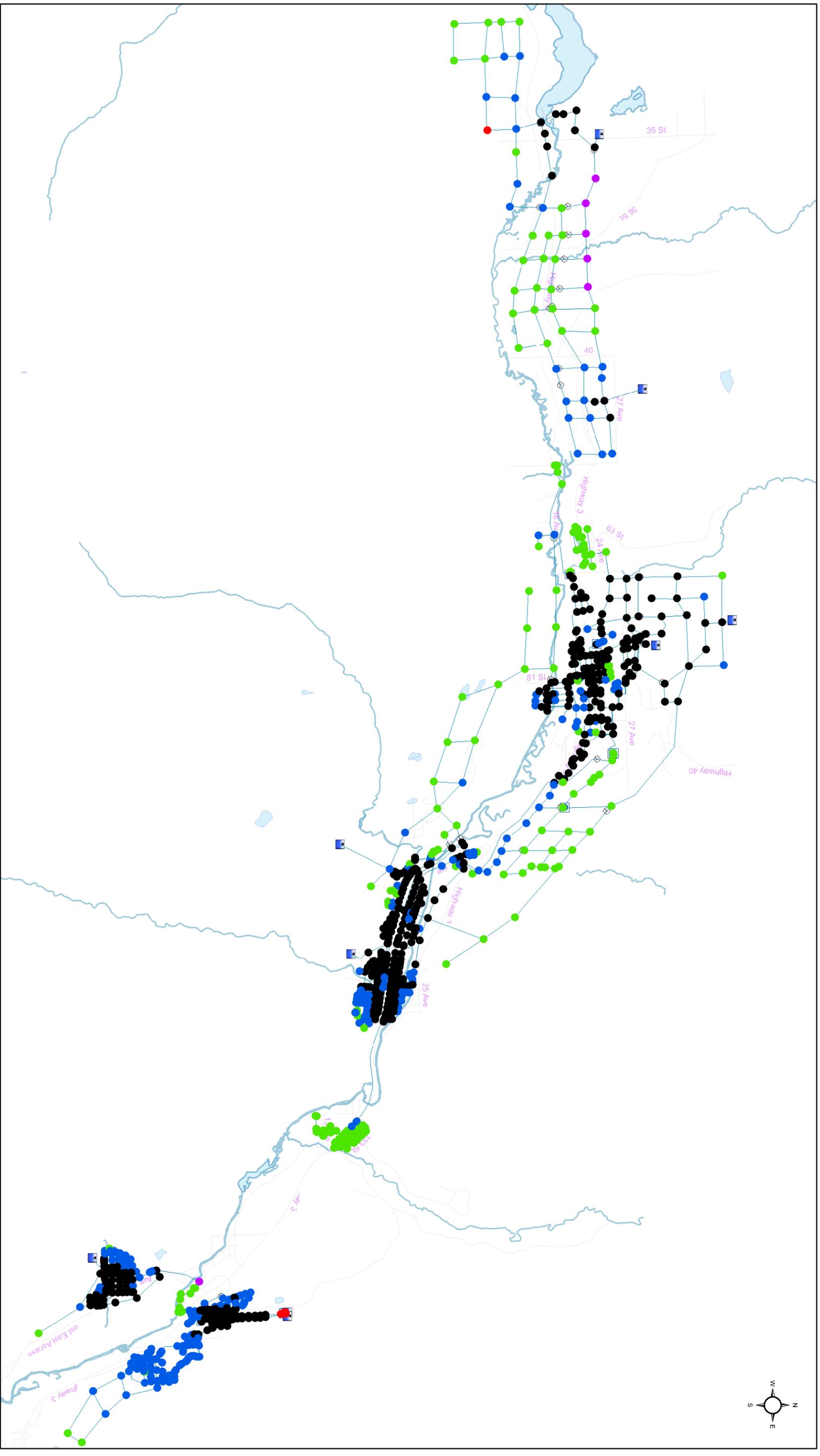
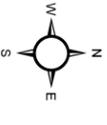
Figure No.

