ISL Water Modeling Report

Date November 6, 2012

Our Reference: 30387

Village of Pemberton
PO Box 100
7400 Prospect Street
Pemberton, BC V0N 2L0

Attention: Caroline Lamont, Manager of Development Services

Dear Madam:

Reference: Village of Pemberton Water Servicing Analysis
Final Report

1.0 Introduction

As requested, a hydraulic network analysis has been conducted for the Village of Pemberton's water system. The purpose of the analysis was to determine the performance of the Village's water system and identify any improvements that may be needed. In particular, the hydraulic analysis was conducted for the following scenarios:

- The existing Village of Pemberton water system,
- The existing water system and the Sunstone Ridge Development Phase 1, and
- The existing water system and the Sunstone Ridge Development Phase 1 plus future developments in the area.

2.0 Design Criteria

The design criteria for the analysis were taken from the Village of Pemberton Subdivision and Control Bylaw 677 and the Master Municipal Construction Document (MMCD).

From the Village bylaw the system pressures and design water demands must meet the following criteria:

System Pressure:	
Minimum System Pressure at Peak Demand	300 kPa
Maximum Allowable Pressure	850 kPa
Maximum Allowable Pressure (by approval)	1035 kPa
Minimum Fire Hydrant Pressure	150 kPa
Design Water Demands:	
Average Daily Demand (ADD)	455L/c/d
Maximum Daily Demand (MDD)	910 L/c/d
Peak Hour Demand (PHD)	1820 L/c/d

For fire flows the Village has adopted the MMCD guidelines and they are as follows:

Development	Minimum Fire Flows (L/s)
Single Family	60
Apartments, Townhouses	90
Commercial	150
Institutional	150
Industrial	225

3.0 Model Set Up

The hydraulic network analysis was carried out using Bentley's WaterCAD Version 8.

Each model scenario was simulated for the following system demands:

- Average Daily Demand (ADD)
- Peak Hour Demand (PHD)
- Maximum Daily Demand (MDD) + Fire flows

It should be noted that the model was not calibrated as information regarding fire flow tests and water meter data were not available at the time of the assessment. Any changes or updates to the model are noted for each model scenario.

4.0 The Existing Water System

The Village's water system is current fed from an existing 1600 m^3 reservoir located near the Benchlands development. The existing water system currently services the Village of Pemberton, a regional area to the north of the Village, and the airport. The industrial park area is currently serviced by the First Nations community to the east and is not part of the existing water system. It should be noted that the existing WaterCAD model that we received accounted for the future demands (immediate and short term) as listed in Table 4.4 of the 2007 Associated Engineering report for the Village. In addition, the exact demand requirements for the area north of the Village are not known at the time of analysis.

Figure 1 shows the existing water network.

Updates to the existing water model include:

- The Pemberton wells off-line during all model simulations
- The Plateau Strata booster pump was active for all scenarios
- The Plateau Strata fire pump was active for the fire flow analysis
- Used the system constraint option in calculating the fire flow analysis and increased the fire flow upper limit to 300 L/s

The results of the existing water system model simulations for ADD, PHD, and MDD + FF are shown in Figures 2 to 4.

From Figures 2 and 3, the model results suggest that the existing water system has adequate pressure for ADD. For PHD, there are some deficiencies located within the Village Core. As

the existing reservoir water level is set at 289.4 m and some the areas in the Village core are at higher elevations (at 251 m) the maximum expected pressure at the highest location would be 149 kPa.

Figure 4 shows the model results for the existing MDD + FF analysis. As commercial areas are much disbursed through the Village, the 150 L/s criterion is used. The existing system can provide around 60-100 L/s in the Village core and to the area east of the Village core. To the east of the BC Railway, there is a small area that meets the fire flow requirement of 150 L/s. For the areas south east of the Plateau Strata and towards the airport the fire flows are between 50 to 60 L/s.

5.0 The Existing Water System with Future Developments

5.1 Sunstone Ridge Development Phase 1

Phase 1 of the Sunstone Ridge Development (SRD) is located 3 km east of the Village core, north of the CN railway. The SRD site will be the first of a number of developments in the Sunstone Ridge area and will consist of single family and multi-family units. The total demands identified for SRD were taken from the Delcan Technical Memorandum dated April 4, 2012 and are as follows:

- ADD = 3.9 L/s
- MDD + FF = 7.8 L/s + FF varies for different types of development
- PHD = 15.5 L/s

The full Technical Memorandum can be found in Appendix B of the report.

With the development of the SRD site, a new reservoir is proposed. A further discussion on the total required demands for the new reservoir, sizing and operation can be found under Section 6.0 of the report.

Updates to the model include:

- Used the proposed pipe network for SRD Phase 1 as per Figure 2 of Delcan's Technical Memorandum
- Provided a looped connection to the Airport and industrial park with the additional of a 300 mm line between the SRD and the industrial park and airport. Therefore, the existing First Nations reservoir in the model was made to be offline for all model scenarios
- Added a PRV to the line that connects to the airport (PRV – 800)
- Created three new pressure zones PZ –360 and PZ – 305 (in SRD) and PZ - 285 (for the line industrial park and airport). Added three pressure reducing valves – PRV 281, PRV 282, and PRV – 284.
- The proposed pipe sizes for the SRD range from 200 mm to 300 mm and are shown in Figure 5.
- The SRD booster pump was added to the model but was turnoff for all model scenarios
- PVC pipes were used with a Hazen-Williams coefficient of 120

The results of the existing water system plus SRD Phase 1 model simulations for ADD, PHD, and MDD + FF are shown in Figures 6 to 8.

From Figures 6 and 7, the model results suggest that the existing water system plus SRD Phase 1 has adequate pressure for ADD and PHD.

Figure 8 shows the model results existing MDD + FF analysis. The fire flow criteria used for SRD Phase 1 is 60 L/s for single family units and 90 L/s for multi-family units. For the airport the fire flow requirement is 150 L/s and for the industrial park the fire flow requirement is 225 L/s. The 150 L/s fire flow requirement is used for the Village core as described in Section 4.0.

The addition of the SRD reservoir helped improve the fire flow conditions for the Village core and for the area east of the Village core. Fire flows for these areas went from around 60 – 100 L/s to around 150 L/s in the Village core and the area east of the Village Core. In SRD the fire flow range from 131 L/s to 159 L/s which is more than sufficient to meet the minimum fire flow requirements. The fire flow flows for the airport are around 176 L/s which is an improvement from the less than 60 L/s without the SRD reservoir. The fire flows for the industrial park range from 159 L/s to 175 L/s and are lower than the required 225 L/s.

5.2 SRD Phase 1 plus Future Developments

Future development areas in addition to the SRD Phase 1 are outlined in Table 1 of Delcan's Technical Memorandum and include a school site, recreational facility, Biro site, commercial site, 22 SF site, and SRD Phase 2. The total demands from the Technical Memorandum are summarized as follows:

Site	ADD (L/s)	MDD (L/s)	PHD (L/s)
SRD Phase 1	3.9	7.8	15.5
School Site	4	8.1	16.1
Recreation Facility	1.6	3.3	6.5
Biro Site	2.9	5.8	11.6
Commercial Site	0.1	0.4	0.9
22 SF Units	0.5	0.9	1.9
SRD Phase 2	2.7	5.5	11

Fire flow requirements vary based on the type of development.

Updates to the model:

- Proposed pipe layout for future development areas in addition to SRD Phase 1 is based on Figure 1 of Delcan's Technical Memorandum
- Added 2 more PRVs - one in the Biro site development – PRV-286 and one near the school site - PRV-288
- Elevations for the Biro site were extrapolated from the Biro Concept Elevations drawing dated March 1, 2012 from Crosland Doak
- Elevations for SRD Phase 2 were taken from the drawing Ravens Crest 2. It should be noted that SRD Phase 2 is located at a higher elevation than the proposed reservoir (SRD Phase 2 highest elevation is about 430 m). From Delcan's Technical Memorandum, the balancing and emergency storage of the SRD Phase 2 development will be provided in a future reservoir at a higher elevation. Thus, SRD Phase 2 was not included in this analysis.
- The proposed pipe sizes for the future development area range from 200 mm to 250 mm and are shown in Figure 9.
- PVC pipes were used with a Hazen-Williams coefficient of 120

The results of the existing water system plus SRD Phase 1 and future development model simulations for ADD, PHD, and MDD + FF are shown in Figures 10 to 12.

From Figures 10 and 11, the model results suggest that the existing water system plus SRD Phase 1 and future development has adequate pressure for ADD and PHD.

Figure 12 shows the model results existing MDD + FF analysis. The fire flow criteria used are as follows:

- Biro Site 60 L/s for single family and 90 L/s for multi-family
- School site, Commercial, and Recreational 150 L/s
- 22 SF Units 60 L/s
- All other areas have the same fire flow requirements as described in Section 5.1.

The available fire flows for the Biro Site and SRD Phase 1 range from around 160 L/s to 300 L/s. This is more than sufficient to meet the required fire flows. The fire flow for the School Site, Commercial and Recreational Facility meet the 150 L/s required fire flow. The fire flows for the airport range from around 190 to 244 L/s while the fire flows for the industrial park range from 166 L/s to 228 L/s and are in most places lower than the required 225 L/s.

6.0 Sunstone Ridge Reservoir

6.1 Reservoir Flows

As briefly mentioned in Section 5.1 a new reservoir is proposed to service SRD Phase 1, future development in the areas as shown Figure 1 of Delcan's Technical Memorandum, airport, and industrial park and to provide fire flows to the Village Core. This new reservoir is to be located in the NW corner of the SRD site with a top of water elevation proposed to be 360.5 m. The total demands for the entire service area of the SRD reservoir are:

- ADD = 21 L/s
- MDD + FF = 45 L/s + FF varies for different types of development
- PHD = 135 L/s (this includes servicing the Village core)

6.2 Reservoir Sizing

The proposed SRD reservoir has been sized based on the MMCD guidelines as follows:

Minimum reservoir size = A + B + C

A = Fire storage
B = Equalization storage (25% of MDD)
C = Emergency storage (25% of A + B)

The storage requirement calculations are shown below:

Existing Reservoir			
Type of Storage		**Calculation**	**Required Storage (m^3)**
A	Fire	2hrs * 150 L/s	1080
B	Equalization	25%*62 L/s MDD*24 hrs	1339
C	Emergency	25%*(A+B)	605
		Total:	3024
		Available Storage:	1600
		Deficit:	(1424)
Proposed SRD Reservoir			
Type of Storage		**Calculation**	**Required Storage (m^3)**
A	Fire	2hrs * 225 L/s	1620
B	Equalization	25%*45 L/s MDD*24 hrs	972
C	Emergency	25%*(A+B)	648
		Total:	3240
Overall Village of Pemberton Storage Requirements			
Type of Storage		**Calculation**	**Required Storage (m^3)**
A	Fire	2hrs * 225 L/s	1620
B	Equalization	25%*107 L/s MDD*24 hrs	2311
C	Emergency	25%*(A+B)	983
		Total Required Storage:	4914
		Available Storage in Existing Reservoir:	1600
		Minimum Required Storage for SRD:	3314

The above calculations are based on the simulated maximum day demands for each reservoir and illustrate the need for the SRD Reservoir to supplement the existing reservoir during fire flow conditions.

