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EXECUTIVE SUMMARY

Kerr Wood Leidal Associates Ltd. (KWL) has been retained by Boss Creek Developments to undertake conceptual design of roads and services for the Vernon Hill Ranch Development. This report outlines the conceptual plan for roads and services to support the rezoning application. Further assessment and engineering will be required during the subdivision approval stages.

The development site is approximately 278 ha located on the west-facing slope of Vernon Hill just east of the City of Vernon. The development will be a Bare Land Strata with approximately 140 lots of various sizes averaging 2.0 ha. per lot. The theme of the development is to provide a country living atmosphere within a protected, natural setting.

Low Impact Development concepts will be utilized for design of the roads and services in order to minimize impacts on the natural landscape and to maintain viewscapes as seen from areas in the valley below the development. Features of the development employing these concepts will include:

- narrow roadway widths to limit the extent of cuts and fills and to reduce stormwater runoff by reducing impervious areas;
- a series of ponds located throughout the site to serve as stormwater detention, as open storage reservoirs to assist with fire fighting and as amenities; and
- open ditches and swales to promote recharging the groundwater table and to mitigate downstream effects of stormwater runoff.

The road network will include a strata-collector road as the main route crossing the site from west to east. A number of strata-local roads will extend from the strata-collector road to access additional properties on the site. Due to areas of steep and challenging terrain, custom hillside road standards have been proposed for the development. A trail network will provide a recreational amenity.

Hydrogeotechnical investigations have concluded that sufficient groundwater is available to service the development. A water system will be designed incorporating wells, a piping distribution network, storage reservoirs and pressure reducing stations. Water treatment will be included to ensure conformance with local and Canadian Water Quality Guidelines.

The stormwater system promotes on-site disposal and provides detention ponds to mitigate runoff to pre-development levels. The ponds will facilitate multi-purpose storage for storm detention and emergency capacity for fire fighting purposes if required.

Wastewater treatment will consist of conventional septic tank systems (Type 1) for each lot provided local soil conditions are suitable. Alternatively, a system utilizing septic tanks on individual lots with local effluent collection and disposal systems servicing a number of lots may be implemented.

1. INTRODUCTION

1.1 BACKGROUND

The purpose of this report is to provide conceptual servicing for the purposes of the rezoning application. Further assessment and engineering is required during the subdivision approval stages. This report accompanies other planning documents and is intended to be submitted concurrent with those reports.

The Vernon Hill Ranch development is located on the west-facing slope of Vernon Hill, east of the City of Vernon within the Regional District of North Okanagan (RDNO) Electoral Area C, occupying approximately 278 ha of land.

Vernon Hill is relatively undeveloped with only a few large single-family properties bordering the lower limits of site. Primary access to the property is from Galiano Road.

The proposed development comprises a Bare Land Strata of approximately 140 lots of varying sizes with an average density of 2.0 ha per lot. The development consolidates seven existing properties on the hillside. Smaller lots will be clustered on more easily developable land with larger properties designated for areas of steeper terrain.

The location of the development is shown on Figure 1 and a preliminary layout plan is shown on Figure 2.

The proposed development guidelines envisage country living on large properties serviced by a community water system, utilities and paved roads observing environmental principles and preserving green spaces. The transportation and pathway network and services will be common to the property owned and maintained by the strata corporation. In keeping with this concept Boss Creek Developments has created proposed building guidelines for residential and non-residential properties as presented in the accompanying planning documents.

1.2 CONSTRUCTION STAGING

Four or five construction stages are anticipated. Stage 1 construction is scheduled for 2007 and will comprise approximately 40 lots at the westernmost portion of the site. The remaining construction is anticipated to take place in future stages over a period of approximately 10 years.

2. ROADS

2.1 ACCESS TO THE DEVELOPMENT SITE

Access to the development property will be via Pottery Road, Robin Road, Sparrow Road and Galiano Road as shown in Figure 1). With the exception of the western portion of Pottery Road these roads are typically rural, single lane each way and are under the jurisdiction of the B.C. Ministry of Transportation (MoT).