5-22

Title

Future Water Distribution System
 Maximum Day Demand Available Fire Flow





Legend

- Pipe
- Reservoir
- Pressure Reducing Valve
- Pump

Available Fire Flow

- < 3,000 l/min
- 3,000 - 4,500 l/min
- 4,500 - 9,000 l/min
- 9,000 - 15,000 l/min
- 15,000 - 18,000 l/min



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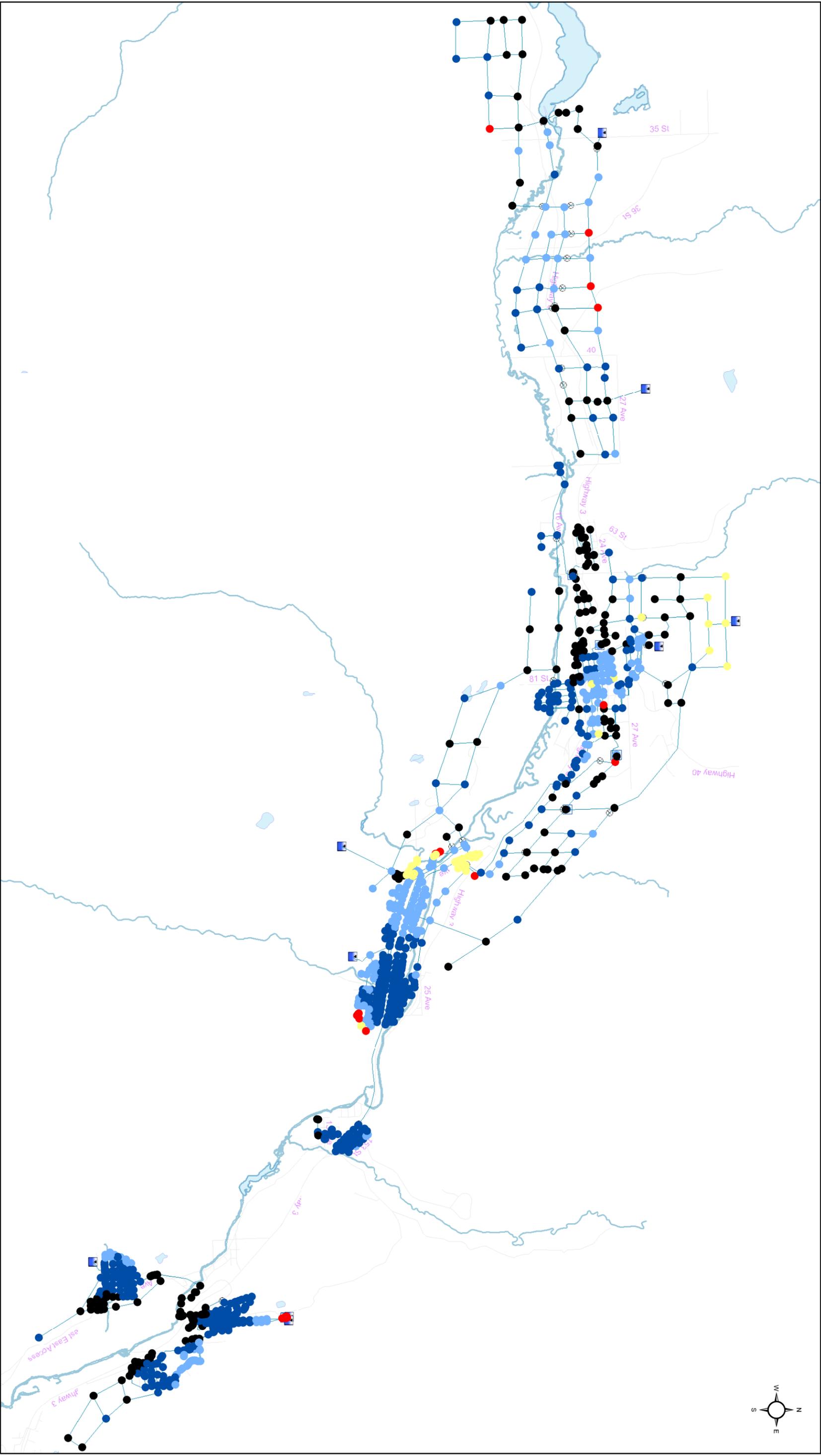
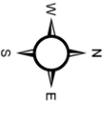
Figure No.

