Ms. Sarah Purchase
ISL Engineering and Land Services Ltd.
#101, 621 10 St
Canmore AB, T1W 2A2

August 16, 2022

Project Number: 2022-046

RE: Geotechnical Investigation for Greenfield Parcel at Canmore Cemetery
Palliser Trail, Canmore AB

Dear Ms. Purchase,

As requested, Taylor Geotechnical Ltd. (Taylor) has conducted a geotechnical investigation for the development of the greenfield parcel at the Canmore Cemetery, located on Palliser Trail in Canmore, AB (site). purpose of the investigation was to identify the subsurface soil and groundwater conditions in the area of interest (see Figure 1 and Figure 2 for reference). Based on our interpretation of this information, comments and recommendations pertaining to the geotechnical aspects of design and construction for proposed development are provided herein.

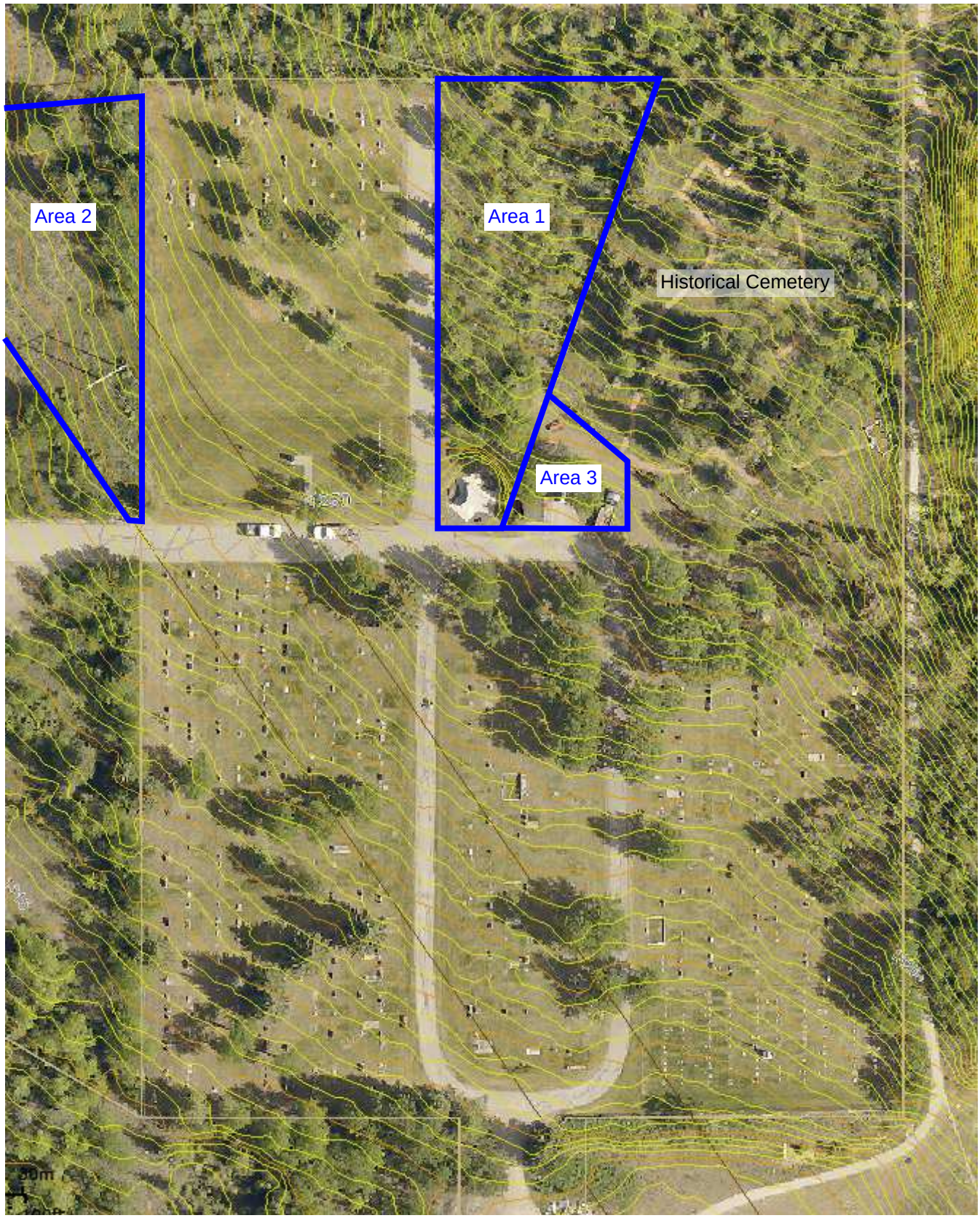
The scope of work for this project was provided in the proposal letter (reference number 1187), dated June 7, 2022. Authorization to proceed was given by the Ms. Purchase on June 15th, 2022.

It should be noted that the scope of this report is limited to the geotechnical assessment of the proposed development. It does not include any investigation, analytical testing, or assessment of possible groundwater contamination, archeological or biological considerations, or sediment control measures. This report should be read in conjunction with the Disclaimer and Limitations which are appended following the text of this letter. The reader's attention is specifically drawn to this information as it is essential for the proper use and interpretation of this report.

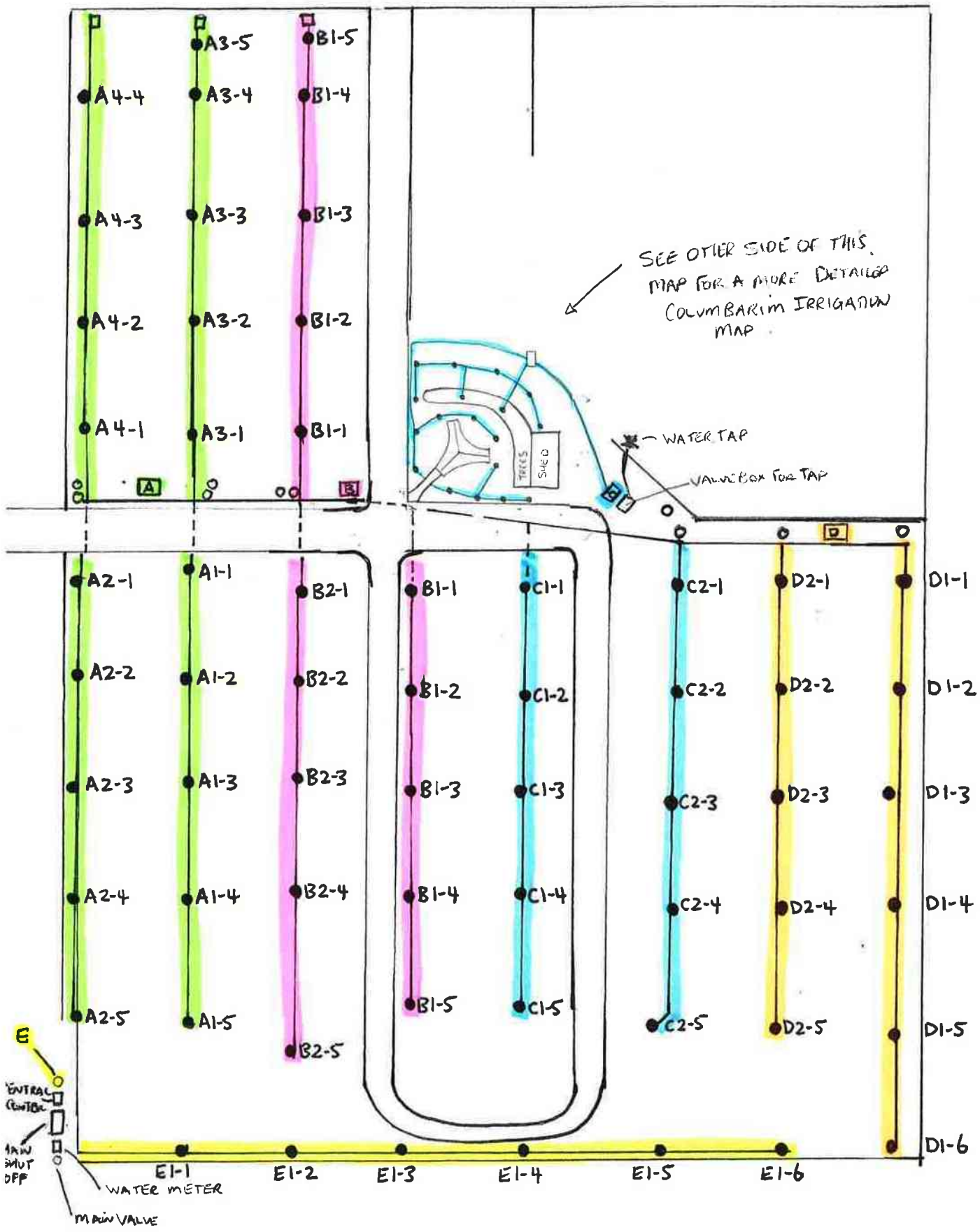
1.0 PROJECT UNDERSTANDING

Based on the project information provided by Ms. Purchase, it is understood the project includes the development of a small parcel of land left unused in the Canmore Cemetery. It is likely that additional columbaria will be constructed on the parcel. Existing columbaria across site have experienced foundation issues; as such, the town wishes to better understand the subsurface conditions at the proposed location to assist in successfully developing the land.

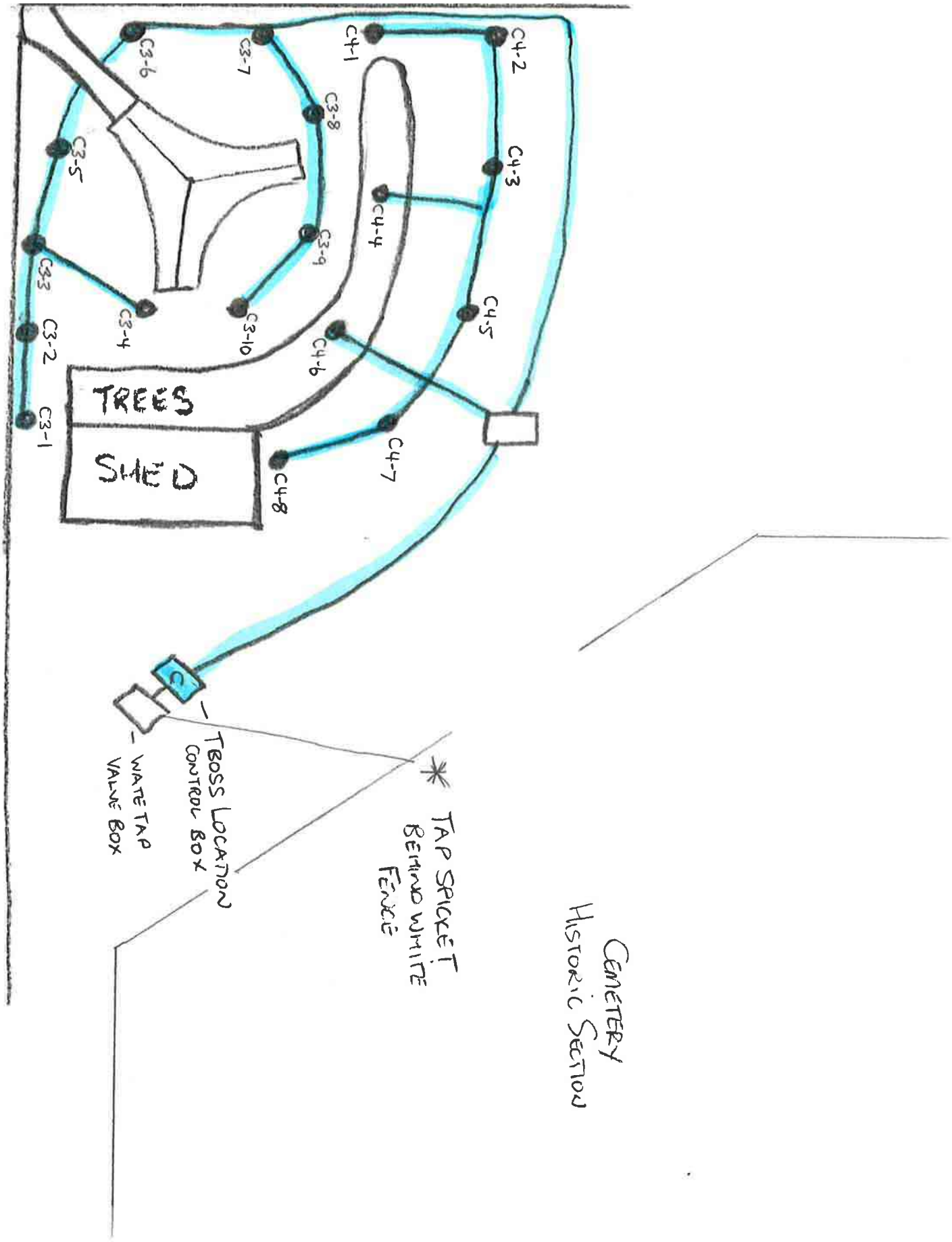
The project site is located on Palliser Trail in Canmore, AB, within the Canmore Cemetery. The cemetery property has an area of 21,791 m^2 in area and is roughly 122 m wide by 170 m long. The site is bound by Silvertip Trail to the north, Benchlands Trail to the south, Palliser Trail to the west, and sloping, forested terrain to the east. The Bow River is the nearest waterbody and is located approximately 1,700 m to the west.

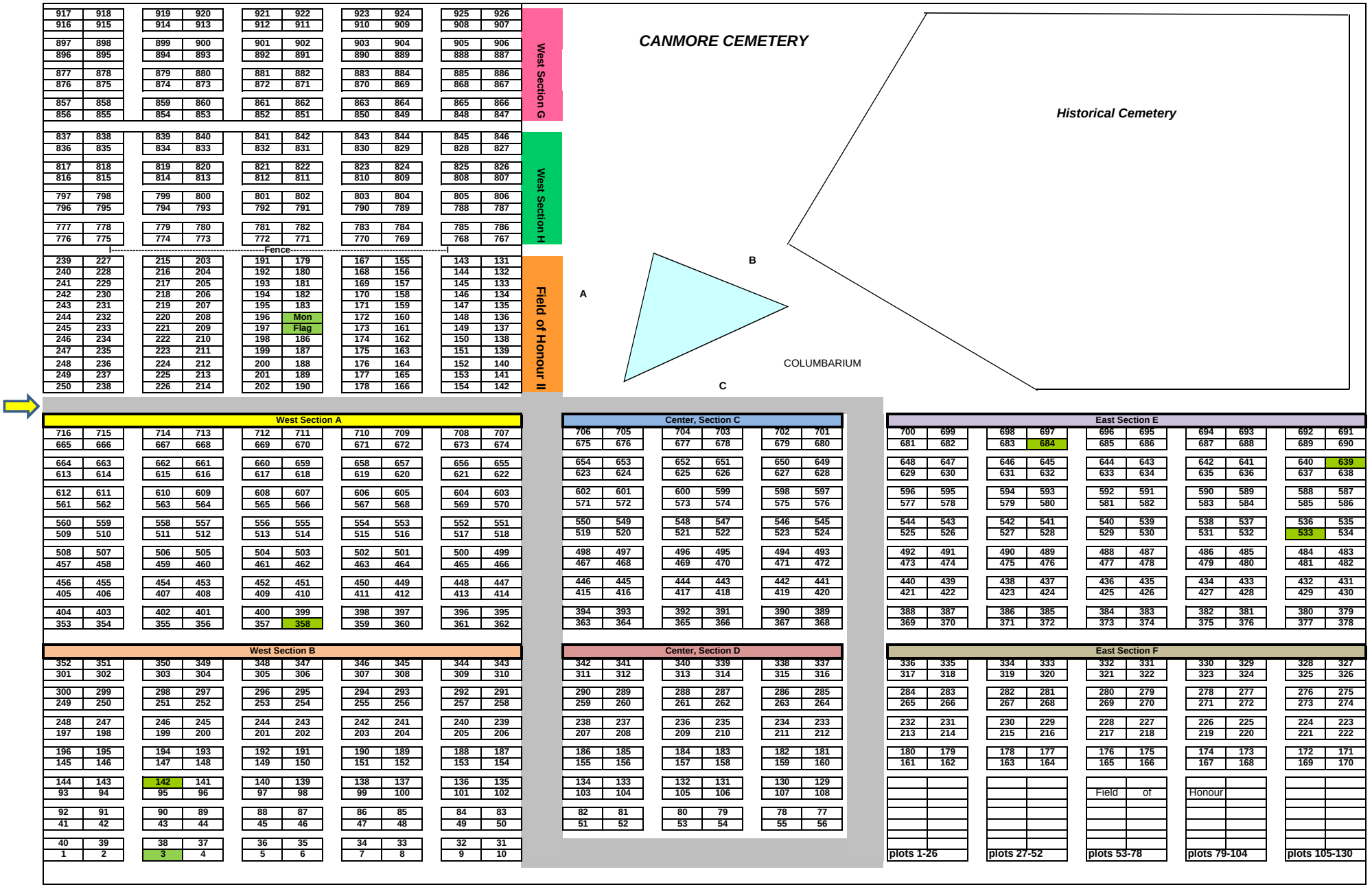

Area 2
Area 1
Historical Cemetery
Area 3

Town of Canmore Cemetery - Irrigation Layout



Town of Canmore Cemetery - Columbarium Irrigation Layout




CANMORE CEMETERY
Historical Cemetery
West Section G
West Section H
Field of Honour II
Fence
A
B
C
COLUMBARIUM
West Section A
West Section B
Center, Section C
Center, Section D
East Section E
East Section F
Field of Honour
plots 1-26
plots 27-52
plots 53-78
plots 79-104
plots 105-130

CANMORE CEMETERY - FINAL DESIGN AND NEW COLUMBARIUM

ISSUED FOR TENDER

1 CONTEXT PLAN
SCALE: 1:500

LANDSCAPE DRAWING LIST

Drawing #	Drawing Title
L0.0	COVER SHEET
L1.0	EXISTING CONDITIONS
L2.0	DEMOLITIONS + REMOVAL PLAN
L3.0	SITE + MATERIALS PLAN
L4.0	LAYOUT PLAN
L5.0	PLANTING PLAN
L6.0	DETAILS- PLANTING
L7.0	DETAILS- SURFACES
L7.1	DETAILS- BOULDER RETAINING WALL
L7.2	DETAILS- COLUMBARIA
L7.3	DETAILS- FURNISHINGS
L8.0	IRRIGATION PLAN
L8.1	DETAILS- IRRIGATION
L8.2	DETAILS- IRRIGATION

CIVIL DRAWING LIST	
DRAWING #	DRAWING TITLE
C-100	SURFACE WORKS AND GRADING PLAN - CREMATION GARDEN
STRUCTURAL DRAWING LIST	
S-100	GENERAL NOTES AND COLUMBARIUM FDN DETAILS

NOTES:

GENERAL WORKMANSHIP

1. CONTRACTOR TO CONFIRM ALL UTILITY SERVICES BEFORE PROCEEDING WITH ANY WORK. CONTRACTOR SHALL INDEPENDENTLY VERIFY UTILITY LOCATIONS, SIZE AND TYPE.
2. NOTIFY THE OWNER'S REPRESENTATIVE OF ANY DISCREPANCIES. OBTAIN WRITTEN APPROVAL FROM THE OWNER'S REPRESENTATIVE PRIOR TO COMMENCING WORK.
3. COLLECT AND DISPOSE OF ALL DEBRIS AND/OR EXCESS MATERIAL FROM LANDSCAPE OPERATIONS. KEEP SURFACES CLEAN AND REPAIR ANY DAMAGE RESULTING FROM LANDSCAPE WORK. ALL REPAIR COSTS ARE THE CONTRACTORS' RESPONSIBILITY.
4. CONFIRM WITH THE OWNER'S REPRESENTATIVE PRIOR TO COMMENCING WORK TO CONFIRM WHEN SITE INSPECTION VISITS WILL BE CARRIED OUT.
5. CONTRACTOR SHOULD BE FAMILIAR WITH THE CANMORE ENGINEERING DESIGN AND CONSTRUCTION GUIDELINES. CONTRACTOR TO REFERENCE THE CANMORE ENGINEERING DESIGN AND CONSTRUCTION GUIDELINES FOR THE FOLLOWING:
   A. WARRANTY PERIOD AND MAINTENANCE REQUIREMENTS
   B. CONSTRUCTION MANAGEMENT
   C. SITE PREPARATION, GRADING, TOPSOIL, SEEDING AND SODDING
   D. PLANT MATERIAL
   E. IRRIGATION SYSTEMS
6. NO FOOD WASTE ALLOWED IN DUMPSTERS. BEAR PROOF CONTAINERS SUPPLIED BY TOWN MUST BE USED.

RESPECTFUL BEHAVIOR

1. CONTRACTORS AND THEIR STAFF, SUPPLIERS AND SUBTRADES MUST BE AWARE THAT THEY ARE WORKING WITHIN A FUNCTIONING CEMETERY AND THAT VISITATIONS MAY BE TAKING PLACE DURING THE COURSE OF CONSTRUCTION AT THE SITE. RESPECTFUL BEHAVIOR IS EXPECTED AT ALL TIME. CONSTRUCTION ACTIVITIES MUST NOT IMPEDE VEHICLE OR PEDESTRIAN MOVEMENT DURING GRAVE VISITATIONS.
2. CONTRACTOR STOP ALL WORK WHEN AN INTERMENT IS IN PROGRESS FOR "RESPECTFUL MOURNING". TOWN TO GIVE A MINIMUM OF 72 HOURS NOTICE.

LEES + ASSOCIATES
Landscape Architects
509-318 Homer Street Vancouver British Columbia Canada V6B 2V2
Tel: (604) 899-3806 Web: www.elac.ca Email: info@elac.ca

Revisions

No.	Date	Status	By
1	OCT. 21,2022	ISSUED FOR 50% REVIEW	LB
2	DEC. 9,2022	ISSUED FOR 90% REVIEW	LB
3	MAR. 24,2023	ISSUED FOR TENDER	LB
4	MAY 12,2023	ISSUED FOR TENDER - UPDATE	LB

ISSUED FOR TENDER
NOT FOR CONSTRUCTION

Client: Town of CANMORE

Project: CANMORE CEMETERY FINAL DESIGN AND NEW COLUMBARIUM

Drawing Title: COVER SHEET AND DRAWING LIST

Date: OCTOBER, 2022
ELAC Project No.: 21-816
Scale (On 22 x 34 Inch Sheet): As Noted
Drawing No.: L0.0
Drawn By: LB
Checked: HR

Z:\Active Clients\Town of Canmore\22-816 Canmore Cemetery Final Design Phase 1\6_CAD\Working Drawings\22-816_Canmore Cem_L0.0_Cover Sheet.dwg)

The purpose of the geotechnical investigation is to provide a factual report of the bearing conditions of the in-situ materials, and to provide recommendations for the design and construction of lightweight structures on site.

2.0 FIELD AND LABORATORY WORK

The geotechnical investigation was carried out on August 2, 2022. At this time, two (2) boreholes were advanced at the site to determine subsurface soil and groundwater conditions, and to collect representative soil samples for laboratory testing. Boreholes were advanced using a sonic-based drill rig operated by Taylor from Canmore, AB. The drilling work was carried out under the supervision of Taylor staff.

Boreholes were advanced to depths of 4.11 m and 3.81 m, respectively. Representative soil samples were collected at selected depths for detailed examination. Standard Penetration Tests (SPTs) with split spoon sampling was completed at select intervals to determine the in-situ density/consistency of the soil deposits and to retrieve disturbed samples.

Borehole 1 (BH-01) encountered refusal at 4.11 m. A Standard Penetrometer Test (SPT) was conducted at a depth of 3.1 m. Borehole 2 (BH-02) encountered refusal at a depth of 3.81 m. Groundwater was not encountered at the time of the geotechnical investigation of August 2, 2022.

Upon completion, a 25 mm PVC standpipe piezometer was installed in BH-02. The piezometer was backfilled with sand and excavation spoils, plugged with bentonite chips and nominally compacted. A follow-up site visit was carried out on August 4, 2022, for the purpose of measuring groundwater within the installed piezometer.

Laboratory testing completed by Taylor included moisture content determinations and gradation analysis. These results are presented in the borehole logs and presented in Appendix A. Chemical analysis of soil for sulphate resistivity was undertaken by KaizenLab in Calgary.

3.0 SUBSURFACE SOIL AND GROUNDWATER CONDITIONS

The following section summarizes the observed subsurface soil and groundwater conditions at the time of the investigation. Generalized stratigraphy is presented below in order of increasing depth. Borehole logs with piezometer installation details are provided within Appendix A of this report. Please note, subsurface conditions were found to vary with depth and between boreholes. It is anticipated that similar or greater variation may exist in areas beyond the boreholes.

The ground surface at both borehole locations (BH-01 and BH-02) consisted of a thin vegetative cover. The vegetative cover was approximately 0.1 m thick.

In both boreholes, the vegetative cover was underlain by a soft to firm, damp, brown silt layer with some clay and trace sand, containing rootlets and organics. The silt layer extended to approximately 2.1 m and 1.2 mbgs, respectively. Moisture content determinations within this material ranged from 19% and 19.4%.

A dense to very dense, dry, brownish grey to grey, sub rounded to sub angular sandy gravel layer with some silt was encountered beneath the silt layer. Both boreholes were terminated in the sand and gravel

layer at 4.11 mbgs and 3.81 mbgs, respectively. This layer is anticipated to extend beyond the drilling depths. Moisture contents within this layer ranged from 0.7% to 3.6%.

Groundwater was not present at the time of the geotechnical investigation on August 2, 2022, or during a site visit on August 4, 2022. Please note, groundwater levels are subject to seasonal variation with the highest water levels likely to occur during the late-spring and summer months.

4.0 GEOTECHNICAL COMMENTS AND RECOMMENDATIONS

Based on the results of the investigation, it is Taylor's opinion that the site is suitable for construction of the proposed development provided the comments and recommendations presented herein are adhered to. The following points summarize the pertinent geotechnical findings which are likely to influence the detailed design and construction of the structure.

- Soft to firm soils with high-silt content were encountered from approximately 0.1 m to 2.1 mbgs. No groundwater was observed at the time of the investigation on August 2, 2022 or during a follow-up site visit on August 4, 2022.
- Silt-rich soils are highly frost suspectable meaning that these materials are prone to excessive heave if exposed to freezing conditions. Heave is followed by settlement and causes significant reduction in bearing capacity when thawing occurs. The risk of frost heave increases significantly with the presence of available moisture from the groundwater table.
- To eliminate the risk of potential building movement from construction on frost susceptible materials, Taylor recommends the implementation of one of the below options:

    1. Removal of the silt layer to expose the underlying sand and gravel material. Construction of strip and spread footings on the in-situ sandy gravel layer at an approximate depth of 2.1 mbgs.

    2. Removal of the silt layer to expose the underlying sand and gravel material. Placement and compaction of 80 mm minus crushed sand and gravel. Construction of a structural slab on the compact fill materials.

4.1 ALBERTA BUILDING CODE

In accordance with the Alberta Building Code, the design of foundations is governed by the use of limit states design. The Alberta Building Code incorporates both Ultimate Limit State (ULS, described as the point of structural failure of the designed element) and Serviceability Limit States (SLS, described as the point of the structure or element no longer being usable) into the scope of foundation design.

4.2 FOUNDATION DESIGN

Based on Taylor's review, use of a traditional shallow foundation system consisting of strip and spread footings or a reinforced structural slab are considered feasible options for design and construction of the proposed building. It is anticipated that the building's foundation will bear on the in-situ compact sandy gravel deposit, or on compacted granular fill material placed on the in situ sandy gravel layer. The sandy gravel layer was observed at depths between 1.2 and 2.1 m below the existing ground surface.

The following presents the recommendations for shallow foundation systems.

4.2.1 Shallow Foundation

The proposed structure can be supported on conventional strip and spread footings or on a reinforced structural slab founded on the sandy gravel deposits or on compacted granular fill material, provided the following comments and recommendations are considered through design and construction.