2.2 TRAFFIC ANALYSIS

Boulevard Transportation Group (BTG) has conducted a traffic impact study for the development. The intersections of Pottery Road at 15th Street and Pottery Road at Highway 6 were analysed by BTG for traffic volumes and levels of service (delays and queue lengths). Key highlights of BTG's report include the following:

- Traffic conditions along Pottery Road, Robin Road, Sparrow Road and Galiano Road are good in terms of level of service assuming build-out of the proposed development.
- The intersection of Pottery Road at 15th Street is unaffected in terms of level of service and the intersection of Pottery Road at Highway 6 is not greatly affected based on build-out of the development and a 10-year horizon.
- The function of the above roads within MoT's jurisdiction will change from local to collector status.
- The expected trip rate for the evening peak hour is estimated to be 1.01 trips/unit (63% incoming and 37% outgoing).
- Based on an estimated 140 units, the numbers of trips attributable to the development during the peak evening hour are 89 inward and 53 outward. The total numbers of trips for all properties based a 10-year horizon (post development) are 228 inward and 194 outward.

BTG's recommendations for off-site road improvements are noted in Section 2.5 below.

2.3 ROAD CLASSIFICATIONS

Table 2-1 lists the road classifications proposed for this site. The terms 'strata-collector' and 'strata-local' are unique to this development in response to the sloped nature of the property and environmental/viewscape objectives.

Table 2-1: Road Classifications

Characteristic	Road Classification			
	Strata-Collector	Strata-Local	Driveway	Emergency Access Lane
Function	Traffic movement and land access of equal importance	Land access primary function	Land access only function	Emergency Egress
Expected Peak Traffic Volumes (trips/hr)	76	2 to 12	1	n/a
Design Speed (km/h)	50	40	n/a	n/a

Because traffic volumes are low, the function of the strata-collector road will be both traffic movement and land access. Strata-local roads will spur off of the strata-collector road and will function primarily for access to properties and trailheads. Driveways will service only to access properties and emergency access lanes will provide alternative routes to egress from the development area under emergency conditions.

2.4 ROAD STANDARDS

OFF-SITE

MoT Section 1420 Subdivision Road Design Parameters will be used as the applicable standards for off-site road improvements.

ON-SITE

MoT's standard for a Rural Local Undivided road is deemed to be too generous for the site, considering the limited traffic volumes, challenging terrain, adverse impact on the natural environment, and impact on views from below the development. For example, achieving MoT requirements for maximum road grades of 9% would necessitate more roadway and wide road section standards would result in large road cuts and fills.

Since the development is slated to be a strata, similar but more suitable guidelines have been developed for roadway design to service the properties while minimizing the impact on the environment and viewscape. Road standards have therefore been adopted for this development based on City of Vernon and the City of Kelowna road standards for hillside developments. Horizontal and vertical geometry will be consistent with these City hillside standards, however, variations will be made to take into account the rural nature of the development. These variations include removal of curb and gutter, parking lanes and sidewalks, and provision of ditches in lieu of curb and gutter.

The following features will be incorporated to minimize impact on the environment:

- Use two-way strata-local roads and/or single lane one-way where practical with pull-outs where appropriate to reduce cuts and fills on the hillside;

- In steep terrain sections, provide short sections of roadway with split elevations between lanes whereby one lane would be situated above the other separated by a sloped median.

- Provide natural-looking retaining walls to limit excavation and fill areas.

The road base structure for each classification of road will be designed based on consideration of local jurisdiction road standards and assessments and recommendations of a geotechnical engineer taking into account the properties of the native soil.

Road barriers will be used along the sides of the roadway at key locations based on the Transportation Association of Canada's (TAC) safety warrants.

A 'dark sky' approach will be used for street lighting. Appropriate streetlights will be selected and installed at intersections and at key locations such as switchbacks.

Roads with rock cuts will incorporate a ditch at the toe of slope for debris catchment. The width of this ditch will depend on the condition and height of the rock. A rockfall hazard analysis will identify areas where special measures or realignment of roads is necessary.

Strata trail width criteria will be a minimum 2.5 m wide travelling surface based on two horses passing. The trails will be surfaced will be either gravel or bark mulch.

A summary of the proposed road standards is shown in Appendix A as Tables 2-2 and 2-3. Typical road sections are shown on Figure 3.