Based on the above, a design storage volume of 3400 m^3 is recommended for the SRD Reservoir.

6.3 Reservoir Operation

In order to connect the SRD reservoir to the existing water system, the existing water line along Pemberton Farm Road from the Plateau Strata is extended north until the CN rail line where it heads east. A 250 mm fill line connects the existing system to the SRD reservoir.

In order to replenish the SRD reservoir, it is expected that the reservoir will be filled primarily overnight. With the addition of the SRD reservoir the system will be more complex to operate and it is critical that PRV settings are carefully selected to avoid the risk of emptying out the SRD reservoir. Additional modeling is required to confirm PRV settings for proper reservoir operation.

7.0 Potential Improvements

Based on the above simulations some potential improvements to the water system could include:

- Even with the addition of the Ravens Crest reservoir there are still some deficiencies in meeting the fire flow requirements. Within the Village Core some of these deficiencies can be improved by pipe twinning (for 150mm pipes) and/or adding a booster station for areas that are located in higher elevations to improve fire flow to 150 L/s. However, it would be most cost effective to identify first what the required fire flow is for these localized areas.
- A 300mm loop between the line to the airport will improve fire flows in the industrial park from (166 L/s – 225 L/s) to (223 L/s – 262 L/s)

The timing of these additional improvements will depend on the Village's budget and rationale for upgrading. It may be possible to implement these as part of a long term infrastructure upgrading strategy.

8.0 Conclusions

The following conclusions are made based on the above:

- The addition of the SRD reservoir will have a dramatic impact in improving the fire flows in the Village core, the area east of the Village core, the airport and industrial park.
- Additional assessment of the SRD reservoir operation is required prior to the detailed design of the reservoir and connecting piping.
- The accuracy of the results is dependent on the input parameters and it would be beneficial to confirm the regional water demands to the north of the Village.
- Additional hydraulic analysis is needed prior to finalizing the reservoir design.

9.0 Closure

This report is submitted in draft format for your review and comments. With your approval, ISL would like to assess the reservoir filling operation in more detail prior any reservoir design activities commencing. Please contact me at 780.438.9000 if you have any further questions.

Prepared by,

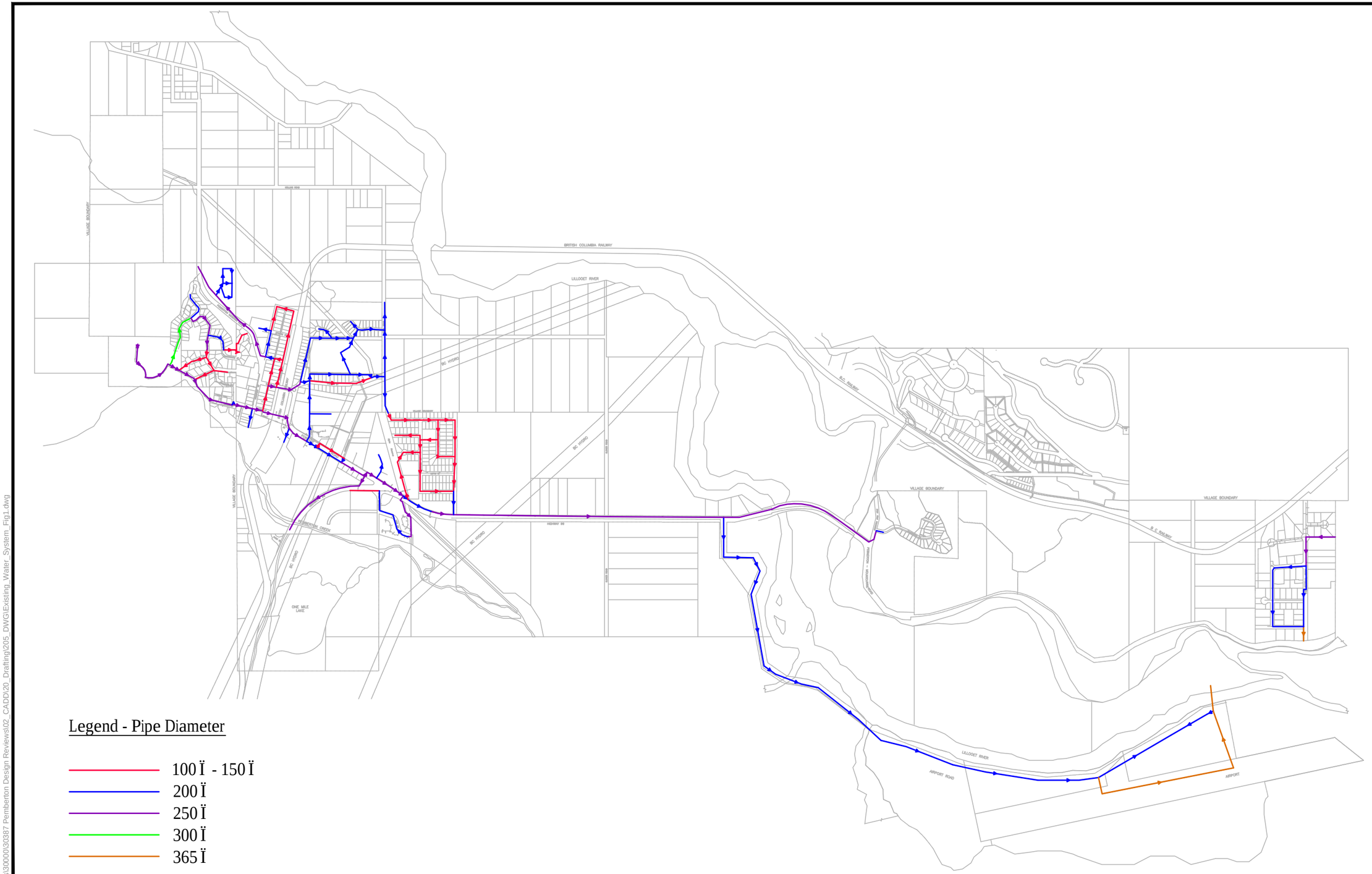
Lily Dam, P.Eng.
Water Resources Engineer

[redacted]

Graham Schulz, P.Eng.
Senior Project Engineer

Attachments

Appendix A – Figures



Legend - Pipe Diameter

- 100 Ï - 150 Ï
- 200 Ï
- 250 Ï
- 300 Ï
- 365 Ï

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PEMBERTON DESIGN REVIEWS

EXISTING WATER SYSTEM

FIGURE 1

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HORZ 1:20 000 — 0 200 400 600 800m

August, 2012

Legend -Pressure

- <=100 kPa
- <=250 kPa
- <=400 kPa
- <=550 kPa
- <=700 kPa
- <=850 kPa

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PEMBERTON DESIGN REVIEWS

EXISTING SYSTEM

AVERAGE DAY DEMAND CONTOURS

FIGURE 2

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HORZ 1:20 000 — 0 200 400 600 800m

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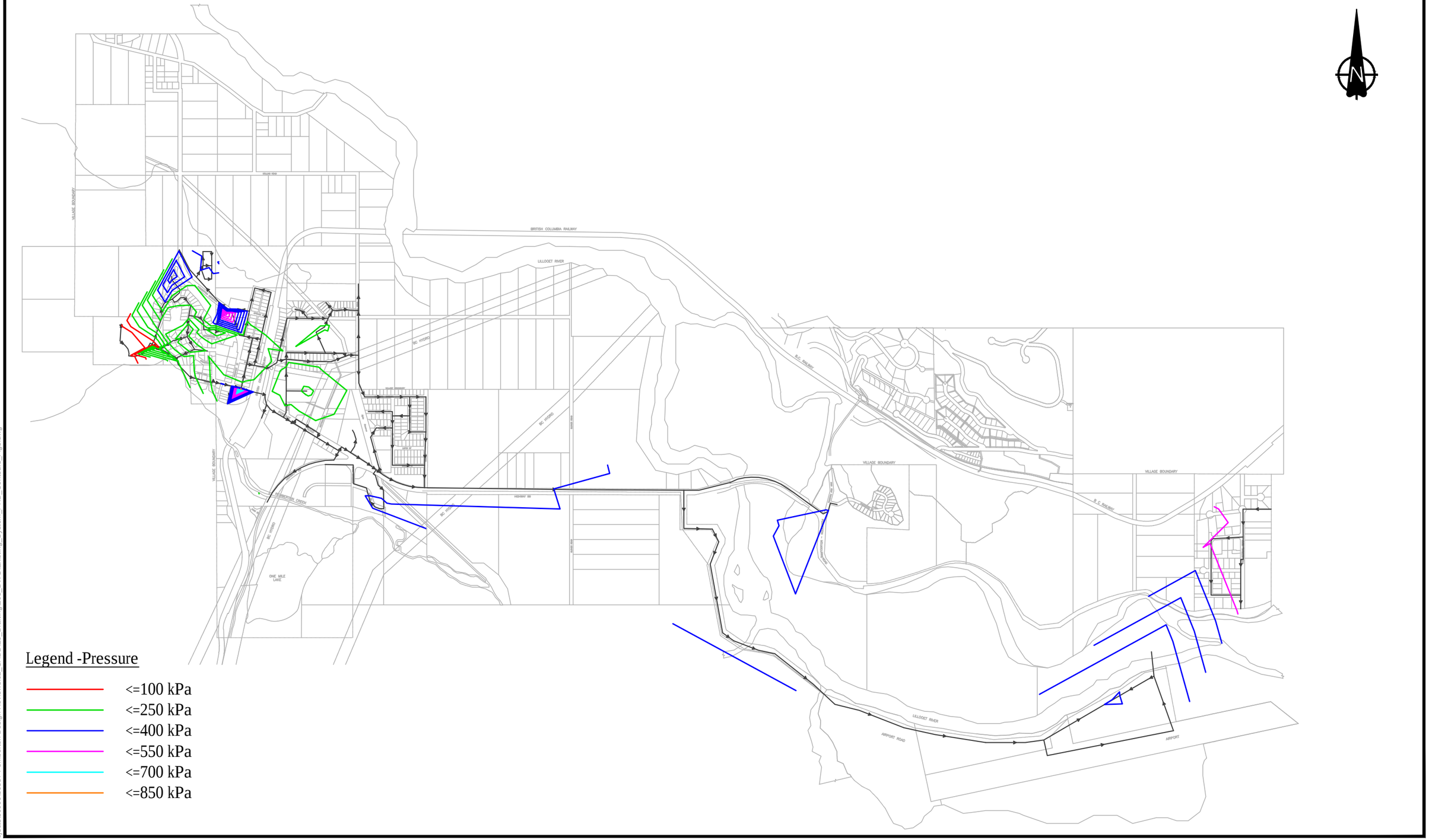