Guidance for geotechnical resistance factors for shallow footings is listed in Table 1. These resistance factor values have been based on the information provided by the Canadian Foundation Engineering Manual (4th Edition, 2006).

Table 1: Geotechnical Resistance Factors, Canmore Cemetery

Case	Resistance factor
Vertical resistance by semi-empirical analysis and in-situ test data	0.5
Sliding based on friction	0.8

Table 2 presents a summary of the unfactored and factored bearing resistance at Ultimate Limit State and Allowable Bearing Capacity for the anticipated site conditions. The values in Table 2 consider vertical loading (footing) scenario with strip footing up to 0.3 m wide, a square pad footing up to 0.3 m by 0.3 m or a structural slab 4.0 m by 4.0 m. Stricter settlement tolerances or footings larger than specified will require additional review. Please take note of recommendations in Section 4.8 below, as these bearing resistances are conditional on adequate site preparation.

Table 2: Summary of Bearing Resistance and Capacity

Soil Conditions	Footing Type	Ultimate Bearing Resistance (kPa)	Factored Bearing Resistance (kPa)	Allowable Bearing Resistance (kPa)
In-situ Sandy Gravel some Silt	Strip and spread founded at 2.1 mbgs	1000	500	333
Compact Fill	Strip and spread founded on compact fill at 0.6 mbgs	500	250	165
Compact Fill	Reinforced slab on grade	700	350	230

Serviceability was considered for the factored bearing resistance given. Provided that the foundation materials are not loosened or disturbed, it is anticipated that foundations designed for these bearing pressure will be subject to settlements less than 25 mm. It is recommended that Taylor review footings with dimensions considering the actual factored building loads to determine if settlement tolerances may be exceeded.

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The above bearing resistance values listed for fill are considered suitable provided that the fill materials are in accordance with the recommendations given in Section 4.8.5.

The seismic response classification for this site is class "D". This site class may be used in the design of building to resist seismic events using the Alberta Building Code, including the determination of Foundation Factors F_v and F_a.

Minimum required footing depths based on frost protection requirements are presented in Section 4.3.

Foundation elements shall be constructed on adequately prepared site soils that a free of organics and deleterious materials, as well as standing or ponding water. Working surface shall be kept reasonably dry throughout foundation construction. If construction proceeds during cold weather conditions, all exposed footings and slabs must be protected from freezing. Under no circumstances should footings or slabs be placed on frozen material or materials that are allowed to freeze. Subgrade soils are not permitted to freeze throughout building construction.

4.3 FROST CONSIDERATIONS

Based on a freezing index of 1,091 degree-day °C in the Canmore area, it is anticipated that the depth of frost penetration is up to 1.8 m below the existing ground surface. Depending on the chosen founding material (i.e., native sandy gravel or compact engineered fill), the required footing depth varies. Please see recommended footing depths for each scenario below.

4.3.1 Native Sandy Gravel

The in-situ soils underlying the proposed structure consist primarily of a sandy gravel with some silt beginning at depths of 1.2 m to 2.1 m below ground surface. As such, the minimum required depth to found on the native material is 2.1 mbgs, which is below the anticipated depth of frost penetration. Founding at 2.1 mbgs is considered adequate in protecting against frost action.

4.3.2 Compact Engineered Fill

To permit shallower footings depths, Taylor recommends founding on compact engineered fill placed on the in-situ sandy gravel material. The fill must contain less than 10 % passing the 0.075 mm (# 200). Due to the coarse-grained nature of this material and the lack of groundwater observed at site, a footing depth of 0.6 mbgs is considered feasible as the material is considered to have negligible potential for frost susceptibility under these conditions.

Please note, the overlying organic soils and silty sand material is considered to have moderate potential for frost susceptibility. Frost susceptible soils have the potential to induce heave which can result in unacceptable amounts of total and differential settlement that can results in possible cracking of the floor slab. As such, it is essential that all fine-grained and organic soils are removed from beneath the building footprint and replaced with compacted fill (as described in Section 4.8.5).

4.4 FLOOR SLAB

It is recommended that grade supported slabs be founded on an under-slab base course consisting of at least 100 mm thickness of 25 mm minus crushed gravel having less than 5% passing the 0.075 mm sieve size. This material should be placed and compacted to 98 percent of Standard Proctor maximum dry

density (ASTM D698). The slab on grade should be structurally separated from all foundation elements and should include a cross joint system to control post construction cracking.

The subgrade soils should be inspected by a qualified geotechnical engineer. Any soft or spongey areas should be removed and replaced with compacted engineered fill materials.

4.5 BELOW GRADE WALLS

The proposed development includes design and construction of below grade walls. This requires consideration of the lateral earth pressures that will act against these structures. The below described earth pressure cases should be considered and applied appropriately.

- Active Earth Pressure (k_A) should be used behind a retaining wall that is unrestrained at the top or for flexible walls that allow for some movement away from the retained soil mass.
- At Rest Pressures (k_O) should be used behind below grade walls that can not tolerate or are restrained from movements.
- Passive Earth Pressure (k_P) act along the front of the retaining wall and considers the horizontal stresses on the wall which push against the soil.

Lateral earth pressure distribution acting against retaining structures or below grade walls can be assumed to be triangular in shape and may be calculated using the below equation. Based on the observed groundwater levels, it is considered unlikely that groundwater will act against below grade walls.

$$P = KQ + K\gamma H$$

Where P is the lateral earth pressure at depth, H below ground level (in kPa)
Q is any surcharge load being applied along the ground surface (in kPa)
K is the coefficient of lateral earth pressure (considering the cases listed above)
γ is the unit weight of soil (in kN/m^3)
H is the depth below ground surface (in m)

Please note, the above equation does not consider hydrostatic pressures acting against the wall. If groundwater is allowed to act against the wall, the following relationship may be used to calculate lateral earth pressures.

$$P = KQ + K\gamma H + \gamma_w d(1 - K)$$

Where γ_w is the unit weight of water (at 9.81 kN/m^3)
d is the depth below the groundwater table (in m)

Recommended design values for these parameters depend on the type of backfill being used. Table 3 summarizes Taylor's recommendations for the anticipated site conditions.

Table 3: Material parameters for soils, Canmore Cemetery

Backfill	Friction Angle, ϕ (Deg)	Unit Weight, γ (kN/m³)	Coefficient of Lateral Earth Pressure		
			Active, K_A	*At Rest, K_O*	*Passive, K_P*
Coarse-grained Site Soils and Engineered Fill	35	21	0.27	0.43	3.70

If requested, Taylor can provide detailed analysis of the site and development specific loading conditions for the design and construction of below grade walls.

It is recommended that free draining backfill is placed behind walls and a positive drainage system should be provided to prevent possible build up of hydrostatic pressures. This material should be compacted using only lightweight compaction equipment. Lift thickness of 200 mm are recommended during construction.

4.6 CONCRETE TYPE (SULPHATE RESISTANCE)

Laboratory testing on a selected sample of the native sand soil was completed by KaizenLab. The testing results reported less than 0.0050% sulphate which presents very low risk of sulphate attack to buried concrete elements. As such, General Use (GU) cement is appropriate for cast in place concrete elements below grade.

4.7 SITE DRAINAGE AND FOUNDATION DRAINAGE

Surface flows are to be directed away from foundation elements. It is recommended that disposal areas for surface water flow are located a minimum of 5 m from building foundations. Collected surface water flows should pass through a silt collector before being directed to sub-drainage system.

It is Taylor's opinion that use of perimeter drainage systems in unnecessary provided all comments and recommendation provided herein are adhered to.

4.8 GENERAL SITE DEVELOPMENT

The following provides general recommendations for development of the site.

4.8.1 Stripping

It is recommended that all existing organic and deleterious materials be removed from within the building footprint. If shallow footings are to be used in construction, it is recommended that the silt layer be removed from beneath the building footprint. Based on the results of the investigation, the minimum required depth of sub excavation is expected to range from 1.2 to 2.2 m below the existing ground surface. It is imperative that highly organic materials are removed prior to footing construction. The subgrade of excavations shall be inspected and approved by a qualified geotechnical engineer prior to construction of footings, as well as before placement of fills or poured concrete.

4.8.2 Construction Excavations

Temporary excavation side slopes in soils encountered on site should be developed at angles no steeper than 1 horizontal to 1 vertical for dry or dewatered conditions. Should excavation extend below the groundwater table at the time of construction, temporary slope angles should be flattened to 2 horizontal to 1 vertical. It is recommended that the horizontal limits of the excavation extend beyond the building perimeter a distance equal to the depth of the excavation.

For excavations below the groundwater table, dewatering should be in place immediately after excavation. Dewatering should work continuously while constructing below the groundwater level.

4.8.3 Temporary Shoring

Depending on the depth and proximity of the excavation to property boundaries and neighbouring structures, temporary shoring may be required. Conventional steel "H" section piles with timber lagging or structural shotcrete shoring may be considered. The design of shoring walls is proprietary in nature and is typically the responsibility of the contractor.

The following site conditions should be considered in design of temporary shoring:

- Water pressure acting behind temporary shoring;
- Dewatering requirements;
- Neighbouring structures near shoring; and
- Overall stability of the shoring system.

Comments and recommendations regarding material parameters and temporary lateral earth pressures are presented in Section 4.5.

Existing structures located behind shoring may be subject to potential movements as a result of construction activities. Generally, the zone of influence extends from the base of the excavation back at an angle of 45 degrees to the horizontal. If a structural element (or part of) is located within that 45-degree envelope, it may be at potential risk of movement or damage. Underpinning of adjacent structures in conjunction with shoring may be required.

Consideration should be given to completing a damage survey of nearby structures prior to excavation including detailed measurements and photographic records of existing damages. Also, development of a movement monitoring program for structural elements within the identified zone of influence should be considered. Establishment of survey monitoring points should be done prior to construction.

4.8.4 Temporary Construction Dewatering

Groundwater was not observed at the time of drilling on August 2, 2022, or on subsequent site visits on August 4, 2022. It is Taylor's opinion that construction dewatering will not be required. However, groundwater levels are susceptible to seasonal fluctuation, with the highest groundwater levels anticipated for the spring and summer seasons. It is anticipated that foundation construction for the proposed development may require dewatering depending upon the time of year construction takes place as well as the final design depth of footings and building subgrade.

A conventional pumping arrangement from collector sumps may be suitable to manage seepage within excavations depending upon the construction methods. Alternatively, a well point system may need to

be considered. Taylor recommends consulting with a hydrogeological engineering consulate to evaluate these options. Construction dewatering methods and pumping rates are the responsibility of the contractor. Dry working conditions are to be maintained throughout foundation construction.

4.8.5 Fill Placement and Compaction

Due to the variable nature of site soils as well as the content of fine-grained material within the observed site soils, re-use of the excavation spoil material for fill is not recommended. Any fill or in situ material that becomes saturated by standing water, groundwater or storm water must be removed and replaced with competent fill.

Taylor recommends importing well-graded 80 mm minus crushed sand and gravel containing less than 10 percent passing the 0.075 mm (# 200) sieve size for general fill material, as needed. Granular fill should be placed in horizontal lifts not exceeding 300 mm in loose thickness and should be compacted to at least 98 percent standard Proctor maximum dry density (ASTM D698).

Structural fill should consist of well-graded 25 mm minus crushed gravel having less than 8 percent passing the 0.075 mm sieve size. A 100 mm layer of compacted structural fill is recommended for an under slab base course for slab on grade construction. This material should be compacted to 98 percent Standard Proctor maximum dry density (ASTM D698).

No organic soils or frozen materials should be included in fill materials. In addition, fill should not be placed on the foundation subgrade or on already placed lifts if these surfaces are frozen. Fill should also not be placed in ponded water, or on excessively wet soil or fill surfaces covered with snow.

It is recommended that the fill surfaces be crowned or sloped during construction to avoid ponding of water. Fills should be placed such that drainage is always away from the structure. Surface water should be drained away from the structure as quickly as possible.

Subject to approval of the engineer, fillcrete, or other self compacting, self densifying fills may be used in situations where traditional backfill could present a hazard to workers, the structure or surrounding structures.

4.8.6 Cold Weather Construction Practices

Please see below for general winter construction comments and recommendations for earthworks. Winter conditions are in affect when the ambient temperature is at or below 0°C, or when there is a probability of the temperature falling below 0°C. The following recommendations pertain to all earthwork activities.

Construction on frozen subgrade conditions poses significant risk to the quality and long-term performance of the work. It is important that the subgrade soils shall not be permitted to freeze. If freezing of the subgrade has occurred, there are two options:

1. The frozen subgrade material should be removed and replaced with approved fill materials (that are also free from frost and frozen material).

2. The subgrade should be appropriately heated so all frost can come out of the soil prior to placement of fills or concrete elements. Subgrade soils should be allowed to moisture condition and be recompacted prior to fill placement.

Once prepared and approved, subgrade soils are not permitted to freeze throughout construction. Ensure that these surfaces are adequately protected throughout the cold weather season using insulated tarps and ground heating.

Frozen fill materials will not achieve adequate compaction. To prevent fill materials from freezing, the following is recommended:

- Use of haul trucks with heated boxes and insulated tarpaulins over the boxes to prevent freezing during transportation.
- If it is not possible to prevent freezing from occurring during transportation and/or prior to placement, fill materials will need to thaw on site. This may involve tarping stockpiles with insulated blankets and applying heat with either forced hot air, stationary heaters, hydronic heaters etc.
- Work in small areas to minimize the time it takes for spreading and compaction of fill materials. Lift thickness should be maximized but not exceed the limitations of the compaction equipment on site.
- During freezing conditions, development of a frozen crust is expected along the surface of exposed material. This frozen crust must be removed prior to placing subsequent lifts.
- If weather conditions and/or selected construction approach are not able to prevent freezing of surfaces between lifts, ground heating or insulating with tarps or a sacrificial loose lift of soil may be considered.
- Use of insulated tarps may be considered for short periods (e.g., overnight) for ambient temperatures greater than -5°C. For longer periods, or for temperatures below -5°C, ground heating or use of a thick sacrificial fill layer should be in place.

Alternatively, uniformly graded crushed gravel containing less than 5% passing the 0.075 mm (or no. 200 sieve size) is recommended for use as general fill material. This material should be placed in lifts not exceeding 0.3 m in thickness and compacted using approved compaction equipment.

Should concrete be placed during cold weather conditions, the cold weather concreting practices laid out by the CSA (Canadian Standards Association) must be followed.

4.9 FIELD REVIEW, MONITORING AND TESTING

It is recommended that Taylor review the final plans and specifications to confirm that they address the geotechnical considerations discussed herein. It is also recommended that provisions be made for an experienced geotechnical engineer to inspect and approve the exposed subgrade soils for foundation construction and granular fill placement. Further, it is recommended that in situ density field tests be

carried out for all placed fills to confirm that satisfactory compaction has been achieved. Appropriate testing concrete materials should also be undertaken for quality assurance purposes.

5.0 CLOSURE

It is trusted that this letter report meets your present requirements. Should you have any questions or need additional information, please do not hesitate to contact Jon Taylor at 403-707-6185 to discuss.

Kind Regards,

TAYLOR GEOTECHNICAL LTD.

Prepared By:

Lukas Williams, BSc, EIT
Geotechnical Engineer in Training

Reviewed By:

PROFESSIONAL ENGINEER ALBERTA
JON TAYLOR

8/16/2022

Jon Taylor, MA, PEng
Geotechnical Engineer

APEGA Permit to Practice #: P14061

PERMIT TO PRACTICE
TAYLOR GEOTECHNICAL LTD.
RM SIGNATURE:
RM APEGA ID #: 169143
DATE: 2022-08-16
PERMIT NUMBER: P014061
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

DISCLAIMER AND LIMITATIONS

This report is delivered subject to the expressed condition that the following disclaimers and limitations concerning use of the report and the liability of Taylor Geotechnical are accepted by the reader.

BASIS OF THE REPORT
This report was prepared for the Client for the purpose of providing geotechnical investigation for the specific site, development, and design described to Taylor Geotechnical by the Client.

The findings, opinions and recommendations in this report are only valid to the extent that the report addresses these specifics and remain subject to the limits described herein.

The opinions and recommendations in this report are based on geotechnical investigation work carried out on site in accordance with the Standard of practice described herein.

The report does not include any investigation, analytical testing or assessment of possible soil and groundwater contamination, archeological or biological considerations or sediment control measures.

The Client should provide Taylor Geotechnical with notice any material changes to the site, development, design and objectives, and provide Taylor Geotechnical with opportunity to revise the report accordingly. Any special concerns or circumstances not contemplated at the time of the report should be communicated so that Taylor Geotechnical may conduct further investigations not otherwise within the scope of services provided.

STANDARD OF PRACTICE
This report has been prepared with reasonable care and skill in accordance with the generally accepted practices for geotechnical services. This report makes no expressed or implied warranties other than being prepared according to the standards of practice described herein.

USE OF THE REPORT
This report is intended for the exclusive use and sole benefit of the Client, its successors and assigns. It makes no representations of fact, opinion or recommendations whatsoever to any other persons ("Third Parties"). No Third Party may use, rely upon or reproduce this report in whole or in part without the written consent of Taylor Geotechnical and on the terms and conditions set by Taylor Geotechnical.

Any use of the report by a Third Party is the sole responsibility of that Third Party. Taylor Geotechnical is not responsible for any damages suffered by Third Parties as a result of this report or decisions made based on this report. This limitation includes no responsibility for changes in real estate values that may occur as a consequence of this report.

All intellectual property and any copyrights in this report belong to Taylor Geotechnical.

Taylor Geotechnical shall keep a paper copy of this report on file and that copy shall take precedence in the event of discrepancy with any circulated or electronic copies.

THE COMPLETE REPORT
The complete report includes all information generated and reported to the client through Taylor Geotechnical's services on this assignment. The report document does not stand alone from Client instructions, communications and other reporting by Taylor Geotechnical to the Client, all of which form part of the report. Taylor Geotechnical is not responsible for use of portions of the report without reference to the whole report.

RELIANCE ON INFORMATION PROVIDED
In preparing this report, Taylor Geotechnical has relied in good faith on information from the Client and further persons. Taylor Geotechnical is entitled to rely on such information and is not required to independently verify the truth of information provided. Taylor Geotechnical accepts no responsibility for any misstatements in the report

resulting from the misinformation, misstatements, omissions, misrepresentations or fraudulent acts by the Client or other persons.

INTERPRETATION OF SITE CONDITIONS

The interpretations of site conditions in this report are based on the conditions at sample locations on a specific site at one point in time, and the opinions and recommendations provided are only valid to that extent.

The interpretation of site conditions involves inherent and unavoidable risks. The identification and classification of soils, rocks, geological units, materials and quantities of the same is inherently judgemental in nature. The investigative practice means that some conditions may not be detected or that actual conditions may vary from sample points. Comprehensive investigations conducted according to the applicable standards by experienced personnel with appropriate equipment can still fail to locate some site conditions.

As conditions may change over time, this report is intended for immediate use. The Client should provide Taylor Geotechnical with any changes to site conditions or new information that becomes available after the date of this report and have Taylor Geotechnical re-consider its opinions and recommendations prior to the Client or Third Parties making decisions based on this report.

REGULATORY CONTEXT

This report was prepared in the context of government regulations and policies in effect and generally promulgated at the time and, unless specifically noted, does not consider any government regulations or policies that were not in effect and generally promulgated at the time it was prepared. Unless specifically stated, this report provides no advice on regulatory issues associated with the site or project.

INDEPENDENT JUDGEMENT OF CLIENT

Opinions and recommendations in this report are based on Taylor Geotechnical's interpretations of information obtained through a limited investigation within a defined scope of services. Taylor Geotechnical is not liable for the independent conclusions, interpretations and decisions of the Client or any Third Parties based on this report. This limitation includes any decisions to purchase, sell, develop, lease or rent land or buildings.

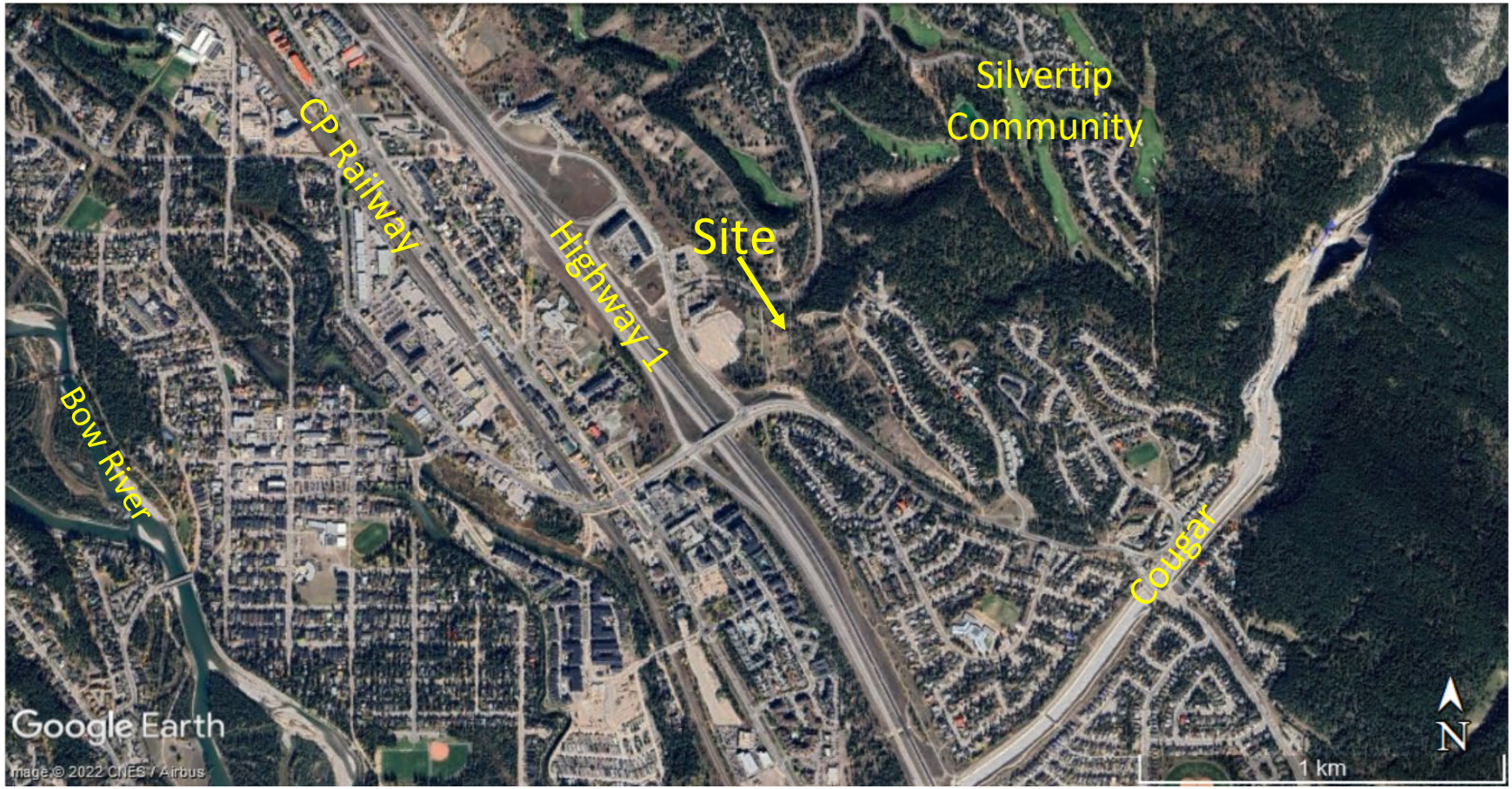
RELEASE OF POLLUTANTS

Geotechnical engineering and environmental consulting work involves risks of encountering and causing the release of pollutants or hazardous substances. Taylor Geotechnical shall have no liability to the Client or Third Parties for such releases unless the substance is specifically identified by the Client prior to the performance of services.

DESIGN AND CONSTRUCTION SERVICES

Where consented to by Taylor Geotechnical, this report may form part of design and construction documents for information purposes even though issued prior to final design. Any differences between the recommendations in this report and the final design should be reported to Taylor Geotechnical, and Taylor Geotechnical to review the final design for consistency with the recommendations prior to proceeding to construction. All recommendations remain subject to field review by Taylor Geotechnical during the construction phase, and Taylor Geotechnical should be retained to conduct such field review to confirm that the site conditions do not materially differ from the interpreted conditions at the time the report was prepared.

These further services may be necessary for Taylor Geotechnical to provide letters of assurance as required by regulatory bodies in some jurisdictions.



Reference: Google Earth Pro (2022)

DATE:	2022-07-28
DRAWN:	RM
DESIGNED:	RM
CHECKED:	JRT
APPROVED:	JRT

TAYLOR GEOTECHNICAL

CLIENT: **ISL Engineering**

PROJECT: **Canmore Cemetery Geotech Investigation**

TITLE: **LOCATION PLAN**

PROJECT #: 2022-047 | FIGURE: 1 | REV.: 0

Reference: Google Earth Pro (2022)

DATE:	2022-07-28
DRAWN:	RM
DESIGNED:	RM
CHECKED:	JRT
APPROVED:	JRT

TAYLOR GEOTECHNICAL

CLIENT: **ISL Engineering**

PROJECT: **Canmore Cemetery Geotech Investigation**

TITLE: **SITE PLAN**

PROJECT #: 2022-047 | FIGURE: 2 | REV.: 0

APPENDIX A: BOREHOLE LOGS AND LAB TESTING RESULTS

TEST HOLE LOG: BH-01

Project: Canmore Cemetery | Project No.: 2022-046

Site Address: 1250 Palliser Trail, Canmore | Client: ISL Engineering and Land Services

Easting: 51.09295 | Northing: -115.34223 | Elevation:

Logged By: Lee Mueller | Reviewed By: Lukas Williams | Investigation Date: August 2, 2022

DEPTH	LITHOLOGIC DESCRIPTION	SYMBOL	SAMPLES NO.	SAMPLES TYPE	MOISTURE	COMMENTS	SPT 25 50 75	PIEZOMETER	METHOD
	Ground Surface								
0	**VEGATATIVE COVER ON SURFACE** Top Soil **SILT** ML, some clay, trace sand, damp, brown, soft to firm, with rootlets and organics.		2081	GS	19.4			No Data	Eijkelkamp SRS 34K Sonic (Vibratory)
1									
2	**SANDY GRAVEL** GW, some silt, dry, brownish grey to grey, dense to very dense, sub round to sub angular.		2082	GS	1.4				
3			2083	SS	0.8		50 ref		
			2084	GS	0.7				
4	End of Test Hole.					Refusal at 4.11 m. Boulder encountered.			
5									

Notes: Surveyed locations and elevations not undertaken at this time

TAYLOR GEOTECHNICAL

TEST HOLE LOG: BH-02

Project: Canmore Cemetery | Project No.: 2022-046

Site Address: 1250 Palliser Trail, Canmore | Client: ISL Engineering and Land Services

Easting: 51.09307 | Northing: -115.34226 | Elevation:

Logged By: Lee Mueller | Reviewed By: Lukas Williams | Investigation Date: August 2, 2022

DEPTH	LITHOLOGIC DESCRIPTION	SYMBOL	SAMPLES NO.	SAMPLES TYPE	MOISTURE	COMMENTS	SPT 25 50 75	PIEZOMETER	METHOD
	Ground Surface							PVC Cap	
0	**VEGATATIVE COVER ON SURFACE** Top Soil							Standpipe	
	SILT ML, some clay, trace sand, damp, brown, soft to firm, with rootlets and organics.		2085	GS	19				Eijkelkamp SRS 34K
1									Sonic (Vibratory)
	SANDY GRAVEL GW, some silt, dry, brownish grey to grey, dense to very dense, sub round to sub angular.		2086	GS	3.1				
2									
			2087	GS	3.6				
3									
	End of Test Hole.					Refusal at 3.81m. Boulder encountered.			
4									
5									

Notes: Surveyed locations and elevations not undertaken at this time.