5-23

Title

Ultimate Water Distribution System
 Maximum Day Demand Available Fire Flow





Legend

- Pipe
 - Reservoir
 - Pressure Reducing Valve
 - Pump
-
- Node Pressure**
- < 40 psi
 - 40 - 50 psi
 - 50 - 70 psi
 - 70 - 90 psi
 - > 90 psi



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Municipality of Crownsnest Pass
 Water Distribution Master Plan
 Figure No. 5-24
 Title
 Future Water Distribution System
 Peak Hour Demand Node Pressure



6.0 Capital Improvement Plan

6.1 OPINION OF PROBABLE COST

This section presents “**conceptual**” cost estimates ($\pm 50\%$) for capital costs associated with the construction of the infrastructure required for the development of the lands described in the previous sections. Due to the conceptual nature of this study and understanding that there exist unknown variables beyond the scope of this study, the cost estimates presented herein include a contingency allowance of 30% and an engineering allowance of 10% of the total estimated capital costs.

These factored level capital cost estimates should be considered realistic, but preliminary at this point and intended to give an order of magnitude opinion of estimated costs for planning and internal budgeting purposes only. No detailed specifications, geotechnical requirements, process flow diagrams, site development or construction drawings have been developed or assessed to obtain “preliminary design level” cost estimates. *Stantec Consulting Ltd. does not guarantee the accuracy of this opinion of probable cost. The actual final cost of the project will be determined through the bidding and construction process.*

**MUNICIPALITY OF CROWSNEST PASS
WATER DISTRIBUTION SYSTEM MASTER PLAN**

Capital Improvement Plan
February 6, 2008

6.1.1 Improvement Alternatives

The costs for each improvement alternative are listed in **Table 6-1** .

Table 6-1 Improvement Alternatives - Opinion of Probable Cost

	Projected Capital Cost	Improvement Trigger
Sentinel Water Supply and Pumping Requirements		
New Reservoirs	6,850,000	Development in Sentinel Growth Area
Coleman Water Supply and Pumping Requirements		
Option 1 New Pump Station	2,980,000	Development outside of current service elevation within Coleman Water System
Option 2 New Reservoir	3,450,000	
Blairmore Water Supply and Pumping Requirements		
Option 1 New Pump Station	3,460,000	Development outside of current service elevation within Blairmore Water System
Option 2 New Reservoir	3,840,000	
Bellevue Water Supply and Pumping Requirements		
Upgrade Pump Station	240,000	Existing Deficiency
Coleman Water Distribution System Upgrades		
Connection to New Pressure Zone (A)	680,000	Existing Deficiency
Connection to New Pressure Zone (B)	270,000	Existing Deficiency
Coleman Water Distribution System Improvement	1,610,000	Existing Deficiency
Blairmore Water Distribution System Upgrades		
Blairmore Coleman Interconnect	2,630,000	Existing Deficiency
Blairmore Transmission Main Improvement	3,360,000	Existing Deficiency
Blairmore Reservoir Looping Improvement	1,390,000	Existing Deficiency
Bellevue Water Distribution System Upgrades		
Bellevue Water Distribution System Improvements	2,570,000	Existing Deficiency
Hillcrest Water Distribution System Upgrades		
Hillcrest – Bellevue Interconnections	1,570,000	Existing Deficiency
Frank Water Distribution System Upgrades		
Blairmore Frank Interconnect	1,840,000	Existing Deficiency
Other Miscellaneous Improvements:		
Replacement of Smaller Mains		
100 mm	6,180,000	Existing Deficiency
150 mm	33,930,000	As existing system infrastructure replacement occurs
Pressure Zone Adjustments		
	TBD	As development progresses
Fire Hydrant Coverage Improvements		
	TBD	As existing system infrastructure replacement occurs