Legend -Pressure

- <=100 kPa
- <=250 kPa
- <=400 kPa
- <=550 kPa
- <=700 kPa
- <=850 kPa

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PEMBERTON DESIGN REVIEWS

EXISTING SYSTEM

PEAK HOUR DEMAND CONTOURS

FIGURE 3

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HORZ 1:20 000 0 200 400 600 800m

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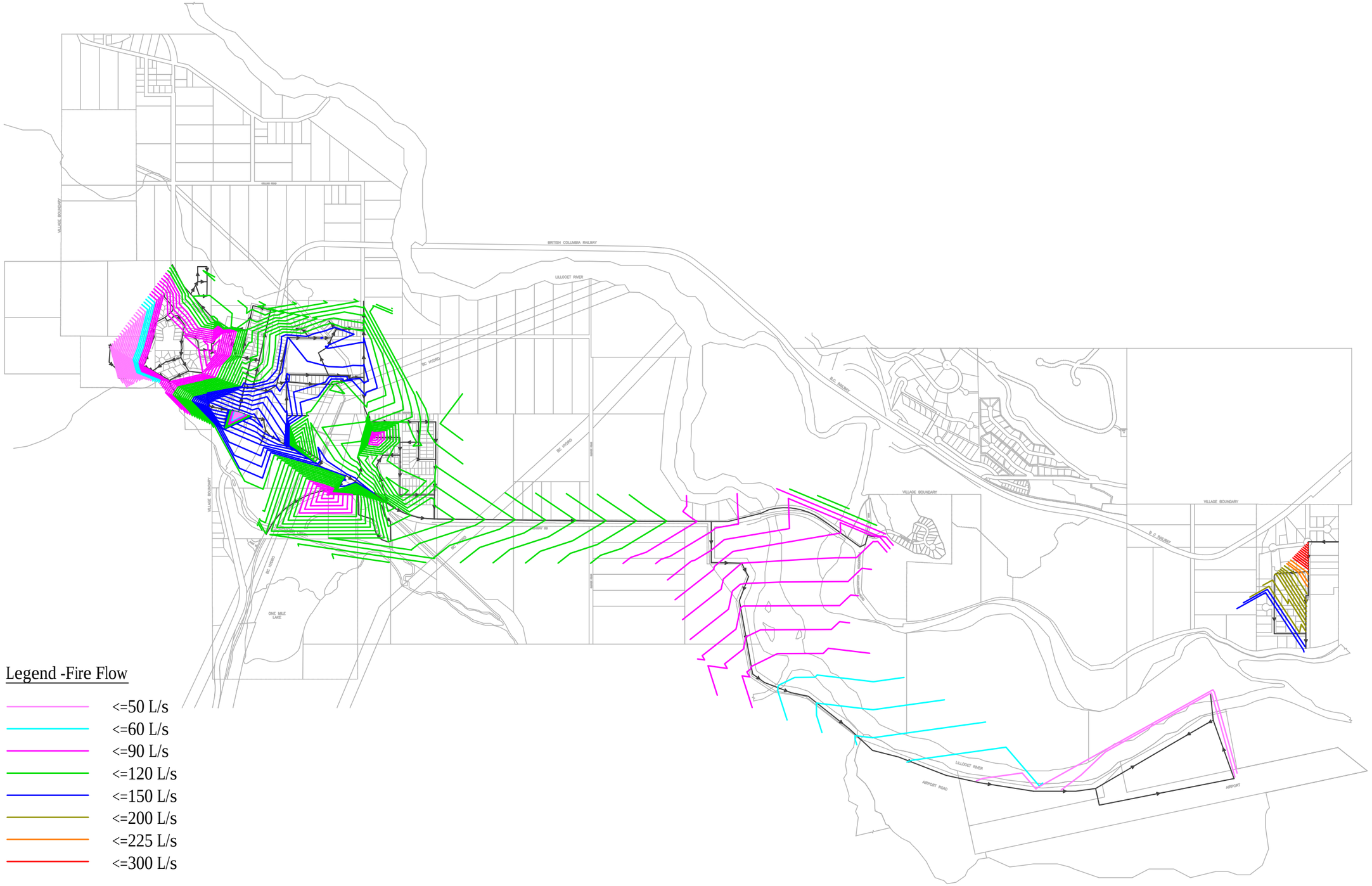

Legend -Fire Flow

- <=50 L/s
- <=60 L/s
- <=90 L/s
- <=120 L/s
- <=150 L/s
- <=200 L/s
- <=225 L/s
- <=300 L/s

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PEMBERTON DESIGN REVIEWS

EXISTING SYSTEM

MAXIMUM DAY DEMAND & FIRE FLOW CONTOURS

FIGURE 4

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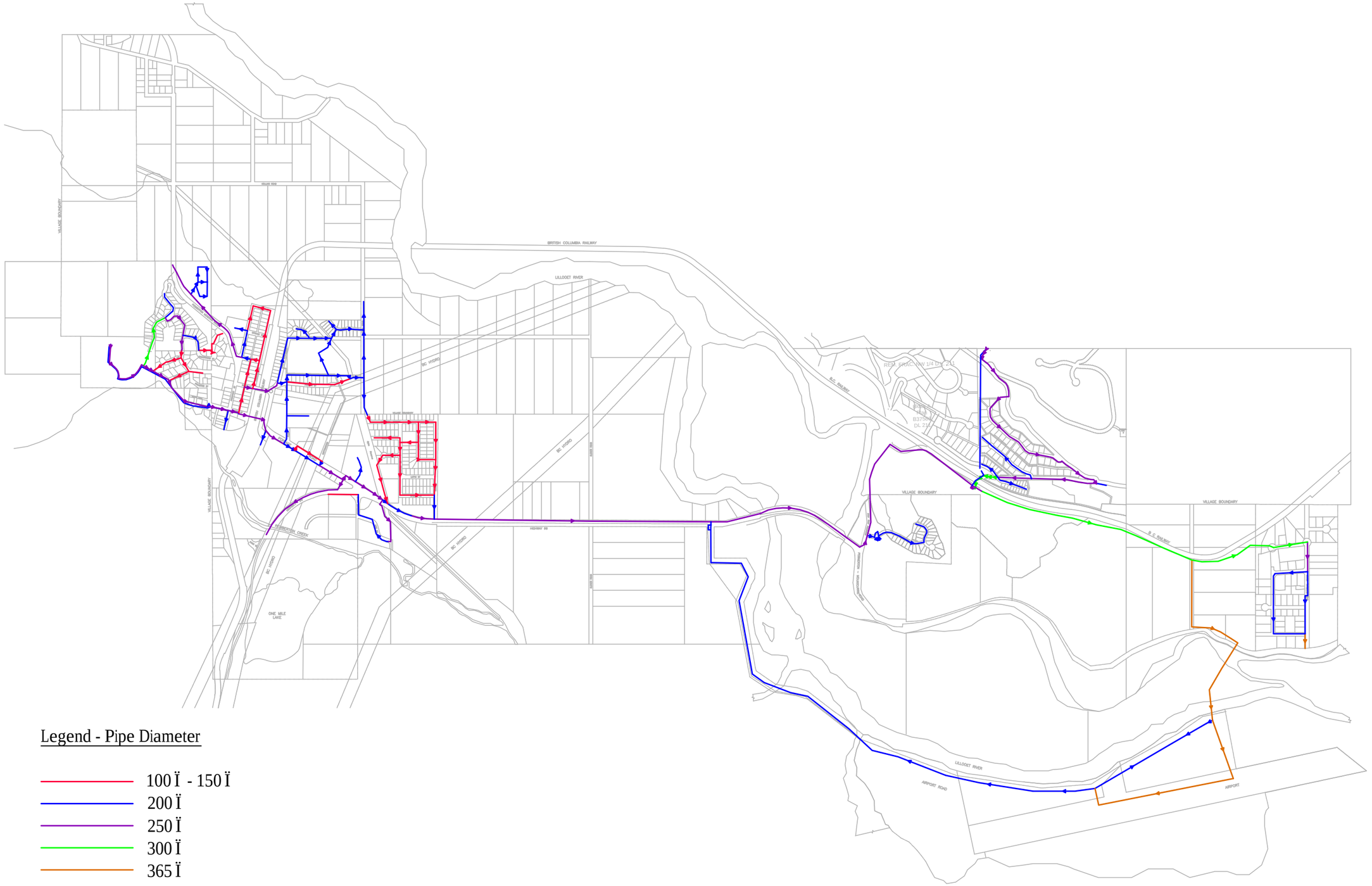