TAYLOR GEOTECHNICAL

GRAIN SIZE DISTRIBUTION (SIEVE ANALYSIS)

TAYLOR GEOTECHNICAL

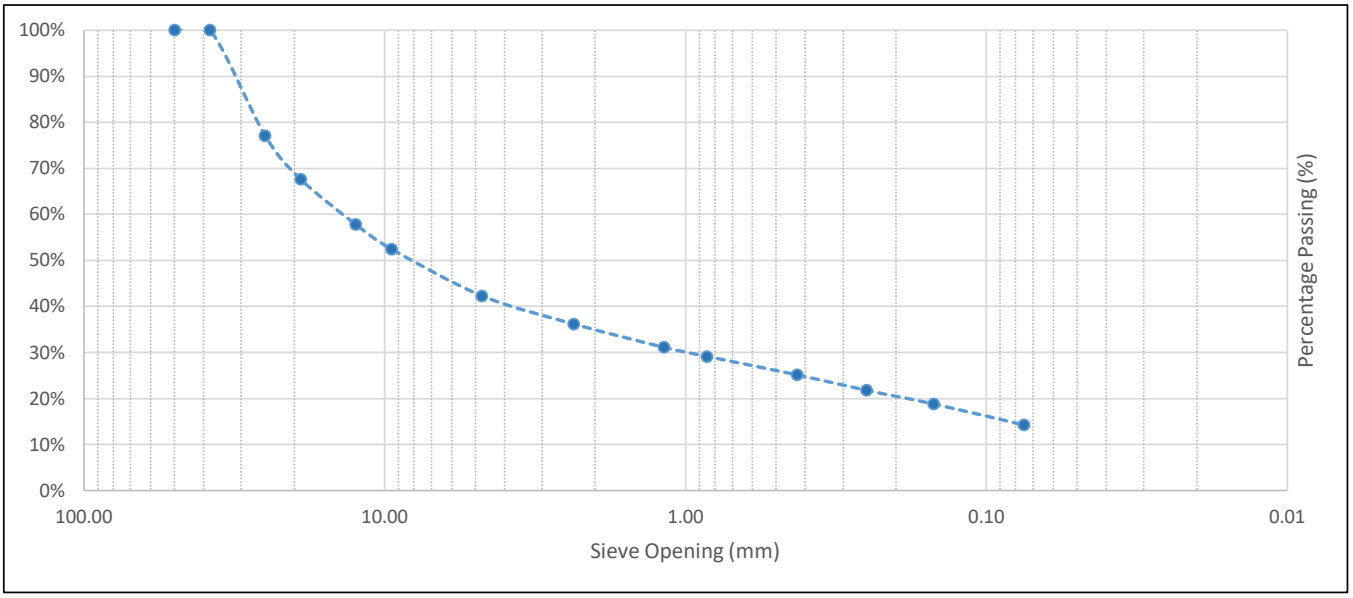
ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

1400 Railway Ave, Canmore, AB, T1W 1P6 T: 888-484-2444 www.taylorgeotechnical.com

Project Number:	2022-046	Received By:	LM	Date:	2022-08-02
Project Name:	Canmore Cemetery	Tested By:	LM	Date:	2022-08-03
TGL Sample Number:	2082	Reviewed By:	LW		
Material Description:	BH1, SA2, Sandy Gravel				

USCS SOIL CLASSIFICATION:	Sandy Gravel, some silt

Sieve No.	Diameter (mm)	Soil Retained (g)	Cumulative Mass (g)	Soil Retained (%)	Percent Passing (%)
4"	101.6	0.0	0.0	0.0%	100.0%
2"	50.00	0.0	0.0	0.0%	100.0%
1.5"	38.10	0.0	0.0	0.0%	100.0%
1"	25.00	885.7	885.7	22.9%	77.1%
3/4"	19.00	368.8	1254.5	9.5%	67.6%
1/2"	12.50	377.9	1632.4	9.8%	57.8%
3/8"	9.50	207.6	1840.0	5.4%	52.5%
No. 4	4.75	393.8	2233.8	10.2%	42.3%
No. 8	2.36	235.7	2469.5	6.1%	36.2%
No. 16	1.180	197.0	2666.5	5.1%	31.1%
No. 20	0.850	76.6	2743.1	2.0%	29.1%
No. 40	0.425	155.5	2898.6	4.0%	25.1%
No. 60	0.250	130.1	3028.7	3.4%	21.8%
No. 100	0.150	113.9	3142.6	2.9%	18.8%
No. 200	0.075	177.6	3320.2	4.6%	14.2%
Pan		550.8	3871.0	14.2%	0.0%
	TOTAL	3871.0			
	FIDELITY	99.93%			



GRAIN SIZE ANALYSIS					
% Gravel (4.75 mm to 75 mm):	57.7%	D10 (mm)	N/A	Cu	N/A
% Sand (0.075 mm to 4.75 mm):	28.1%	D30 (mm)	1.000	Cc	N/A
% Silt and Clay (< 0.075 mm):	14.2%	D60 (mm)	15.000		

Comments: Mechanical shaker SS14-00079 used for 8 min, hand shake for 1 min.

MOISTURE CONTENT AND VISUAL IDENTIFICATION

TAYLOR GEOTECHNICAL

PROJECT NAME: Canmore Cemetery
PROJECT NUMBER: 2022-046
DATE: 02-Aug
COMPLETED BY: LM
REVIEWED BY: LW

TGL SAMPLE ID	TESTHOLE #	SAMPLE #	TARE ID	TARE MASS (g)	TARE + WET SAMPLE (g)	TARE + DRY SAMPLE (g)	Depth Start (feet)	Depth Finish (feet)	Depth Start (m)	Depth Finish (m)	Interval Length (m)	Moisture Content (%)
2081	BH-01	1	T7	4.28	117.63	99.2	0	5	**0.00**	**1.52**	**1.52**	**19.4%**
2082	BH-01	2	T3	4.28	186.65	184.22	7	10	**2.13**	**3.05**	**0.91**	**1.4%**
2083	BH-01	3	T4	4.27	152.45	151.28	10	10.75	**3.05**	**3.28**	**0.23**	**0.8%**
2084	BH-01	4	T2	4.32	144.19	143.18	11	13.5	**3.35**	**4.11**	**0.76**	**0.7%**
2085	BH-02	1	B13	4.3	92.65	78.54	0	4	**0.00**	**1.22**	**1.22**	**19.0%**
2086	BH-02	2	B2	4.25	188.25	182.77	4	5	**1.22**	**1.52**	**0.30**	**3.1%**
2087	BH-02	3	B12	4.3	187.38	181	7	9	**2.13**	**2.74**	**0.61**	**3.6%**

Unit# 288, 2880 45 Ave S.E.
Calgary, AB, T2B 3M1
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

ANALYTICAL REPORT

Client: Taylor Geotechnical
12-109 Bow Meadows Crescent
Canmore, AB, T1W 2W8

Attention: Jon Taylor

KaizenLAB JOB #:	**325301**
DATE RECEIVED:	04-Aug-2022
DATE REPORTED:	10-Aug-2022
PROJECT ID:	2022-046
LOCATION:	Canmore Cemetary

KaizenLAB Sample #: 325301_001 **Sample ID:** 2087-BH02 SA3
Date Sampled: 2-Aug-2022 10:30 **Matrix:** Soil

Parameter Description	Units	Result	Detection Limit
Sulphate (%)	%	<0.0050	0.0050

Test Methodologies

Water-Soluble Sulphate in Soil: Modified from ASTM C 1580-05

Final Review by:

Carleen Scott
Client Services Representative

Town of Canmore

Engineering Department

Engineering Design and Construction Guidelines

June 2020

Town of CANMORE

Document Version History

Version	0.1	Date	22 June 2020	Author	Chantale Blais
Description: Full revision of EDCG. Includes new sections on Transportation Systems and Steep Creeks. Includes Landscape Design Guidelines and Solid Waste.					

Version	Date	Author
Description		

Version	Date	Author
Description		

Version	Date	Author
Description		

Town of CANMORE

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Appendices

1. INTRODUCTION

The *Engineering Design and Construction Guidelines* (EDCG) are intended to aid developers, engineering consultants, landscape architects and contractors in the design and construction of infrastructure and amenities.

This document is a consolidation of engineering design standards, landscape design standards and solid waste standards for the construction of public infrastructure and amenities owned or maintained by the Town of Canmore. This document covers topics ranging from approval processes for development and subdivisions, surface and underground infrastructure design guidelines, transportation system guidelines, to steep creek hazards and other local conditions.

Unless otherwise noted in the EDCG, the Town of Canmore follows the latest versions of the City of Calgary's standard specifications for water, sanitary, stormwater and transportation systems. The EDCG shall always take precedence over the above noted standard specifications in the event of conflict.

The EDCG as well as the latest version of the City of Calgary's standard specifications shall form part of all contract documents for the installation of all new infrastructure and amenities and for maintenance work on all existing infrastructure and amenities within the Town of Canmore.

1.1 Document Revisions

The first edition of the EDCG was developed in 1998. Since then, numerous revisions have been made with major revisions completed in 2005 and 2010. The present version of the guidelines is a revision of the whole document and includes two new sections: Section 7, Transportation Systems and Section 9.3, Steep Creeks. This version also includes two documents that were previously stand-alone guidelines: Section 10, Landscape Design Guidelines and Section 11, Solid Waste guidelines.

1.1.1 Future Updates and Amendments

Change is a constant and as such the EDCG will need to be updated. The process for future updates and amendments is described below:

1. Initiating a Change
    a. Either the Town of Canmore (through Engineering Manager), the building and development industry, represented by Bow Valley Builders and Developers Association (BOWDA) or a private party may propose a change to EDCG.
    b. Either Town, BOWDA or private party submits a written request to the other party noting the EDCG section that is proposed to be changed, how it is recommended to be changed, with supporting rationale.

c. Town and BOWDA EDCG Committee representatives to meet and/or discuss via email the proposed changes and come to a consensus on the changes.
d. Town to update EDCG accordingly

2. Periodic Review
    a. Town and BOWDA EDCG Committee to meet annually to review EDCG and identify any issues with EDCG or sections of EDCG that need to be amended or improved.
    b. Town and BOWDA EDCG Committee to determine best approach to the identified issue and come to consensus on any changes to EDCG.
    c. Town to update EDCG accordingly.

3. Full Review of EDCG
    a. A full review of the EDCG is to occur every 5 years to ensure that the guidelines are up to date and are using industry best practices.
    b. The Town, the BOWDA EDCG Committee and other relevant stakeholders to review EDCG and come to consensus on any changes or updates to EDCG.
    c. Town and BOWDA EDCG Committee review the Process for Changing and Reviewing, and Dispute Resolution Process.
    d. Town to update EDCG accordingly.

4. Dispute Resolution
    A process is being defined and the EDCG will be updated once it is ready.

1.2 Organization of Document

Readers may not be familiar with some of the abbreviations and terms used in the EDCG - Refer to Appendix A for a complete list of abbreviations (Table 1) and a glossary of terms (Table 2) used in the EDCG.

Figures are located at the end of each section.

2. APPLICATIONS AND PERMITS

This section of the *Engineering Design and Construction Guidelines* (EDCG) provides developers, consultants and builders with the information necessary, from an engineering perspective, to submit a complete application for a subdivision approval, development permit (DP) or building pemit (BP) and to obtain acceptance of a completed development. As well, information about commonly required permits for various construction activities is provided.

The above noted applications are made through the Town of Canmore's Planning and Development Department (commonly referred to as the Planning Department) and must meet all Planning Department requirements. The Planning Department will coordinate the necessary reviews and requirements with other Town departments including Engineering, Public Works and emergency Services.

Road use, excavation and other permits listed in Section 2.7 are applied for through the Town's Engineering Department, unless otherwise noted.

2.1 Relevant Bylaws

Developers, builders and their consultants and contractors must comply with relevant bylaws and bylaw, as amended from time to time, that may include provisions and requirements in addition to those included in this document (EDCG). Where revised or updated, the most recent version will be used. Relevant Town of Canmore bylaws include the following:

- *Traffic and Road Use Bylaw* 2014-06
- *Building Permit Bylaw* 2008-25
- *Regulating Blasting Explosives Bylaw* No. 32-96
- *Sewerage Use Bylaw* 2015-18
- *Noise Control Bylaw* 1997-11
- *Water Bylaw* 2003-39
- *Land Use Bylaw current version*
- *Business Registry Bylaw* 2015-02
- *Protection of Municipal Improvements and Lands Bylaw* No. 15-2001
- *Tree Protection Bylaw 2019-10*
- *Wildlife Attractant Bylaw 2017-10*

Copies of bylaws are available for viewing or download from the Town of Canmore website at www.canmore.ca.

2.2 Contractual Relationships

This section is intended to provide an overview of the roles and responsibilities of parties involved in the development process. Please see Appendix A for definitions of the roles described below.

2.2.1 Developer/Town Engineer

The developer may be required to enter into an agreement (subdivision servicing agreement or development agreement) with the Town to complete the construction of a subdivision or other development in accordance with Canmore's Land Use Bylaw and the EDCG. The developer is, and shall remain, responsible to the Town for the full and proper performance of all obligations and municipal improvements under the agreement. When, in the opinion of the Town engineer, the work being performed is not receiving full-time inspection (or the otherwise-approved level of inspection), or it can be shown that the work is not being completed in accordance with the applicable standards, the Town may issue a stop order to the developer. The Town, as specified in the agreement, may stop construction and installation of municipal improvements at any time. A copy of the stop order shall also be given to the contractor to stop work on the municipal improvements. Any work on municipal improvements that is completed while a stop order is in effect may be rejected by the Town engineer.

2.2.2 Developer/Consulting Engineer

The developer must retain a consulting engineer, and a landscape architect as described in Section 10.2 of the Landscape Design Guidelines section of this document, to ensure municipal improvements conform to, or exceed, all standards and guidelines. It is the responsibility of the developer to inform the Town engineer of the hiring of a consulting engineer and/or landscape architect. Upon hiring, the developer (or the consulting engineer/landscape architect on behalf of the developer) shall complete and submit to the Town engineer a notice of engagement letter. A sample of this letter is provided in Appendix B.

2.2.3 Developer/Contractor

The developer shall enter into a contract with the contractor(s), to complete the construction of a subdivision or development in accordance with the designs and specifications approved and accepted by the Town. The contractor is responsible to the developer for the quality of municipal improvements and for conformance with the EDCG. It is the responsibility of the developer and contractor to comply at all times with the terms and conditions of the *Alberta Occupational Health and Safety Act.*

2.2.4 Town/Contractor/Consulting Engineer

There is no direct contractual relationship between the contractor and the Town. In the interests of efficiency and clear communication, any communication from the Town engineer regarding ongoing work shall be communicated directly to the consulting engineer and/or developer unless otherwise agreed upon in writing.

There is no direct contractual relationship between the Town and the consulting engineer and/or a landscape architect in the construction process. The full responsibilities of the consulting engineer are listed in Appendix A. The consulting engineer and/or a landscape architect liaises with the Town engineer as required, including but not limited to commencement of construction, construction meetings, design/construction changes and issuance of Construction Completion Certificates (CCCs) and Final Acceptance Certificates (FACs). As the consulting engineer and/or a landscape architect is the representative of the developer, the Town engineer has the right to request through the consulting engineer and/or a landscape architect that observed deficiencies be corrected. In the interests of clear communication, the Town engineer must copy the developer on such instructions when issued. It is the developer's responsibility to review and understand the full scope of the obligations of the consulting engineer.

Any verbal communication must be followed up with a written or digital (i.e., e-mail) record of the communication, by one or more of the parties.

2.3 Classification of Project and Engineering Requirements

When applications are received, the Town shall designate the application into one of four development/project categories: very small, small, intermediate and large developments (see subsections 2.3.1 to 2.3.4, below). Fees and level of engineering review for a development shall be determined by the project category. The project categories and typical projects described below are both general and subjective and the Town reserves the right to reasonably determine a project's category. The project fee schedule can be found on the Town of Canmore website: www.canmore.ca

Note that subdivisions are considered developments. In this section, subdivision refers to a specific area of land characterized by the splitting of larger parcels of land into smaller blocks, lots, reserves, roadways, rights-of-way, etc., and may include the installation of related municipal improvements on or adjacent to those lands to service developments on those lands.

Development in this section refers to buildings, structures or works located on one or more parcel of land in a new or existing subdivision and the related municipal improvements on or adjacent to the parcel to be developed.

The Town reserves the right to determine the engineering requirements for any development application. The requirements for each development/project category are defined below.

2.3.1 Very Small Development

Very small developments typically refer to renovations, balconies, porches and accessory buildings with no new, or altering of, existing services, grades or drainage.

Engineering Requirements

Although there is typically no engineering component involved, the Town reserves the right to have any project reviewed by the Town engineer, or to ask that a consultant be engaged should the Town feel that the project requires specialized knowledge (e.g., structural retaining walls, fuel storage tanks, stormwater management).

Typically requires no additional engineering permits or agreements.

2.3.2 Small Development

Small developments are defined as detached dwellings, duplex, garages (including garage/garden suites), small industrial, institutional or commercial projects with a minimal engineering component, or other serviced buildings under 200 m^2. The Town reserves the right to ask any developer or builder to obtain the services of a consulting engineer if they feel that the project requires specialized knowledge (e.g., structural retaining walls, complex servicing). Small developments that fall within the criteria outlined in the Stormwater section of the EDCG (Section 6) shall require a consulting engineer for their stormwater requirements.

Minor on-site engineering review is when there are changes in lot grading, drainage, stormwater management, or the lot is located in a Low Steep Creek Hazard zone.

Engineering Requirements

In addition to the Town requirements mentioned above, certain small development infrastructure inspections must be witnessed by the Town. The Engineering Department requires a minimum of 24 hours advanced notice for these inspections (contact the Engineering Department at 403-678-1504).

Infrastructure inspections that must be witnessed by the Town include the following:

- verification of adequate slope and depth of water and sanitary lines
- placement of weeping tile
- water (or air) pressure test (water service pipe and low pressure sanitary sewer pipe)
- materials confirmation
- insulation specifications and placement (if required).

Contractors shall have the bedding and servicing in place but still exposed for inspections.

2.3.3 Intermediate Development

Any development that requires construction of new or replacement of water, sanitary or storm service connections. Typically defined as multi-unit (3 to 10 units) and subdivisions creating 10 lots or less.

Engineering Requirements

These applications require a consulting engineer and a notice of engagement letter as outlined in the Submission Requirements section (Section 2.5.1), below.

2.3.4 Large Development

Large developments are defined as multiplexes greater than 10 units (may be integral to one structure or multiple structures); buildings with a floor area more than 2,000 m^2; commercial, industrial or institutional developments generating more than 100 vehicle trips per hour (or at the discretion of the Town) and projects of unusual complexity (at the discretion of the Town) where significant variances to Town guidelines and standards are required.

Subdivisions creating more than 10 lots shall be considered large developments.

Engineering Requirements

These applications require a consulting engineer and a notice of engagement letter as outlined in the Submission Requirements section (Section 2.5.1), below.

2.4 Development/Subdivision Application Review Process

Development permits (DP) are required for most developments and shall be obtained from the Town of Canmore Planning Department.

The milestones detailed below outline the engineering review process for subdivisions and developments. The engineering review process timeline is based on these milestones and is intended to work alongside the requirements of the Planning Department.

Pre-application meeting to introduce a proposed development and get an initial review of subdivision or development proposals to determine if any specific requirements apply are required for intermediate and large developments. The Town's Planning Department can provide guidelines for pre-application meetings.

2.4.1 Milestone #1 – Development Permit/Subdivision Approval

The DP/subdivision approval is usually the first milestone of the review process for a development project. This is also the milestone where securities are determined (see 2.4.5 for details). A DP/subdivision approval is required prior to commencing construction on a development project or municipal improvement such as roads, sewers, waterworks, driveways, landscaping, etc., associated with a development. Detailed plans shall be submitted for review and acceptance before a DP is issued (see Section 2.5 for details). Typically, when a development permit/subdivision approval is released, the developer is free to start stripping and grading a site and to start installing deep utilities subject to receipt and acceptance by the Town engineer of signed and sealed civil engineering drawings, as issued for construction.

For small developments, a building permit (BP) may be the first milestone of the review process where a DP is exempted in the Land Use Bylaw.

2.4.2 Milestone #2 - Building Permit

Once a DP has been approved, a building permit (BP) is required. When a BP is released, the developer is able to start construction of foundations and buildings. For some situations, a foundations-only building permit may be granted; however, this is not a preferred process by the Town. A foundations-only building permit shall result in an additional review fee.

The requirements of a building itself are governed by the safety codes officer pursuant to the Alberta Building Code.

Any changes from the DP in the civil or mechanical systems/drawings shall be communicated to the Town Planning Department by letter and with an updated revision block on the drawings. In an effort to reduce the time required for an engineering review of the building permit application, the Town encourages consulting engineers to provide the Town with a letter stating what changes have been made to the BP drawings from the DP drawings. This letter is to be included with the BP submission.

2.4.3 Milestone #3 - Construction Completion Certificates

The Construction Completion Certificate (CCC) procedure is the process the Town engineer uses to sign off on all municipal improvements performed by others. Developers of both subdivisions and developments shall adhere to this process for successful project completion and for the return of securities.

Construction Completion Certificates - Categories & Classification

The intent of a CCC is to ensure that all components of infrastructure construction have been addressed. Drawings showing the extent of works covered in an application shall be submitted with all applications. Templates for the CCC forms can be obtain from the

Engineering Department. For both developments and subdivision, the Engineering Department requires CCCs to be completed/accepted in the following categories:

- underground infrastructure - water and water services (if applicable)
- underground infrastructure - sanitary sewer and sanitary services (if applicable)
- underground infrastructure - storm sewer and storm sewer services (if applicable)
- surface works – concrete: curb, gutter and sidewalk
- surface works – asphalt: parking lots, roads, recreational paths
- surface grading - overland storm and drainage, grading
- surface grading – landscaping
- facilities - storm ponds, lift stations, booster pump stations, recreation facilities.

Municipal improvements are classified into two groups, private and public. This classification shall determine if a municipal improvement is subject to a warranty period. Both private and public municipal improvements can be included on one CCC provided that all works are complete and that the accompanying map clearly delineates private and public works. Clear delineation of private and public municipal improvements is to be included in the subdivision servicing agreement or development agreement, as applicable to the development, and identified on the record plan.

Private municipal improvements require a CCC only, no warranty period is needed. These are works that are not maintained or serviced by the Town after the developer's obligations are met.

Public municipal improvements require a CCC, a two-year warranty period and a FAC. The two year warranty period starts after acceptance of the CCC. These are works that the Town will own, operate and maintain when all the developer's obligations are met.

Where a utility easement is required through or on private property and the infrastructure will be owned by the Town, the public municipal improvements process shall apply.

Construction Completion Certificates – Inspection

After either a public or private municipal improvement is completed, the consulting engineer for civil works CCC or landscape architect for landscaping CCC shall complete the following tasks in the order shown:

1) Inspect the municipal improvement, record any deficiencies and advise the contractor to repair any deficiencies.
2) Once the contractor has repaired the deficiencies, carry out further inspection(s) until satisfied with the corrections.
3) Ensure all related outstanding field orders are resolved.
4) Submit the CCC record drawings and the required documents for the private and/or public municipal improvements for Town review and acceptance.
5) Arrange and conduct an inspection attended by representatives of the consulting engineer/landscape architect, Town engineer (and contractor and developer if they

choose). Representatives of the Town's Engineering Department shall be available for the site inspections within a reasonable time from the date of request (typically within two weeks).

6) If deficiencies are noted at the time of inspection, a list of those deficiencies shall be prepared by the consulting engineer/landscape architect and submitted to the Town engineer for agreement.
7) When the deficiencies have been corrected, the consulting engineer shall, within a reasonable period of time, request a re-inspection of the deficient items with the Town engineer. The consulting engineer can request the Town engineer to defer inspections of the corrected deficiencies to the FAC inspection.

An inspection fee will be charged to the developer for repeat and extra inspections beyond those listed above and for additional inspections requested by the developer or developer's representative

Construction Completion Certificates – Landscaping Specific Requirements

The contractor shall be aware of the following CCC inspection requirements and details:

- Transplant material shall be made available at the source for inspection by the Engineering Department.
- Despite the approval of transplant material at the source, the Engineering Department shall still have the right to inspect plants upon arrival on site or during the course of construction and to reject plants that have been damaged or that do not conform to the specifications.
- Plant material at CCC and FAC shall be true to name and species (type); structurally sound; well-branched; healthy, vigorous and free from disease and insect infestations, rodent damage, sun scald, frost cracks, and other untreated abrasions to the bark; and densely foliated with a healthy, well-developed root system. Pruning wounds must show vigorous callous growth on all edges. All parts must show live and green cambium tissue when cut.

Construction Completion Certificates – Notes

The Town requires that record drawings be submitted at CCC acceptance or no later than 90 days after CCC acceptance. For public improvements, the Town requires that the record drawing be submitted no later than December 15 to allow time for the Town to add the new assets into its records.

Acceptance of CCCs by the Town engineer indicates only acceptance of the certificates that the consulting engineer has issued. The Town accepts no responsibility for deficiencies, failures, incomplete work, errors, omissions, faulty materials, design failures or non-performance of the design. Evaluation of the performance of the private and public municipal improvements shall be at the sole discretion of the Town engineer.

It is the responsibility of the developer to ensure that private and public municipal improvements are constructed in accordance with the drawings accepted by the Town engineer. Should failures during the warranty period occur in the municipal improvements as a result of deficiencies, failures, incomplete work, errors, omissions, faulty materials, design failures or non-performance of the design, then it is the responsibility of the developer to direct the consulting engineer, landscape architect and/or contractor to correct or redesign the municipal improvements to obtain suitable performance and acceptance by the Town engineer.

Note that the Engineering Department will only perform inspections from May 15 to September 30, in good weather conditions and when the ground is free and clear of snow. Inspections may be performed after September 30 provided good weather and snow free conditions exist.

A template of CCC form is found in Appendix B.

2.4.4 Milestone #4 – Occupancy

When occupancy is granted, building owners and/or tenants can occupy the premises. A developer typically applies for occupancy when construction is very near completion.

For small developments, in addition to any planning and safety code requirements, occupancy is dependent on successful inspection of the water, sanitary sewer (and storm sewer if applicable) servicing by the Town.

For intermediate and large developments, in addition to any planning and safety code requirements, the Engineering Department requires that CCCs for water and sanitary (including utility trench compaction tests, water pressure tests, bacteriological tests and hydrant flow tests) be submitted by the consulting engineer and accepted by the Town prior to the release of occupancy.

Occupancy applies to developments and not to subdivision; however, it should be noted that, in new subdivisions, the subdivision will need to have CCC approval of the underground infrastructure for occupancy to be granted to the pertinent development lots.

2.4.5 Milestone #5 –Securities

The grouping and application sequence of CCCs shall be detailed and recorded as a schedule that is part of the development agreement or subdivision servicing agreement signed by a developer and the Town. Where possible, developers are encouraged to group components together for efficiency. Two examples of possible groupings follow:

Grouping 1:

- sanitary sewer mains
- water mains

- water and sanitary sewer services
- storm drainage system

Grouping 2:

- roadways (w/first lift asphalt)
- roadways (2nd lift asphalt)
- shallow utilities (including street lighting)
- pathways and trails
- landscaping.

These guidelines shall cede to any project-specific stipulations outlined in the development agreement or subdivision servicing agreement for a given project.

Prior to release of securities pertaining to record drawings, record drawings shall be submitted to the Town of Canmore to the satisfaction of the GIS Department. Record drawings not conforming to Town standards, including syntax and formatting, will not be accepted. Record drawings shall be received by the Town within 90 days of successful CCC inspection.

It is the Town engineer's discretion to determine the amount to remain held in security depending on the extent of outstanding deficiencies. Securities as noted below will be held until the record drawings have been approved.

Typically, securities shall be reduced as follows:

- 60% - for successful CCC acceptance
- 20% - for successful record drawings submission
- 20% - for successful FAC acceptance

The Town shall retain a minimum $5,000 security until the FAC is accepted by the Town engineer.

