Bethel Land Corporation
401 - 37989 Cleveland Ave
Squamish, B.C.
V6B 0C8

Attention: **Caroline Lamont**
Land Development Manager

Re: **Nkwûkwma Development (Pemberton Benchlands)**
Development Servicing Report

At your request and to support the proposed Nkwûkwma Development (Pemberton Benchlands) rezoning submission to the Village of Pemberton, InterCAD has carried out an engineering study relating to on-site road access and site servicing of the development layout as prepared by EKISTICS. The results of our study are summarized below.

1. Introduction

The objective of this study is to provide a general overview of the access and servicing requirements for the proposed Pemberton Benchlands development.

A Neighbourhood Concept Plan (NCP) was previously prepared for the site and presented to the Village of Pemberton in 2005. This NCP was subsequently adopted into the Village of Pemberton (VoP) Official Community Plan (OCP) in 2007. Anticipated site servicing requirements were presented as part of this NCP, however, evolving site constraints and limitations have since required that the development layout be revisited, and servicing requirements re-evaluated based on this revised layout.

The current development plan proposes approximately 267 units, consisting of single-family lots, townhomes, and an apartment complex.

Servicing for Phase 1 of the Benchlands (herein referred to as Phase 1) was previously completed in 2005. Most of the remaining undeveloped areas of the Benchlands are substantially higher in elevation and constrained primarily by rugged site topography, archaeological sites, existing creeks, and rockfall hazard zones.

Note there is a portion of the upper Benchlands that will be subject to future, long-term development and a separate rezoning application. A gun range previously occupied these lands and as such has resulted in the area being contaminated by traces of total metals and hydrocarbons. These contaminated lands are excluded from this rezoning application and will be subject to an approved contamination remediation plan prior to being rezoned. It is however important to consider the future

expansion of this area in the infrastructure planning and assessment of the Benchlands site and existing infrastructure.

The proposed servicing plans for roads, water distribution, sanitary sewers and drainage are appended to this report with specific commentary below.

2. Road Network

The road network for the Benchlands is illustrated in *Appendix A – Road Network Plan*. The concept of the plan is to access the developable lands in the upland areas using a collector road that extends from existing Eagle Ridge Drive and loops onto itself while linking the various developable benches.

Given the rugged and often steep topography, frequent use of maximum road grades as permitted by the VoP Subdivision and Development Control Bylaw (#677, 2011) will be required to access the developable benches throughout the Benchlands. Significant cut and fill slopes may also be required at some locations.

The topography also constrains the horizontal alignment flexibility of the road network. In many cases, the roads must have sufficient length to maintain a maximum grade of 12% or less (8% through intersections) while also minimizing the impact caused by major cut and fill slopes. This results in lower design speeds to help facilitate tighter curve radii and better accommodate the challenging site topography.

With the future expansion of the development into the upper portions of the Benchlands (the area excluded from this rezoning application), it is expected that the collector road would be extended and loop around onto the lower collector, establishing a ring-road configuration. A combination of local roads and cul-de-sacs would branch off the collector extension.

Specific design requirements such as right-of-way widths, local road and cul-de-sac lengths, changes in vertical grades, etc. have also been considered. A full design criteria summary has been prepared for the Benchlands development to help elaborate on the design requirements noted above. It is expected the proposed road network will be designed and constructed to satisfy these requirements. See *Appendix B – Road Design Criteria Summary*.

Note that the lanes reflected in the road network are considered conceptual in nature and have not been reviewed as part of the road network analysis. Lanes should be limited to 12% grade and will need to accommodate single-unit trucks and, in some cases, fire truck turning movements.

3. Water Distribution Plan

The water distribution plan for the Pemberton Benchlands is illustrated in *Appendix C – Water Distribution Plan*.

There are currently two existing reservoirs within the Pemberton Benchlands site with a top water level (TWL) of approximately 290m in elevation and a combined capacity of approximately 3,130m^3. The reservoirs are supplied by three wells in Pioneer Park and Foughberg Park, drawing water from the Pemberton Creek Fan Aquifer. These reservoirs provide adequate water pressure to service lands below elevation 260m (pressure zone 1), encompassing existing Phase 1 of the Benchlands and the remainder of the Pemberton Village.

The entirety of the proposed development is located above the pressure zone 1 boundary with significant elevation change. Servicing of these lands will require the construction of a new reservoir and associated pump stations within the Benchlands to service the proposed development. A new reservoir is being proposed within the upper limits of the current development boundary, with a TWL of approximately 350m elevation. This reservoir will feed two additional pressure zones (zones 2 and 3) above the existing 260m zone 1 pressure zone elevation. Each zone will encompass an elevation range of approximately 50m. The reservoir will require a volume of approximately 1,800m^3, based on 366m^3 of balancing storage, 1080m^3 of fire storage and 362m^3 of emergency storage.