Legend - Pipe Diameter

- 100 Ï - 150 Ï
- 200 Ï
- 250 Ï
- 300 Ï
- 365 Ï

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PEMBERTON DESIGN REVIEWS

EXISTING WATER SYSTEM INCLUDING RAVENSCREST

FIGURE 5

30387

HORZ 1:20 000 0 200 400 600 800m

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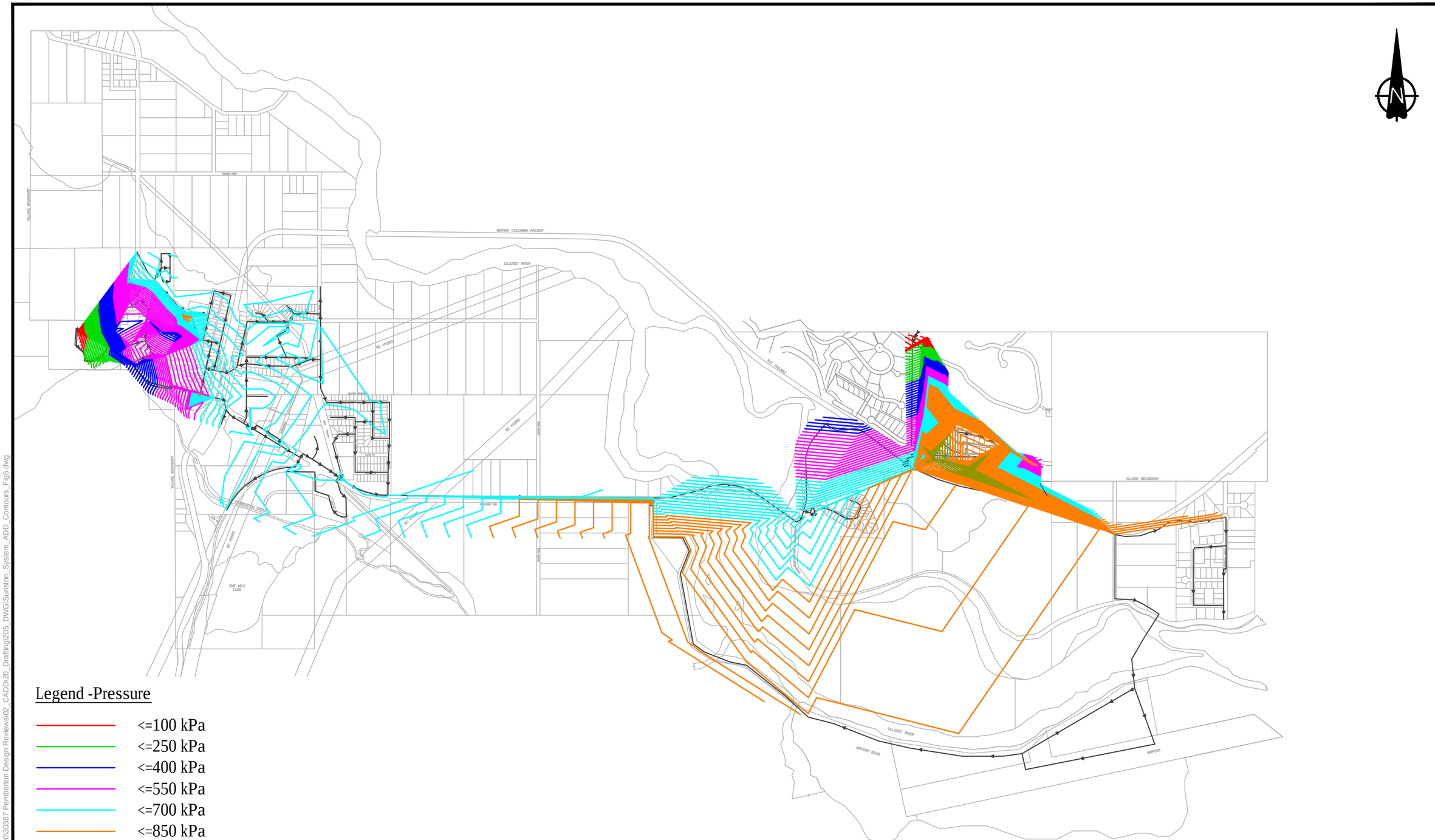

Legend -Pressure

- <=100 kPa
- <=250 kPa
- <=400 kPa
- <=550 kPa
- <=700 kPa
- <=850 kPa
- <=1035 kPa

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PEMBERTON DESIGN REVIEWS

SUNSTONE RIDGE
AVERAGE DAY DEMAND CONTOURS

FIGURE 6

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HORZ 1:20 000 — 0 200 400 600 800m

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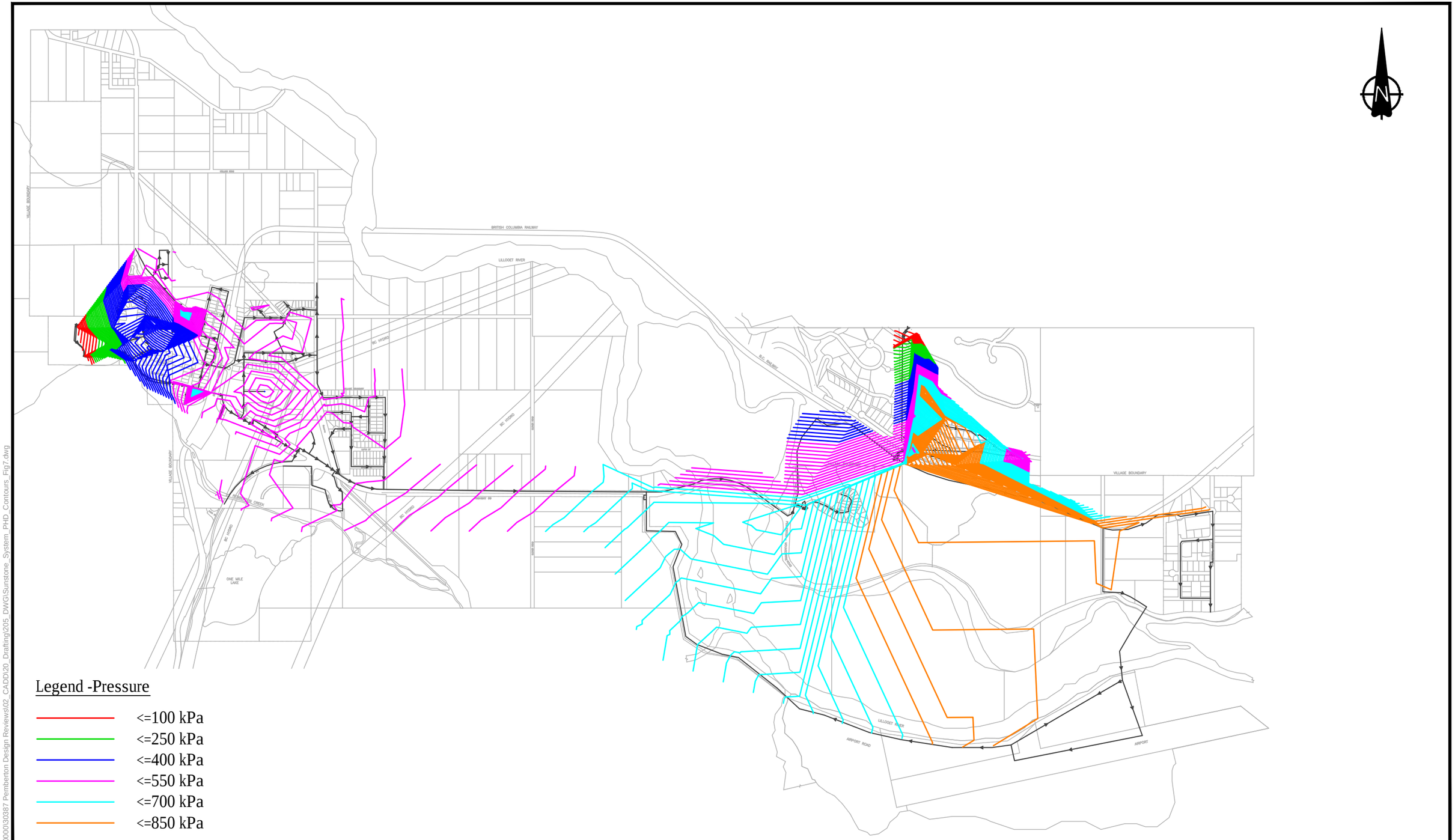

Legend -Pressure

- <=100 kPa
- <=250 kPa
- <=400 kPa
- <=550 kPa
- <=700 kPa
- <=850 kPa

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PEMBERTON DESIGN REVIEWS
SUNSTONE RIDGE
PEAK HOUR DEMAND CONTOURS

FIGURE 7
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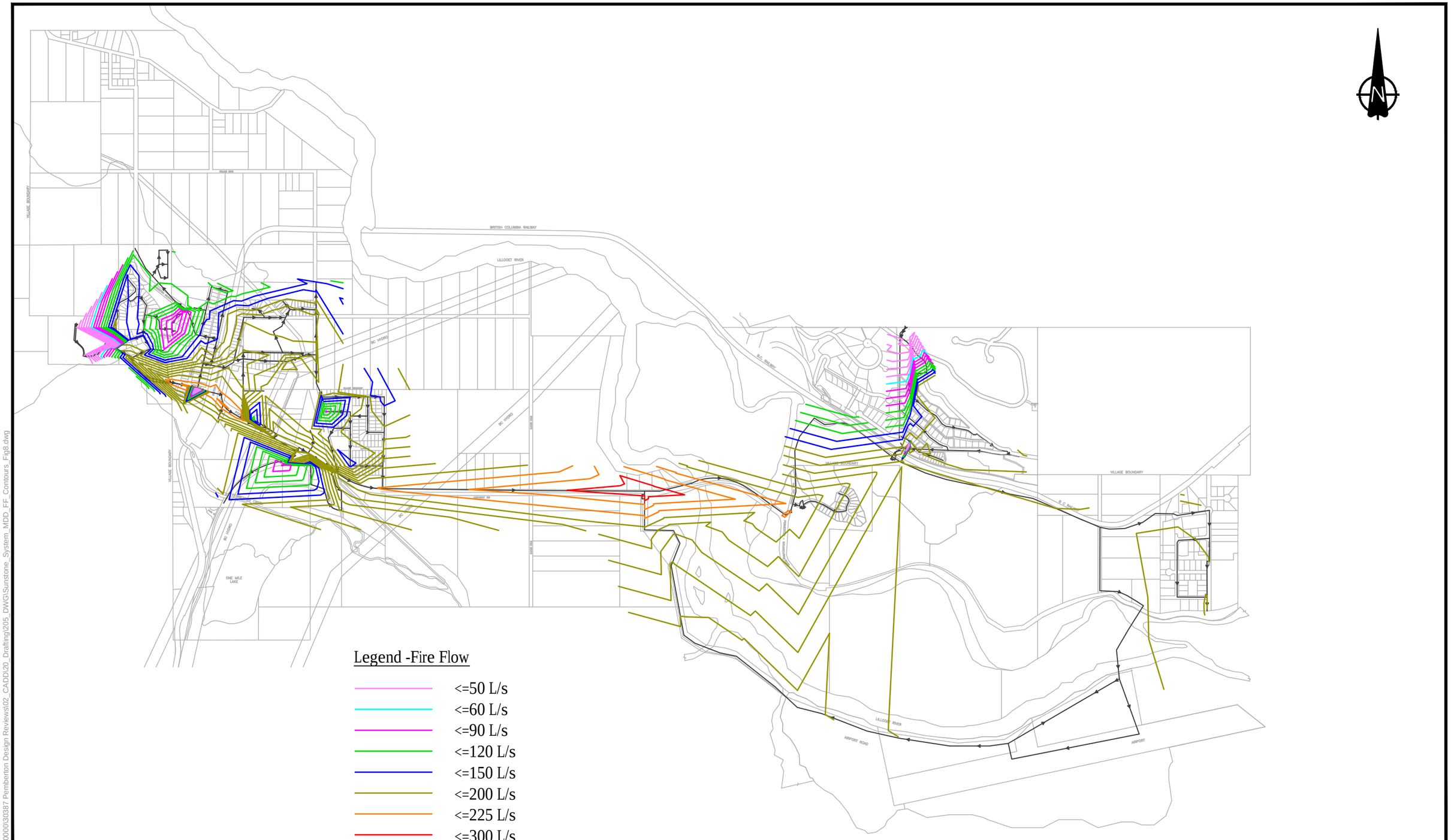