2.4.6 Milestone #6 – Warranty Period and Maintenance Requirements

Landscaping

All plant material shall be maintained from the time of planting until the date of acceptance of the FAC.

Maintenance shall include all measures necessary to establish and maintain all plant material in a vigorous and healthy growing condition. Non-mulched beds and tree pits shall be freshly cultivated and free of weeds, rubbish and debris. Mulched beds shall be free of weeds, rubbish and debris.

Pruning shall be limited to the removal of dead or injured branches, stray branches, double leaders, and to compensate for loss of roots as a result of transplanting. All dead and

broken branches shall be removed. Leaders shall not be cut unless a lateral can be trained to take its' place. Branch collars shall not be cut, and stubs shall not be left when pruning. Only clean, sharp tools shall be used for pruning.

All damage to the turf, tree wells and the surrounding work area shall be repaired before leaving the site. Debris shall be cleaned on a daily basis and disposed of off-site, leaving the project site in a tidy and safe condition.

Plants shall be watered three times within the first 72 hours of planting and every four days thereafter for the first six months after planting (weather dependent). After six months, plants shall be watered and every 10 to 14 days. Care shall be taken to not wash soil away from plantings when using high pressure watering. Air holes shall not be left when using a root probe.

Invasive plants (weeds) shall be removed from the planting beds by turning soil to a depth of 250 to 300 mm and then hand-digging the weeds without disturbing vegetation. Weeds in tree wells shall be removed by hand-digging out the weeds only. Weeds shall be disposed of in a proper manner.

Disease and insects shall be controlled. Where possible, physical methods shall be used to eliminate the cause of insect infestations. If chemical treatment is necessary, the chemical shall be approved by the Engineering Department and/or the Parks Department prior to its use; all product data shall be provided to the Town. Chemical products shall be applied by a licensed applicator and in accordance with the manufacturer's recommendations and government regulations. The applicator shall have experience performing this type and scale of work and shall provide proof of this experience.

Plant material that has died shall be removed immediately. Unacceptable plant material shall be replaced with healthy plant material of the same size and species.

Prior to issuance of a FAC, the pre-determined warranty/maintenance period must be complete and all deficiencies corrected.

2.4.7 Milestone #7 – Final Acceptance Certificate

A successful Final Acceptance Certificate (FAC) inspection signifies the end of the warranty period (typically two years) and marks that time at which public municipal improvements get turned over to the Town. All deficiencies must be rectified to the satisfaction of the Town engineer prior to signing of a FAC. Generally, a successful FAC signifies the end of a developer's obligations for public municipal improvements and the Engineering Department's involvement in the development administration process.

A template FAC form is found in Appendix B.

2.5 Submission Requirements

All submission forms including drawings, letters, reports and any other documentation shall be submitted in PDF or equal, un-editable digital format. Original applications shall have all correspondence dated and submitted to the Town's file transfer protocol (FTP) site or as otherwise agreed upon by the developer and the Town. When hard copy drawings are required, drawings shall be to a suitable metric scale and printed on 24" x 36" size sheets unless otherwise agreed to by the Town.

Consulting engineers and landscape architects shall submit all drawings in PDF and CAD format, unless permission is granted by the Town to use a different format. As a default, the Town will require that drawings conform to the City of Calgary's new CAD *Standard.* See the City of Calgary website for details.

Applications that are incomplete or are not in accordance with the requirements shall be rejected.

All revisions to existing applications for subdivisions or developments shall include a letter prepared by the consulting engineer which gives a description of the revisions. Any significant variances from the Town's guidelines that are proposed by a developer or consulting engineer shall be discussed with the Engineering Department prior to making an application. If proposed variances are minor, they may be noted in the application letter.

2.5.1 Notice of Engagement

The notice of engagement letter from the consulting engineer shall be submitted with the application A sample letter is provided in Appendix B.

2.5.2 Field Services

Field services shall be supplied by the consulting engineer and/or landscape architect as needed to ensure that all agreements, standards and guidelines, Town procedures and bylaws are adhered to for the duration of the agreement and construction field review process. Field services shall be carried out by and are the responsibility of the consulting engineer/landscape architect for private and/or public municipal improvements that are not under the direct supervision and witnessed by the Town engineer. Field services shall include design, construction field review inspection, testing, record keeping and all other related activities. The consulting engineer/landscape architect is responsible for ensuring that all field service staff under his or her supervision are trained to use the Town's standards and guidelines, procedures and bylaws.

2.5.3 Level of Service

The consulting engineer/landscape architect is responsible for determining the level of service required to adequately close-out a project as stipulated in these guidelines. It shall also be the responsibility of the consulting engineer/landscape architect to employ professional, knowledgeable, qualified staff to provide the above services and to adequately submit all required documentation, field submittals and record drawings as stipulated in these guidelines.

The Town engineer shall evaluate and immediately advise the developer if, in the Town engineer's opinion, the consulting engineer/landscape architect is not providing sufficient inspection and supervision according to generally accepted engineering practices.

2.5.4 Plot Plan

A surveyed plot plan shall be prepared by an Alberta land surveyor and shall show all existing/proposed legal components/settings of the property. The plot plan must be submitted as part of the development application. Developers shall show the planned long-term legal responsibilities for all private and/or public municipal improvements, both on-site and off-site, in terms of ownership and maintenance obligations. The extent of the intended responsibilities shall be clearly delineated on the plot plan. The plot plan is to be submitted digitally; however, it may be accompanied by a hard copy.

For intermediate and large developments, a plan showing the proposed ownership (hence operation and maintenance obligations) of the public versus private municipal improvements (both offsite and onsite) is also requested at this stage.

2.5.5 Landscaping Plans Requirements

For all developments that include municipal improvements on Town owned land or land operated by the Town, landscaping drawings shall be provided digitally.

2.5.5.1 Pre-Application - Landscape Concept Plans (optional)

As per Section 2.4 of the EDCG, although it is not a requirement of the permitting process, the developer is encouraged to engage the Town in a pre-application meeting to introduce a proposed development and provide concept landscape plans as follow:

- The proposed site improvements and existing features to be retained.
- A grading plans showing existing and proposed contours and existing features to be retained.
- An accurate and comprehensive environmental survey showing topography, ground cover, size and location of trees, site drainage, rock outcroppings and other natural features.

2.5.5.2 Formal Application - Detailed Landscape and Construction Drawings

Detailed landscape and construction drawings are a requirement of applications where municipal improvement will be built on Town owned land or land operated by the Town. They shall be provided digitally and should include the following:

- detailed layout plan
- detailed planting plan
- detailed grading plan
- detailed irrigation plan
- detailed of solid waste facilities including locations
- construction details of all landscaping improvements
- specifications for all landscaping improvements.

Construction landscape plans and specifications must also detail the intended methods of protecting and maintaining natural systems and features during construction.

Landscape detailed and construction drawings need to be approved by the Town prior to commencement of construction.

2.5.6 Servicing Report (Design Brief)

Intermediate and Larger development applications shall require an engineering report prepared by the consulting engineer that identifies the proposed water and sanitary sewer servicing design for the proposed development, the impacts on the capacity of the existing infrastructure and possible requirements for public infrastructure upgrades.

The Town's *Utility Master Plan* shall be used as a reference document in the preparation of this report.

2.5.7 Stormwater Management Plan

Intermediate and larger development applications require a complete stormwater management plan. This plan shall be submitted in report-style by a professional engineer with experience in the field of stormwater management. The terms of reference for the report shall be determined by the Town engineer, using these guidelines, following an initial review of the proposed development. The consulting engineer is encouraged to communicate with the Town engineer in the early stages of the proposed development to ensure the report covers issues of concern to the Town.

2.5.8 Traffic Impact Assessment

Traffic impact assessment reports may be required for development and subdivision applications. The terms of reference for these reports shall be determined by the Town

engineer, using these guidelines, following an initial review of the proposed development. The consulting engineer is encouraged to communicate with the Town engineer in the early stages of the proposed development to ensure the report covers issues of concern to the Town.

2.5.9 Wellhead Protection Area

For projects located in the wellhead protection area, a hydrogeological report may be required, depending on the type of development proposed, in accordance with the Town's *Land Use Bylaw*. For projects in the wellhead protection area conforming to the *Land Use Bylaw,* the Town engineer may alternatively require a letter from the consulting engineer stating that no adverse impacts on the aquifer are anticipated due to construction or the design of the project.

2.5.10 Construction Management Plan

All developments and subdivision, which require an engineering review, shall submit a site-specific construction management plan (CMP) that details the components of the construction and includes an erosion and sediment control plan for the life of the project.

The developer/builder is responsible to submit a CMP at the development permit or subdivision approval application stage and accepted by the Town engineer prior to any construction commencing.

2.5.11 Site Grading/Overland Flow Drainage Plan

The site grading/overland storm drainage plan shall be used for both planning and engineering purposes. The site grading/overland storm drainage plan shall reflect the requirements outlined in the grading and storm water management sections of the EDCG. The site grading/overland storm drainage plan is meant to show three main aspects of design as follows:

- design elevations of earthworks – specifically those along property boundaries and building faces
- building floor elevations, storm sewer, invert elevations and locations
- a representation of how overland storm drainage will behave in the design storm event.

Details of the site grading/overland storm drainage plan shall include the storm design features listed below. See Figure EDCG AP 2.1 Grading Plan Requirements.

Detached Dwellings and Duplexes

- directional flow arrows based on finished grading for minor event
- directional flow arrows based on finished grading for major event

- vegetative drainage features including berms and swales
- location and details of weeping tile assembly and associated infiltration pit
- finished grading of retaining wall (sufficient points to show slope).

Larger Projects

In addition to the requirements for detached dwellings and duplexes, larger projects will require more detail including:

- areas outside the property lines that drain into the development
- constructed drainage features including catch basins and piped system infrastructure, size, material specifications
- construction details and locations of all infiltration basins
- any infiltration values used in the storm calculations
- storm specific landscaping that is part of stormwater treatment
- drainage areas and coefficients of run-off
- the boundaries of high-water levels for detention ponds
- trapped low areas in the subdivision.

Design calculations shall also be provided indicating the hydraulic design of the system.

2.5.12 Sites with Building Grade Plan and Lowest Top of Footing Requirements

Typically, when a subdivision is created, the consulting engineer will create a building grade plan (also known as a grade slip, development grading plan) for each development lot created. Developments in new subdivisions shall conform to the site servicing and grading requirements shown on the accepted building grade plan for that subdivision.

If a building is proposed with a footing elevation lower than the lowest top of footing elevation shown on the accepted building grade plan, the proposal shall be accompanied by a letter from a qualified consulting engineer addressing the proposed change. The statement shall indicate that the proposed variance will have no adverse impact on the development or the servicing of that site, or alternatively, that all impacts and required mitigation have been addressed in the proposed variance. This variance shall be noted on the lot grading plan accompanying the building permit application. See Figure EDCG AP 2.2 Building Grade Plan – Minimum Requirements.

2.6 Additional Documentation Required at Construction Completion Certificate Submission

All testing noted below shall be performed by an independent testing firm contracted by the developer or consulting engineer. For small developments, testing shall be required prior to release of excavation permit deposits. The following additional documentation shall be required with CCC submissions:

- foundation bearing pressure (including compaction and moisture content if foundations are placed on fill)
- letter from geotechnical engineer if weeping tile is not installed
- compaction results as per requirements of the excavation permit
- for footing elevations lower than that indicated on the building grade plan, a letter from a consulting engineer representing the builder as outlined in the requirements above
- for subdivisions with trapped lows, the developer is to register applicable caveats on impacted lots and provide verification of the caveat registration to the Town prior to any lot sales.

2.6.1 Site Grading/Overland Storm Drainage: Record Drawing Requirements

Small Developments

A site inspection for site grading/overland storm drainage shall be done by the Engineering Department in conjunction with the Planning Department's landscaping inspection. The Engineering Department shall be looking for general conformance to the drainage/overland storm drainage plan that was submitted with the BP.

Intermediate and Large Developments

The consulting engineer shall be responsible for verifying that the site grading/overland storm drainage is performing as intended prior to the CCC application. A CCC shall be required for both private and public municipal improvements, with the private improvements not being subject to a warranty period.

The record drawings can be submitted with the surface works record drawings for the project. In this case, surface works refers to roadways, paths, etc. Grading shall be shown to give a general indication of slopes and low spots on the site.

2.6.2 Shallow and Deep Utilities

Record Drawings

The layout plan shall indicate all deep utilities (i.e., water, sanitary sewer and storm sewer). Direction of flow, alignments, locations in relation to property line or mains as well as the purpose, material type and size of mains is required on the plan. Related infrastructure pertaining to these utilities is also required (catch basins, manholes, hydrants, and appurtenances). A metric chainage, where appropriate, shall be shown. Design calculations for water main and service sizing, as well as sanitary design calculations shall be referenced on the drawings.

The consulting engineer is responsible to show the proposed placement of all proposed shallow utilities as well as associated street furniture. Pedestals, transformers or other shallow utility appurtenances shall be shown with approximate dimensions.

Water System Reports

CCC submissions for watermains and hydrants shall include the following testing and documentation:

- A pressure test shall be completed under the supervision of the consulting engineer as outlined in Section 4 of the EDCG. The water pressure test shall be taken against the CC valve.
- Disinfection procedures shall be done as outlined in Section 4 of the EDCG.
- Bacteriological tests shall be done by an accredited laboratory.
- A hydrant flow test shall be done as outlined in Section 4 of the EDCG.
- Compaction test results (trench backfill) shall be provided for both private and public on-site and off-site municipal improvements. Compaction testing shall be done so there is adequate representation of the trench backfill area.
- Water record drawings shall include the following information:
    - valves, bends, tees and junctions of all watermains
    - main and service sizes, material type and class
    - facility plans for mechanical infrastructure (PRV booster stations).

Sanitary and Storm System Reports

CCC submissions for sanitary and underground stormwater infrastructure shall include the following testing and documentation:

- A leakage test shall be completed under the supervision of the consulting engineer as per Section 5 of the EDCG. All pipes with inverts below the 1:100-year groundwater elevation shall be tested.
- A pressure test shall be completed for low pressure sewer systems as per Section 5 of the EDCG.
- Compaction test results (trench backfill) shall be provided for both private and public municipal improvements. Compaction testing shall be done so there is adequate representation of the trench backfill area.
- A closed-circuit television (CCTV) inspection shall be completed and shall include all newly placed public mains that are 150 mm or larger. The consulting engineer shall view and sign-off on the CCTV inspection results. The CCTV inspection results shall be submitted to the Town digitally.
- Sanitary record drawings shall include the following information:
    - locations and surveyed inverts of manholes and catch basins (drywells)
    - main and service sizes, material type and class
    - slopes of gravity mains and services
    - service invert elevations at terminus
    - facility plans for mechanical infrastructure (lift stations).

2.6.3 Surface Works

Record Drawings

The layout plans for surface works shall indicate all locations and measurements (widths and radii etc.), and the type of material used for roads, lanes, parking areas, sidewalks, walkways, pathways, curbs and gutters. Plans shall include the location of street signage, traffic signage, pavement markings, animal proof waste containers and postal kiosks. Separate details may be required for corner detailing at intersections. Concrete curbs, gutters, sidewalks and other concrete surface works shall be included on the plans.

CCC submissions for surface works shall include the following testing and documentation:

Concrete Works

Concrete Strength Test Results: for concrete on public municipal improvements. Testing shall be taken in such a way to give an adequate representation of all concrete used for the public municipal improvements.

Compaction results for base, sub-base and sub-grade.

Paved Roadways (First Lift) And Pathways

- Marshall Mix Analysis of the asphalt material (intermediate and large developments)
- compaction results for base, sub-base and sub-grade – include pathways
- gradation tests for base and sub-base granular material
- compaction tests for first lift asphalt

Paving (Second Lift – If Required)

- Marshall Mix Analysis of second lift asphalt
- compaction tests for second lift asphalt.

Surface works record drawing shall include the following information:

- centerline or curb/gutter line of roads (indicated by unbroken polyline)
- edges
- finished grades at corner radii, vertical curves and intermediate points if more than 50 metres between other grade points
- cross-section of roadway and pathway structure
- other relevant surface works as required including manholes, catch basins, valves, hydrants, streetlights and signage.

2.6.4 Facility Plans

All facilities shall require record drawings as well as any pertinent operation and maintenance (O&M) manuals from manufacturers. This information is required as part of the CCC submission. See Section 2.4 of the EDCG for more information.

Lift station, pump house, PRV chamber and reservoir record drawings shall include the following details:

- description and location of the facility
- electrical and instrumentation record drawings (schematic and PLC programming)
- mechanical record drawings (process piping, pumps, schematics, probe settings, HVAC, etc.)
- equipment manufacturers' information.

For information about irrigation system record drawings, see Part 10 of the EDCG.

Operations and Maintenance Manuals

Operation and maintenance (O&M) manuals shall be submitted to the Town for public municipal improvements constructed along with record drawings. The O&M manuals shall be prepared according to the minimum requirements outlined in this section. Other documents (ex: Construction Contract Documents) with the Town for specific municipal improvements or capital projects may include more detailed requirements.

The O&M manual shall be an organized compilation of all operating and maintenance data pertaining to any facility provided by the developer and shall be prepared by the consulting engineer. Manuals shall be provided in a three-ring or similar type of binder with hard covers and spine, divider sheets with labeled tabs and envelopes for over-sized inserts. The binder shall be of heavy-duty construction, suitable for removing and inserting pages, and of adequate size for the material presented. The O&M manual may include more than one volume. All binders shall be clearly labeled with the date, name and location of the facility.

Three complete hard copy sets of the O&M manuals and one digital version on portable digital device shall be submitted to the Town prior to, or together with, the CCC application. The O&M manuals shall be subject to review by the Town engineer prior to acceptance by the Town. Operation and maintenance manuals shall include, but not be limited to, the following information:

- list of names and contact details of firms involved in the design, construction and supply of equipment or services for the facility
- general description, application and operating conditions of the facility
- equipment manufacturer's detailed technical information including installation, operation and maintenance instructions, parts lists and component diagrams
- installation and performance test results
- inspection compliance certificates

- warranties and guarantees.

2.6.5 Landscaping

Record Drawings

A document detailing total lengths and size of trails (asphalt and gravel/clay), furniture inventories, park signage inventories, playground inventories, fencing inventories, irrigation inventories, total area of maintained turf/sports fields/active areas (municipal reserves) and total area of undevelopable, solid waste bins, unmaintained natural areas (environmental reserves) shall be submitted to the Town.

The following information is required for each new improvement:

- installer's name
- manufacturer
- supplier
- cost
- part number
- installation date
- material item is made of
- GPS location of each asset
- length and width of trail
- manufacturer's expected life of asset.

2.6.6 Electronic Data Submission Requirements

Delivery Methods

Data shall be provided by email, USB drive, FTP site, external file sharing site such as Dropbox, or by an alternate method as approved by the Town.

Acceptable File Types

Data shall be provided in PDF and CAD format. All files shall adhere to the new City of Calgary CAD Standard and meet the Spatial Reference standards below. City of Calgary downloadable CAD templates may be used to assist in the preparation of drawing submissions.

Spatial Reference Standards

All data shall be provided in NAD83 3TM projection with reference meridian being 114° West as per the City of Calgary CAD standard.

2.7 Other Engineering Permits and Utility Locates

This section of the EDCG is provided to advise developers, consulting engineers and builders of other application and approval requirements prior to any construction in the Town of Canmore. The intent is to provide applicants with the information necessary to submit a complete application. Please note that failure to comply with the permit instructions and conditions may result in processing delays, a rejected permit application and/or a stop work order.

2.7.1 Utility and Pipeline Locations

Prior to commencing work, the contractor shall contact the appropriate agencies listed below and other private utility locator as required to locate existing underground utilities and pipelines in or adjacent to the construction work site prior to commencement of work. In addition to Alberta One-Call, any utility companies not covered under Alberta One-Call (ex: Shaw Communications) as well as EPCOR shall be contacted at the number below for locates of water, sanitary and storm utilities.

- Alberta One-Call: 1-800-242-3447
- EPCOR (Water and Sanitary Utilities): 1-403-609-6400
- Shaw Communications (Dig Shaw): 1-866-344-7429

2.7.2 Road Right-of-way Usage Permits (Road Use Permits)

Road use permits are required for any work within a Town of Canmore road right-of-way prior to any construction activity or placement of construction equipment or materials, including oversize equipment or structure moves. Please see the Town of Canmore's website at www.canmore.ca for the most up-to-date application form and process. Applications shall be submitted a minimum of two full business days in advance. If a partial or full road closure is required, the application shall be submitted a minimum of four weeks in advance. In emergency situations the Town may waive or reduce the minimum advance notice requirement.

Special conditions exist for Highway 742 (Three Sisters Drive, Three Sisters Parkway and Spray Lakes Road). Prior to any work on/near this highway, the applicant/contractor shall contact Alberta Transportation at 403-297-6311 and obtain a letter of approval.

Traffic control person (flag person) accreditation is required by the Town on arterial and collector roads when a directional closure is required. Any individual acting as a traffic control person shall be properly trained.

2.7.3 Request for Permission to Work Permits – Outside Regular Hours

A permission to work permit is required when an applicant or contractor wishes to work before 7:00 a.m. and after 10:00 p.m., Monday to Saturday, and any time on Sundays or statutory holidays. The application and further information about this process is available on the Town of Canmore's website at www.canmore.ca.

2.7.4 Excavation Permit

An excavation permit is required to excavate or break-up the surface of a road, lane/alley, sidewalk or landscaped area within a road or utility right-of-way or other public land (e.g., parks and municipal reserve). Please see the Town of Canmore's website for the most up-to-date application form and process. Applications shall be submitted a minimum of two full business days in advance. If a partial or full road closure is required, the application shall be submitted a minimum of four weeks in advance.

2.7.5 Blasting Permit

A blasting permit is required for all drilling and blasting operations within the Town of Canmore and shall conform to Town's *Regulation of Explosives Bylaw* 32-96, the provisions of the *Explosives Act* (Canada) and the regulations made thereunder, and with the provisions of the *Occupational Health and Safety Act - General Safety Regulation*. In the event of conflict between any of these, the more stringent shall take precedence. As there is inherent danger with blasting activities, these applications shall be handled on a case by case basis. The application for a blasting permit can be found on the Town of Canmore's website at www.canmore.ca.

2.7.6 Demolition Permit

A demolition permit is required, which is applied for through the Town's Planning and Development Department, whenever an existing structure is to be demolished. Procedures and requirements for utility disconnects and waste disposal requirements are dealt with by the Engineering Department through this permit process in addition to Building Code requirements.

2.7.7 Cross Reserve Permit

A Cross Reserve Permit, applied for through the Town Parks department, is required for any work on Town owned or managed public spaces, such as Municipal Reserves and Park spaces.

2.7.8 Engineering Department Fees

The schedule of fees assessed by the Engineering Department for engineering services is reviewed and updated annually. The current *Master Fee Schedule* is available on the Town of Canmore's website at www.canmore.ca.

2.7.9 Statutory Plans and Guiding Documents

Some of the relevant guiding documents adopted by the Town of Canmore are described below. Please note that this is not a complete list and the most recent version of the referenced documents below can be found on the Town of Canmore website at www.canmore.ca.

- *Municipal Development Plan*
- *Area Structure Plans*
- *Area Redevelopment Plans*
- *Land Use Bylaw*
- *Integrated Transportation Master Plan*
- *Utility Master Plan*
- *Undermining Guidelines*

2.8 Figures

Figure EDCG AP 2.1 Grading Plan Requirements

Figure EDCG AP 2.2 Building Grade Plan – Minimum Requirements

Figure EDCG AP 2.3 Drawing Title Block Specifications – Horizontal Layout

Figure EDCG AP 2.4 Drawing Title Block Specifications – Vertical Layout

3. SITE GRADING AND DRAINAGE

This section of the EDCG serves as a reminder to developers, engineers and contractors of the importance of erosion and sediment control (ESC) when constructing in Canmore. The use of proper ESC measures is extremely important to the Town of Canmore. Silt and fines clogging existing storm systems is an enormous maintenance burden that is growing. It is essential that the importance of ESC measures is understood by all members of a development team and that proper ESC measures are maintained from the beginning of a project right through to the landscaping warranty period.

This section also provides information to support the incorporation of more sustainable design practices into projects being built in Canmore. For example, grading of a site, as well as the construction procedures used to achieve the desired grading, are directly related to the amount and effectiveness of stormwater infiltration to on-site storage.

3.1 Required Reading

- Town of Canmore. *Guidelines for Subdivision and Development in Mountainous Terrain*. Council, Resolution 282-2006.June 13, 2006
- Town of Canmore current *Land Use Bylaw*
- Section 9.4 Groundwater
- Province of Alberta. *Canmore Undermining Review Regulation*. Sec. 1.4.1.1 Alberta Regulation 114/1997

3.2 Design Considerations

Where developments and subdivisions exist in high groundwater conditions, the Town reserves the right to ask for a geotechnical investigation to address specific issues related to groundwater.

3.2.1 Minimize Grading

Grading for all lots is to be kept to a minimum. Building types shall be chosen and built in such a way that they accommodate the pre-development landscape as much as reasonably possible. Alterations to the natural topography should be minimized as per the Town's *Guidelines for Subdivision and Development in Mountainous Terrain*.

3.2.2 Lowest Top of Footing

Lots with existing development grading plans almost always have a dictated lowest top of footing elevation. In cases where applications do not have a dictated lowest top of footing

elevation, a professional engineer will need to be engaged to confirm if a building can be serviced by gravity for the sanitary sewer system.

3.2.3 Field Testing

In addition to the requirements of the drawings, the consulting engineer shall resolve all issues related to unsuitable soil conditions that could affect construction or the development of a subdivision. This shall include inspecting the sub-grade prior to placing any fill and conducting the appropriate testing on all fill placed.

The consulting engineer shall inspect stripping and grading operations to certify compliance with the standards and guidelines in this section of the EDCG. The provision of spot inspections by the consulting engineer during stripping and grading shall be left up to the discretion of the consulting engineer.

The consulting engineer shall provide all field test results to the Town of Canmore Engineering Department.

3.2.4 Grading Transition Between Properties and Street ROW

Particular attention must be given to transitions with neighboring properties to ensure that proposed grades transition smoothly to existing grades. Designers will be required to show the existing grades as per the plot plan on all submissions.

When developing in the valley bottom, in most cases the minimum habitable floor elevation is dictated by Figure EDCG HLC 9.8, 1:100 Year Design Groundwater Elevations. Developers should be mindful of neighboring grades that are not reflected on Figure EDCG HLC 9.8.

In some cases, using this elevation without being mindful of neighboring grades can cause the proposed dwelling to fall in a low spot with respect to neighboring grades and eliminate the possibility of an escape route for a major event. See Figure EDCG GRD 3.1 Overland Escape Route, for more information. Developers are required to have their legal plot plan reflect elevations of neighboring parcels that will fall higher than their minimum habitable floor elevation.

The Engineering Department reserves the right to dictate a higher minimum habitable floor elevation should they feel that any proposed habitable space may be affected by runoff.

3.2.5 Grading and Stormwater

Grading plans should be mindful of the stormwater management of the site and all designers are encouraged to become familiar with the information in the Stormwater section of the EDCG (Section 6). As described in the Town of Canmore's *Land Use Bylaw*, developers are reminded that grading shall not direct stormwater runoff to neighboring

private properties or onto Town sidewalks or onto a lane or street, except in accordance with an approved grading plan.

Lots are to be graded in such a way that quantity and velocity of surface runoff is minimized, and that infiltration and detention is maximized, as reasonable, throughout the site.

Grading of lots should follow the appropriate development grading plan where available.

Where there is no existing development grading plan (or in the case of a re-development), two general approaches to grading will be used which are described in the following figures: Figure EDCG GRD 3.2 Lots in Valley Bottom: General Grading, and Figure EDCG GRD 3.3 Lots on Slope: General Grading.