To supply the reservoir, a pump station will be required adjacent to the two existing zone 1 reservoirs that draws water from the existing supply main. From this pump station, a new zone 2 water supply / distribution main will provide water to the new reservoir as well as distribute water to the pressure zone 2 system.

A second pump station will be located beside the new reservoir, consisting of a series of domestic pumps that will have the ability to provide both daily domestic and fire flow demands to pressure zone 3. A small number of lots within the current development are within zone 3, as well as the whole extent of the future development to the west.

Zone 3 will be serviced by the pump station noted above and not by an additional zone 3 reservoir as originally envisioned in the NCP due to complications in positioning and accessing a reservoir in the upper lands of the future development. Only one location within the future development would provide adequate elevation to supply zone 3 by gravity; investigation related to this location found conflict with a significant archeological site as well as extremely challenging road grades / alignment issues to reach the reservoir site having to traverse steep slopes and hazardous rockfall zones.

Note that the existing zone 1 reservoirs supply and distribution mains will also require relocation so as to follow the proposed alignment of the collector road and suit the new development layout. A standby generator will accompany both proposed pump stations for emergency backup purposes. Detailed engineering analysis will be required to determine the exact sizing of the pump station and piping systems, and to confirm locations and operating parameters for the pressure reducing stations.

Water Demands

To understand the impact the development will have on the existing Village of Pemberton water distribution network, anticipated daily demands have been determined for the development as it is reflected in *Appendix C*, along with future demands for long-term development build-out.

Populations of both proposed and future development phases for the purpose of calculating water demands are as follows:

	Single Family Units	Single Family Population	Townhome Units	Townhome Population	Apartment Units	Apartment Population	Total Population
Proposed	135	405	92	249	40	68	**722**
Future	81	243	106	287	-	-	**530**
Total	**216**	**648**	**198**	**536**	**40**	**68**	**1,252**

Note:
(1) Population counts are based on the following: 3 persons per single-family unit; 2.7 persons per townhome unit; 1.7 persons per apartment unit.
(2) Number of units are based on Ekistics development plan, dated 18-Jan-2021.

Table 1: Development Populations

The daily demands per capita are as follows:

Average Daily Domestic Flow (L/capita/day)	Maximum Daily Domestic Flow (L/capita/day)	Peak Hour Domestic Flow (L/capita/day)
455	910	1,820

Note:
(1) Per capita demands are derived from Village of Pemberton Bylaw 677 – Section 3.2.
(2) These daily demand flows do not account for fire suppression / sprinkler system flows.

Table 2: Residential Daily Demand Per Capita

Considering the populations and per capita demands above, the daily demands anticipated for the development are determined as:

Land use	Daily Demands		
	Average Daily Domestic Flow (L/day)	**Maximum Daily Domestic Flow** (L/day)	**Peak Hour Domestic Flow** (L/hour)
Proposed			
Single Family	184,275	368,550	30,713
Townhomes	113,295	226,590	453,180
Apartments	30,940	61,880	123,760
Proposed Total	**328,510**	**657,020**	**1,314,040**
Future			
Single Family	110,565	221,130	442,260
Townhomes	130,585	261,170	522,340
Apartments	-	-	-
Future Total	**241,150**	**482,300**	**964,600**
TOTAL	**569,660**	**1,139,320**	**2,258,640**

Table 3: Daily Water Demands

A minimum fire flow of 120L/s is expected given that the proposed development includes townhomes and apartments; it is expected that this fire flow can be achieved with the proposed watermain network. However, the fire flow storage within the proposed reservoir is approximately 1080m^3, of which is enough volume to provide a 150L/s fire flow (for commercial and institutional uses) for up to 2 hours (not including emergency storage).

It is uncertain whether any upgrades to the existing water supply are required to service the projected additional demands (i.e. new supply wells if the existing supply is found to be inadequate, etc.). The Village of Pemberton should advise as to whether any upgrades are anticipated.

4. Sanitary Sewer Plan

The proposed sanitary sewer servicing plan for the Benchlands is illustrated in *Appendix D –Sanitary Sewer Schematic*.

A sanitary sewer pump station exists at the intersection of Eagle Ridge Drive and Pemberton Meadows Road, of which was constructed as part of the Phase 1 development. A sanitary sewer trunk main extends uphill from this pump station to the end of existing Eagle Ridge Drive. A sanitary forcemain

also connects the pump station to a gravity sewer line at the intersection of Prospect Street and Pemberton Meadows Road, where effluent eventually makes its way to the Pemberton Wastewater Treatment Facility.