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PEMBERTON DESIGN REVIEWS

SUNSTONE RIDGE

MAXIMUM DAY DEMAND & FIRE FLOW CONTOURS

FIGURE 8

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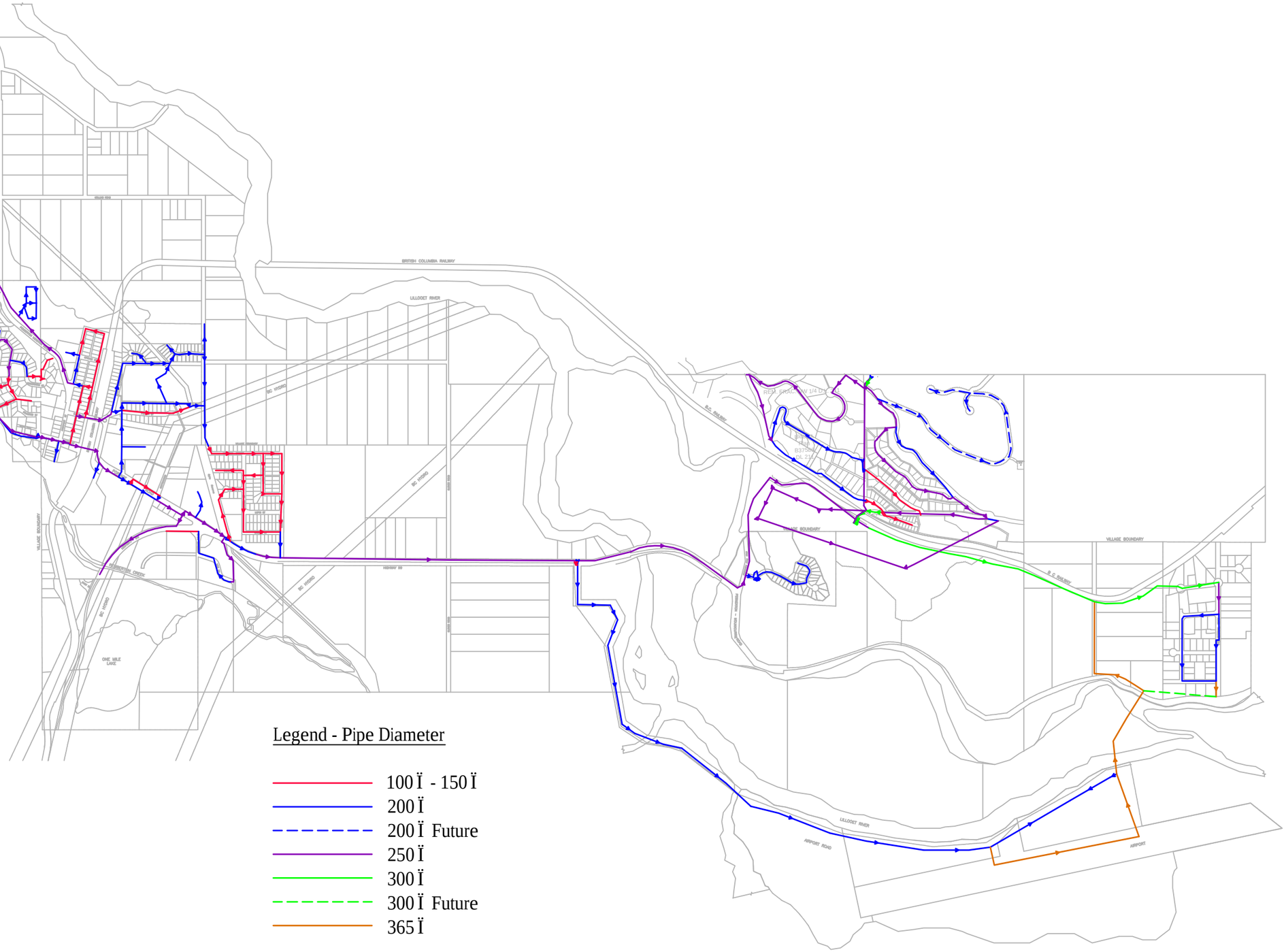

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PEMBERTON DESIGN REVIEWS

EXISTING WATER SYSTEM INCLUDING SUNSTONE RIDGE, BIRO SITE & RECREATION FACILITY

FIGURE 9

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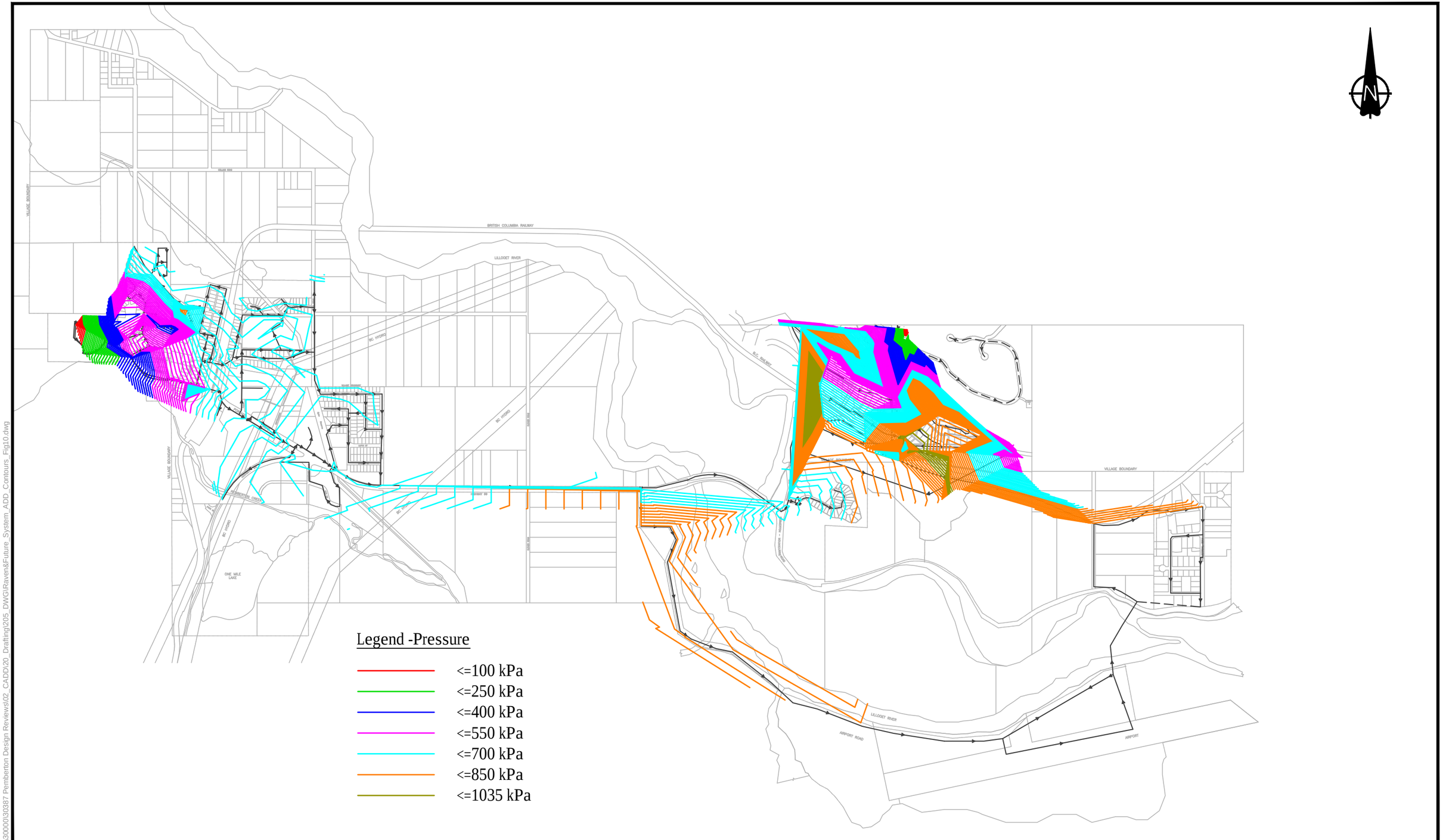