It should be noted that grading is intrinsically related to stormwater and landscaping. Developers should address these three areas concurrently. As a general rule, to distinguish landscaping from grading, designers are asked to consider the shape of the land to be the grading, and the landscaping to be the plantings themselves on top of that shaped land. Should discrepancies arise between grading and landscaping design, the grading plan will always govern over the landscaping plan.

3.3 Special Features

3.3.1 Retaining Walls

Retaining walls that are higher than 1.0 m or a series of retaining walls where the combined slope is steeper than 3H:1V (see Figure EDCG GRD 3.8 Retaining Wall Sketch) must be designed and sealed by a professional engineer (typically structural or geotechnical, or both for large structures). The Town may accept retaining walls on slopes steeper than 3H:1V where approved and sealed by a professional engineer. The design submitted to the Town shall include a letter of engagement outlining the scope of the professional engineer's assignment, which is to include the engineer's responsibility as engineer of record, design and specifications for all elements, and inspection for compliance with the design.

Plan and elevation drawings shall also be submitted to the Town and must show general dimensions including:

- wall foundation and minimum toe embedment
- wall backfill and drainage
- wall inclination
- elevation of top and bottom of wall
- sizing of all elements
- material type
- dimensions of offset of wall from property boundaries and structures

- The engineer of record shall indicate on the retaining wall design whether or not the wall requires safety railings and shall provide rationale for the decision. Details and dimensions of safety railing (guard) on top of retaining wall.

Upon completion, the engineer of record shall submit a letter to the Town certifying that the retaining wall has been constructed in accordance with the design or outlining where deviations have occurred along with rationale.

3.3.2 Window Wells and Sunken Entrances

The following are design criteria for window wells and sunken entrances (see Figures EDCG GRD 3.4 Window Well Drain, and EDCG GRD 3.5 Sunken Entrances):

- Window wells and sunken entrances shall not be placed in drainage paths.
- Grading around sunken entrances and window wells shall ensure runoff is directed away from the wells.
- Sunken entrances shall have a step up or curb at ground level entry point.
- Window wells and sunken entrances will require a drain that directs runoff trapped in the well to an appropriately sized seepage pit.

3.3.3 Weeping Drain Tile

Weeping tile is required for all developments, including low density residential, unless otherwise recommended by a geotechnical engineer based on a thorough investigation and analysis of local subsurface soil and groundwater conditions, and such recommendations are accepted by the Town engineer.

The investigation and analysis by the geotechnical engineer must consider the possibility of localized and intermittent springs resulting from intense rainstorms or snowmelt, or from preferential groundwater pathways including service pipe trenches and bedding materials.

All lots requiring weeping tile must be shown in a distinctive manner using symbols and legend on the design drawings. Should weeping tile not be required as per direction of the geotechnical engineer, it can be omitted in the construction phase.

All weeping tile is to be day-lighted or connected by a sump pump discharge to on-site infiltration facilities or to a local drainage system as accepted by the Town engineer. Elevation views of weeping tile showing specific elevations of inverts and bottom of soak-away pits will be required for all applications. If piped storm systems are to be used, their design shall take into account the contributions of weeping tile for sizing purposes. All weeping tile connected to a storm system will need to be indicated on the application and be accepted by the Town engineer.

Weeping tiles shall NOT BE CONNECTED to the sanitary sewer system.

See Figure EDCG GRD 3.6 Weeping Drain Tile.

3.3.4 Garage Drains

All garage drains shall meet the requirements of the *Alberta Building Code* and Alberta Environment standards.

The Town engineer may require an oil grit separator to be placed in the garage (Figure EDCG GRD 3.7 Garage Drainage [Single Family Residence]). The developer may offer a variation of the design, but the function of the oil grit separator must remain the same. Final design will be subject to acceptance of the Town engineer.

3.3.5 Driveways

Grading of lots must accommodate a smooth transition from the front of the property to the street ROW. This is especially critical with driveways that access a sloped street. Retaining to accommodate access must be done on private property to allow the Town to modify the street within existing street grades.

Driveway grades must adhere to the latest edition of the City of Calgary Roads Construction Standard Specifications.

Driveway widths must not exceed the limits stated in the Town of Canmore's *Land Use Bylaw.*

3.4 Permits and Commencement of Construction

Typically, stripping and grading signal the commencement of construction. It is up to the developer or contractor to ensure all necessary permits and approvals from other governing agencies are in place prior to work. No construction, including stripping and grading, shall take place without a construction management plan (CMP) that has been approved by the Town. See Section 2.5 of the EDCG for further information about submission requirements.

It is the responsibility of the developer to ensure that erosion and sediment control (ESC) measures are in place prior to construction commencement. It is essential that ESC measures are kept in place for the duration of the project including through the placement of landscaping. The removal of vegetation and topsoil during construction or other soil disturbing activities, as well as groundwater disturbing activities can have detrimental impacts on the Town's stormwater management infrastructure, its surface water bodies, and the groundwater aquifer. The Town of Canmore requires contractors to follow the most recent edition of the City of Calgary Water Resources', *Erosion and Sediment Control Guidelines* with regards to details and specifications. Consultant shall propose reporting requirements as applicable to the Town of Canmore.

3.4.1 Lot Grading Certificate

Following completion of construction, the homeowner or builder may be required to submit a final lot grading plan prepared by a certified land surveyor or professional engineer. The final lot grading plan shall certify that the final grades comply with the original design within acceptable variances or shall provide an explanation of significant variances.

The lot grading certificate must be accepted by the Town before a Development Completion Certificate (DCC) will be issued.

3.5 Figures

For independent development lots:

Figure EDCG GRD 3.1 Overland Escape Route

Figure EDCG GRD 3.2 Lots in Valley Bottom: General Grading

Figure EDCG GRD 3.3 Lots on Slope: General Grading

Figure EDCG GRD 3.4 Window Well Drain

Figure EDCG GRD 3.5 Sunken Entrances

Figure EDCG GRD 3.6 Weeping Drain Tile

Figure EDCG GRD 3.7 Garage Drainage (Single Family Residence)

Figure EDCG GRD 3.8 Retaining Wall Sketch

4. WATER SYSTEM

Water system elements not specifically referenced in this document shall be in accordance with the latest edition of the documents listed below in Required Reading.

4.1 Required Reading

- Alberta Environment. *Standard and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems*.
- ANSI/AWWA C651. *Disinfecting Water Mains*.
- City of Calgary. *Design Guidelines for Subdivision Servicing*.
- City of Calgary, Water Resources. *Standard Specifications Waterworks Construction*.
- Town of Canmore. *Utilities Master Plan, Water and Sanitary.*
- Town of Canmore. *Water Bylaw* 2003-39.

Note: Provincial Standards and Guidelines take precedence, followed by the Town of Canmore then City of Calgary where discrepancies occur.

4.2 Design Parameters

4.2.1 Demands and Peak Factors

Water demands shall be determined in accordance with the latest edition of the Town's *Utilities Master Plan* based on land use, density and unit consumption rates. Specific design flow rates and peak factors for residential, commercial, industrial and institutional developments or defined land use districts shall follow minimum rates shown in the *Utility Master Plan* or other criteria applicable to specific developments in accordance with good engineering practice, and as approved by the Town engineer.

Table 4-1 provides a summary of current and future water demands, system pressures and the associated design criteria.

Table 4-1: Water Demand and Pressure Summary

	Units	Design Criteria	
		Current – 2014 Population (17,663[a])	Ultimate Population (31,700)
Average Daily Demand (ADD)			
Water Treatment Plant Production (composite)	L/c/d	420	360
Consumption (residential only)	L/c/d	285	250
Commercial	m^3/ha/d	16	16
Peak Day Water Demands (PDD)	Peak Factor[b]	2 x ADD	2 x ADD
Peak Hour Water Demands (PHD)	Peak Factor[b]	4 x ADD	4 x ADD
Minimum System Pressures			
Peak Hour Demand	kPa	350	350
Peak Day Demand Plus Fire Flow	kPa	140 at fire flow hydrant	140 at fire flow hydrant
Maximum System Pressures	kPa	620	620

Notes:
a) The current population includes an allowance for M.D. of Bighorn DMF and HH of 696 people (equivalent).
b) For large industrial or commercial developments, peak factors specific to the types of developments proposed shall be used.
L/c/d Litres per capita per day
m^3/ha/d cubic metres per hectare per day

4.2.2 Pressure Zones

The distribution system shall be designed with consideration given to various pressure zones within the subdivision. Pressure shall be maintained within a range of 350–620 kPa (40–90 psi). If the proposed subdivision is to be tied into the existing downtown distribution system, it shall be designed so that the downtown pressure does not exceed 496 kPa (72 psi).

See notes in Section 4.3.10.4 of the *Engineering Design and Construction Guidelines* (EDCG) for pressure requirements of individual services.

4.2.3 Fire Flows

Pipes in the waterworks system and private service connections shall be adequately sized. Sufficient numbers of hydrants shall be installed to provide the minimum required fire flows at each location.

Water supply for fire protection systems shall meet Fire Prevention Bureau and Insurance Underwriters and Alberta Building Code requirements, whichever is more stringent.

The required fire flows for large residential, commercial or industrial developments shall be determined in accordance with the latest edition of the *Fire Underwriters Survey Guide to Recommended Practice*. However, the required fire flows shall not be less than those specified for general land use categories or types of development indicated in Table 4-2 below.

Table 4-2: Required Fire Flows

Land Use Category or Development Type	Fire Flow (litres per second)	Design Criteria Time Duration (hours)
Detached and Duplex Residential	85 L/s	2 h
Multi-Family, Small to Medium Size Units	120 L/s	2 h
Commercial, Institutional, Industrial – adequately separated, 3 floors or less	200 L/s	2.5 h
Multi-Family, Medium Density (4-plex to 6-plex)	200 L/s	2.5 h
High Density, Multiple Closely Spaced or Contiguous Buildings of 3 or More Floors	300 L/s	3.5 h

The intent of the criteria above is for the network to be design for build out. In areas where system modeling determines the above noted criteria cannot be achieved with existing boundary conditions, these will be considered on a case by case basis by the Town of Canmore Engineering Department and the proposed systems consultant. For the Peak Hour Demand minimum pressure specifically, the Town will consider lower pressure to a minimum of 280KPa when it is clearly demonstrated that the target minimum pressure of 350KPa cannot be achieve.

4.3 Design and Construction of Water System Components

4.3.1 General Notes

Any proposed water distribution system or part of a system shall be designed to serve the area within a subdivision development boundary as well as any area that is contiguous with the proposed system. Proposed extensions to the water distribution network shall be modeled by the consulting engineer under various demand scenarios to determine the required water main sizes. The impact of all new major developments placing significant water demands on existing water supply, storage, transmission and distribution systems and the need for any resulting off-site improvements shall also be determined by network modeling. Existing network operating conditions at the proposed connection nodes (i.e., boundary conditions) will be provided by the Town upon request.

Development (or redevelopment) of a site currently served by a well requires that the water supply be switched to the municipal water supply as per the Town of Canmore *Water Bylaw*. The existing well is then to be decommissioned as per Provincial regulations.

Distribution mains shall be continuous (looped) whenever possible. Where a closed system (dead end) is accepted, the maximum number of single dwelling units shall not exceed 45 on a permanent basis.

No cross-connections are allowed under any conditions. Backflow prevention devices shall be installed, inspected and tested as required by applicable regulations (e.g. plumbing code).

Water system components shall remain accessible. There shall be no obstruction or impediment to free and direct access to any service, water main, valve, curb stop, fire hydrant, water meter or other appurtenances on the waterworks system.

See the City of Calgary *Standard Specifications Waterworks Construction* for water systems to be installed in areas contaminated or potentially contaminated with volatile organic compounds.

4.3.2 Easements, Legal Requirements and Implications

Distribution mains shall not be placed on private land without a registered easement. The typical minimum easement or public utility lot (PUL) width for an independent water main (or any main) is 9.0 m. The typical minimum easement or public utility lot width increases to 12.0 m for two utilities in the same easement with the deeper main located near the center. Services shall not be connected to a water main located in an easement nor PUL Easement or PUL width reduction may be considered if mains have shallow, insulated bury.

A sufficient number of valves shall be provided to permit isolation of the main in the easement or PUL without disruption of services outside the easement.

Where a reduced easement or PUL may be accepted by a variance and where future maintenance of mains would be difficult due to proximity of foundations or other adjacent improvements, the Town may require the mains to be placed into a casing pipe or the foundations (of adjacent improvements) protected by some other method.

Any landscaping improvements approved by the Town in excess of sod or hard surfacing within a utility right-of-way/easement (URW) that may be disturbed by future maintenance operations will be replaced by sod or the approved hard surfacing to match adjacent areas by the Town.

Development permit (DP) applications shall include an overall plan showing what portions of the water system being constructed will function as a private system. Any on-site portions of distribution water mains to be owned and maintained by the Town of Canmore require a URW survey plan prepared by a legal surveyor (and not by description) to be registered

accompanied by the Town's standard Utility Right of Way agreement or return of securities or to obtain DCC.

4.3.3 Water Mains Design in Town Right-of-Way

4.3.3.1 Size

Water mains shall be consistent with those in adjacent subdivisions so that continuity of main size is maintained between subdivisions. The maximum length of mains between ties permissible in residential development are as follows:

- 150 mm diameter mains (in cul-de-sac less than 150 m in length only)
- 200 mm diameter mains: maximum 550 m between ties
- 250+ mm diameter mains: maximum 760 m between ties.

Minimum main size shall be 200 mm diameter in a residential subdivision and 250 mm diameter in an industrial or commercial subdivision. The Town engineer may require that larger mains be installed to service or benefit adjacent or future developments or as required when, in the opinion of the Town, the increase in size is required to hydraulically compensate for dead end mains or high-density developments. *Endeavour to Assist* financial clauses for oversize mains will be considered in development agreements.

Mains in residential cul-de-sacs that are shorter than 150 m may be reduced to 150 mm diameter.

Flush-outs shall be required at the end of a dead-end watermain if there is no hydrant located at or near the end of the main. The flush-out shall be of sufficient size to provide 0.75 m/s of velocity in the main and shall have a minimum diameter of 50 mm. See Figure EDCG WAT 4.1 Typical 50mm Watermain Flush-Out for flush-out details. A park service may be accepted in lieu of a separate flush-out subject to acceptance by the Town engineer.

4.3.3.2 Cover

In streets, lanes, PULs and easements, the minimum cover from the top of the water main to the final surface grade shall be as follows:

- 2.7 m in clay soil
- 3.3 m in soil that is predominantly gravel.

For dead end mains, the minimum cover from the top of the water main to the final surface grade shall be as follows:

- 3.0 m in clay soil
- 3.3 m in soil that is predominantly gravel.

In areas with high groundwater, water mains may be installed with less cover and insulated where accepted by the Town engineer. The minimum depth of bury in such areas shall be as reasonably achievable but not less than 1.8 m below the final surface grade, subject to Town approval.

In areas where pipe insulation is used, insulation shall be as specified in Section 4.3.3.4 of the EDCG.

4.3.3.3 Backfill Requirements

Backfill requirements for deep utility services shall be in accordance with the latest edition of the City of Calgary *Standard Specifications Waterworks Construction*.

Much of the Town of Canmore sits on an aquifer and has fluctuating groundwater levels. As a result, specific attention should be given to the need for clay plugs. The spacing (frequency) of clay plugs shall be as follows or as otherwise approved by the Town:

- on slopes of 4–7%: not more than 100 m apart
- on slopes greater than 7%: not more than 50 m apart
- at all intersecting pipes in steep slope areas.

4.3.3.4 Insulation

Insulation used for in-ground construction shall be extruded polystyrene to CAN/ULC S701, Type 4 classification. Approved products are Dow Chemicals HI-40 or HI-60 and Owens Corning Foamular 400 or 600, or as otherwise accepted by the Town.

Where required by the Town, pre-insulated piping systems incorporating a core pipe, polyurethane foam, closed-cell insulation and outer jacket shall be used in place of sheet or granular insulation materials in the pipe zone. Pre-insulated piping systems shall be designed for each specific application in accordance with the manufacturers' recommendations.

See Figures EDCG Water WAT 4.2 Box Insulation Requirements: Services & Mains 150mm & Smaller and City of Calgary Standard Specifications Waterworks Construction, file Number 453.1044.001 and 453.1045.001 for further information. The Town of Canmore EDCG Figure takes precedence except in situations not covered by this Figure.

4.3.3.5 Material

Approval of pipe material, and any other materials used in the distribution system shall be as per the latest version of the City of Calgary *Standard Specifications Waterworks Construction*.

4.3.4 Isolation Valves

Valves on distribution mains shall be located to minimize the number of valves required to be closed in order to isolate a section of main. The maximum number of isolating valves for a section of main shall be four. No more than one hydrant shall be isolated (out of service) when a single section of main is isolated.

All valves in the distribution system shall be equipped with a 50 mm x 50 mm operating nut and shall turn counter-clockwise (left) to open.

Isolation valves required at intersections shall be placed on property line extensions to facilitate operation and maintenance (see Figure EDCG WAT 4.3 Valve Placement at Intersections).

Private water systems shall have an isolation valve on the Town side of the entrance to the private system.

4.3.5 Booster Pump Stations

Design guidelines will be provided by the Town to streamline booster pump station designs. Each installation, however, will be reviewed by the Town on a site-specific basis.

Sizing calculations and detailed drawings shall be submitted for review and acceptance by the Town. Equipment and programmable logic controller (PLC)/supervisory control and data acquisition (SCADA) systems shall be designed in accordance with the requirements of the Town and utility operator. These standards change as new technologies emerge and as existing facilities in Canmore are upgraded. Contact the Engineering Department for current requirements at the planning stage of new projects.

The equipment shown in Table 4-3 shall be installed as a minimum, unless otherwise reviewed and accepted by the Town.

Table 4-3: Booster Pump Station Equipment and Manufacturer

Equipment	Approved Manufacturer
Pumps (potable water supply)	Peerless, Gould, Myers or Weir
Master Control Cabinets	Allen-Bradley
Level Controls	Milltronics
Programable Logic Controllers	Modicon, Allen-Bradley, ITT Flygt
Electrical Relays/Transfer Switches	Allen-Bradley
Variable Frequency Drives	Allen-Bradley

4.3.6 Pressure Reducing Valves

Pressure reducing valves (PRVs) and PRV stations shall maintain a constant downstream pressure regardless of varying inlet pressure. The City of Calgary *Standard Specification Waterworks Construction* shall be followed, except as noted below.

Town of Canmore PRVs and PRV stations shall be complete with and conform to the following minimum requirements:

- Valves shall have a tight monolithic structure. Where construction joints occur, water stops shall be incorporated.
- Each structure shall be insulated with spray-on urethane foam on all interior walls and ceiling (reinforced mesh required).
- A floor drain and sump shall be used wherever practical and outside the groundwater protection zone.
- All steel piping shall be painted blue (to Alberta Environment standards).

Piping and fittings within a PRV station shall comply with the following requirements:

Piping and fittings within a PRV station shall be a prefabricated steel module including pipe, fitting and flanges, with a fusion-bonded epoxy internal lining and external coating that meets the City of Calgary's *Standard Specifications Waterworks Construction*, section 505.01.02 Type A. The external coating for all piping shall also comply with the City of Calgary's standard detail sheet #45, note #9. The external coating should be blue in colour, either as pigmentation in the fusion-bonded epoxy (if available) or as an additional overcoat of compatible material.

The external coating of the pipe cast within the wall of the PRV chamber shall form a watertight seal with the concrete to protect against groundwater infiltration. The coating in this area may be roughened or otherwise treated as recommended by the manufacturer. Alternatively, a waterstop flange can be welded around the outside of the pipe in the centre of the embedded section of pipe. This flange can be left uncoated to form a better bond with the concrete. The exterior coating of the pipe outside of the wall of the PRV chamber shall be wrapped with an approved Polyethylene tape or Denso Mastic tape or Yellow Jacket shrink sleeve.

All PRVs and PRV stations shall have a surge relief valve tied to the storm sewer or other suitable option to provide physical protection of downstream pressure settings. If a surge relief valve is not possible or practical, the PRV station shall include a downstream surge-arrester that will automatically close the valve if the downstream set pressure is exceeded.

If required, PRV stations shall have a pressure sustaining pilot control to protect upstream pressures. An analysis of flow requirements for each pressure zone will be required to determine the need for this option. If a pressure sustaining pilot control is required, the design shall include the following:

- "Y" screens to capture grit and debris on the pilot line
- position indicators
- liquid-filled pressure gauges for both upstream and downstream
- adequate pipe supports.
- pilot control isolating cocks for valves 75 mm or larger
- isolating gate block valves to allow bypass and valve servicing
- speed controls as determined by the valve supplier
- domestic water supply valve bypass
- epoxy-coated valves
- valves and piping that meet all pressure requirements
- inlet and outlet ventilation piping.

Detailed drawings of the proposed pressure sustaining pilot control installation shall be sent to the Town for review and acceptance prior to tendering or fabrication as applicable. Once constructed, all operating pressures shall be clearly marked in the PRV station and in the operating/maintenance manuals supplied to the Town. This shall include an operating description of each installation, including location.

4.3.7 Hydrants

4.3.7.1 Hydrant Type

Hydrants shall be free draining. If hydrants are installed in areas with high groundwater, the hydrant drains shall be plugged. Non-draining hydrants shall have the top and caps painted red and shall be clearly marked with a disk labelled *Fire Service Only* installed on the hose port; the disk shall be installed when the hydrant is installed.

All hydrants shall be Mueller (Modern and Super Centurion), McAvity (Clow Brigadier McAvity), or AVK (model 2700 and 2780) unless otherwise approved by the Town engineer.

All hydrants shall be 150 mm dry barrel type with one 100 mm diameter "Storz" pumper connection and two 65 mm threaded hose connections. Threaded hose connections shall be 4 threads per inch (TPI) conforming to the Alberta Mutual Aid (AMA) thread standard.

The exterior of the hydrant above and 300 mm below the grade-line flange shall be painted in accordance with City of Calgary Standard Specifications Waterworks Construction, Section 505.01.00 (Type C) in the following colours:

- red body, equal to C.I.L. #22370, Riley PM2506 or Approved Equal
- black caps (for free-draining hydrants)
- red top.

Hydrant details can be found in Figures EDCG WAT 4.4 Hydrant Details, EDCG WAT 4.5 Hydrant Valve Tie-Back and EDCG WAT 4.6 Hydrant Valve Tie-Back Flanged Valve to Flanged Tee.

4.3.7.2 Hydrant Coverage

Hydrants shall be located such that proper hydrant coverage is provided for the entire subdivision, development or as required by Emergency Services.

To provide complete coverage of any structure, hydrants shall be spaced so that the maximum distance from the hydrant shall not exceed 90 m radius in low-density residential areas or 60 m radius for institutional, commercial, industrial and high-density developments (measured along the street).

4.3.7.3 Hydrant Placement

Hydrants shall be placed to provide complete accessibility and to minimize the possibility of damage from vehicles or injury to pedestrians. Where possible, hydrants should be placed at intersections. Mid-block hydrants should be avoided unless required for specified coverage. Hydrants in cul-de-sacs shall be located at the entrance of the cul-de-sac.

The minimum distance from a hydrant to any driving surface or any structure shall be 2.0 m or 1.0 m from back of curb. If a suitable location is unavailable, bollards shall be placed around the hydrant between the driving surface and the hydrant. Bollards shall be placed such that they do not block access to the pumper or hose ports. Trees or above-grade hard landscaping in the vicinity of hydrants shall be located to maintain adequate clearance from the hydrant.

The minimum distance of a hydrant from a power pole, light standard or transformer shall be 3.0 m unless a greater separation is required by a utility company.

4.3.7.4 Hydrant Construction Requirements and Sign-off

Newly-installed hydrants on private and public property shall be functional and shall be put into service before construction of new buildings on the property proceeds beyond the foundation stage where such stages are constructed primarily of combustible materials.

Newly-installed and non-functioning hydrants shall be clearly marked with a cover bag labeled *Out of Service* or other marking as accepted by the Town. Bags shall be a commercially-available product manufactured from polyethylene or canvas for this specific purpose. Bags shall be installed when the hydrant is installed and shall not be removed until the requirements of Sections 4.3.8 and 4.3.9 have been met.

A hydrant flow test shall be performed on all newly-installed hydrants according to AWWA Manual M-17. A copy of the results shall be forwarded both to the Engineering and

Emergency Services Departments prior to putting the hydrants into service and prior to the acceptance of the Construction Completion Certificate.

All hydrant installations, whether new construction or the repair of existing, shall be reviewed by the consultant and/or utility operator prior to backfilling. The consultant is responsible for final sign-off of the hydrant.

4.3.7.5 Permission to use Hydrants for Construction

Prior to hydrant usage, the user shall apply to the utility operator and/or the Town.

A meter shall be obtained from the utility operator prior to the use of the hydrant. The user shall follow the rules of use as established by the utility operator and the Town *Water Bylaw*, including payment of deposits and water usage charges.

The hydrant user shall only use the hydrant designated by the utility operator. The user accepts responsibility for any and all damages caused by improper use of the designated hydrant during use of that hydrant.

If it is determined by the utility operator that the meter or hydrant has been tampered with for the purpose of fraudulent misrepresentation of usage during the use of the hydrant, then the deposit paid by the user shall be forfeited and the user shall be suspended from further hydrant use in addition to any fines or penalties levied pursuant to the non-permitted use.

4.3.8 Private Water Mains and Hydrants

All hydrants and water mains supplying water for firefighting that are located on private property are the responsibility of the private development to maintain unless there is a registered utility right-of-way (URW) plan and agreement executed jointly with the Town.

The minimum URW width for a fire line or combined line shall be 9.0 m with the line located near the centre of the easement. A variance to the easement width may be considered if the water line is insulated and installed at a shallower depth or if building foundations adjacent to the line extend below the depth of the line.

4.3.9 Tie-ins, Disinfection, Bacteria Test and Final Flushing of Water Mains

The order of testing and disinfection shall be in accordance with the latest editions of ANSI/AWWA C605, *Underground Installation of Polyvinyl Chloride Pipe (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings*, Section 10-Preparation for Use, and the City of Calgary *Standard Specifications Waterworks Construction*. Where discrepancies between these documents occur, ANSI/AWWA C605 shall govern.

The contractor shall notify the utility operator and consultant a minimum of three full business days in advance of any proposed water main tie-in or service disruption. This is to ensure that there are no conflicts with system operation or maintenance and to allow for time to comply with any special procedures required by the utility operator or the Town. See the *Watermain Tie-in Checklist* included in Section 4.5 of the EDCG.

New watermains and hydrants shall be flushed, hydrostatically (pressure) tested, disinfected, tested for bacteria and flushed as outlined below. The developer is responsible for ensuring that the construction drawings at the subdivision approval or development permit (DP) stage include the information described in the following sections.

4.3.9.1 Operation of Isolation Valves

Isolation valves shall be opened by the utility operator to put a watermain into service only after the watermain pressure and bacteriological testing has been completed and accepted by the Town.

All operation of isolating valves shall be by the utility operator except in the case of an emergency or other unforeseen shutdown requirement, and then only by qualified operators with immediate notification, or under the direction of the utility operator.

4.3.10 Service Connections

All detached and duplex lots within a new subdivision must be pre-serviced. Developers wanting to use services other than those provided will require permission from the Town.

Each lot requires one service of suitable size with a curb stop/isolation valve located 0.3 m from the property line. More than one service for any lot may be authorized by the Town under appropriate terms and conditions and in conformance with the National Plumbing Code.

Where existing lots are not serviced, but subject of subdivision application, the provision of services may be deferred to the Development permit stage at the discretion of the Town. The Town will generally require registration of a Deferred Servicing Agreement on the title of the lots without municipal services.

Services for separately-titled properties may not cross under another property and shall connect to main services located on common property. Variances are allowed under the plumbing code for multi-unit properties such as condos.

For any redevelopment, if the connection from the curb stop to the main is deemed unsuitable for use by the Town engineer and needs to be replaced, the developer shall replace the service to the main without compensation from the Town.

In general, existing water and sanitary sewer services greater than thirty years of age are to be replaced by developer/builder.