Due to the relatively steep terrain, the sanitary sewer will use a gravity system in proposed roads and lanes. Servicing easements will also be required periodically throughout the development (with appropriate construction and maintenance access), namely at the termination of downhill cul-de-sacs.

The proposed collector road will carry a sanitary sewer trunk main that extends from the upper areas of the proposed development, picking up sanitary sewer branches from connecting local streets and cul-de-sacs. The trunk main will tie into the existing sanitary sewer trunk in Eagle Ridge Drive. Sanitary trunk main extensions are also anticipated as part of the future, long-term development into the lands currently excluded from the rezoning application. The future lots serviced by these trunk extensions will also flow to the existing Phase 1 pump station.

Sanitary Flow Contribution

Based on the anticipated populations of the proposed and future phases of the development (per *Section 3* above), the anticipated effluent flows that will be directed to the existing sanitary sewer trunk main in Eagle Ridge Drive and in turn to the existing pump station adjacent Pemberton Meadows Road have been determined. Per Village of Pemberton Bylaw 677 – Section 4.2, a residential average domestic flow rate of 410L/capita/day and an infiltration rate of 0.17L/s/ha was adopted for the peak flow calculations. The peaking factor was calculated per MMCD Design Guidelines (2014) – Section 3.4. The peak flows that will be introduced into the existing sanitary sewer trunk main in Eagle Ridge Drive for both the proposed and future build-outs are as follows:

	Population (persons)	**Average Daily Domestic Flow** (L/day)	**Inflow and Infiltration** (L/day)	**Average Daily Domestic Flow + Infiltration** (L/day)	**Peaking Factor** -	**Peak Flow** (L/s)
Proposed	722	296,020	159,805	455,825	3.31	11.4
Future (1)	1252	513,320	267,762	781,082	3.13	21.7

Note:
(1) Future population and flows are inclusive of proposed populations (i.e. total population after full development build-out.

Table 4: Sanitary Flow Contributions

It is assumed that the existing trunk in Eagle Ridge Drive has adequate capacity to convey the flow introduced from the upland Benchlands development given that the first phase of multi-phase projects typically take into consideration future project expansion, however, this should be verified by the Village of Pemberton. The Village should also confirm that the existing Phase 1 pump station, along

with the remainder of the system up to and including the Pemberton Wastewater Treatment Facility has adequate capacity to support the development, or, if any offsite servicing upgrades are anticipated.

For some lots with exceptionally steep terrain, individual private pumping may be required to move effluent up from the building locations to the proposed gravity system. This should be explored and evaluated through detailed design.

5. Stormwater Management Plan

The purpose of an Integrated Stormwater Management Plan (ISMP) is to demonstrate clear intent of how the development intends to be proactive in applying land-use planning tools to protect property and aquatic habitat, while at the same time accommodating land development and population growth. An ISMP applies a science-based understanding of how natural watersheds function and how this function is affected by land use change. The methodology normally relies on a roundtable process that brings people with knowledge about future land use needs, high-value ecological resources and chronic flooding problems, with the objective of effectively integrating planning, engineering and ecological perspectives. The outcome of this process is to:

- develop watershed performance targets based on site-specific rainfall data, supplemented by streamflow data and on-site soils investigations; and
- translate these performance targets into design guidelines that can be applied at the site level to mitigate the impacts of land development.

The fundamental stormwater management concept is to simulate natural (pre-development) conditions in which much of the day-to-day rainfall either evaporates, supports vegetation, or soaks into the ground rather than flowing directly into watercourses. Therefore, the underlying objective of stormwater management facilities is to intercept stormwater runoff from impervious surfaces and direct it into absorbent areas and/or groundwater retention zones such as rock pits; thereby providing a 'disconnect' between the source of the runoff and the conveyance system. However, such measures are usually insufficient to entirely mitigate the effects of urban development, so detention basins/ponds are also used to attenuate peak storm events.

It is expected that a detailed ISMP will be provided with the initial phase of the Benchlands expansion, per the VoP Subdivision and Development Control Bylaw (#677, 2011), Section 5.2, of which will govern the subsequent phases of the development. It is however important to recognise the stormwater management objectives of the project and their potential implications on the planning of the Benchlands development.

It is noted that Phase 1 implemented a system of surface water collection (open ditches) along all roads, and much of the drainage was routed through a detention pond. While this requires additional roadway widths of approximately 2 metres, the use of open drainage promotes infiltration and groundwater recharge, and helps to improve stormwater quality. For these same reasons, the use of open drainage systems within the proposed Benchlands development is also encouraged.

The conceptual drainage plan is illustrated in *Appendix E – Drainage Master Plan*. This plan represents the anticipated post-development drainage patterns and identifies preferred locations of detention facilities. The intent is that drainage from undeveloped areas will be routed into natural drainage water courses, using ditches, pipes and culverts as needed. To holistically understand the proposed function of stormwater management across the site after full build-out, the future phases of the development have been included in the assessment below.