2.5 OFF-SITE ROAD IMPROVEMENTS

From Boulevard Transportation Group's traffic impact analysis, the following specific off-site road improvements are recommended:

- Incorporate solid yellow centerline along Robin Road, Sparrow Road and Galiano Road;
- Add curve warning signs at Sparrow Road, Robin Road as appropriate;
- Add a "No Exit" sign at the south dead end of Galiano Road;
- Add a "Stop" sign for the south approach of Galiano Road;
- Add curve warning signs for Sparrow Road and north Galiano Road approaches;

- Add a checkerboard backstop sign to alert Sparrow Road Approach traffic of mandatory turn;
- Add a switchback curve warning sign at the Galiano Road switchback; and
- Provide flagging at the switchback corner near the end of Galiano Road if conflicts arise during construction between trucks and automobiles.

Consistent with BTG's recommendations, preliminary requirements identified with MoT include road widening and minor road re-grading along Galiano Road of approximately 1 km to improve access to the development.

2.6 PRELIMINARY ROAD NETWORK

A preliminary on-site road network is shown on Figure 2.

STRATA-COLLECTOR ROADS

A single strata-collector road will act as the primary access route traversing through the site. The strata-collector road will begin at the end of Galiano Road and will connect to the forestry road at the eastern boundary of the site. The strata-collector road will have a 7.0 m wide paved surface with 1.0 m wide gravel shoulders on each side. The width of the shoulders may need to be widened if shallow utilities are underground.

STRATA-LOCAL ROADS

The strata-local roads will have 6.0 m and 4.0 m wide paved surfaces depending on whether the road is two-lane or single lane respectively. Due to the very low trip volumes, single-lane strata-local roads will provide adequate service for most of the lots. Pullouts will be provided periodically on single lane roads at strategic line-of-sight locations to allow for passing. Sharp corners will be widened to two lanes for safety and turning room.

Cul-de-sacs, or hammerheads, will be provided at the ends of dead end roads to provide a means of turning around, especially for emergency vehicles.

DRIVEWAYS

Most driveways will service a single property however there are a number of exceptions where common driveways will be used (with associated easements). Long driveways will require a hammerhead or other means to allow emergency vehicles the ability to turn around. Driveways will typically be 3.5 m wide.

EMERGENCY ACCESS LANES

Emergency access routes will be provided at specific locations to provide a secondary means of egress from/to the site in the case of an emergency. The width of the access lane will generally be 4.0 m.

2.7 MAIL BOX LOCATIONS AND TRANSIT BAYS

Mailbox locations will be determined during the design stage in coordination with Canada Post.

Public transit is not an expected requirement for the site.

3. WATER SYSTEM

3.1 WATER SUPPLY AND QUALITY

The development site is located outside the Greater Vernon Services water service area and is not supplied with an existing community water system. Several surface watercourses traverse the development site however they are seasonal and do not provide an adequate water supply source. Based on the foregoing, groundwater is considered the only viable source of potable water for the proposed development.

Golder Associates Ltd. conducted a hydrogeological review and test well drilling program to determine if suitable sources of groundwater are available. Their report "Groundwater Potential Evaluation and Test Well Drilling Program, Vernon Hill Ranch, Vernon, B.C. – July 24, 2006" is included as an attachment.

The relevant findings of the Golder investigation are:

- Three wells were developed with significant sustainable capacities: Well #2 – 2.9 L/s, Well #3 – 6.3 L/s and Well #4B – 12.6 L/s.

- Laboratory analyses of water samples confirms the following exceptions to the Guidelines for Canadian Drinking Water Quality:

  - Well #2 has elevated turbidity, hardness and total iron;
  - turbidity, manganese, hardness and iron are issues with Well #3; and
  - turbidity, total dissolved solids, iron, manganese, hardness and uranium are issues with Well #4B.

- The combined capacity of wells #2 and #3 is 9.2 L/s, sufficient to supply the development.

- The likelihood of well interference between wells developed on site and those to the west in the valley is considered remote.

- Each well may be under the direct influence of surface water, filtration and disinfection treatment.

The water supply needed to service a 140-lot development is 8.2 L/s, which can be provided by Wells #2 and #3. The supply requirement is based on Greater Vernon Services water design standards and excludes additional irrigation supply of 0.8 L/s/ha for large lots as this criteria is not applicable to this development.

Once the detailed service planning is complete, the supply requirement may be increased to account for possible agricultural and livestock needs.