If the property owner/developer does not think a service needs to be replaced, they may expose the existing service at the curb stop for inspection by the Town. See Figure EDCG WAT 4.7 Water Service Ownership.

4.3.10.1 Placement and Separation

Horizontal separation requirements for services shall be as follows:

Service pipes smaller than 50 mm:

- 3 m from building foundation
- 2 m from property line
- 0.3 m from another deep utility line
- 2 m from a shallow utility line *
- 3 m from power pole, light standard or transformer.

Service pipes 50 mm and larger:

- 4 m from building foundation
- 4 m from property line
- 2 m from another deep utility line
- 2 m from a shallow utility line *
- 4 m from power pole, light standard or transformer.

*Shallow utility companies may require different separation. Separation requirements must be verified by the consulting engineer.

Services installed to existing buildings shall be on an alignment that will best suit the interior plumbing, or as required by the Town engineer. A water service expansion loop (gooseneck) shall be laid in the horizontal position.

Service pipe 100 mm and larger that passes through building floor slabs or exterior foundation walls shall be steel or ductile iron with an approved coating and lining.

All water services shall be installed complete with isolation valve, rod and stem, an approved means of protection during construction and marker posts. The water service pipe shall be plugged in a manner compatible with the service pipe to prevent ingress of foreign material and contamination of the service pipe and to prevent discharge in case the service valve is opened.

4.3.10.2 Materials

All water service materials shall comply with NSF/ANSI 61.

For detached dwellings and duplexes the following materials will be accepted for new water services:

- Service pipe shall be cross-linked polyethylene (PEX), sizes 20-40 mm, minimum SDR-9, conforming to AWWA C-904, ASTM F876/877, CSA B137.5; as manufactured by Rehau (Municipex), Plasco, or approved alternative.
- Should PEX not be available, service pipe up to and including 40 mm shall be Type K soft copper conforming to ANSI/AWWA C800-89 Standard and ASTM B88. All copper pipe shall be third-party certified (TPC).
- For 50 mm services, the Town of Canmore allows only polyethylene pipe, minimum SDR-9 or PC160, conforming to ANSI/AWWA C901, PE3408 or 3608 or 4710 and SCA B137.1. Compression-type fittings with stainless steel inserts or electro-fusion joints shall be used. The Town of Canmore does not allow 50 mm copper service pipe of any type.

For multi-unit residential, commercial and institutional construction, the Town will accept polyvinyl chloride (PVC) pipe - ANSI/AWWA C900 Standard and ASTM B88, minimum class 150, DR-18 pipe for new water service 100 mm diameter and larger. The Town will also consider HDPE material for pipe 100mm or larger.

4.3.10.3 Insulation

All services shall be protected against freezing. Where the specified cover cannot be maintained, insulation of the service is required as shown on Figure EDCG Water WAT 4.2.

4.3.10.4 Pressure Guidelines for Services

The minimum water service size for detached residential lots is 20 mm. Where the static water pressure measured at the main is less than 345 kPa (50 psi), a 25 mm (minimum) service connection is required.

Services with static water pressures above 620 kPa (90 psi) shall have a pressure reducing valve installed in the residence and notation shall be made on the servicing plan. Existing pressure zones in the Town are described in the *Utility Master Plan*. Pressure zone boundaries may be adjusted to incorporate new developments or to respond to operational issues. Contact the Engineering Department for current requirements at the planning stage of a new development.

4.3.10.5 Inspections

Detached Dwellings and Duplexes

All service connections, both construction from the main to the curb stop and construction from the curb stop to the building, shall be inspected by the Town of Canmore's Engineering Department prior to backfilling. Service installation from the curb stop shall precede construction of the footings on new developments.

For water services up to 25 mm, all on-site servicing up to the water meter shall be inspected by the Town of Canmore. The contractor shall arrange an inspection a minimum of one full business day in advance with the Town of Canmore.

Contractors are reminded that water service lines 50 mm and smaller must be one piece from the curb stop valve to the inside of the building up to the future building meter.

The contractor is responsible to pressurize the water line from the curb stop to the end of pipe. All residential connections up to and including 50 mm shall be hydro-static (water) tested to 1050 kPa (150 psi), or 1.5 x line operating pressure, whichever is greater. Services installed under freezing conditions or subject to freezing prior to a building being heated may be tested with air to 450 kPa (65 psi). The test pressure shall not exceed the manufacturer's recommended maximum test pressure. The contractor is responsible for providing manufacturer's documentation on the product being installed.

Following satisfactory testing, and prior to the water meter being installed, the builder shall install a reduced flow meter-spacer. This spacer may be obtained from the Town's building inspector or utility operator. The spacer is installed in the water line at the point where the water meter will be installed and allows for testing of the system. The builder shall install a wire for an external reading device as per drawing WAT-01. As the final requirement of obtaining an Occupancy Certificate, contact EPCOR Water Services to have the spacer removed, a water meter installed and the curb stop opened. Refer to the Town of Canmore *Water Bylaw* (2003-39) for details governing connections and operation of curb stops. See Figure EDCG WAT 4.10 Residential Water Meter Installation (20mm Example).

Multi-unit Residential and Commercial, Institutional and Industrial

The consulting engineer engaged by the builder/property owner is responsible for inspections of the installation of all public/private servicing. This includes the pressure test of the water service from the curb stop to the end of the pipe (length of pipe must be long enough to reach and will eventually be hooked up to the water meter) and for submission of test results to the Town of Canmore prior to application for a water meter.

The consulting engineer is responsible to ensure that all pipe work is reviewed prior to backfilling. The Construction Completion Certificate, Final Acceptance Certificate or Development Completion Certificate may not be accepted if review of new construction and/or maintenance work is not signed off by the consulting engineer.

All commercial/industrial service connections and multi-family (R3) sites with services greater than 50 mm shall be hydrostatic (water) tested to 1050 kPa (150 psi), or 1.5 x line operating pressure, whichever is greater. The test pressure shall not exceed the manufacturer's recommended maximum test pressure. The contractor is responsible for providing manufacturer's documentation on the product being installed if requested by the Town engineer.

Commercial/industrial or multi-unit developments with service size 50 mm or smaller shall be as per detached dwellings and duplexes above.

4.3.10.6 Service Connections to Existing Water Mains

Detached Dwellings and Duplexes

A saddle connection is required, as per the City of Calgary's *Water Resources, Standard Specification, Water Works Construction*, for services to detached dwellings and duplexes. All water service pipe shall be continuous from main to curb stop and from the curb stop into the building with no couplings joining short lengths of pipe. Copper water pipe may not be suitable if the required length exceeds the maximum length available for copper pipe. In such a case, PEX or polyethylene (PE) pipe should be used.

Multi-unit Residential, Commercial and Institutional

A cut in connection is required for extensions to the distribution system or connections to a private system for on-site development. These connections are usually done at 90° to the existing main. The contractor is responsible for effective disinfection, including methodology of chlorination, for the existing line that is affected by the cut in connection. The method of disinfection may need to be approved by the Town unless it directly follows methodologies outlined in relevant AWWA or City of Calgary standards. The Town engineer may require a hot tap connection in situations where the main line is considered critical, and not suitable for a cut in connection. The consultant is responsible for reviews and final sign off.

On pre-serviced sites to the property line, isolation valves/curb stops shall be operated by an authorized party in accordance with the *Water Bylaw*. Plumbers and other contractors may not operate isolation valves/curb stops exceeding 25 mm (as per Town of Canmore *Water Bylaw*). Contact EPCOR for more information on authorized isolation valve/curb stop operation.

On un-serviced sites, the contractor shall first install the services from the Town's mains to the property line. The consulting engineer engaged by the developer/property owner is responsible for reviews of the installation of all off-site servicing and submission of all required testing requirements. Following satisfactory installation of the public portion of the service, the line shall be flushed, pressure tested, and, if necessary, disinfected and tested, after which time the isolation valve/curb stop shall be closed. The isolation valve/curb stop shall not be opened until acceptance of the installation by the Town of Canmore after which an authorized party may open the curb stop upon request by the developer/property owner.

4.3.10.7 Placement of Subdivision Pre-service

All services shall be identified with a marker post. Posts shall be 50 x 100 mm, blue painted wood stakes extending from the invert of the terminated service connection to a minimum of 0.6 m above the ground level.

Flexible Pre-services

The water service pipe shall be extended 5.0 m into the property with a coil of pipe of sufficient length that there are no joints or couplings between the curb stop and water meter. The coil(s) of service pipe are to be left in a wooden box capable of withstanding earth pressures and protected from freezing. See Figure EDCG WAT 4.8 Pre-Service Connection Detail: Flexible Pipe.

Non-Flexible Pre-services

For services of non-flexible material (e.g. 150 mm PVC BR18) the developer shall install the pre-servicing as shown in Figure EDCG WAT 4.9 Pre-Service Connection Detail: Non-Flexible Pipe.

4.3.10.8 Abandonment of Existing Services

All abandonment of existing services requires a demolition permit and shall be witnessed by either the Town, the utility operator or the developer's consulting engineer. Water service lines shall be abandoned at just beyond the property line, at the curb stop or at the main as directed by the Town engineer. Abandonment of existing water services shall be required if an existing building is demolished and nothing is constructed on site or if an existing building is demolished and a new building requiring different service sizes is erected or if the Town engineer determines the existing service cannot be used due to condition.

For redevelopment of a site where either the existing water service is not acceptable as deemed by the Town or the utility operator or the sanitary sewer is replaced to the main, the water service shall also be replaced. The existing service shall be terminated at the main, and a new tie-in installed (saddle or direct tap as applicable, complete with mainstop). The Town or the utility operator may deem the existing service unacceptable due to the condition of the pipe and valve, type of pipe material, insufficient hydraulic capacity or if inadequate depth of cover and uninsulated.

If lots are being consolidated, the water service(s) shall be abandoned as follows:

1) The service line shall be excavated back to the property line or curb stop.
2) The service to be terminated shall be shut off at the curb stop.
3) The service line is to be cut 300 mm from the curb stop and crimped if copper pipe or plugged with a manufactured plug approved by the Town if material other than copper.

The main stop or saddle shall be repaired or replaced if it is deemed unacceptable by the Town or EPCOR Water Services.

4.3.10.9 Metering

The Town of Canmore requires a water meter to be installed on all residential, commercial, institutional and industrial services. If a water meter is not installed, an Occupancy

Certificate will not be granted. Utility billing, including water, wastewater, solid waste and recycling is effective from the date the water meter is installed. Once the meter is installed, the water shall be turned on by EPCOR. For installation or more information, contact EPCOR Water Services. The stipulations for metering are as follows:

- For each legal land title, installation of one water meter is required.
- No branch line or tap is permitted between a water meter and the curb stop. For multi-unit developments a multi service header pipe may be permitted, as per City of Calgary, Standard Specification, Waterworks Construction. A header splitter on the property side, after the curb stop could be ok, as long as each unit has an isolation valve and meter on the service to each unit.
- A subsidiary water meter may be provided on the downstream side of the Town's meter by a customer for their own purposes. Subsidiary water meters shall have a tag to identifying it as a private water meter.
- All water services shall be connected to water meters.
- The Town of Canmore shall determine the size, type and number of water meters to be supplied and installed for each customer.

Detached Dwellings and Duplexes

For detached dwellings, a single service and a single meter is required. For up-and-down, back-to-front duplexes, there is one service to the building and one water meter for each unit. For side-by-side or semi-detached duplexes, one service and one water meter is required for each side.

Garden Suites

For garden suites, it is expected water (and sanitary sewer) services will be connected to the existing dwelling services; downstream of the water meter for water

Multi-Family Residential

For multiple housing units consisting of three or more side-by-side units, one service feeds the building with one water meter per unit.

Metering Requirements

For multi-unit dwellings, each dwelling unit shall be metered individually. All water meters shall be installed at the header, where the service line enters the building and shall be located in one common area.

The builder shall install one wire per meter for an external reading device as per Figure EDCG WAT 4.10 Residential Water Meter Installation (20mm Example). Water meters shall be chosen and placed in a way that requires the least amount of maintenance and are readily accessible.

In residential multiplexes with four or more units, a minimum one common hose bib shall be required and shall be metered. Placement of the hose bib shall accommodate contractors as

well as residents. See Figure EDCG WAT 4.11 Residential Multi-Unit Water Meter Installation (20mm Example).

Commercial, Institutional and Industrial

Single-unit commercial buildings require a single service and single water meter. For multiple side-by-side units in industrial and commercial buildings, one water meter per legal land title is required.

Each site will be unique with respect to flow requirements and water meter sizing. The sizing of the meter will affect the water and wastewater rates. Where a request for a specific meter size is not received, the Town reserves the right to choose the size of water meter to be installed. The builder shall install a wire for an external reading device. See Figures EDCG WAT 4.12 Commercial Water Meter Installation, EDCG WAT 4.13 Residential Multi-Unit and Commercial Water Meter Installation and EDCG WAT 4.14 Commercial Water Meter Installation – Positive Displacement Meter (38mm and up).

4.3.11 Park/Irrigation Service

See Section 10.6.11.

4.4 Figures

Figure EDCG WAT 4.1 Typical 50mm Watermain Flush-Out

Figure EDCG WAT 4.2 Box Insulation Requirements: Services & Mains 150mm & Smaller

Figure EDCG WAT 4.3 Valve Placement at Intersections

Figure EDCG WAT 4.4 Hydrant Details

Figure EDCG WAT 4.5 Hydrant Valve Tie-Back

Figure EDCG WAT 4.6 Hydrant Valve Tie-Back Flanged Valve to Flanged Tee

Figure EDCG WAT 4.7 Water Service Ownership

Figure EDCG WAT 4.8 Pre-Service Connection Detail: Flexible Pipe

Figure EDCG WAT 4.9 Pre-Service Connection Detail: Non-Flexible Pipe

Figure EDCG WAT 4.10 Residential Water Meter Installation (20mm Example)

Figure EDCG WAT 4.11 Residential Multi-Unit Water Meter Installation (20mm Example)

Figure EDCG WAT 4.12 Commercial Water Meter Installation

Figure EDCG WAT 4.13 Residential Multi-Unit and Commercial Water Meter Installation

Figure EDCG WAT 4.14 Commercial Water Meter Installation – Positive Displacement Meter (38mm and up)

4.5 Water Main Tie-in Checklist

(Example only. List to be specific to the development.)

Water System Tie-In / Scheduled Disruption Checklist			
Task	Responsibility		
	Consultant	EPCOR	Contractor
Obtain all required permits from Town (www.canmore.ca)			
Prepare Service Interruption Notice to residents			
Review Service Interruption Notice			
Notify residents of service interruption (minimum 48 hours prior)			
Notify Town of Canmore Engineering, EPCOR & EMS of service interruption and out of service hydrants			
Provision of all hoses, gauges, etc. to facilitate work			
Shut off existing service valves affected by service interruption			
Boundary valve operation for service interruption			
Bag out of service hydrants			
Installation of new cut in tees and valves at tie-in points			
Swabbing new pipe, valves & fittings with superchlorinated water (to AWWA C651)			
Inspection of installation of new cut tees and valves at tie-in points			
Flushing (operation of boundary valves)			
Operation of existing hydrants for flushing			
Operation of new valves and hydrant for flushing			
Choose water discharge location (and de-chlorination method if required)			
Dechlorination			
Turbidity measurements of flushing water			
Bacteriological sample collection after service interruption			
Approval to re-activate mains and services after service interruption			
Re-activation of boundary valves and mains			
Infrastructure installation past tie-in valve			
Bag out of service hydrants			
Onsite infrastructure installation inspection past tie-in valve			
Preliminary flushing (operation of boundary valves)			
Preliminary flushing (operation of onsite valves and hydrants)			
Hydrostatic test			
Pressure gauge readings			
Operation of existing hydrants for water injection during superchlorination			
Superchlorination (to AWWA C651) (commencement measurements)			
Superchlorination concentration measurements (after 24 hours)			
Choose water discharge location (and de-chlorination method if required)			

Water System Tie-In / Scheduled Disruption Checklist			
Task	Responsibility		
	Consultant	EPCOR	Contractor
Flushing (operation of boundary valves)			
Flushing (operation onsite valves and hydrants)			
Dechlorination			
Chlorine concentration measurements			
Turbidity measurements			
Bacteriological sample collection			
Record and distribute water testing results			
Compilation of test results and CCC applications			
Notification that Town has accepted onsite water testing results			
Activation of new waterworks infrastructure and services			

5. SANITARY SEWER

Sanitary sewer system elements not specifically referenced in this document shall be in accordance with the latest edition of the documents listed below in Required Reading.

5.1 Required Reading

- Alberta Environment. *Standard and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems*.
- City of Calgary. *Design Guidelines for Subdivision Servicing*.
- City of Calgary. *Standard Specifications Sewer Construction*.
- City of Calgary. *Wastewater Lift Station Design Guidelines.*
- Town of Canmore. *Sewerage Use Bylaw*, 2015-18.
- Town of Canmore. *Utilities Master Plan, Water and Sanitary*.

5.2 Design Parameters

Any sanitary system or part of a system shall be designed to serve not only the area within the subdivision development boundary, but, in the opinion of the Town engineer, any area which is tributary to the system in accordance with the *Utilities Master Plan* and pertinent documents from the Town of Canmore Engineering Department.

5.2.1 Sewage Flow Generation and Peak Factor

Specific sewage design rates for residential, commercial, industrial or institutional developments or defined land use districts should follow minimum rates shown in the latest edition of the *Utilities Master Plan* or other criteria applicable to specific developments in accordance with good engineering practice. Since peak sewage flows may vary greatly with type and density of development, each case must be considered on an individual basis. Flow demand calculations shall be referenced on the drawings. Direction of flow shall also be shown on the drawings.

Table 5-1 shows the minimum sewage design rates given in the 2017 edition of the *Utilities Master Plan*.

Table 5-1: Sewage Design Rates

Development Type	Minimum Sewage Design Rate
Residential	360 L/c/d (40 persons/developable ha min. for detached residential)
Commercial/Industrial	17000 L/ha/d gross hectares
Hotels	600 L/unit/d

Peaking Factors (Multiplied by Dry Weather Flow Except as Noted)

The peak (population generated) flow for a residential population shall be determined by the following formula:

$$Q_{ppw} = \frac{GxPxPf}{86.4}$$

Where:

Q_{ppw}	=	peak dry weather flow (L/s)
G	=	the per capita average daily design flow (L/c/d)
P	=	the design contributing population in thousands
Pf	=	"a peaking factor"

The peaking factor (Pf) to the larger of 2.5 or Harmon's Peaking Factor where:

Harmon's Peaking Factor	=	1+14 / (4+P ½)
Where P	=	The design contributing population in thousands

Residential	Harmon Formula determination (2.5 minimum)
Commercial, Industrial, Institutional	3.5
Hotel	4.0
Composite	Peak wet weather flow (WWF) = 3.8 x ADWF at WWTP

Extraneous Flow Allowance

The minimum inflow/infiltration outside high groundwater regulated areas shall be 0.284 L/s/ha. The minimum inflow/infiltration within high groundwater regulated areas shall be 0.66 L/s/ha.

Hydraulic Capacity

The capacity of any section of a sanitary line shall be determined based on the portion of the line which has the least slope. The Manning formula shall be used to calculate gravity flow in pipes.

Use Manning's n=0.018 for pipes older than 1980 and n=0.013 for pipes from 1980 and newer.

5.3 Design and Construction of Sanitary Sewer Components

5.3.1 Gravity and Force Main

5.3.1.1 Type

Gravity mains shall be polyvinyl chloride (PVC) with a minimum standard dimension ratio (SDR) 35 unless otherwise accepted by the Town engineer. In areas of high groundwater, fused PVC or high-density polyethylene (HDPE) pipe may be considered for reducing extraneous flow. Clay tile, cast iron or concrete sewer pipes are not permitted.

5.3.1.2 Size

Minimum sizes of public sanitary mains are as follows:

- Residential Subdivision: 200 mm diameter minimum
- Commercail., Multi-family, Mixed Use, Industrial Subdivision: 250 mm diameter minimum; unless the consulting engineer can demonstrate flows and grades justify a smaller diameter.

5.3.1.3 Slopes

Minimum permissible slope for sanitary sewer pipes shall be as per Alberta Environment, *Standards and Guidelines for Municipal Water, Wastewater and Storm Drainage Systems.*

For limited service areas with low flows where the depth of flow at the minimum slope will be less than one third of the pipe diameter for the peak daily design flow, and for curved sewers, increase the minimum slope by 50%.

5.3.1.4 Cover

For gravity mains the minimum cover from crown to finished grade shall be 2.50 m. If the required cover cannot be maintained, insulation, as per Figure EDCG WAT 4.2 Box Insulation Requirements: Services & Mains 150mm & Smaller, or as per manufacturer's recommendations as designed by the consultant, shall be required or as designed by a professional engineer and accepted by the Town.

Force mains shall be designed as for water mains. In streets, lanes, easements and public utility lots (PUL's) the minimum cover from crown to the final grade shall be 2.7 m in clay or silty soils and 3.3 m where the soil is predominantly gravel. If the required cover cannot be maintained, insulation shall be required as per water mains.

5.3.1.5 Placement and Alignment

Sewer main shall be laid as straight as possible. If a simple horizontal curve is required to conform to curved streets, curved sewers may be permitted provided it meets the manufacturers recommendation and with the following restrictions:

- The minimum grade of the sewer shall be increased by 50% throughout the curved section.
- Modification to manhole spacing may be required where sewers are curved.
- The maximum deflection of each pipe shall not exceed manufacturer's specifications.

For all commercial and multi-unit residential sites where deep utility services are to be installed within predominantly clay or other relatively impermeable material such as bedrock, a clay plug shall be installed within the trench backfill adjacent to the site boundary. The clay plug shall be as described in the latest edition of the City of Calgary's *Standard Specifications Sewer Construction*.

5.3.1.6 Extraneous Flow

Where the invert of a sanitary main falls below the 100-year groundwater elevation, or where required by the Town engineer, an inspection for infiltration/exfiltration limits shall be undertaken prior to a Construction Completion Certificate (CCC) being issued. Refer to ASTM D3212 and the City of Calgary's *Standard for Sewer Construction.*

5.3.1.7 Video Inspection

A closed-circuit television (CCTV) video inspection of all sanitary mains shall be undertaken in accordance with the City of Calgary's *Standard Specifications Sewer Construction*. Observations shall be coded in accordance with the NASSCO (National Association of Sewer Service Companies), *Manual of Sewer Condition Classification* or Town approved equivalent.

The CCTV video inspection must be received and accepted by the Town prior to CCC.

5.3.2 Manholes

All manholes and appurtenances shall conform to the City of Calgary, *Standard Specifications Sewer Construction* and City of Calgary, *Design Guidelines for Subdivision Servicing* except as noted below.

- Standard, precast, pre-benched manholes shall be used where possible.
- Sewer inverts through manholes shall be benched to provide directional flow.
- The maximum distance between manholes shall be 120 m. In all cases, a manhole is required at the upper most end of a sewer for flushing and cleaning.

- The invert of services entering manholes shall be less than 760 mm above the outgoing invert. If the drop is greater, a drop structure shall be provided.
- Services greater than 150 mm shall require a manhole where tying to the main.

A continuous mortar bed shall be placed between the top slab, collars and frame as shown on City of Calgary Detail Sheet 38. Mortar shall not be placed solely on the inside face of the collars.

5.3.3 Frames and Covers

Manhole frames and covers shall be manufactured of gray iron or ductile iron castings. Gray iron components shall conform to ASTM A48. Ductile iron components shall conform to ASTM A536.

Proof load testing shall be in accordance with AASHTO M-306 as 'HS-20' loading (178kN).

A certificate of compliance shall be provided to the Town on request. The certificate shall be signed and sealed by a professional engineer, licensed to practice in Canada and qualified in metal and material testing and who has witnessed the testing.

If requested, the manufacturer shall submit to the Town stamped and signed shop drawings with full dimensions and with markings specified.

The castings shall be manufactured to the following tolerances:

- mating parts: less than 50 mm +/- 0.8 mm
- mating parts: 50 mm to 300 mm +/- 1.5 mm
- mating parts: greater than 300 mm +/- 3.0 mm
- other dimensions to 900 mm +/- 3.0 mm

Shallow (150 mm) manhole frames and *Town of Canmore – Sanitary* solid covers or other covers as approved by the Town shall be installed on all sanitary manholes for municipal improvements on public property.

5.3.4 Low Pressure Sanitary System Mains

Development areas in the Town which cannot be adequately or economically serviced by gravity sewer systems may be serviced by low pressure sanitary (LPS) systems where approved by the Town. All LPS systems shall be engineered in accordance with applicable regulations, generally accepted design principles and approved equipment manufacturer's recommendations. Low pressure sewer mains shall be sized to suit the area and type of development to be serviced by the LPS system.

Terms and conditions of the Town of Canmore, *Sewerage Use Bylaw 2015-018* apply to LPS systems. See Section 5.3.8 of the *Engineering Design and Construction Guidelines* (EDCG) for information about LPS system service connections.

5.3.5 Lift Stations

Lift stations are generally located along mains where needed to overcome gravity. The use of lift stations in subdivision design should be minimized whenever possible. Where unavoidable, rationale should be provided describing why no alternative design was viable. The intent of the guidelines in this section of the EDCG is to streamline sanitary lift station design. However, each lift station installation will be reviewed by the Town on a site-specific basis. Detailed design briefs and engineered drawings with completed calculations shall be submitted for review and acceptance by the Town.

Lift stations shall be located, designed and constructed in accordance with the City of Calgary, *Wastewater Lift Station Design Guidelines* and require the following equipment, as a minimum:

- electrical hoist
- heating/ventilation as per Alberta Environment standards
- intermediate floor and clear access
- sub-structure concrete or steel with cathodic protection
- interior lighting
- minimum of two pumps with automatic alternating operation
- 100 mm camlock connection on discharge piping for emergency bypass
- separate check and isolation valves for each pump (ball type check valve, full ported eccentric isolation valve)
- valve operators outside chamber so no access required
- amp meters on all motors over 5 HP
- emergency power, fueled by diesel
- inlet flow metering (continuous) and pump hour meters
- motion detection system (outside lighting)
- outlet flow metering
- pressure gauges and pressure transmitters on the discharge piping.

Table 5-2, below, shows lift station equipment along with approved manufacturers that shall be installed as a minimum, unless otherwise reviewed and accepted by the Town.

Table 5-2: Lift Station Equipment and Manufacturer

Equipment	Approved Manufacturer
Master Control Cabinets	Allen-Bradley
Level Controls	Milltronics
Programmable Logic Controllers	Modicon, Allen-Bradley, ITT Flygt
Electrical Relay/Transfer Switches etc.	Allen-Bradley
Variable Speed Drives	Allen-Bradley
Pumps (submersible, sewage)	ITT Flygt

Programmable logic controller (PLC)/supervisory control and data acquisition (SCADA) systems shall be designed in accordance with the requirements of the Town and utility operator. These standards change as new technologies emerge and as existing facilities in Canmore are upgraded. Contact the Engineering Department for current requirements at the planning stage of new projects.

5.3.6 Service Connections – Gravity Services

5.3.6.1 Size

The pipe diameter and class of pipe used for gravity service connections shall conform to the City of Calgary, *Standard Specifications Sewer Construction*.

5.3.6.2 Cover

Minimum cover for gravity service connections, from crown of pipe to finished grade, shall be 2.50 m. If the required cover cannot be maintained, insulation shall be required as per Figure EDCG WAT 4.2 Box Insulation Requirements: Services & Mains 150mm & Smaller, or as per manufacturer's recommendations as designed by a professional engineer and accepted by the Town.

5.3.6.3 Placement and Alignment

A separation of 0.6 m shall be maintained between individual services along mains. Sanitary services shall be placed a minimum of 2 m off neighboring property lines. Where practical, sanitary services shall be placed below a foundation wall as opposed to boring through the wall.

Bends in gravity services are discouraged. Designers are encouraged to provide straight gravity servicing wherever practical. Gravity servicing with bends will require a variance. A maximum of two 22.5° bends will be allowed only where it can be shown that a practical

methodology for emergency cleanout is possible. Variances will require approval of the Town engineer.