The drainage system comprises of two catchment areas, both of which will drain into detention ponds before infiltrating or overflowing into existing drainage channels and existing stormwater infrastructure. Each catchment is described below:

Catchment 1 comprises of all the developable land captured in this rezoning application as well as a portion of the future developable area currently omitted from this application. Because of the steep terrain, runoff from the development will be collected into a piped drainage system on the main collector road (Eagle Ridge Drive extension) and will eventually discharge into the existing storm water detention pond in Al Staeshli Park. Little is known about this existing detention pond and the downstream infrastructure; it is assumed that the pond flows directly into an existing piped system in Dogwood Street and eventually discharges into Pemberton Creek near Aster Street.

The existing capacity of the detention pond is unknown, although the pond will likely require upsizing to accommodate the additional detention requirements introduced from the upland development. Preliminary calculations suggest that this detention pond will require approximately **1,700m³** holding capacity (which includes a safety factor of 1.5) to ensure post-development runoff rates are moderated to pre-development conditions.

The original Pemberton Benchlands Neighbourhood Concept Plan (2007) contemplated that this pond would convey a similar catchment to what is currently presented in this rezoning application and should therefore have been constructed with adequate capacity for this approved future development. However, the existing condition of this pond should be evaluated with the Village of Pemberton to understand its current functional effectiveness, along with the capacity of the downstream system. If sufficient capacity can not be built into this infrastructure, it may be necessary to upgrade the drainage system on Eagle Ridge Drive such that flows can be directed to a new detention pond on the eastern side of Pemberton Meadows Road, before being discharged into a watercourse running adjacent the Arn Canal.

Note there may be an opportunity to incorporate other, smaller, detention facilities throughout the development to reduce the size of this overall catchment and therefore the size of the Al Staeshli Park detention pond. This should be explored further through detailed design.

Catchment 2 is entirely within the area of future development. This catchment will be directed to a new detention pond located in the upper Benchlands, before being discharged into an existing natural drainage watercourse, which eventually finds its way to Pemberton Creek.

6. Closing

We trust that the information discussed above suits your current needs. Please contact the undersigned if you have any questions or would like to discuss any aspect in further detail.

Yours truly,

[redacted]

Daniel Arnold, EIT

[redacted]

Stephen Clinton, PEng

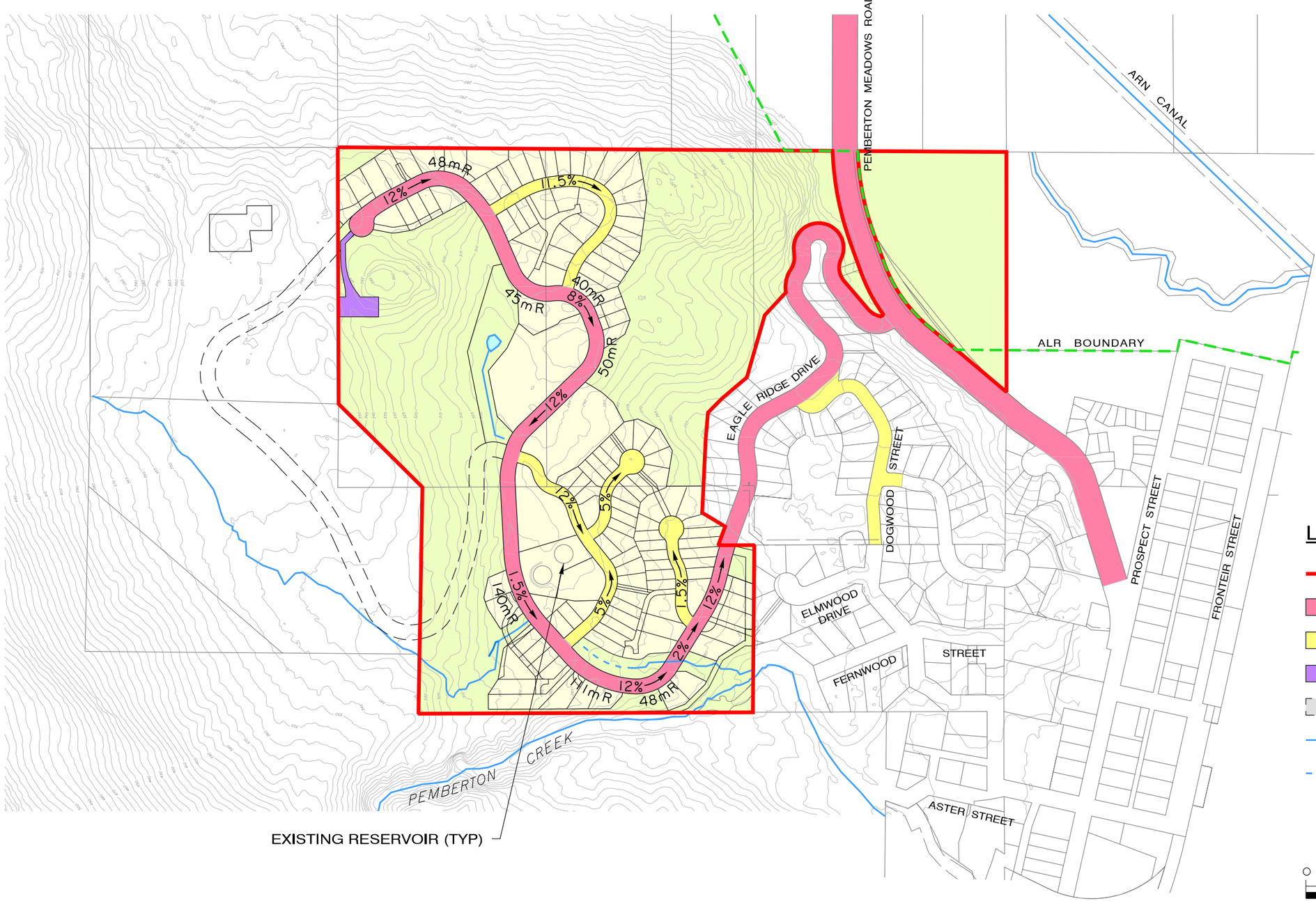
Appended:

- Appendix A – Road Network Plan
- Appendix B – Road Design Criteria Summary
- Appendix C – Water Distribution Plan
- Appendix D – Sanitary Sewer Schematic
- Appendix E – Drainage Master Plan

Appendix A

Road Network Plan

I:\AE5I\ustn\design\drawings\servicing\Road-schematic.dgn 21/02/043:54:02 PM



InterCAD Services Ltd. CONSULTING ENGINEERS

Bethel Land Corporation
Nkwukwma Development

ROAD NETWORK PLAN

Appendix B

Road Design Criteria Summary

InterCAD

ROAD DESIGN CRITERIA SUMMARY

Client : **Lil'Wat Nation / Bethel Land Corporation Partnership** File: **AE51**

Project: **Nkwukwma Development (Pemberton Benchlands)** Date: **Feb 4, 2021**

1. Design Speed

Criteria	VoP Subdivision Bylaw No.677	VoP Hillside Development Guidelines	Proposed for Nkwukwma Development
Collector Road	50km/hr [1]	-	30km/hr [3]
Local Road	50km/hr [1]	20-40km/hr [2]	30km/hr [3]

1 See Village of Pemberton Subdivision Bylaw No.677 (2011), Section 6.3.1

2 Suggested design speed for Local Roads per Village of Pemberton Hillside Development Design Guidelines (2019), Streetscape Design.

3 A 30km/hr design speed has been adopted to reduce the required horizontal curve radii of road alignments (see following section), such that road alignments can better accommodate the challenging site topography. 30km/hr design speed is also consistent with the already-built Phase 1 of the Pemberton Benchlands.

2. Horizontal Curve Radii

Criteria	VoP Subdivision Bylaw No.677	TAC	Proposed for Nkwukwma Development
Collector Road	30m [1]	30m [2 3]	30m
Local Road	30m [1]	30m [2 3]	30m

1 Village of Pemberton Subdivision Bylaw No.677 (2011), Section 6.4.1 defers to TAC Geometric Design Guide (2017) for horizontal alignment design.

2 See TAC Geometric Design Guide (2017), Figure 3.2.4. Calculated minimum radii are for low speed urban design.

3 Assumes roadway crossfall is 2% normal crown (conservative estimate, as a superelevated road would allow smaller radii).

3. Vertical Gradients

Criteria	VoP Subdivision Bylaw No.677	TAC	Proposed for Nkwukwma Development
Minimum Grade	-	0.5% [1]	1% [2]
Maximum Grade			
Collector Road	12% [3] (14%) [4]	12% [5]	12%
Local Road	10% [3] (12%) [4]	15% [5]	12% [4]
Approach Distance for Minor Road [6]	3% for minimum 15m [7]	3% (max 5-6%) for 20m [8]	3% for minimum 15m [7]
Uphill Cul-de-sac Grades	12% [9]	-	12% [9]
Downhill Cul-de-sac Grades	10% (max. 5% for last 50m) [10]	-	10% (max. 5% for last 50m) [11]
Cul-de-sac Bulb Grades	5% [11]	-	5% [11]

1 See TAC Geometric Design Guide (2017), Section 3.3.2.5.

2 A minimum 1.0% grade has been adopted to ensure adequate / positive surface drainage is achieved on local and collector roads (including through intersections and at curb returns).