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PEMBERTON DESIGN REVIEWS

RAVENSCREST & FUTURE DEVELOPMENT

AVERAGE DAY DEMAND CONTOURS

FIGURE 10

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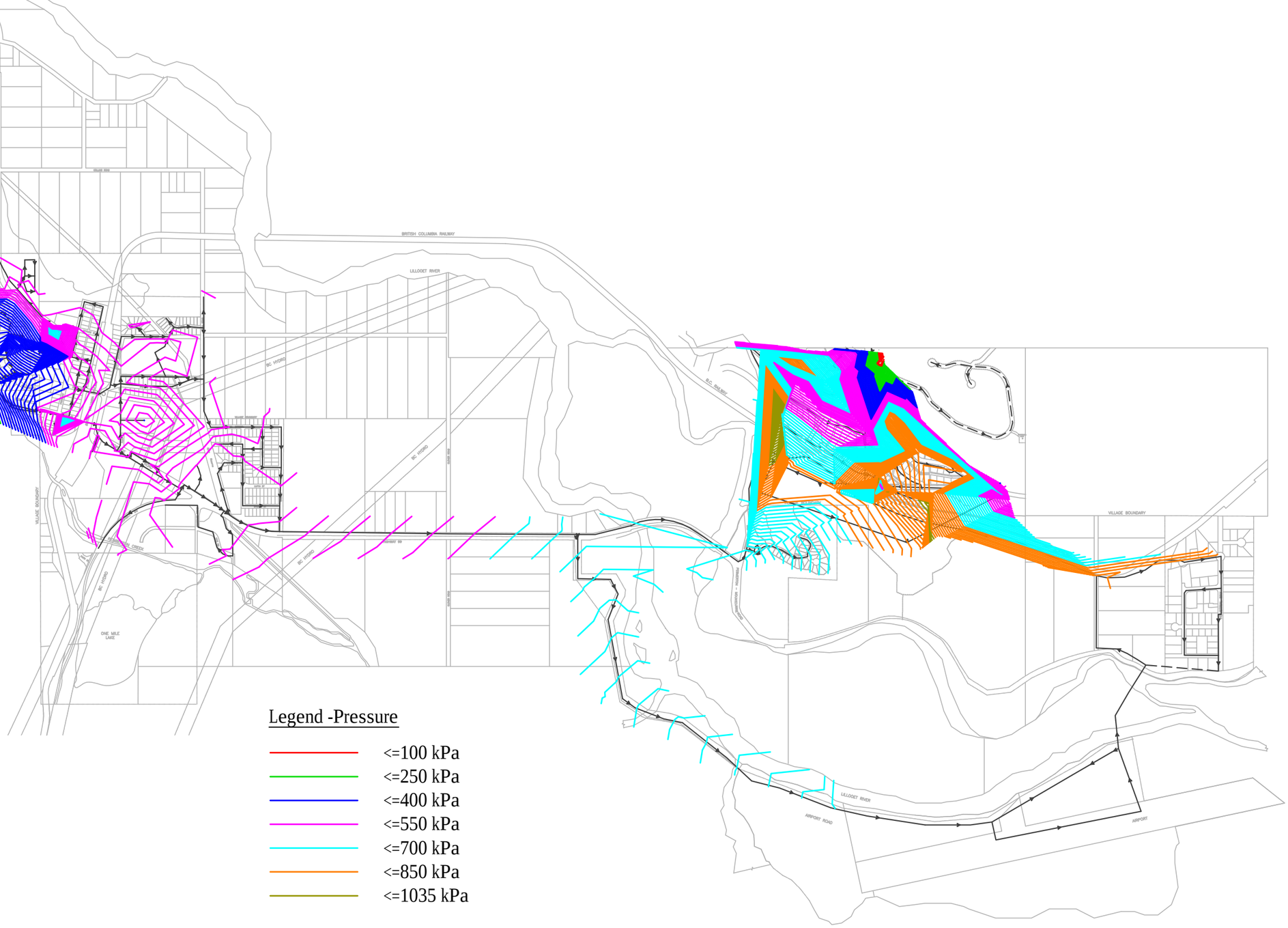

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PEMBERTON DESIGN REVIEWS

SUNSTONE RIDGE & FUTURE DEVELOPMENT

PEAK HOUR DEMAND CONTOURS

FIGURE 11

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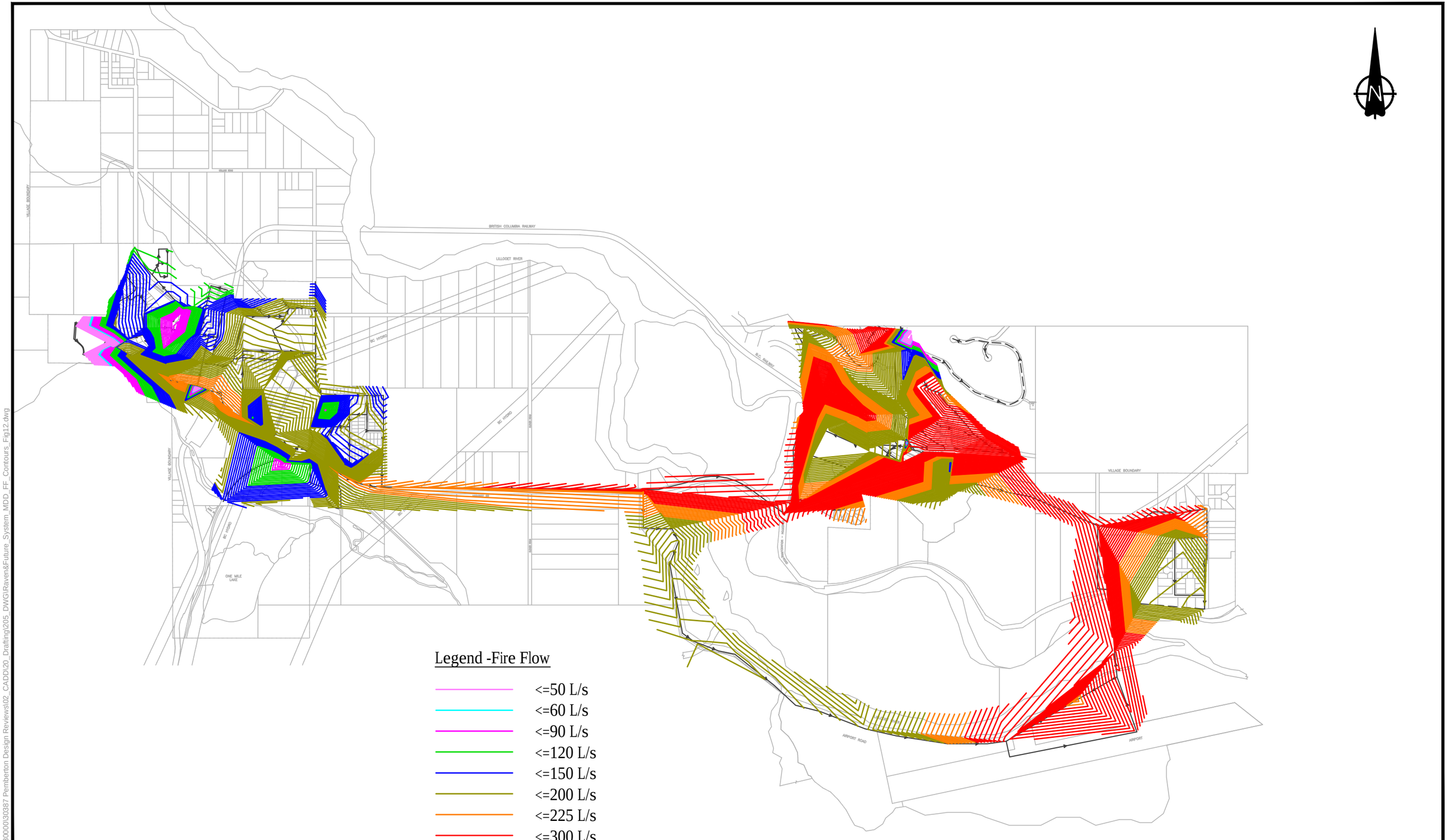

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PEMBERTON DESIGN REVIEWS

SUNSTONE RIDGE & FUTURE DEVELOPMENT

MAXIMUM DAY DEMAND & FIRE FLOW CONTOURS

FIGURE 12

30387

HORZ 1:20 000 0 200 400 600 800m

August, 2012

Appendix B – Delcan Technical Memorandum

Technical Memorandum

To:	Graham Schulz, P.Eng ISL Engineering	Date:	April 04, 2012
cc:	Cam McIvor, Project Manager / Grant Campbell, P.Eng		
From:	Colin Kristiansen, P.Eng Todd Bowie, P.Eng	Our Ref:	EB3766

RE: Sunstone Ridge Development – Water Demand Assessment & Preliminary Servicing Arrangements

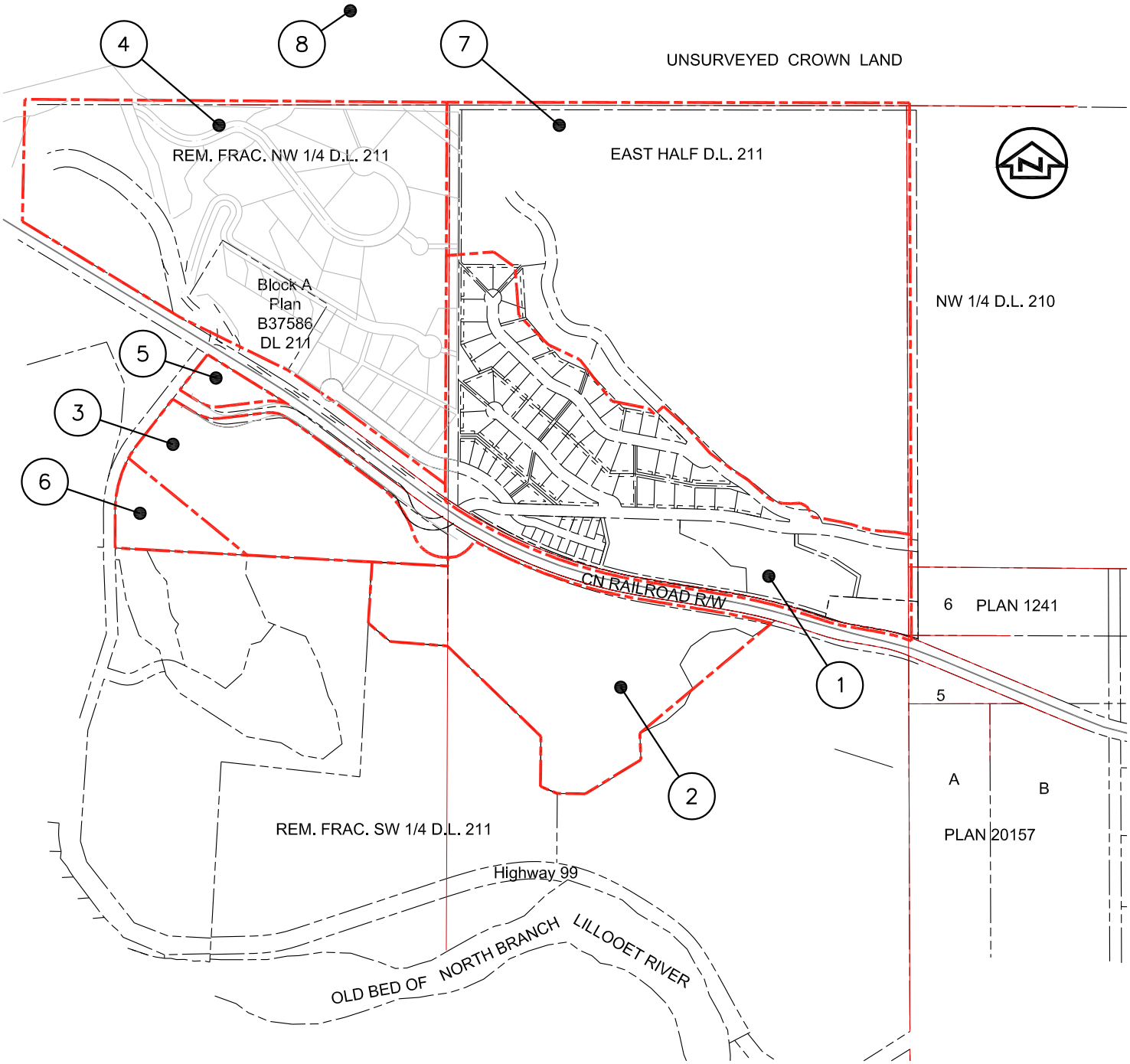
Delcan has been retained to provide engineering services for the development of Phase 1 of the Sunstone Ridge Development (SRD), located in the Village of Pemberton, 3 km east of the Village Centre.