**MUNICIPALITY OF CROWSNEST PASS
WATER DISTRIBUTION SYSTEM MASTER PLAN**

Capital Improvement Plan

February 6, 2008

6.1.2 Future Development Needs

In addition to the costs for trunk mains and upgrades to the existing system there are costs related to construction of mains to service lands within the growth areas. **Table 6-2** provides a list of costs related to the infrastructure within the proposed development areas.

Table 6-2 Growth Area Pipe Network - Opinion of Probable Cost

	Projected Capital Cost
Growth Area Infrastructure	
Sentinel Growth Area Pipes	21,040,000
Blairmore Coleman Growth Area Pipes	24,780,000
Hillcrest Growth Area Pipes	1,520,000
Bellevue Growth Area Pipes	2,640,000

6.2 CAPITAL IMPROVEMENT PLAN

The master plan has defined two groups of improvements for the Municipality of Crownsnest Pass water distribution system. Existing system and future system improvements are ranked and discussed in the following sections.

6.2.1 Existing System Capital Improvement Ranking

Table 6-3 lists the ranking of the two proposed capital improvements for the existing system. Each improvement alternative is ranked based on cost and subjective criteria such as benefiting area, constructability, technical feasibility, operating costs, and regulatory requirements.

Table 6-3 Existing System Capital Improvement Rankings

Improvement Rank	Description of Capital Improvement
1	Upgraded Bellevue Pump Station
2	Bellevue Water Distribution System Improvements
3	Coleman Water Distribution System Improvement
4	Blairmore Coleman Interconnect
4	Blairmore Reservoir Looping Improvement
6	Blairmore Transmission Main Improvement
7	Connection to New Pressure Zone (A)
8	Blairmore – Frank Interconnect
9	Connection to New Pressure Zone (B)
10	Hillcrest – Bellevue Interconnections
Unranked	Pressure Zone Adjustments
Unranked	Replacement of Smaller Mains
Unranked	Fire Hydrant Coverage Improvements

6.2.2 Future System Capital Improvement Ranking

Table 6-4 lists the rankings of the infrastructure projects required to service the growth areas described in this report. Each project is not given a specific ranking as they are dependent on the actual progression of development within the Municipality.

Each improvement alternative is ranked based on cost and subjective criteria such as constructability, technical feasibility, operating costs, and regulatory requirements.

Table 6-4 Future System Capital Improvement Rankings

Improvement Rank	Description of Capital Improvement	
	Sentinel Water Supply and Pumping Requirements	
1		New Reservoir
	Coleman Water Supply and Pumping Requirements	
<i>2</i>	<i>Option 1</i>	<i>New Pump Station</i>
1	Option 2	New Reservoir
	Blairmore Water Supply and Pumping Requirements	
<i>2</i>	<i>Option 1</i>	<i>New Pump Station</i>
1	Option 2	New Reservoir

In general the preference is to construct new reservoir storage to provide the range of flow and pressure required for development at higher elevations. The operating costs will tend to be lower than regular operation of full pump stations that provide the range of flows required in the new development areas.

In the case where it is not practical to construct new reservoir storage pump stations become a valid alternative to provide servicing.

MUNICIPALITY OF CROWNEST PASS
WATER DISTRIBUTION SYSTEM MASTER PLAN

Capital Improvement Plan
 February 6, 2008

6.3 DEVELOPMENT COSTS

Four individual development cost scenarios were developed for the infrastructure servicing requirements for the Municipality of Crowsnest Pass.

Table 6-5 lists the area based development costs neglecting the additional cost of upgrading any water treatment plants, wells or other source development. Area based costs are calculating by dividing the cost of infrastructure required for a specific area by the developable area in question. This gives a measure of the relative cost to service different areas in different each community.