3 See Village of Pemberton Subdivision Bylaw No.677 (2011), Table 6.2.

4 Village of Pemberton Subdivision Bylaw No.677 (2011), Section 6.16.2 states that maximum roadway grades may be increased by 2% greater than those shown in Table 6.2, subject to Village of Pemberton approval. However, MMCD Design Guidelines (2014), Section 5.19.1 states that this is not recommended in cold climates. MMCD Design Guidelines (2014), Table 5.4 also suggests that the maximum grade for a Local Road is 12% (excluding an additional 2% grade).

5 See TAC Geometric Design Guide (2017), Table 3.3.1.

6 "Grade bench" for approaching road. Assumes that the minor road is approaching a stop condition. Also applies for Culs-de-sacs.

7 See Village of Pemberton Subdivision Bylaw No.677 (2011), Section 6.16.3.a.viii.

8 See TAC Geometric Design Guide (2017), Section 9.7.3.4. TAC notes that this approach distance can be reduced to one to two car lengths on minor roadways with minor traffic volumes. Where physical and economical considerations dictate, an approach grade of 5-6% is acceptable.

9 Village of Pemberton Subdivision Bylaw No.677 (2011), Table 6.2 specifies a maximum grade of 10% for culs-de-sacs in uphill conditions. However, per Section 6.16.3.a.xi (Hillside Standards) of the Bylaw, the maximum allowable grade is noted as 12%.

10 See Village of Pemberton Subdivision Bylaw No.677 (2011), Section 6.16.3.a.x.

11 See Village of Pemberton Subdivision Bylaw No.677 (2011), Section 6.16.3.a.ix.

Client : **Lil'Wat Nation / Bethel Land Corporation Partnership** File: **AE51**

Project: **Nkwukwma Development (Pemberton Benchlands)** Date: **Feb 4, 2021**

4. Vertical Curve K Values

Criteria	MMCD [1]	TAC	Proposed for Nkwukwma Development
Minimum Crest	4 [2]	2 [3]	7 (4) [5]
Minimum Sag	4 [2]	2 [4]	6 (4) [5]
Approaching Stop Condition	-	-	2 [6]

1 Village of Pemberton Subdivision Bylaw No.677 (2011), Hillside Standards, Section 6.16.3.d defers to MMCD Design Guidelines (2014) - Hillside Road Alignment Standards, Section 5.4 for alignment design criteria.

2 See MMCD Design Guidelines (2014), Table 5.19.4. Note that these values correspond to a 40km/hr design speed, as outlined in the same table.

3 See TAC Geometric Design Guide (2017), Table 3.3.2. Assumes that the road is illuminated and at 0% grade.

4 See TAC Geometric Design Guide (2017), Table 3.3.5. Assumes that the road is illuminated and at 0% grade.

5 Non-bracketed K values will be used where possible; these K Values are consistent with a typical 50km/hr design speed and provide greater stopping sight distance. Bracketed K values will be utilized only when challenging site topography warrants smaller vertical curves. Bracketed K values also meet minimum TAC stopping sight distance requirements, when distances are adjusted for roadways on grade (see below).

6 Greater K values will be utilized where site topography permits. A K value of 2 also meets BC Building Code fire access requirements; see BC Building Code, Section 3.2.5.6.

5. Stopping Sight Distances

Criteria	Down Grades				0%	Up Grades			
	12%	9%	6%	3%		3%	6%	9%	12%
Minimum Distance [1]	37m	35m	35m	35m	35m	31m	30m	29m	29m

1 See TAC Geometric Design Guide (2017), Table 2.5.3.

6. Rights-of-way and Road Lengths

Criteria	VoP Subdivision Bylaw No.677	TAC	MMCD	Proposed for Nkwukwma Development
Maximum Cul-de-sac Length [1]	150m (210m) [2]	-	200m [3]	150m (210m) [2]
Minimum Right-of-Way Width				
Collector Street	20m / 21m [4]	20m to 24m [5]	15m / 18.5m [6]	18m
Local Street	20m / 21m [4]	15m to 22m [7]	14m / 15.4m [8]	15m
Cul-de-sac	18m [4]	-	-	18m [4]
Cul-de-sac Terminus Radius	15m R [4]	-	-	15m R [4]

1 Distance is measured from the edge of the intersecting road through to the center of the cul-de-sac bulb.

2 See Village of Pemberton Subdivision Bylaw No.677 (2011), Section 6.6.2. Where secondary emergency access is provided, a cul-de-sac length of 210m is allowed.