The purpose of this Technical Memorandum is to present the design basis for the water demand assessment, identify the water demands for the SRD site and other surrounding potential short term development sites, and present preliminary storage reservoir sizes.

Development Plan

The SRD site is anticipated to be the first phase of a number of developments in the Sunstone Ridge area. The location of the SRD site and proposed surrounding developments are shown in **Figure 1**. Details on the development plans are as follows:

1.	Sunstone Ridge Development Site (Phase 1)	78 single-family units 142 multi-family units
2.	School Site	1200 student school building 800 student boarding building
3.	Recreation Facility Site	30,000 ft^2 ice arena building 12,000 ft^2 swimming pool building
4.	Biro Site	31 single-family units 77 multi-family units Resort Hotel
5.	Commercial Site	100,000 ft^2 neighbourhood commercial
6.	22 SF Site	22 single-family units
7.	Sunstone Ridge Development Site (Phase 2)	130 units



POTENTIAL DEVELOPMENT SITES

1	SUNSTONE RIDGE SITE	4	BIRO SITE	7	SUNSTONE RIDGE PHASE 2
2	SCHOOL SITE	5	COMMERCIAL	8	LIL'WAT DEVELOPMENT (LONG TERM)
3	RECREATION FACILITY	6	22 SF UNITS		

Design Parameters

The following documents were referenced to predict the water demands of the SRD site and surrounding short-term development sites:

Village of Pemberton Subdivision and Development Control Bylaw #677, 2011

Squamish Lillooet Regional District (SLRD) Subdivision and Development Servicing Bylaw #741, 2002.

MMCD Design Guideline Manual, 2005.

Water Supply for Public Fire Protection, Fire Under Writers Survey (FUS), 1999.

Sewerage System Standard Practice Manual (SSSPM) Version 2, 2007.

Key parameters used in the assessment are summarized below:

Parameter	Value	Reference
Population per Dwelling	Single Family = 4 people/unit Multi Family = 3 people/unit	SLRD Bylaw #741
Per Capita Demand (litres/capita/day)	Average Daily Demand (ADD) = 455 l/c/d Maximum Daily Demand (MDD) = 910 l/c/d Peak Hour Demand (PHD) = 1820 l/c/d	Pemberton Bylaw #677
Other Demands	Students = 70 L/student/day Boarders = 400 L/boarder/day Arena = 85,000 L/day Swimming Pool = 50 L/m^2 Shopping Center = 0.1 L/m^2 Restaurant = 150 L/seat	MMCD MMCD MMCD SSSPM MMCD MMCD
Minimum Fire Flow Requirements	Single Family (non-sprinkled) = 60 L/sec Multi Family (non-sprinkled) = 90 L/sec Commercial (non-sprinkled) = 150 L/sec	MMCD Design Guidelines
Minimum Fire Storage Requirements	Single Family (non-sprinkled) = 216,540 L Multi Family (non-sprinkled) = 567,540 L Commercial (non-sprinkled) = 1,080,000 L	FUS Manual
Minimum Reservoir Size (A+B+C)	A = Fire Storage; B = Equalization Storage (25% of MDD) C = Emergency Storage (25% of A+B)	MMCD

Water Demand & Storage Assessment

Two preliminary servicing designs are being developed for the SRD site, one for servicing only the SRD site, and one for servicing all of the short term potential development sites. This will establish the difference in facilities and costs associated with the SRD site and the neighbouring properties, and may form the basis for cost sharing arrangements such as latecomers' fees. Predicted water demands from each of the individual sites are summarized in **Table 1.**

Table 1: Summary of Water Demand Predictions

Site	ADD (L/sec)	MDD (L/sec)	PHD (L/sec)
1. SRD Site (Phase 1)	3.9	7.8	15.5
2. School Site	4.0	8.1	16.1
3. Recreation Facility	1.6	3.3	6.5
4. Biro Site	2.9	5.8	11.6
5. Commercial Site	0.1	0.4	0.9
6. 22 SF Units	0.5	0.9	1.9
7. SRD Site (Phase 2)	2.7	5.5	11.0
Totals	**15.8**	**31.7**	**63.5**

* assumed incl. 50 seat restaurant

Servicing Arrangement 1 - SRD Phase 1 Site Only

The first servicing arrangement is limited to only the SRD site. The arrangement would involve a connection to the Village of Pemberton water system at Pemberton Farm Road. Water would be pumped to a proposed reservoir in the north-west corner of the SRD site. The proposed reservoir would supply the SRD development. Two strategies for this servicing arrangement are presented below: A) fire flows provided by connection to Village system; and, B) fire flows provided by on-site reservoir.

Strategy A:

The connection to the Village system would provide both fire demand flows and storage. The connection to the Village system, the proposed pump station, and the reservoir fill line would be sized to accommodate the MDD + fire flows. Minimum fire flow for the development would be 90 L/sec for the townhouse sites.

Village Connection Flow Requirements: 97.8 L/sec
Reservoir Storage Requirement: 210,000 L

Strategy B:

The proposed reservoir would provide both peak hour balancing storage and fire demand storage. The connection to the Village system, the proposed pump station, and the reservoir fill line would be sized to accommodate the MDD. Minimum fire flow for the development would be 90 L/sec for the townhouse sites.

Village Connection Flow Requirements:	7.8 L/sec
Reservoir Storage Requirement:	920,000 L

Servicing Arrangement 2: All Short Term Development Sites

The second servicing arrangement includes the SRD site and the surrounding short term development sites. The overall servicing arrangement would be the same as arrangement 1 with a connection to the Village of Pemberton water system at Pemberton Farm Road and water pumped to a proposed reservoir in the north-west corner of the SRD site. It is assumed that balancing and emergency storage for the SRD Phase 2 development will be provided in future reservoir at a higher elevation. Similar to arrangement 1, there are two strategies for this servicing arrangement: A) fire flows provided by connection to Village system; and, B) fire flows provided by on-site reservoir.

Strategy A:

The connection to the Village system would provide both fire demand flows and storage. The connection to the Village system, the proposed pump station, and the reservoir fill line would be sized to accommodate the MDD + fire flows. Minimum fire flow for the development would be 150 L/sec for the commercial and institutional sites.

Village Connection Flow Requirements:	181.7 L/sec
Reservoir Storage Requirement:	710,000 L

Strategy B:

The proposed reservoir would provide both peak hour balancing storage and fire demand storage. The connection to the Village system, the proposed pump station, and the reservoir fill line would be sized to accommodate the MDD. Minimum fire flow for the development would be 150 L/sec for the commercial and institutional sites.

Village Connection Flow Requirements:	31.7 L/sec
Reservoir Storage Requirement:	2,060,000 L

Preliminary Servicing Layout

The preliminary water serving layout for the SRD site is shown in **Figure 2**. Pipe sizes for the four servicing strategies are summarized in **Figures 3 – 6**.

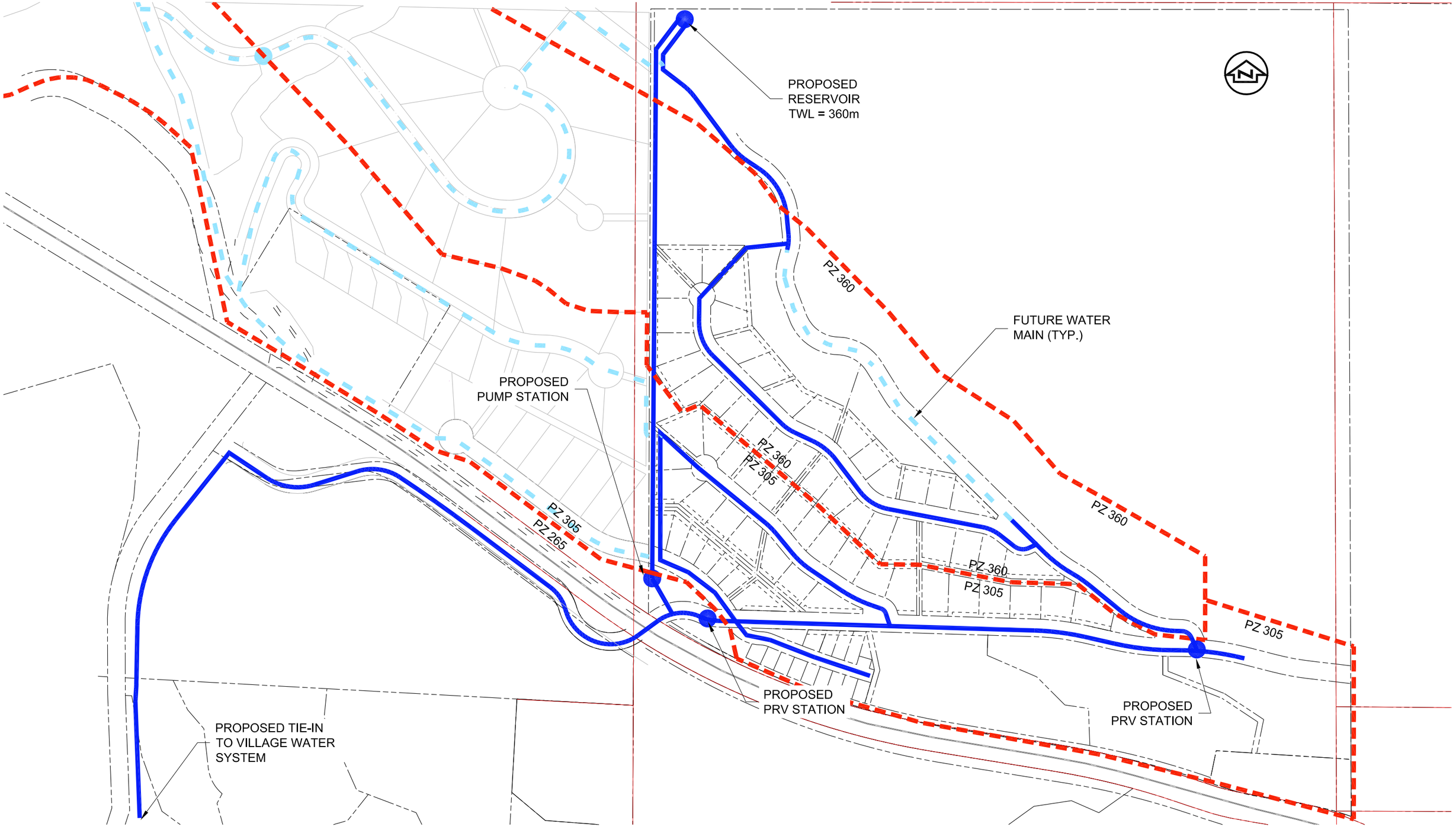


Figure 2: Water Servicing Concept

Figure 3: Servicing Arrangement 1-A
(SRD Site Only, Fire Flow from Village)