Table 6-5 also provides the overall development costs for the Municipality of Crowsnest Pass.

Table 6-5 Scenario 1 – Growth Area Based Development Costs (WWTP Upgrades Not Included)

	Projected Capital Cost	Area	Development Cost (per Hectare)
Sentinel Growth Area			
New Reservoirs	\$6,850,000		
Pipe Network	\$15,730,000		
Total	\$22,580,000	854	\$26,000
Coleman Blairmore Growth Area			
Coleman Reservoir	\$3,450,000		
Blairmore Reservoir	\$3,840,000		
Pipe Network	\$18,260,000		
Total	\$25,550,000	757	\$34,000
Bellevue Growth Area			
Bellevue Pump Station Upgrades	\$240,000		
Pipe Network	\$1,920,000		
Total	\$2,160,000	100	\$22,000
Hillcrest Growth Area			
Bellevue Hillcrest Interconnection	\$1,570,000		
Pipe Network	\$1,100,000		
Total	\$2,670,000	50	\$53,000
Municipality of Crowsnest Pass			
All Infrastructure	\$52,960,000	1761	\$30,000

7.0 Summary of Recommendations

7.1 EXISTING SYSTEM RECOMMENDATIONS

7.1.1 Blairmore Coleman Interconnect

The pipe upgrade as shown in will provide a connection from Coleman to the existing Blairmore distribution system. This upgrade will increase the level of service to the area adjacent in the area of the connection point. Service pressures and total available fire flow will be increased during higher demand periods.

The total capital improvement value is \$2,630,000.

7.1.2 Blairmore Transmission Main Improvement

This upgrade will increase the service pressures under high demand conditions to portions of Blairmore. More importantly the total available fire flow in areas within Blairmore will be increased.

The total capital improvement value is \$3,360,000.

7.1.3 Blairmore Reservoir Looping Improvement

This upgrade will increase the service pressures in a high elevation area. More importantly the total available fire flow will be increased.

The total capital improvement value is \$1,390,000.

7.1.4 Coleman - Connection to New Pressure Zone (A)

The pipe upgrade will provide a connection from new pipe network to the existing pressure zone CM-5. This arrangement will eliminate the booster pump that currently services this area. Service pressures and total available fire flow will be increased.

In addition to the interconnection mains in the immediate area will require pipe size upgrades to maximize the potential of the upgrade.

The total capital improvement value is \$680,000.

7.1.5 Coleman - Connection to New Pressure Zone (B)

The pipe upgrade will provide a connection from new pipe network to the existing pressure zone CM-4. This arrangement will eliminate the booster pump that currently services this area. Service pressures and total available fire flow will be increased.

In addition to the interconnection mains in the immediate area will require pipe size upgrades to maximize the potential of the upgrade.

The total capital improvement value is \$270,000.

7.1.6 Coleman Water Distribution System Improvement

The previously planned upgrade increase the level of service to the existing Coleman service area and is required for portions of the future Coleman service areas.

The total capital improvement value is \$1,610,000.

7.1.7 Bellevue Distribution System Improvements

This upgrade will increase the service pressures under high demand conditions to portions of Bellevue. More importantly the total available fire flow in areas within Bellevue will be increased.

The total capital improvement value is \$2,570,000.

7.1.8 Upgraded Pump Station

The existing Bellevue pump station can not provide the full range of required flows. The pump station will be upgraded to provide the required level of service for current and future service areas.

The total capital improvement value is \$240,000.

7.1.9 Blairmore Frank Interconnect

The pipe upgrade will improve the existing connection from Frank to the existing Blairmore distribution system. This upgrade will increase the level of service to the area adjacent in the area of the connection point. Service pressures and total available fire flow will be increased during higher demand periods.

The total capital improvement value is \$1,840,000.

7.1.10 Other Improvements

System Data Collection

Detailed analysis of the water distribution system is impacted by a lack of system operational data. As the SCADA system for the Municipality of Crowsnest Pass is expanded the data collection should be enhanced to include:

- Pressures and flows for pumps
- Levels, inflows and outflows for reservoirs.