For all multi-family or commercial sites where a sanitary service is to be installed within predominantly clay or other relatively impermeable material such as bedrock, a clay plug shall be installed within the trench backfill adjacent to the property line. The clay plug shall be as described in the City of Calgary, *Standard Specifications Sewer Construction*.

5.3.7 Test Manholes

Test manholes shall be required on sanitary sewer services from commercial and industrial establishments where wastewater discharges containing restricted or prohibited materials is possible. These test manholes shall facilitate sampling and testing of the wastewater from these premises. Inspection and testing shall be in accordance with the Town of Canmore, *Sewerage Use Bylaw 2015-18*. See figures at the end of this section for a typical detail of a test manhole.

5.3.8 Service Connections – Low Pressure Sanitary System Services

Service connections to an existing low pressure sanitary (LPS) system shall comply with the design criteria developed for that system. The design criteria may be obtained upon written request from the Engineering Department. Terms and conditions of the Town of Canmore, *Sewerage Use Bylaw 2015-18* apply.

Applications for connection shall be made using the forms appended to this section. All conditions for the LPS system shall be completed as stated in the schedule appended.

Private system owners shall be responsible for all operation and maintenance of private grinder pump systems including and not limited to all replacement costs.

5.3.8.1 Size

Low pressure sanitary system service connections shall be a minimum of 38 mm copper tube sizing (CTS) HDPE with a minimum pressure rating of 1,100 kPa (160 psi) from the LPS main to the building connection.

5.3.8.2 Cover

Minimum cover from crown of pipe to finished grade shall be 2.7 m in clay, 3.3 m in granular soils. If the required cover cannot be maintained, insulation shall be required as per Figure EDCG WAT 4.2 Box Insulation Requirements: Services & Mains 150mm & Smaller, or as per manufacturer’s recommendations as designed by a professional engineer and accepted by the Town.

5.3.8.3 Placement and Alignment

A horizontal separation of 0.6 m shall be maintained between individual services along mains. Sanitary services shall be placed a minimum of 2 m off neighboring property lines.

5.3.8.4 Curb Stop Component

The curb stop shall have an adjustable cast iron service box with stem as per City of Calgary, *Standard Specifications Sewer Construction*.

The curb stop shall conform to Town of Canmore specifications for water service connections except that it will have *Sanitary* printed on the curb stop.

5.3.8.5 Grinder Pumps

Connections to LPS systems shall be with a grinder pump system capable of solids grinding and appropriate dynamic head to deliver contents under a wide range of pressure conditions.

The pumping chamber (sump) shall be manufactured from HDPE, fiberglass reinforced pipe (FRP), sulfate-resisting concrete or other approved corrosion-resistant material. The sump shall be protected from freezing, be leak-proof and resist the infiltration of groundwater. The sump shall be sealed and vented in accordance with the Plumbing Code. For a typical detached dwelling unit, the net pump-out capacity of the collection sump (tank) should not exceed 500 L. The total pump-out capacity of the sump shall be larger and include reserve storage capacity for power outages, etc. For homes with above-average water consumption (due to installations of hot tubs, swimming pools, etc.), or for multi-unit residential developments, a professional designer should be consulted for proper sump sizing.

Grinder pumps designed for a LPS system application shall be manufactured by Environment One, Hydromatic, Meyers or equal approved by the Town engineer with a design capacity of 41 L/min at 27 m (11 US gpm at 90 ft.) total dynamic head. The pump shall be capable of intermittent operation at pressures at least 25% above and 50% below the design rating.

The pump shall be complete with controls to automatically start and stop the pump at pre-selected liquid levels in the sump.

The discharge piping shall include unions or couplings that allow the pump to be disconnected for servicing or repair. The discharge piping shall also include a double check valve, shutoff valve and pressure gauge within the building or access chamber.

5.3.9 Service Connections – Existing Systems

Upon redevelopment of previously serviced lots where the sanitary service is not PVC, a new PVC service to the main shall be installed at the expense of the developer. The new service shall be on the same alignment as the existing service and, may utilize the existing service tie-in at the main if the existing connection is of acceptable material and in good condition. Existing pre-formed junctions on the main shall be utilized with a suitable transition fitting. Existing strap-on saddles shall be removed and replaced to suit the new PVC service pipe.

If not replacing the existing service along the original alignment, the old service shall be terminated at the main at the expense of the developer.

In general, sanitary sewer services greater than thirty years of age are to be replaced by developer/builder.

If the property owner/developer does not think a service needs to be replaced, the gravity sanitary sewer service must be CCTV-video inspected by a qualified contractor, and the video provided to the Town. If, following service inspection or review of video footage, the Town deems that the existing service is in good condition, is adequately sized and is insulated or at adequate depth below frost, the service does not have to be replaced. However, the property owner shall execute a *Service Replacement Exemption Letter*, a copy of which can be obtained from the Town Engineering Department.

When an existing service pipe is composed of a material other than PVC, a service replacement exemption will be considered by the Town engineering, as above.

5.3.10 Abandonment of Existing Services

All terminations of existing services require a Demolition Permit, unless otherwise approved as part of a development or building permit application, and a Road Use and Excavation Permit and shall be witnessed by the Town, the utility operator or an authorized professional acting on behalf of the Town, or the developer's consultant.

Sanitary sewer services shall be abandoned as follows:

1) The service line shall be excavated and removed from the main to the property line.
2) If the service line is not completely removed within the property, the service line shall be cut at property line and the private service sealed with a watertight cap or plug if the service material is PVC. If the service line is composed of a material other than PVC, the service pipe shall be plugged with a non-shrink grout.
3) If the service material at the main is PVC, the terminated service shall be capped. If the service material is vitrified clay pipe (VCP) or other material, the stub shall be covered with a plastic cap. Capping of sanitary lines is preferred; grouting of pipe will be considered on a case-by-case basis by the Town.

4) If the service is a LPS service, the main stop shall be closed and a 300 mm length of service pipe shall be left in place and sealed with a watertight cap. If the service pipe is not removed on the private property, the curb stop shall be removed and the service pipe plugged with a plug with the same pressure rating as the pipe.

5.4 Figures

Figure EDCG SS 5.1 Standard Sanitary Lateral Cleanout

Figure EDCG SS 5.2 Commercial/Industrial Sanitary Inspection Chamber

6. STORMWATER

It is important that designers and others treat these guidelines as a tool to assist them and not as a rulebook for stormwater management solutions. There are many site-specific issues that affect development and stormwater management planning. Although these guidelines provide practical and specific guidance, there must be flexibility to account for site-specific conditions. Stormwater management solutions are location dependent and this must be recognized when applying the guidance provided in this document.

Stormwater shall be treated as a resource. As opposed to the traditional capture, detain and release approach, development teams are encouraged to harvest, reuse, and re-infiltrate stormwater as much as is practical to the site. In undermined areas, alternative approaches to infiltration may need to be considered.

An integrated planning and design approach will be required for stormwater management. An integrated approach acknowledges expertise in environmental and land-use planning, aquatic and terrestrial ecologies, and water chemistry in addition to the more traditional disciplines of municipal engineering and surface and sub-surface water resources. This approach requires a higher degree of interdisciplinary interaction between land-use planners, engineers, landscape architects and environmental scientists at the earliest stages of a project. Details of design that are normally provided at the building permit (BP) stage or field fit, may be required at earlier stages of design.

Low impact development storm management and techniques shall be used whenever practical, particularly reducing the imperviousness of the site. Please visit the following website for information about low impact development techniques - http://www.alidp.org/

Developers are encouraged to use stormwater systems that reduce the amount of manufactured infrastructure required. Developers are encouraged to harness the slope of the land. Where practical, natural materials and organics are to be used as filtering media.

6.1 Required Reading

- Alberta Environment. *Standards & Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems*. Latest edition.
- Alberta Environment. *Municipal Policies and Procedures Manual*. Latest edition.
- City of Calgary. *Stormwater Management & Design Manual*. Latest edition.
- Town of Canmore. *Central Stormwater Study*. Prepared by Mountain Engineering Ltd. December 2003 (Revised January 2006).
- Town of Canmore. *Canmore Stormwater Master Plan*. Prepared by Westhoff Engineering Resources & Klohn Crippen Consultants. March 2005.

- Other stormwater management reports specific to respective developments (as part of area structure and area redevelopment plans, subdivision applications) as available from the Town or respective developer.

6.2 Referenced Reading

- City of Calgary. *Stormwater Management and Design Manual*.
- Fisheries and Oceans. *Land Development for the Protection of Aquatic Habitat*. September 1993.
- National Research Council. *National Guide to Sustainable Municipal Infrastructure: Conveyance & End of Pipe Measures for Stormwater Control*. 2004.
- National Research Council. *National Guide to Sustainable Municipal Infrastructure: Source and Onsite Controls for Municipal Drainage Systems*. 2004.
- National Research Council. *National Guide to Sustainable Municipal Infrastructure: Stormwater Management Planning*. 2004.

6.3 Conceptual Planning

6.3.1 Hierarchical Approach

Stormwater management planning for subdivisions and developments shall be based on a hierarchical approach. This entails working from the watershed to the sub-watershed to the subdivision and finally down to the site level. The hierarchical approach acknowledges the linkage and interdependence of community planning to stormwater management planning at all levels. This is particularly important when designing legal boundaries of new subdivisions. When subdividing large tracts of land, development teams are encouraged to seek out boundaries that complement the existing hydrology and existing stormwater aspect of the site. Parcel selection should complement the existing or planned infrastructure.

The following four key aspects of stormwater systems need to be addressed.

1) Quantity

In addition to reducing erosion implications, stormwater designs shall minimize the potential for downstream flooding and ponding. A wide spectrum of rainfall events shall be accounted for and it must be shown that smaller storms are kept on site as stipulated in this chapter.

2) Quality

Stormwater designs shall reduce contaminant loading from urban storm drainage to meet current removal requirements of Alberta Environment.

3) Erosion and Sediment Control

All stormwater designs shall incorporate erosion and sediment control (ESC) measures as the City of Calgary standards.

Stormwater management shall be designed and constructed such that downstream erosion is prevented.

4) Hydrologic Cycle

Stormwater management shall be designed in accordance with the principles of the hydrologic cycle. Stormwater designs shall try to mimic the original characteristics of the site hydrology. Please note that in some literature, this aspect of stormwater management is also known as base flow maintenance.

6.3.2 Design

Any stormwater system design shall strive to balance the following goals:

- comply with current editions of Alberta Environment, *Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage* and the City of Calgary's *Stormwater Management Design Manual*
- consider principles of sustainability discussed in this section
- minimize the potential risks to persons and property within the development boundaries
- minimize inconvenience caused by surface ponding and flooding
- identify trapped low areas and place caveats on affected lots
- mitigate potential for downstream flooding and erosion
- conform to the relevant accepted stormwater management master plan for the area
- reduce contaminant loading from urban storm drainage and industrial runoff discharges by the use of best management practices
- design pretreatment and infiltration facilities to operate under cold climate conditions and to be protected from damage due to frost
- not pump stormwater unless it forms part of a progressive system for rainwater harvesting or as otherwise deemed acceptable to the Town engineer
- grade lots in such a way that quantity and velocity of surface runoff is minimized, and infiltration and detention is maximized throughout the site (as is practical)
- include acceptable stormwater management techniques that direct runoff to an acceptable drainage system for lots that are lower than adjacent roadways
- direct runoff from an event that cannot be infiltrated to an appropriate stormwater system
- keep runoff from flowing onto / across pedestrian walkways or multiuse pathways as is practical
- provide an overland flow outlet for major storm events that will reduce detrimental impacts of affected properties.
- sustain sites, pre-development hydrologic regime by using techniques that infiltrate, filter, store, and evaporate stormwater runoff close to its source.

- utilize plants to support phytoremediation by helping to contain, degrade, or eliminate pollutants and mitigate contamination of soil, water, and air.

6.3.3 Stormwater Management in High Groundwater Conditions

In instances (developments and subdivisions) where high groundwater exists, the Town reserves the right to ask for a geotechnical investigation to address specific issues of groundwater including highest anticipated groundwater level and lowest footing elevation for each lot.

6.3.4 Stormwater, Grading and Landscaping Relationship

Developers must be aware of the relationship between stormwater, grading and landscaping. These disciplines will need to work together. Stormwater management will dictate the grading, and landscaping will be dictated by both of these factors. Development teams are encouraged to bring these three disciplines together at the early stages of the project in accordance with the integrated planning and design approach to ensure one cohesive design. It is recognized that compromises may be required to maintain a balance with existing policies and guidelines.

6.4 Design and Construction of Stormwater Management Components

6.4.1 Runoff Coefficients

The average runoff coefficient shall be weighed according to the amount of each type of area tributary to a given inlet. Values of coefficients should be in accordance with standard values from the City of Calgary's *Stormwater Management Design Manual*.

6.4.2 Dual Drainage Concept

For all sites, storm drainage shall be designed on the basis of minor and major systems.

Minor systems include components such as roof leaders, gutters, lot drainage, underground pipe systems (if applicable), and on-site infiltration. Minor systems provide a basic level of service by conveying flows during minor storm events. In Canmore, the 1:5-year, 1-hour event shall be used for design of minor systems.

Major systems include components such as lot drainage, roads, gutters, and storage facilities. Major systems convey runoff from the extreme events in excess of the minor system capacity. In Canmore, the City of Calgary stormwater criteria shall be used for design of major systems. Extended-period modeling may be required for larger developments, as directed by the Town.

Provisions shall be made for overland drainage during frozen ground conditions or over-saturation of the infiltration zone.

6.4.3 Design of Small Sites in the Valley Bottom

Small (detached dwellings and duplexes) and medium sized developments located on the valley bottom shall generally follow a “treatment, then infiltrate” approach to deal with stormwater runoff (see Figure EDCG STM 6.1 500m OGS Infiltration Zone). Design calculations shall follow the steps as outlined in Section T.M 2.8 of the Town of Canmore’s 2005 *Stormwater Master Plan*. Stormwater details shown in Figures EDCG STM 6.2 Rain Garden: Full Infiltration (Typical Section) and EDCG STM 6.3 Typical Drainage Well are to be used for infiltration of the site stormwater runoff. Installation of the weeping tile itself and the soakaway pit shall form part of the infrastructure inspections by the Town.

6.4.4 Design of Large Sites

For sites 2.0 ha and larger (or where required by the Town engineer), an overland flow analysis shall be provided for all new subdivisions and for all redevelopment sites in Canmore. The Town will require detailed computer modeling to be carried out to define the complete system, including depth of flow and velocity along the conveyance route, as well as the behavior of trap-lows and their interaction with storm sewers. Stormwater runoff determination for all new areas shall be made using a unit area release rate approach unless otherwise specified in a Stormwater Management Master plan accepted by the Town.

6.4.5 Surcharged Pipe Storage

Surcharged pipe storage is discouraged in the Town of Canmore. However, with approval from the Town engineer, storage tanks can be used. For example, rain tank systems and Brentwood Industries StormTank Modules are acceptable.

6.4.6 Infiltration Systems

Infiltration systems shall address and show the 100-year groundwater elevation, lowest parkade elevation, lowest floor elevation, lowest footing elevation and geotechnical infiltration rates as applicable. Infiltration systems shall be placed with a minimum of 0.6 m clearance (from the lowest horizontal plane of the system) from the 100-year groundwater elevation as is practical.

In redevelopments, designers shall strive to re-infiltrate the first 19 mm/day of runoff in the 1:5-year event.

6.4.7 Infiltration Facilities

An infiltration rate of $8x10^{-4}$ m/s has typically been used in the lower valley area of Canmore, unless the site-specific geotechnical testing shows otherwise. An infiltration rate based on 24-hour sustained saturated condition, may be used to calculate infiltration area requirements. The rate shall be based on in-situ tests performed at the proposed infiltration site, or on conservative values based on similar soils and laboratory testing. A suitable reduction factor dependent on finished site conditions shall be applied to the infiltration rate to account for possible future sediment build up and clogging. Where the peak runoff rate is greater than the adjusted infiltration rate, buffer storage shall be provided.

Detention storage volume, where required for infiltration purposes, shall include only the drywell volume and effective porosity of the drain rock around the drywell that is located above the 1:100-year groundwater elevation. For infiltration tanks, the basin bottom and side area shall be used to calculate the required area. For drywells, the drain rock circumference times height shall be used to calculate the required area.

Pretreatment best management practices (BMP) shall be used to reduce solids input to an infiltration system and to capture hydrocarbons. In the wellhead protection zone, additional treatment to remove pollutants may be required by the Town. These treatment processes may include vegetative filters, sumps, detention storage, oil-grit-separators (OGS) etc.

Capability for inspection and maintenance (access ports and entrances) shall be provided for all infiltration facilities.

6.4.8 Stormwater Ponds

Detailed information on stormwater ponds shall be submitted to the Town with an application. See Alberta Environment's *Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage System* for further information.

The following minimum parameters shall be used for the design of dry pond facilities:

- design discharge rate (storage capacity): pre-development 1:5-year storm runoff rate (i.e., capture and treatment of the 1:5-year storm event based upon a storm of 12-hour duration with a minimum 25 mm depth over the development area)
- overflow spillway capacity: post-development 1:100-year storm event
- emergency spillway capacity: greater than post-development 1:100-year storm event.

Dry pond facilities shall have a pre-treatment sump for sediment removal and an armored inlet and outlet structure.

Discharge and conveyance of pond flows shall not cause erosion of natural or man-made drainage systems downstream. Top slopes shall be wide enough to provide a safe and stable work area able to accommodate maintenance vehicles and personnel. All interior

surfaces of the pond shall be protected from erosion and, where possible, vegetated with suitable plant types to promote the removal of stormwater pollutants. The pond shall be signed at appropriate intervals advising of the maximum water depth, dangers of flash flooding, and prohibiting public use for consumption or bathing. Ponds shall have filtered outlets for low flow release that will drain the 1:5-year storm in a period of 48 hours. Ponds with a discharge located within 500 m of any natural water course shall incorporate an approved OGS unit, or other water quality enhancement BMP acceptable to the Town, prior to discharge to the water course.

6.4.9 Outfalls

All stormwater runoff from subdivision and site development areas shall be managed prior to discharge for both water quality and quantity control to minimize the adverse impact on the environment. Design of outfalls into any watercourse shall be submitted for review and acceptance by the Town, Fisheries and Oceans Canada, and by Alberta Environment.

6.4.10 Culvert End Details

Culvert inlet and outlet details shall typically be constructed per the latest edition of the Alberta Transportation *Highway Geometric Design Guide*, as detailed in figure C-4.7, Hand Laid Rock Riprap. Also refer to Alberta Transportation's *Highway Geometric Design Guide*, Section C-4 for culvert installation guidelines.

The consultant may request to exclude the installation of a clay seepage seal if they believe it would provide negligible benefit due to coarse granular native soils and intermittent flow. Such requests are subject to the Town's approval.

Rock supplied for riprap shall be local, hard, durable, angular in shape, resistant to weathering and water action, clean and shall meet the following Class 1 gradation:

- 0% larger than 450 mm
- 20–50% larger than 350 mm
- 50–80% larger than 300 mm
- 100% larger than 200 mm

Small outfalls (300 mm and smaller) with low outlet velocities may be proposed with smaller gradations.

Rip rap shall be placed on a geotextile.

6.4.11 Piped Systems

Storm sewers shall be designed as a separate sewer system. Effluent from sanitary sewers or any potentially contaminated drainage from industrial, agricultural or commercial

operations shall not be discharged to storm sewers. Contaminated drainage means the introduction of any foreign or undesirable physical, chemical or biological substance into the environment which results in or is likely to result in deleterious effects.

Storm sewers shall be designed and constructed in accordance with the City of Calgary's *Stormwater Management and Design Manual* and the City of Calgary's *Standard Specifications Sewer Construction*.

The minimum size for a public storm sewer is 300 mm diameter in low-density residential subdivisions and 375 mm diameter in multi-family, commercial and industrial subdivisions. There is an exception to these minimum sizes for weeping tile roadway drains, which typically vary from 100 mm to 250 mm diameter.

6.5 Best Management Practices

Stormwater best management practices (BMPs) are methods of managing stormwater drainage for adequate conveyance and flood control that are economically acceptable to the community. Stormwater BMPs are management methods that retain as much of the natural runoff characteristics and infiltration components of the undeveloped system as possible and reduce or prevent water quality degradation.

Stormwater BMPs are normally looked at as five levels of control. All stormwater systems shall address these five levels of control, as noted below. It is generally accepted that the cost of control measures increases as they get farther from the source. As such, the order in which these BMP control measures should be addressed is the same order in which they are listed below (starting closest to the source). In addition to the Town of Canmore *Stormwater Mater Plan*, designers are encouraged to review the documents referenced in Section 6.1 of the EDCG for more details regarding these controls. All stormwater BMPs require acceptance by the Town.

6.5.1 Five Levels of Best Management Practices Control

1) Pollution Prevention

Pollution prevention involves public education, awareness and participation, in addition to regulations, enforcement, and application of bylaws. Developers should have literature summarizing the specifics of the private stormwater management system that is to be included with the purchase of the detached dwellings and duplex units. This literature should be made available to the governing bodies that represent a conglomerate of units such as a condominium board. The literature must specify a recommended maintenance schedule along with a description of what type of inspections will be required.

2) Source Controls

Source controls are measures designed to minimize the generation and entry of pollutants into stormwater runoff. Emphasis is on non-structural and semi-structural measures applied at or near the source. Examples of source controls include:

- minimizing the sediment that is used in the winter for ice control
- minimizing pollutant content for salt/sediment used on ice
- catch basin cleaning
- use of environmentally friendly de-icing agents
- runoff separation: runoff that has not travelled across a vehicle carriage way will not require pretreatment and can be infiltrated directly into the ground.

3) Lot Level Best Management Practices

Lot level BMPs are practices that reduce runoff volumes and/or treat stormwater before it reaches a municipal conveyance system. These controls can be either structural or non-structural in nature and applied at the individual lot level or on multiple lots that drain a small area. Typically, these techniques would be implemented on individual dwelling lots or for small commercial/industrial lots.

4) Conveyance Best Management Practices

Conveyance BMPs are measures that mitigate the impacts of urbanization when conveying runoff such as promoting soil moisture replenishment, groundwater recharge and infiltration, where practical. Conveyance systems for both the minor and major systems shall be low energy overland flow where practical. Designers are reminded that runoff needs to be of a quality so that it does not negatively affect the groundwater. Stormwater conveyance systems transport drainage from developed areas through sewer or grassed swale systems.

5) End of Pipe Best Management Practices

End of pipe BMPs provide flow attenuation, major flow conveyance, and water quality enhancement of stormwater before discharge into a receiving water body. A number of end-of-pipe alternatives are available for application depending on the characteristics of the upstream catchment, and the regulations and requirements for water quality in the receiving waters. End of pipe practices that provide extended detention reduce the rate of stormwater discharge by storing the stormwater runoff temporarily and releasing it at a controlled rate. Water quality treatment is provided through enhanced settling and biological processes.

6.6 Maintenance

The consultant shall be responsible for providing the Town with a suggested maintenance schedule for all treatment facilities on private lands as well as those on right-of-ways (ROWs). The maintenance schedule should suggest the frequency for replacement of filters for all components that are meant to filter runoff and for all filter mediums. There should also be a suggested schedule for the removal of sediment and any other maintenance

requirements to ensure the treatment facilities are functioning properly with maximum efficiency.

6.7 Figures

Figure EDCG STM 6.1 500m OGS Infiltration Zone

Figure EDCG STM 6.2 Rain Garden: Full Infiltration (Typical Section)

Figure EDCG STM 6.3 Typical Drainage Well

7. TRANSPORTATION SYSTEMS

The Town of Canmore's 2018 *Integrated Transportation Plan* (ITP) provides strategic direction for how to accommodate current and future transportation needs. This section provides guidelines for the design and construction of roadways, pathways and developments in support of achieving the goals outlined in the ITP.

In order to accommodate expected growth in a manner consistent with community values, the ITP provides vision and guiding principles. This vision includes achieving a 40% non-vehicular share of travel trips in the Town Centre during peak season. The guiding principles of the ITP have informed development of this guideline.

7.1 Layout and Connectivity

The layout, classification and connectivity of a newly planned subdivision is subject to approval of the Engineering Department. Road and pathway networks should coincide with the layout shown under the applicable statutory document, to ensure logical ties to adjacent subdivision areas. If the adjacent street system has not been developed, interim access arrangements must be provided to accommodate walking, cycling, transit and driving. Where new development is not connected to the existing or planned active transportation and transit network, the developer shall be responsible for providing or improving off-site connectivity to connect the development. Where a broader community benefit can be demonstrated, a cost share with the municipality may be considered.

The following criteria are to be incorporated into the layout of streets during subdivision, in addition to criteria outlined in Figure EDCG STR 7.1 Design Elements for Urban Thoroughfares.

Network Planning

Intersecting roads should be as near to 90° as possible. Intersection angles of less than 75° will not be accepted by the Town. Intersections on the inside of curves are undesirable and should be eliminated wherever possible. A minimum standard corner cut of 4.5 m by 4.5 m, or as stipulated by the Town, will be provided at all intersections.

Where new commercial and mixed-use areas are being planned, a street-oriented pattern of development with high-quality pedestrian realm is encouraged. This is characterized by buildings that are built to minimum setbacks with building entrances directly on the street, prioritizing walking, cycling and transit activity over driving. Vehicular access is typically from side streets or lanes to create an uninterrupted pedestrian realm. In these areas, access to the rear of properties is encouraged through the provision of lanes.

In general, high-quality built form and an uninterrupted pedestrian realm are encouraged to create inviting public spaces. In newly-developing areas that consist primarily of residential land uses of medium to higher densities, access to properties (including any rear-fronting

developments) shall be provided via lanes rather than fronting driveways. In newly-developing residential areas that feature rear-fronting developments, access shall be provided via private mews of a reduced right-of-way width compared to local roadways. In new areas that consist of detached residential housing with no accessory dwelling units or rear-fronting developments, consideration will be given to front driveway accesses to the adjacent local roadway.

Topography may influence the layout of roadway networks, and the above guidelines may be adapted to meet local contexts, as determined in collaboration with the Town.

Where there are existing natural features in newly planned areas, neighbourhood layout should planned to maximize public access to these features. Natural features should be used as focal points within the community and should be leveraged to enhance community and neighbourhood designs.

Transit Considerations

Convenient and universally accessible pedestrian connections shall be provided between planned transit infrastructure and adjacent origins and destinations. Where future transit service has not yet been identified in developing areas, road designs should provide consideration for the retrofitting of transit infrastructure within the road environment, and particularly with respect to how transit infrastructure will interact with space for walking, cycling and automobile travel. Infrastructure layout and rights-of-way should be designed to include the space required for future transit stops.

Walking and Cycling

Where a new area is being developed outside of the 2018 ITP's All Ages and Abilities Cycling Network, street and block layout should encourage efficient and direct pedestrian and bicycle travel to the transportation network and destinations. An understanding of how an existing area functions in terms of place and movement will enable the proposed points of connection and linkage to be identified, both within and from the site, so that desire-lines are achieved. This is especially important when traversing mountainous terrain.

New cycling routes should be laid out in an efficient manner with regard to topography and shall strive to maintain connectivity and directness. Routes that require multiple road crossings, abrupt T-junctions, turns, dog-legging and sudden changes of elevation (particularly where susceptible to ice build-up) should be avoided.

The transportation network shall be highly permeable for walking and cycling trips, and to provide access to transit infrastructure. Where roads may be discontinuous, connectivity shall be provided for active transportation trips to minimize circuitous routing and longer trip lengths. A walking and cycling break-through point between buildings shall be provided no less frequently than every 100 m on each block (or every 125 residential units, whichever is the lesser value) to provide connectivity for shorter trips.

In some cases, pathways outside of the road right-of-way may provide the most direct active transportation connections between newly developing areas and the established active transportation network. Opportunities should be identified to create direct pathway linkages to support active transportation trips and recreational opportunities. The provision of separate pathways will not replace the need to provide active transportation infrastructure within the road right-of-way but should be viewed as an opportunity to provide a well-connected network that serves the overall community.