3.2 WATER SYSTEM PLANNING

The development site is situated on Vernon Hill from Galiano Road at about 570 m elevation to the upper reaches of the property at about 1,100 m. The development will be serviced with a privately operated community water system comprising of the following:

- Groundwater sources comprising one or more production wells and a back up well capable of supplying at least 50% of the development water demand.
- A water treatment plant(s) to treat groundwater to meet local and Canadian Drinking Water Quality Guidelines.
- One or more water storage reservoirs providing fire storage and the maximum day water demand for the site, plus an irrigation allowance.
- Distribution mains sized to convey fire flows throughout the developed area.
- Fire hydrants placed strategically to protect both the developed areas and to assist in forest fire fighting.
- Infrastructure designed and constructed generally in accordance with Greater Vernon Services standards.

The site may require up to twelve water pressure zones. Ideally, pressure zones will be developed to mirror zones established by Greater Vernon Services, however, this may not prove practical or necessary.

The water system will be owned by the strata corporation and operated by a certified water system operator.

3.3 CONCLUSIONS

Hydrogeotechnical investigations identified significant potential for groundwater sources throughout the site and a test drilling and well development program has demonstrated that sufficient groundwater is available to service the development. The quality of the groundwater varies with each well, and some parameters exceed the objectives in Canadian Water Quality Guidelines, requiring treatment to meet these standards.

The water distribution system will be designed generally following the principles of the standards of Greater Vernon Services and Interior Health.

4. WASTEWATER SYSTEM

4.1 WASTEWATER SERVICING

The development is outside the Vernon or Coldstream sewerage areas and community wastewater service is not planned for the site. Strata properties will be serviced by one of the following options:

- On-lot treatment systems comprising conventional septic tanks (Type 1), Type 2 or Type 3 wastewater treatment plants with on-lot effluent disposal to ground where soil conditions allow.

- A treatment system comprising individual on-lot septic tanks (Type 1), Type 2 or Type 3 wastewater treatment plants and local effluent collection systems servicing a number of properties with effluent disposal to ground.

The estimated total residential wastewater volume at build-out will be in the order of 140 to 180 m^3/day. All sewage disposal systems will be designed to comply with the requirements of the Interior Health Authority and the Ministry of Environment.

In support of assessing the opportunities for development for a community type wastewater collection, treatment and ground disposal systems, Golder Associates Ltd. have completed a report "Preliminary Soils Investigation Boss Creek Ranch Development, Vernon, BC – September 22, 2006" which accompanies this submission.

Further investigations at the detailed design stage will identify the level of wastewater treatment and the location of adsorption fields to service the proposed lots. Wastewater planning will further consider the impact of effluent disposal on groundwater sources and environmentally sensitive areas of the site.

5. STORMWATER MANAGEMENT

5.1 APPROACH

The purpose of this section is to outline the preliminary strategy for stormwater management. The strategy establishes criteria that will be used to design drainage works throughout the development. The strategy also identifies preliminary drainage infrastructure to be incorporated into the buildings and roads. Conceptual plans are presented based on the proposed land use, densities and impervious coverage. Further analysis will be completed once rezoning has been approved and will form the stormwater management plan for the site.

The focus of the stormwater management concept for Vernon Hill Ranch is to maintain the natural hydrology of the watershed through practical and creative design. Surface water will connect to detention ponds using enhanced natural run-off channels, storm swales and open ditches allowing for efficient conveyance of the water through the site. Detailed design of the stormwater management plan will be done prior to a subdivision application being submitted.

The stormwater plan includes retaining and managing peak run-off flows on site and by routing the water to the detention ponds where it will be possible to have a post-development drainage flow that does not increase flows from the pre-development baseline. The ponds will facilitate multi-purpose storage for storm flow events and emergency capacity for fire fighting purposes if required. The most inspiring part of the stormwater plan, and where the creative design aspects come into play, is the incorporation of the stormwater system into the public amenities throughout the development. Vernon Hill Ranch will design their plan so that it is an integral part of the natural environment benefiting the wildlife and the community atmosphere for public enjoyment.

5.2 SITE DESCRIPTION

The Vernon Hill Ranch site is characterized by steep topography and mostly second-growth forest.