**MUNICIPALITY OF CROWSNEST PASS
WATER DISTRIBUTION SYSTEM MASTER PLAN**

Summary of Recommendations
February 6, 2008

- Data should be collected, summarized and stored at 5 – 15 min intervals, depending on data storage and archiving capabilities.

Additional scoping is required to determine a value for this project.

Areas of High Pressure

The existing pressure zones should be revised to limit the areas that are exposed to pressures greater than 620 kPa (90 psi).

Fire Hydrant Coverage Improvements

As the development and redevelopment of the overall water distribution system occurs, efforts should be made to install additional fire hydrants to maximize fire hydrant coverage within the distribution system.

Additional scoping is required to determine an improvement value for this project.

Replacement of Smaller Mains

As aging water mains are replaced in the distributions system pips should be sized to ensure that the system is designed to maximize looping and the availability of fire flows.

The total replacement values for 100 mm and 150 mm pipe are:

- 100 mm = \$ 6,180,000
- 150 mm = \$ 33,930,000

7.2 FUTURE SYSTEM RECOMMENDATIONS

7.2.1 Water Supply and Pumping

In order to provide water services to the proposed growth areas additional reservoir storage will be required in Sentinel, Blairmore, and Coleman. In Sentinel the reservoirs are required to provide peaking and fire storage. In Blairmore and Coleman the reservoirs are required to provide fire protection and service flows for areas currently above the service elevations in each community.

The total capital improvement value for each growth area is:

Sentinel Reservoirs:	\$ 6,850,000
Coleman Reservoir:	\$ 3,450,000
Blairmore Reservoir:	\$ 3,840,000

7.2.2 Hillcrest – Bellevue Interconnections

This upgrade will fulfill the additional storage requirements for the Hillcrest Water Distribution system by leveraging the unallocated storage in the Bellevue Water Distribution System.

The total capital improvement value is \$1,570,000.

7.3 SYSTEM IMPROVEMENT COSTS

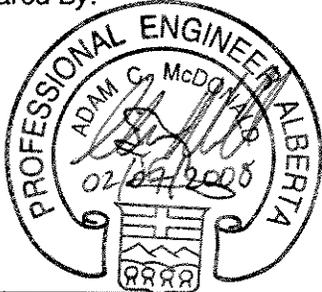
The total projected cost to construct infrastructure to support the development of the proposed 1,800 ha of developable area within the Municipality of Crowsnest Pass is \$52,960,000. This equates to approximately \$30,000 per hectare of developable land as tabulated in **Table 6-5**.

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WATER DISTRIBUTION SYSTEM MASTER PLAN

8.0 Corporate Authorization

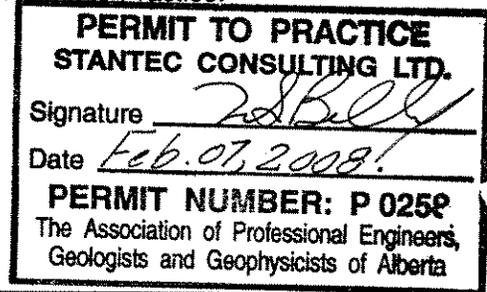
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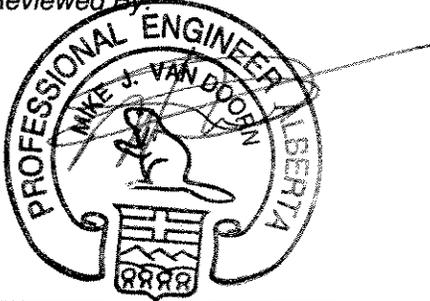
Adam McDonald, P.Eng.
Associate,
Stantec Lethbridge

Permit to Practice:



Mark Bellamy, P.Eng.
Senior Principal,
Stantec Lethbridge

Reviewed By:



Mike Van Doorn, P.Eng.
Senior Associate,
Stantec Lethbridge