3 See MMCD Design Guidelines (2014), Section 5.9.

4 See Village of Pemberton Subdivision Bylaw No.677 (2011), Table 6.1. Where there is no development adjacent the road, a 20m right-of-way is recommended. Where development is on both sides of the road, a 21m right-of-way is suggested.

5 See TAC Geometric Design Guide (2017), Table 2.6.5 The right-of-way width varies depending on design speed. A 50km/hr design speed denots a 20m right-of-way, whereas a 24m right-of-way is suggested for an 80km/hr design speed.

6 See MMCD Design Guidelines (2014), Table 5.19.3. Where development is adjacent one side of the road, a 15m right-of-way is recommended. Where development is on both sides of the road, an 18.5m right-of-way is suggested.

7 See TAC Geometric Design Guide (2017), Table 2.6.5 The right-of-way width varies depending on design speed. A 30km/hr design speed denots a 15m right-of-way, whereas a 22m right-of-way is suggested for a 50km/hr design speed.

8 See MMCD Design Guidelines (2014), Table 5.19.3. Where development is adjacent one side of the road, a 14m right-of-way is recommended. Where development is on both sides of the road, a 15.4m right-of-way is suggested.

Client : **Lil'Wat Nation / Bethel Land Corporation Partnership** File: **AE51**

Project: **Nkwukwma Development (Pemberton Benchlands)** Date: **Feb 4, 2021**

7. Intersections

Criteria	VoP Subdivision Bylaw No.677	TAC	Proposed for Nkwukwma Development
Minimum Spacing between Intersections	60m [1]	60m [2]	60m
Maximum Grade through Intersections	-	- [3]	8% [4]

1 See Village of Pemberton Subdivision Bylaw No.677 (2011), Section 6.9.3.a. This spacing is applicable for intersections along Collector Roads.

2 See TAC Geometric Design Guide (2017), Section 9.4.2.2. This spacing is applicable for intersections along Collector Roads.

3 TAC Geometric Design Guide (2017) Section 3.3.5.1.6, notes that an at-grade intersection occurring on a roadway with moderate to steep grades, should ideally have reduced gradient through the intersection, desirably less than 3%. This however, typically applies to intersections with greater design speeds (at or above 50km/hr).

4 Municipalities in the Greater Vancouver area commonly adopt a maximum grade of 8% for major roads through an intersection. Reference City of Coquitlam Subdivision and Development Servicing Bylaw No.3358 (2003), Section 5.11; City of Burnaby Design Criteria Manual, Section 6.4.1. The overarching design criteria for intersections will be to ensure that sight lines and sight distances (adjusted for approaching grades) are met, in accordance with the TAC Geometric Design Guide (2017), Chapter 3 and Chapter 9.

Appendix C

Water Distribution Plan

PEMBERTON MEADOWS ROAD

ARN CANAL

EXISTING PRV STATION

PROPOSED ZONE 3 PUMP STATION

360

310

260

ZONE 3

ZONE 2

ZONE 2

ZONE 1

PROPOSED PRESSURE ZONE 2 & 3 RESERVOIR TWL 350m

EAGLE RIDGE DRIVE

EXISTING PRV STATION

DOGWOOD STREET

PROSPECT STREET

FRONTEIR STREET

ELMWOOD DRIVE

STREET

FERNWOOD

ASTER STREET

PEMBERTON CREEK

EXISTING RESERVOIR (TYP)
TWL 290m

PROPOSED PRESSURE ZONE 3 PUMP STATION

RELOCATED ZONE 1 SUPPLY AND DISTRIBUTION MAINS

EXISTING PRV STATION TO BE RELOCATED TO SUIT NEW DEVELOPMENT

EXISTING WATER WELL (TYP)

LEGEND

- SITE BOUNDARY
- PRESSURE ZONE BOUNDARY
- EXISTING RESERVIOR SUPPLY WATERMAIN
- RELOCATED RESERVOIR SUPPLY WATERMAIN
- EXISTING ZONE 1 WATERMAIN
- RELOCATED ZONE 1 WATERMAIN
- PROPOSED ZONE 2 WATERMAIN
- PROPOSED ZONE 3 WATERMAIN
- FUTURE ZONE 3 WATERMAIN

0 100 200 300

1:5000

WATER DISTRIBUTION PLAN

Bethel Land Corporation
Nkwukwma Development

Appendix D

Sanitary Sewer Schematic

PEMBERTON MEADOWS ROAD

ARN CANAL

EXISTING
SANITARY
LIFT STATION

EAGLE RIDGE DRIVE

DOGWOOD STREET

ELMWOOD
DRIVE

FERNWOOD

STREET

PROSPECT STREET

FRONTEIR STREET

ASTER STREET

PEMBERTON CREEK

EXISTING RESERVOIR (TYP)