The development will comprise approximately 140 properties of varying sizes while maintaining an average density of 2.0 ha per lot. It has been specified in the rezoning application that lot coverage shall not be greater than twelve percent (12%) of the total lot area.

Existing drainage within the development area consists of several well-defined channels and ravines, as well as areas where drainage is generally undefined. It appears that there

has been limited surface runoff or erosion in these channel formations for many years. Based on these observations, it is concluded that during the majority of storm events, rainfall is infiltrated into the soil. As a result, surface water is only conveyed in the channels during extreme storm events, most likely under frozen ground conditions. This function is consistent with local anecdotal information.

Overland flow routing from the development to receiving waters at BX or Vernon Creeks has not been investigated at this time; this issue will be further analyzed as part of the stormwater management plan. From the initial field investigation it appears that there is a safe route to Vernon Creek, however, the capacity of this will be reviewed for the 100-year storm event during development of the plan.

5.3 STORMWATER DESIGN CRITERIA

The site is under the jurisdiction of the Regional District of North Okanagan (RDNO). RDNO does not have any specific stormwater design criteria, therefore, the design criteria and guidelines that will be applied to the site during the development of the stormwater management plan will be developed based on reference to the following documents:

- City of Vernon "Subdivision and Development Servicing Bylaw No. 3843, Schedule F, Regulations, Standards and Specifications for the Design and installation of Drainage Systems", 1992.

- British Columbia Ministry of Water, Land and Air Protection "Stormwater Planning: A Guidebook for British Columbia", May 2002.

- Canada Department of Fisheries and Oceans (Pacific Region and Habitat Management Division) and BC Environment Integrated Management Branch, "Land Development Guidelines for the Protection of Aquatic Habitat," 1992.

DISCHARGE OBJECTIVES

Based on the review of the above documents, the design criteria and discharge objectives that will be used as part of the stormwater management plan are shown in the table below.

Table 5-1: Summary of Design Storm Events and Discharge Objectives

Component	Criteria/Guidelines
Hydrotechnical Component (Flood Protection)	▪ Minor Drainage System – 5-year return period design event.[1] ▪ Major System – 100-year return period design event.[1] ▪ Provide on-site or off-site detention facilities to restrict the post-development peak runoff to the pre-development condition for all storm events up to the 100-year return period.
Environment	▪ Maintain existing groundwater base flow regime by capturing and infiltrating at a minimum the 50% of the 2-year storm event.[2]

1. City of Vernon "Subdivision and Development Servicing Bylaw".
2. British Columbia Ministry of Water, Land and Air Protection "Stormwater Planning: A Guidebook for British Columbia", May 2002.

DESIGN STORM EVENTS

Winter and summer storm events with durations ranging from 30 minutes to 24 hours will be used for drainage system design. Summer and winter precipitation depths for the 24-hour duration storm event are provided in Table 5-2 below.

Table 5-2: 24-Hour Precipitation

Return Period	Summer Rainfall Depth (mm)	Winter Rainfall and Snowmelt Depth (mm)
2-year (MAR)	21.8	48.2
5-year	27.2	53.6
100-year	41.8	68.2

1. Winter depths are calculated by adding 1.1 mm/hr snowmelt to the summer rainfall amounts.

ANTECEDENT SOIL MOISTURE CONDITIONS

The following soil moisture conditions will be analyzed for each of the design storm events as part of the stormwater management plan:

- **Frozen:** Frozen ground; assumed to be 100% impervious in all areas; and
- **Un-Frozen:** Soil moisture between wilting point and field capacity (assumed at 4% and 31% respectively).

5.4 PROPOSED STORMWATER STRATEGY

Land development typically involves creation of impervious areas via pavements and building roof areas. These surfaces are then connected to storm sewer conveyance systems. This increased impervious area and flow concentration can result in increased and faster responding peak flow rates during extreme rainfall-runoff events that can cause flooding and erosion. Increased impervious area may also reduce the quantity of water

infiltrated into the ground, thus potentially having a negative impact on groundwater regimes.

In the case of this development, the overall increase in impervious area will be minimal relative to the large site size. Focus will be on prevention of local roadside erosion, avoiding concentration of runoff volumes and protection of existing watercourses.