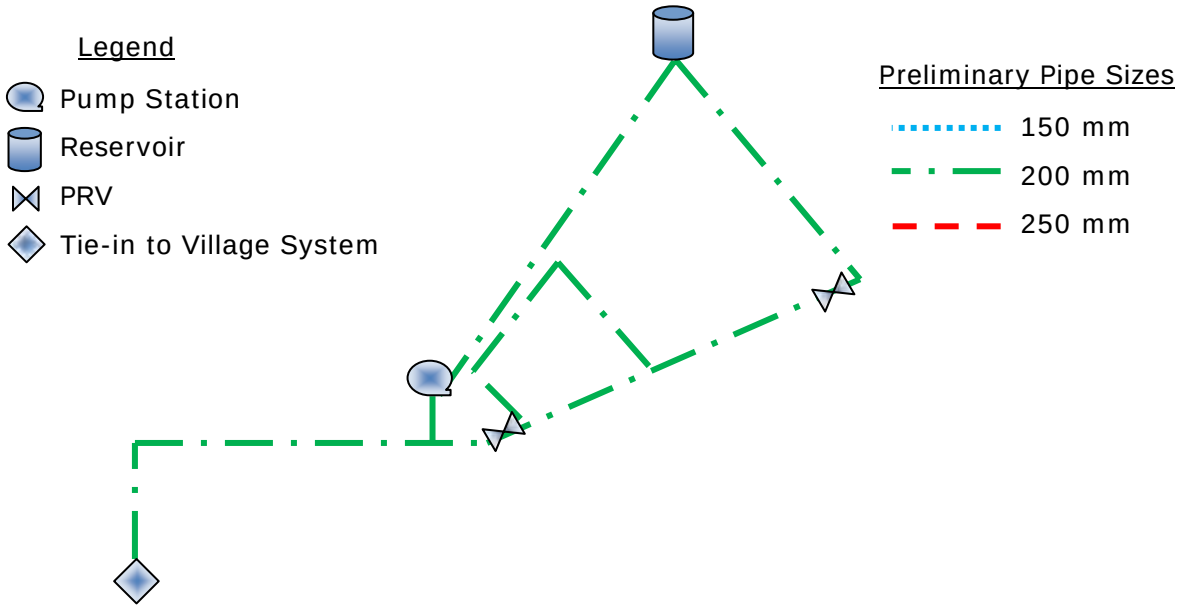


Figure 4: Servicing Arrangement 1-B
(SRD Site Only, Fire Flow from Reservoir)

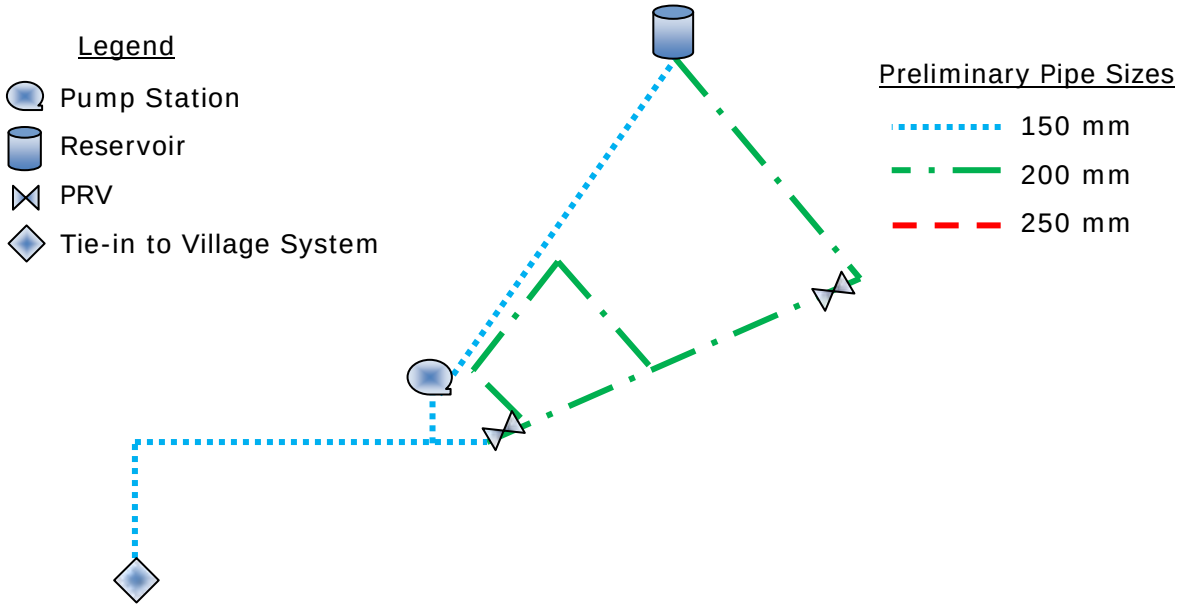


Figure 5: Servicing Arrangement 2-A
(All Short Term Development, Fire Flow from Village)

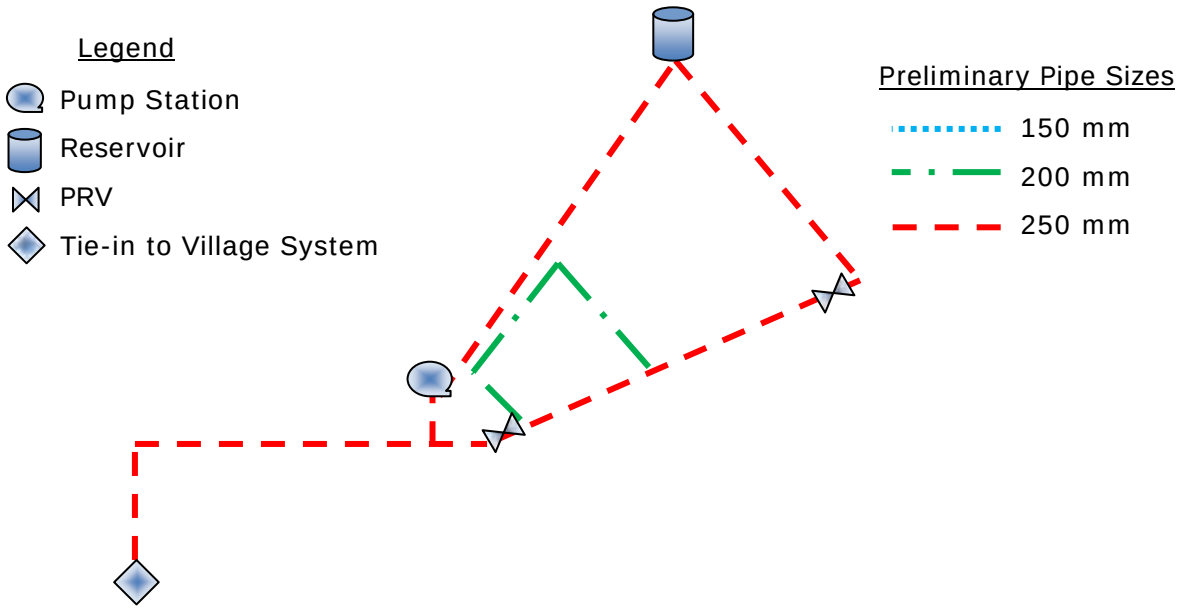
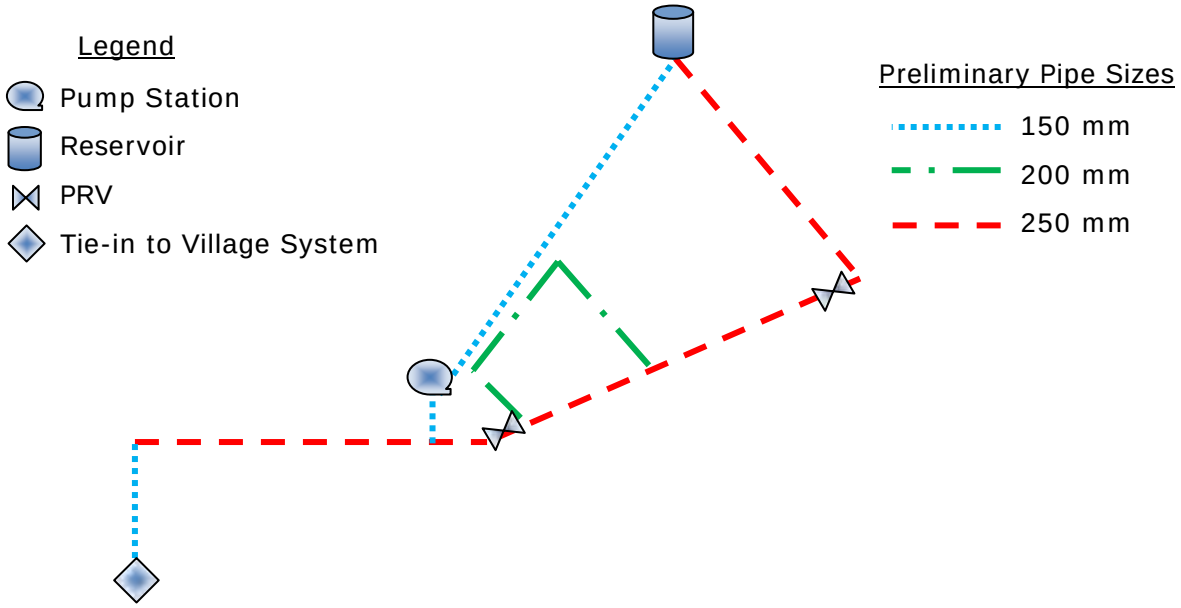


Figure 6: Servicing Arrangement 2-B
(All Short Term Development, Fire Flow from Reservoir)



Conclusions

To proceed with preliminary design of the water supply infrastructure required for the SRD development, the minimum available pressure at the proposed connection to the Village Water System at Old Farm Road is required for the following flows: 7.8 L/sec; 31.7 L/sec; 97.8 L/sec; and, 181.7 L/sec.

Following confirmation of the available flow and pressure at the Village connection, Delcan will proceed with laying out the details of the preliminary design. Details will include: hydrant locations, pipe sizes, air valve locations, valve locations, service connection locations, pumping requirements, and reservoir sizing requirements.