LEGEND

- SITE BOUNDARY
- EXISTING SANITARY LIFT STATION
- EXISTING SANITARY SEWER
- EXISTING SANITARY FORCEMAIN
- PROPOSED SANITARY SEWER
- FUTURE SANITARY SEWER
- PROPOSED CATCHMENT
- FUTURE CATCHMENT

0 100 200 300

1:5000

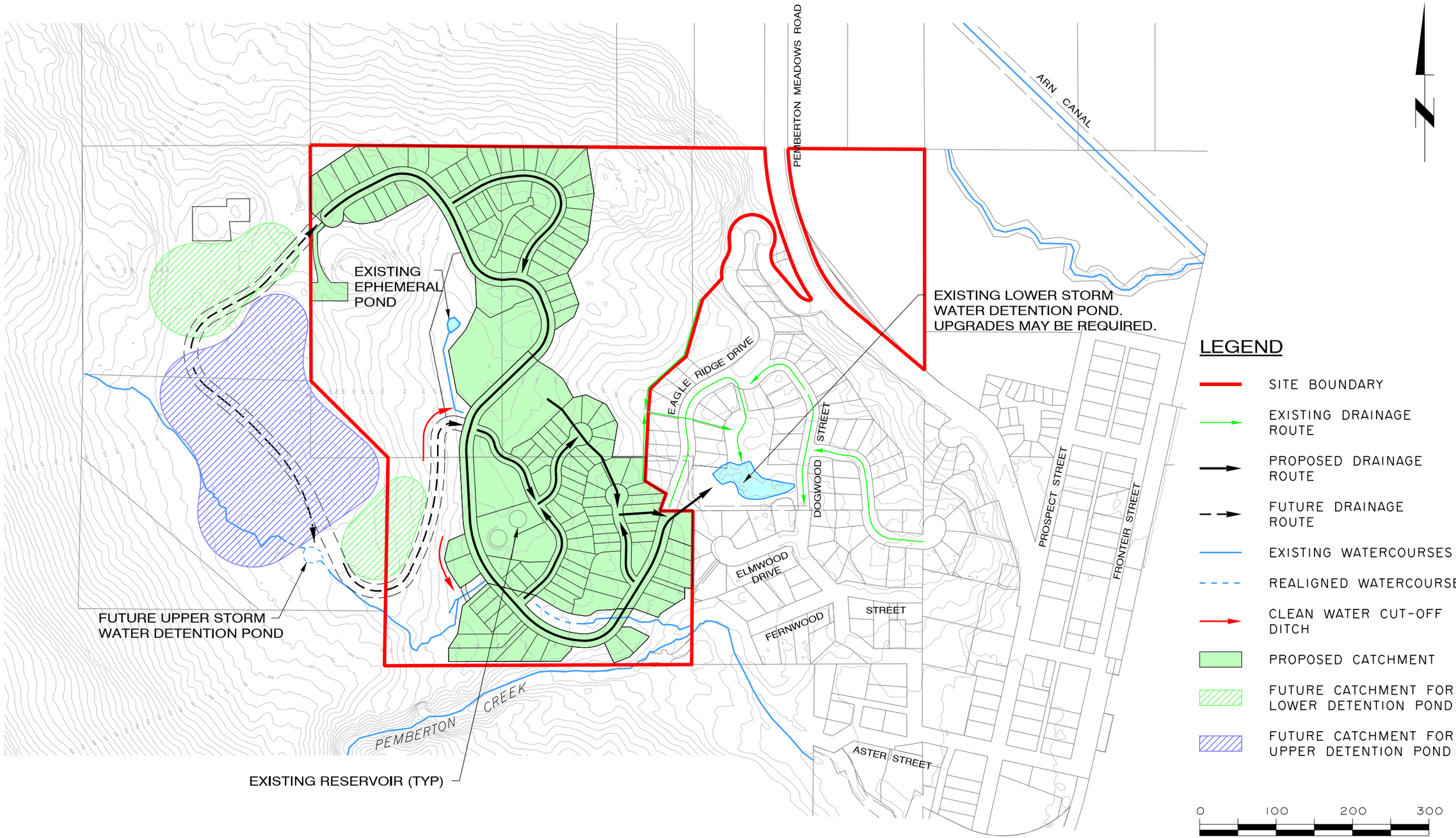
Bethel Land Corporation
Pemberton, Benchlands

SANITARY SEWER SCHEMATIC

Appendix E

Drainage Master Plan

I:\AE51\ustn\design\drawings\servicing\stm-schematic.dgn 21/02/09 3:38:12 PM



InterCAD Services Ltd. CONSULTING ENGINEERS

Bethel Land Corporation
Nkwukwma Development

DRAINAGE MASTER PLAN