To reduce the impact on the existing watershed, the stormwater management plan will be designed towards no net increase in peak flow and volume from the site. The plan will strive to maintain the natural hydrology of the watershed. To accomplish this objective, stormwater for all events up to 100-year return period storm event will be addressed.

Vernon Hill Ranch is adopting policies, which will minimize the usual problems associated with stormwater run-off. Through the creation of large properties, an allowable floor area of no more than 12 % on any residential property and a Design Review Committee which must approve not only house plans but also landscaping and grading plans, stormwater will be properly managed on the individual lots. The complete stormwater management plan will utilize the public amenity areas to create stream features and several appropriately placed detention ponds (see figure 4) to ensure effective stormwater detention with small discharges to ground.

THAWED GROUND CONDITIONS

The following outlines the proposed drainage infrastructure to achieve the discharge criteria for thawed ground conditions.

On-lot Stormwater Systems

The proposed on-lot drainage infrastructure consists of the following:

- disconnected roof leaders;
- a maximum impervious built area of 12%; and
- a lawn basin and detention/infiltration rock trench to capture high intensity rainfall events if it can not be infiltrated on the surface (likely for the smaller, steeper lots);

Based on the preliminary soil investigations (Golder, August 9, 2006), KWL field investigations, and given that the lot sizes will ranging from 0.4 to greater than 2.0 ha, on-lot infiltration is recommended for storms up to the 100-year design event under non-frozen ground conditions. Preliminary calculations based on the proposed lot coverage and estimated infiltration rates have shown this should be feasible for most lots because of the high permeability of the soil and large percentage of available pervious area.

Road Stormwater System

The road template proposed for the development will include roadside infiltration swales on roads that are less than 10% grade.

On roads with grades greater than 10% infiltration is not feasible and swales will be replaced with rock-lined channels. These channels will be directed to strategically-located detention ponds throughout the development. Also, due to the steep terrain, it is likely that a rock-lined channel or main trunk may need to be connected to the roadside swales at the bottom of the development to collect concentrated flows which have not been infiltrated. These interceptor trenches/sewers would then convey flows to detention ponds and then to off-site drainage courses.

Detention ponds will be sized to ensure that the site discharges less than the predevelopment flow rate up to the 100-year design storm. The ponds will likely also have the dual purpose of providing a readily accessible water for fire fighting purposes should it be needed in the development or elsewhere on Vernon Hill. The ponds may require flow augmentation from groundwater sources during summer months to provide the required fire flow storage volume. The ponds will also establish wildlife areas, vegetation buffer zones and attributes which enhance the lifestyle opportunities by incorporating them as an integral component of the trail and public area systems.

FROZEN GROUND CONDITIONS

For frozen ground conditions, runoff from rooftops and some pervious areas will be directed to the lawn basin and infiltration into the soil will occur. Runoff from other pervious areas will be directed to the roadways; this runoff will in-turn be conveyed to detention facilities and then eventually off-site as it does in the predevelopment state. The volume of water leaving the site will likely be less for the post-development condition than the existing condition because some of the stormwater will be captured and infiltrated by on-lot and local detention/infiltration facilities.

5.5 CONCLUSIONS

This section outlines the proposed stormwater strategy for the Vernon Hill Ranch development. A stormwater management plan for the site will be developed during the roads/subdivision design stage. The plan will strive to maintain natural hydrology in the watershed. To accomplish this objective, stormwater for all events up to 100-year return period storm event or less will be mitigated. The plan will determine the design flows and sizes of all facilities and mitigative measures.

6. SHALLOW UTILITIES

6.1 GAS

Terasen Gas is the current gas service provider. There are currently no gas mains near the development boundary. Off-site gas main extensions will be required to service the development.

6.2 HYDRO, TELEPHONE AND CABLE

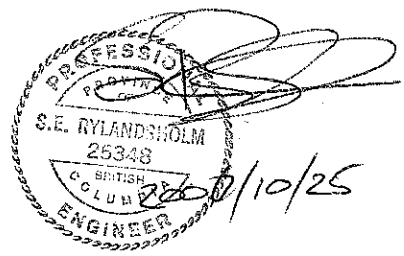
Shallow utilities servicing from BC Hydro, Telus and Shaw Cable is feasible. The services would be located underground or overhead within the road rights-of-way.

7. CLOSURE

This report presents the conceptual servicing approach and feasibility based on investigations completed to date and discussions with approval and utility agencies. It is expected that opportunities for enhancements, and new constraints, will be identified during subsequent investigations. Design of site infrastructure will respond to these challenges and opportunities.

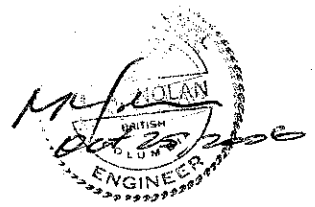
Prepared by:

KERR WOOD LEIDAL ASSOCIATES LTD.



S.E. (Sven) Rylandsholm, P.Eng.
Project Engineer

Reviewed by:



M. A. (Mike) Nolan, M.Eng., P.Eng
Project Manager

STATEMENT OF LIMITATIONS

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This document represents KWL's best professional judgement based on the information available at the time of its completion and as appropriate for the project scope of work. Services performed in developing the content of this document have been conducted in a manner consistent with that level and skill ordinarily exercised by members of the engineering profession currently practising under similar conditions. No warranty, express or implied, is made.

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Table 2-2: Design Parameters Based on Road Classification

Classification	Parameters					
	Max Units Served	Design Speed (km/h)	Max. Grade (%)	ROW (m)	Paved Width (m)	Streetlights
Collector	300	50 (20) [2]	12	16	7.0	at intersections, switchbacks & key locations
Local	100	40 (20) [2]	12	14.1	6.0 (2-lane) 4.0 (1-lane)	at intersections, switchbacks & key locations
Driveway	4	--	15	n/a	3.5	n/a
Emergency Access Lane	--	--	15	4.5	4.0 [5]	none

Notes:
1 See Table 2-2 for alignment design criteria for each design speed.
2 Minimum permitted design speed reduction, where necessary due to topographic constraints.
3 All parking shall be managed on-site or within small parking pullouts, as required.
4 Maximum grade permitted where necessary due to topographic constraints.
5 Asphalt or gravel surfacing.

Table 2-3: Alignment Design Criteria

Criteria	50km/h	40km/h	30 km/h
1. Horizontal Curve Radii			
Roadway Crossfall:			
▪ normal crown (-2%)	165m	90m	45m
▪ 2% superelevation	120m	65m	30m
▪ 4% superelevation	80m	45m	22m
Through intersections	120m	70m	40m
2. Superelevation			
Maximum Superelevation	4%	4%	4%
Maximum Superelevation at intersections	4%	4%	4%
3. Superelevation Transition Lengths			
Transition Lengths:			
▪ normal crown to +2%	22m	20m	20m
▪ normal crown to +4%	33m	30m	30m
Min Tangent Length between reversing:			
▪ 2% superelevation	13m	12m	12m
▪ 4% superelevation	26m	24m	22m
4. Gradients			
Minumum Grade	0.5%	0.5%	0.5%
Maximum Grades:			
▪ on horizontal tangents	12%	12%	12%

Notes:
1 Values for transition lengths include tangent runout applied at the same rate as superelevation runoff.
2 60% of superelevation runoff occurs on the tangent approach and 40% on the curve, resulting in a minimum length of tangent between reversing curves of 120% of the superelevation runoff length.

Criteria	50km/h	40km/h	30 km/h
▪ on minimum radius horizontal curves	9%	10%	10%
Grades Through Intersections:			
▪ with design speed on major road [1]	8%	8%	--
▪ approach distance for major road	5m	0m	--
▪ with design speed on minor road [2]	5%	6%	6%
▪ approach distance for minor road [7]	15m	5m	5m
Notes: 1 6% desirable. 2 4% desirable. 3 Minimum distance behind the edge of pavement for the major road that the specified grade may not be exceeded.			
5. Vertical Curve K Values			
Minimum Crest	8	4	2
Minimum Sag	7	4	2
Crest/Sag on approach to stop condition	3	2	2
6. Stopping Sight Distances			
Down grades:			
▪ 12%	78	52	34
▪ 9%	73	50	32
▪ 6%	69	48	31
▪ 3%	66	46	30
▪ 0%	63	45	30
Up grades:			
▪ 3%	61	44	29
▪ 6%	59	42	29
▪ 9%	57	41	28
▪ 12%	56	40	28