Universal design principles shall be adhered to for all elements of the pedestrian realm to facilitate year-round access to public infrastructure and spaces. Where there are limitations to this, alternate means of access shall be provided. Best practices in cycling design shall be applied in the development of new or retrofitted cycling infrastructure. Recommended "desirable" standards identified within the *Alberta Bicycle Facilities Design Guide* shall be used as a minimum standard, unless otherwise approved by the Town.

Public Realm

High quality streetscapes are encouraged where an approved plan exists and in other locations, subject to approval by the Town. The design of the public realm should strive to create a sense of place and establish opportunities and spaces for social gathering, community activities and events. Elements such as benches and seating nodes, bicycle parking, waste receptacles, landscaping, public art, opportunities for place-making and play are encouraged. More information of architectural and urban design standards can be found within the Land Use Bylaw.

7.2 Street Design

Roadway cross sections are provided for general guidance and represent an ideal for new construction. Street designs are to be developed in consultation with the Engineering department where site specific conditions such as topography and network design warrant a deviation from the guidelines presented. There may be contexts (such as retrofitting missing infrastructure into an existing corridor) where it may be appropriate to accommodate all required elements as part of a rural cross-section, based on existing drainage patterns and infrastructure.

Beyond the direction provided in this guideline, reference can be made to the following geometric design guides. Where this guideline and the following differ, the EDGC is to take precedence unless otherwise approved by the Town:

- Bylaw 2014-06: *Traffic and Road Use Bylaw* (Consolidated 2017-04-11)
- Transportation Association of Canada. *Geometric Design Guide for Canadian Roads* (2017 Metric Edition)
- Alberta Transportation and Utilities: *Highway Geometric Design Guide*
- *Alberta Bicycle Facilities Design Guide*
- Association of Pedestrian and Bicycle Professionals: *Essentials of Bike Parking*

- City of Calgary: *Access Design Standards*
- Safety Codes Council: *Barrier-free Design Guide*
- City of Calgary: *Universal Design Principles*
- City of Edmonton: *Access Management Guidelines*
- Applicable local standards

7.3 Road Classification

7.3.1 Public Realm

In urban areas, the space adjacent to the carriageway is known as the public realm. This is the public space along a street where people can walk, sit, cycle, wait for transit and interact with each other. The public realm is comprised of:

- The boulevard (or furnishing zone) where infrastructure such as streetlights, benches, bike racks, and landscaping are located adjacent to the curb. The furnishing zone may be primarily hardscaped in busy commercial environments, or it may consist of landscaping materials, which play an important role in snow storage and infiltration. Intermittent parking bays may also be accommodated within this space along local and collector roadways.
- The active transportation zone is located adjacent to the boulevard (or furnishing zone). This is the space where people can walk or cycle along a corridor, free of obstructions. The size of the active transportation zone that is required to accommodate people walking depends on the roadway classification and adjacent land uses, as outlined in sections 7.3.2, 7.3.3 and 7.3.4.
- The frontage (or buffer) zone is located between the active transportation zone and building faces or property lines. It provides people walking with an offset from adjacent buildings, and provides clearance from doors opening outwards, etc.

Details on how to accommodate these elements into various roadway classifications is outlined in Sections 7.3.2, 7.3.3 and 7.3.4, and Figures EDCG STR 7.3 Local Residential (ULU 50) Parking Both Sides Cross-Section, EDCG STR 7.4 Local Rural Residential Parking Both Sides Cross-Section, EDCG STR 7.5 Collector (UCU 50) Parking Both Sides Cross-Section and EDCG STR 7.6 Arterial (UAD 50) No Parking Cross-Section.

7.3.2 Local Roads

Local roads provide direct access to abutting residential properties. They collect and distribute trips from residential properties to collector roads. Public transit may occasionally operate along sections of local road (see Figure EDCG STR 7.3).

Table 7-1 provides a summary of design values for local roads. More context regarding the application of these values can be found in the sections following.

Table 7-1: Local Road Quick Reference Table

Design Element	Value
Target Road Capacity	2000 vehicles per day
Design Speed	30km/h
Posted Speed	30km/h
Driving Surface Width*	5.5m (no lane differentiation)
Sidewalk Width	1.8m
Boulevard Width	2.2m
Parking Bay Width**	1.95m

*Measured from lip of gutter
**Measured from back of concrete invert crossing to face of curb (see EDCG STR 7.3)

Local roads are expected to carry volumes up to 2000 vehicles per day. Local roads may be used to connect development to the core cycling network. Vehicle speeds, grades, road maintenance, volumes, street design, parking use and turnover, passing opportunities, and road length will be considered in approvals.

Design speeds of 30 km/h should be used for local roads. Speed limits shall be posted at 30 km/h. The driving surface width shall be 5.5 m, with no lane differentiation (6 m from face or curb to face of curb).

Under certain contexts and at the discretion of the Town, consideration may be given to the application of a rural cross-section for local roadways, as shown in Figure EDCG STR 7.4 Local Rural Residential Parking Both Sides Cross-Section.

Walking

Local roads shall have 1.8 m wide concrete sidewalks on both sides. Next to parking bays, sidewalks may be constructed monolithically with the curb and gutter adjacent to the parking bay. Monolithic sidewalk shall be a minimum width of 2.3 m. Decorative treatments or materials may be considered on a case by case basis by the Town where they fit in with an approved streetscape design.

Sidewalks shall be separated from driving surfaces by a curb and gutter and by a minimum 2.2 m wide boulevard to accommodate snow storage, parking, lighting and landscaping. Where parking is provided on only one side of the street, a 2.0 m minimum boulevard width may be allowed on the opposite side of the street, subject to review and approval by the Town.

Next to parking bays, sidewalks should be constructed monolithically with the curb and gutter adjacent to the parking bay. When a midblock pedestrian crossing is required, it shall

be placed where there are no parking bays, such that the maximum distance crossed by a pedestrian is the width of the travel lanes (5.5 m).

Universal design principles shall be adhered to for all elements of the pedestrian realm, to facilitate year-round access to public infrastructure and spaces. The City of Calgary's *Universal Design Handbook* provides guidance on universal design principles. Where this guide differs from the *Universal Design Handbook*, this guide shall take precedence.

Cycling

Cycling on local roads will be accommodated in shared-use lanes. Vehicle volumes and speeds on these roads should be low (less than 500 vehicles per day, with fewer than 50 vehicles in the peak hour). Network design and traffic calming elements may be applied in order to achieve target vehicle volumes and speeds, in accordance with best practices identified in the *Alberta Bicycle Facilities Design Guide*.

Where local roads are identified on the cycling network, connectivity must be provided to other cycling routes, and necessary cycling connections must be facilitated across intersections and roads.

Public Transit

Where transit operates along a local road, bus stops shall be provided within the boulevard, and stopping may be accommodated within the travel lane. Where transit operates along a local road, new or retrofitted infrastructure should meet universal design principles and should tie into adjacent walking and cycling infrastructure.

New transit stops should include a fully accessible concrete pad in addition to a shelter, garbage and recycling bin, bench, "next bus" signage and bicycle parking as determined by the Town. All new transit stops shall include pedestrian level lighting, in accordance with Section 7.7 of the EDCG. Pocket easements may be required for the accommodation of transit stop infrastructure outside of road right-of-way, and as such must be considered at each stage of the planning approval process, whether stops are built during the initial phases of a new development or added later by the Town.

Where transit operations will interact with cycling infrastructure, best practices in cycling design should be applied, as outlined in the *Alberta Bicycle Facilities Design Guide* (2018).

Where there is no existing transit service and new road networks are being developed, street designs should provide consideration for the retrofitting of transit infrastructure within the road cross-section.

Parking

On-street parking is encouraged on both sides of the street and must be accommodated within parking bays. Parking bays may be interspersed with street trees, landscaping, as well as street lighting. Parking bays may be placed either as opposing parking bays on both sides of the street or on alternating sides of the street and should accommodate a maximum

of 3–5 vehicles. Parking bays shall be separated from travel lanes by a 0.5 m wide concrete invert crossing and shall be 1.95 m wide from the back of the concrete invert crossing to the face of curb. Standard curb with 250 mm reverse gutter shall be used between the edge of the parking bay and adjacent sidewalk.

Access, Layout and Intersections

Rights-of-way for local roads shall be 15.3 m wide where parking is provided on both sides of the road. Where parking is provided on only one side of the road, right-of-way widths may be reduced, at the discretion of the Town. A 3.5 m wide utility right-of-way must be provided on both sides of local road rights-of-way to accommodate utility requirements except where it can be demonstrated that utility requirements can otherwise be accommodated based on approved street and utility designs.

Intersections with collector or arterial side streets may be controlled by roundabouts, stop or yield signage, or signals as determined by a transportation engineer. Intersections with other local roadways may be controlled by yields or four-way stops, as determined by a transportation engineer. Traffic calming measures, such as raised crossings, and raised intersections, are to be considered at all intersections and crossings and in particular areas with higher volumes of pedestrian activity, and areas where speed compliance may be a concern.

At intersections, corner radii shall be designed to the minimum value as demonstrated to operate acceptably by a transportation engineer. Table 7-2 outlines design and control vehicles for local roadways. Exceptions may apply and should be discussed at the time of the pre-application meeting. Control vehicles may have larger turn radii than design vehicles and may be accommodated using aprons or space from adjacent lanes where deemed appropriate by a transportation engineer, and to the satisfaction of the Town. In addition to the design and control vehicles below, intersection geometry shall include accommodation for walking and cycling, and shall adhere to universal design principles.

For further details on the design vehicles below, refer to TAC GDG Section 2.4.

Table 7-2: Design Vehicles by Roadway Classification

Street Classification	Design Vehicle	Control Vehicle	Control Vehicle Allowable Encroachments
Local Road	Passenger Car	Waste Collection Truck, School Bus, Fire (Ladder) Truck, Medium Single Unit Truck	Maneuver within hard surfaced areas. Minimum 0.3m clearance to pavement edge and any vertical obstructions.

In new areas with street-fronting residential development, properties shall use private mews to access local roads as opposed to each having separate driveways abutting a local street.

Direct access may be permitted to residential properties where mews are not available, subject to review and approval by the Town. See Section 7.4 of the EDCG for design considerations where front driveways are permitted access to a local road. Minimum acceptable intersection spacing is 60 m between centerlines.

Restrictions

Offset intersections are generally discouraged but may be considered on a case-by-case basis along residential streets if the offset is 60 m or greater between centrelines, subject to review and approval the Town. Where this is the case, provisions should be made for providing direct active transportation connections through the area.

Culs-de-sac

A cul-de-sac must provide a 5.0 m PUL or MR to provide walking and cycling connectivity through the end of the bulb to tie into adjacent facilities, except where it can be demonstrated that there will be no future connections within (or beyond) an ASP area.

Maximum cul-de-sac lengths must account for emergency access requirements, as outlined in NFPA 1141 and the Calgary Fire Department Access Standard.

7.3.3 Collector Roads

Collector roads collect and distribute trips from residential, commercial and industrial areas. They distribute travel from neighbourhood to neighbourhood within the community and serve secondary trip generators, such as from schools, community business centers, parks, sports fields, etc. Public transit may operate along collector roads within the community (see Figure EDCG STR 7.5 Collector (UCU 50) Parking Both Sides Cross-Section).

Table 7-3 provides a summary of design values for collector roads. More context regarding the application of these values can be found in the sections following.

Table 7-3: Collector Road Quick Reference Table

Design Element	Value
Target Road Capacity	< 10,000 vehicles per day
Design Speed	30km/h
Posted Speed	30km/h
Travel Lane Width*	3.0-3.3m
Boulevard Sidewalk Width**	1.8m
Boulevard Width	2.8m
Unidirectional Bike Path Width	2.3m
Parking Bay Width***	1.95m

*Measured from lip of gutter
**Except where adjacent to on-street parking (see Walking section)
***Measured from back of concrete invert crossing to face of curb

Travel lane widths for collector roads shall be 3.3 m to the lip of the gutter where two opposing travel lanes are adjacent. Where there is separation between opposing travel lanes, minimum lane widths of 3.0 m (to the lip of the gutter) may be considered acceptable to the Town, providing that it can be demonstrated that there will be no mirror overhang into adjacent walking/cycling refuge space by design or control vehicles.

Consideration may be given to the application of a rural cross-section for collector roadways, subject to review and approval by the Town. All of the same elements must be provided within road right-of-way, as are identified on Figure EDCG STR 7.5.

Walking

Collector roads shall have 1.8 m wide concrete sidewalk on both sides. Decorative treatments/materials may be considered by the Town on a case by case basis, where they fit in with an approved streetscape design.

Next to parking bays (and where not adjacent to cycling infrastructure), sidewalks may be constructed monolithically with the curb and gutter adjacent to the parking bay. Monolithic sidewalk shall be a minimum width of 2.3 m. Where monolithic sidewalk is provided next to parking in a school zone (and where not adjacent to cycling infrastructure), sidewalks should be a minimum width of 2.5 m.

Sidewalks should be separated from driving surfaces by a curb and gutter and a minimum 2.8 m wide boulevard to accommodate parking, snow storage, lighting and any landscaping. Where sidewalks are adjacent to bike paths, see boulevard requirements under the Cycling sub-section, below.

Midblock pedestrian crossings shall be placed where there are no parking bays such that the maximum distance crossed by a pedestrian does not exceed the width of the travel lanes.

Universal design principles shall be adhered to for all elements of the pedestrian realm to facilitate year-round access to public infrastructure and spaces. The City of Calgary's *Universal Design Handbook* provides guidance on universal design principles. Where this guide differs from the *Universal Design Handbook*, this guide shall take precedence.

Cycling

Where a collector road is identified as part of the *2018 Integrated Transportation Plan's* All Ages and Abilities Cycling Network, cycling shall be accommodated on unidirectional (raised) bike paths. Unidirectional bike paths shall be a minimum width of 2.3 m to accommodate side-by-side cycling, unless otherwise approved by the Town. There may be certain contexts under which a section of bidirectional bike path may be considered through road right-of-way, to accommodate connectivity and desire lines, however this must be reviewed on a case-by-case basis by the Town and must ensure that conflicts with intersections, driveways and accesses are minimal or absent.

Bike paths shall be separated from the driving surface with space to accommodate buffering, parking, snow storage, lighting and landscaping (default of 2.8 m), except where accepted by the Town that buffering requirements cannot physically be met. Where parking bays are constructed adjacent to separated cycling infrastructure, a minimum hard-surfaced buffer of 0.6 m shall be provided from the back of curb to the edge of the cycling facility.

Where a collector road is identified as part of the cycling network, connectivity must be provided to nearby cycling routes and necessary cycling connections must be facilitated across intersections and roads.

Bike routes should be designed in accordance with best practices as identified in the *Alberta Bicycle Facilities Design Guide*.

Utility appurtenances shall be located outside of bikeways and paved roadway shoulders accessible to cyclists whenever possible. Appurtenances within these areas shall be “bike-safe” models with top elevations set flush with or slightly below (4 mm maximum) the surrounding pavement surface.

Under certain conditions, along a new collector road that is identified as a cycling route, and where separated walking and cycling facilities do not yet exist, consideration may be given to providing a 3.5 m shared-use pathway as a first stage of construction, subject to review and approval by the Town. Additional boulevard width, appropriately graded and structured to accommodate the eventual widening and separation of walking and cycling modes, would be provided adjacent to the pathway. Threshold levels for determining walking and cycling volumes that warrant separation are available within the *Alberta Bicycle Facilities Design Guide*.

Where reduced widths of bike path or shared-use path are proposed, expected volumes of people walking and/or cycling shall be provided through a Transportation Impact Assessment, based on the infrastructure required to achieve mode share targets in the Integrated Transportation Plan, as well as adjacent land uses and planned connectivity to the cycling network.

Public Transit

Transit may operate along collector roads within the community. Transit stops may be accommodated within travel lanes along collector roads. Where transit operates along a collector road, new or retrofitted infrastructure should meet universal design principles and should tie into adjacent walking and cycling infrastructure.

New transit stops must include a fully accessible 3 m x 12 m concrete pad in addition to a shelter, garbage and recycling bin, bench, "next bus" signage and bicycle parking as determined by the Town. See Figure EDCG STR 7.8 Collector Concrete Bus Stop Layout. All new transit stops shall include pedestrian level lighting, in accordance with Section 7.7 of the EDCG. Pocket easements may be required for the accommodation of transit stop infrastructure outside of road right-of-way, and as such must be considered at each stage of

the planning approval process, whether stops are built during the initial phases of a new development or added later by the Town.

In some cases, transit infrastructure may be integrated into the frontage of new developments (on private property) with a Public Access Easement.

Where transit operations will interact with cycling infrastructure, best practices in cycling design should be applied as outlined in the *Alberta Bicycle Facilities Design Guide*.

Where there is no existing transit service and new road networks are being developed, street designs should provide consideration for the retrofitting of transit infrastructure within the road cross-section.

Parking

On-street parking is encouraged on collector roads and must be accommodated with parking bays. Parking bays may be interspersed with street trees, landscaping and street lighting in the boulevard. Parking bays may be placed as opposing parking bays on both sides of the street or on alternating sides of the street and should accommodate a maximum of 3-5 vehicles per parking bay.

Parking bays shall be separated from travel lanes by 0.5 m wide concrete invert crossing and shall be 1.95 m wide from the back of the concrete invert crossing to the face of curb. Standard curb with 250 mm reverse gutter shall be used between the edge of the parking bay and adjacent sidewalk.

Access, Layout and Intersections

Rights-of-way for collector roads shall be 22 m wide. A 3.5 m wide utility right-of-way must be provided on both sides of local road rights-of-way to accommodate utility requirements except where it can be demonstrated that utility requirements can otherwise be accommodated based on approved street and utility designs.

Intersections with other collector or arterial roads may be controlled by roundabouts, stop or yield signage, or signals, as determined by a transportation engineer. Intersections with local roads may be controlled by yields or four-way stops, as determined by a transportation engineer. Raised crossings or intersections or both should be considered at all intersections and crossings and applied at key crossing locations, areas with higher volumes of pedestrian activity, and areas where speed compliance may be a concern. Raised crossings and intersections ramp the roadway up to the elevation of paths and sidewalks.

At intersections, corner radii shall be designed to the minimum value as demonstrated to operate acceptably by a transportation engineer. Table 7-4 outlines design and control vehicles for collector roadways. Exceptions may apply and should be discussed at the time of the pre-application meeting. Control vehicles may have larger turn radii than design vehicles and may be accommodated using aprons or space from adjacent lanes where deemed appropriate by a transportation engineer, and to the satisfaction of the Town. In

addition to the design and control vehicles below, intersection geometry shall include accommodation for walking and cycling, and shall adhere to universal design principles.

For further details on the design vehicles below, refer to TAC GDG Section 2.4.

Table 7-4: Design Vehicles by Roadway Classification

Street Classification	Design Vehicle	Control Vehicle	Control Vehicle Allowable Encroachments
Collector Road	Single-unit Bus, Passenger Car	School Bus, Fire (Ladder) Truck	Manoeuvre within hard surfaced areas. Minimum 0.3m clearance to pavement edge and any vertical obstructions.

Crosswalks shall be placed where there are no parking bays, such that the maximum distance crossed by a pedestrian is the width of two travel lanes (6.6 m). Where space permits, 3 m wide pedestrian refuges (median islands) may be provided at crosswalks, which will require a reduction of the boulevard/parking/furnishing zone in the vicinity of the refuge to accommodate vehicle travel lanes.

Where cycling facilities are provided, a "protected intersection" shall be designed to mitigate conflict zones.

Minimum acceptable intersection spacing is 100 m between center lines.

Along collector roads planned with street-fronting development, and where existing layout permits, properties shall endeavor to use common lanes or local roads to access properties as opposed to providing direct access to a collector road. Where no lane or local road is available, direct access may be permitted to properties, subject to review and approval by the Town.

For additional information on access, refer to Section 7.4 of the EDCG.

7.3.4 Arterial Roads

Arterial roads facilitate mobility and longer distance travel, tying into the collector road network. Arterial roads serve the major trips between principle areas of trip generation with relatively few controlled access points. Transit may operate along arterial roads within the community (see Figure EDCG STR 7.6 Arterial [UAD 50] No Parking Cross-Section).

Table 7-5 provides a summary of various design values for arterial roads. More context regarding the application of these values can be found in the sections following.

Table 7-5: Arterial Road Quick Reference Table

Design Element	Value
Target Road Capacity	15,000 vehicles per day
Design Speed	50km/h
Posted Speed	50km/h
Travel Lane Width*	3.3m
Sidewalk Width:	
Commercial or high-activity areas	3.0m
Pedestrian-oriented** roadways	2.5
Non-pedestrian-oriented roadways	1.8m
Boulevard/Furniture Zone Width	3.0m
Unidirectional Bike Path Width	2.5m
Parking Bay Width***	-

*Measured from lip of gutter
**Pedestrian-oriented roadways feature buildings and site designs that are human-scaled and that encourage interaction with the surrounding pedestrian realm.
***Measured from back of concrete invert crossing to face of curb

Travel lane widths for arterial roads shall be 3.3 m to the lip of the gutter. Where there is separation between opposing travel lanes, and under constrained conditions, minimum lane widths of 3.0 m (to the lip of the gutter) may be considered acceptable to the Town, providing that it can be demonstrated that there will be no mirror overhang into adjacent walking/cycling refuge space by design or control vehicles. Median separation may be provided intermittently along arterial corridors, to provide refuge at pedestrian crossing locations, or to accommodate turn bays at intersections. Emergency access must be considered in the layout/frequency of medians, to allow emergency vehicles opportunities to pass queued traffic.

Vegetative boulevard and medians should be designed to accommodate a balance of trees, storm specific landscaping and bio filtration where possible.

Consideration may be given to the application of a rural cross-section for arterial roadways, subject to review and approval by the Town. All of the same elements must be provided within road right-of-way, as are identified on Figure EDCG STR 7.6.

Walking

Planning and design of the pedestrian realm is related to anticipated levels of pedestrian activity within different contexts and based on adjacent land uses. The following dimensions are provided for sidewalk facilities, and reflect pedestrian clear zones exclusive of signage, street furniture and any other obstacles to pedestrian travel:

- Commercial or high-activity areas shall have a 3.0 m boulevard sidewalk on both sides of the road.
- Street-oriented arterial roads shall have a 2.5 m boulevard sidewalk on both sides of the road.
- Non-street-oriented arterial roads shall have a 1.8 m boulevard sidewalk on both sides of the road.

Sidewalks should be separated from curb and gutter by a minimum 3.0 m wide boulevard or furniture zone. In a commercial or high-activity street the furnishing zone may be predominantly hardscaped. Where a sidewalk is adjacent to a bike path, see boulevard requirements under the Cycling subsection, below.

Marked pedestrian crossings shall include median refuge islands that allow pedestrians to cross one direction of travel at a time.

Universal design principles shall be adhered to for all elements of the pedestrian realm to facilitate year-round access to public infrastructure and spaces. The City of Calgary's *Universal Design Handbook* provides guidance on universal design principles. Where this guide differs from the *Universal Design Handbook*, this guide shall take precedence.

Cycling

Where an arterial road is identified as part of the *2018 Integrated Transportation Plan's* All Ages and Abilities Cycling Network, cycling shall be accommodated on unidirectional (raised) bike paths. Unidirectional bike paths shall be a minimum width of 2.5 m to accommodate side-by-side cycling, unless otherwise approved by the Town. There may be certain contexts under which a section of bidirectional path may be considered through road right-of-way, to accommodate connectivity and desire lines, however this must be reviewed on a case-by-case basis by the Town and must ensure that conflicts with intersections, driveways and accesses are minimal or absent.

Bike paths shall be separated from the driving surface by adequate space within the boulevard or furniture zone to accommodate transit stops, snow storage, landscaping and lighting (default of 3 m), except where accepted by the Town that buffering requirements cannot physically be met.

Where an arterial road is not identified as part of the cycling network, a 3.5 m wide shared-use path shall be provided on both sides of the road to accommodate walking and cycling trips.

Bike routes should be designed in accordance with best practices identified in the *Alberta Bicycle Facilities Design Guide.*

Utility appurtenances shall be located outside of bikeways and paved shoulders accessible to cyclists whenever possible. Appurtenances within these areas shall be "bike-safe" models

with top elevations set flush with or slightly below (4mm maximum) the surrounding pavement surface.

Under certain conditions, along an arterial road that is identified as a cycling route, and where separated walking and cycling facilities do not yet exist, consideration may be given to providing a 3.5 m shared-use pathway as a first stage of construction, subject to review and approval by the Town. Additional boulevard width, appropriately graded and structured to accommodate the eventual widening and separation of walking and cycling modes, would be provided adjacent to the pathway. Threshold levels for determining walking and cycling volumes that warrant separation are available within the *Alberta Bicycle Facilities Design Guide*.

Where reduced widths of bike path or shared-use path are proposed, expected volumes of people walking and/or cycling shall be provided through a Transportation Impact Assessment, based on the infrastructure required to achieve mode share targets in the Integrated Transportation Plan, as well as adjacent land uses and planned connectivity to the cycling network.

Public Transit

Transit may operate along arterial roads within the community. Where transit operates along an arterial road, new or retrofitted infrastructure should meet universal design principles and should tie into adjacent walking and cycling infrastructure.

New transit stops must include a fully accessible 3 m x 12 m concrete pad in addition to a shelter, garbage and recycling bin, bench, "next bus" signage and bicycle parking as determined by the Town. All new transit stops shall include pedestrian level lighting, in accordance with Section 7.7 of the EDCG. Pocket easements may be required for the accommodation of transit stop infrastructure outside of road right-of-way, and as such must be considered at each stage of the planning approval process, whether stops are built during the initial phases of a new development or added later by the Town.

In some cases, transit infrastructure may be integrated into the frontage of new developments within an easement area.

Where transit operations will interact with cycling infrastructure, best practices in cycling design should be applied as outlined in the *Alberta Bicycle Facilities Design Guide*.

Where there is no existing transit service and new road networks are being developed, street designs should provide consideration for the retrofitting of transit infrastructure within the road cross-section.

Parking

On-street parking will not be provided along arterial roads. Where a street-oriented context permits, the provision of any on-street parking shall be limited to parking bays.

Parking bays may be interspersed with street trees, landscaping and street lighting and should typically accommodate a maximum of 3–5 vehicles. Each bay shall be separated from travel lanes by a 0.5 m concrete invert crossing and shall be 2.25 m wide from the back of the concrete invert crossing to the face of the curb. Standard curb with 250 mm reverse gutter shall be used between the edge of a parking bay and any adjacent sidewalk.

Access, Layout and Intersections

Rights-of-way for arterial roads shall be 30 m wide. A 3.5 m wide utility right-of-way are to be provided on both sides of local road rights-of-way to accommodate utility requirements except where it can be demonstrated that utility requirements can otherwise be accommodated based on approved street and utility designs..

Intersections with other arterial roads may be controlled by roundabouts or signals, as determined by a transportation engineer. Intersections with collector or local roadways may be controlled by two-way yields, two-way stops, signals or roundabouts, as determined by a transportation engineer.

At intersections, corner radii shall be designed to the minimum value as demonstrated to operate acceptably by a transportation engineer. Table 7-6 outlines design and control vehicles for arterial roads. Exceptions may apply and should be discussed at the time of the pre-application meeting. Control vehicles may have larger turn radii than design vehicles and may be accommodated using aprons or space from adjacent lanes where deemed appropriate by a transportation engineer, and to the satisfaction of the Town. In addition to the design and control vehicles below, intersection geometry shall include accommodation for walking and cycling, and shall adhere to universal design principles.

For further details on the design vehicles below, refer to TAC GDG Section 2.4.

Table 7-6: Design Vehicles by Roadway Classification

Street Classification	Design Vehicle	Control Vehicle	Control Vehicle Allowable Encroachments
Arterial Road	Single-unit Bus and Passenger Car	School Bus, WB-21	Encroachment into adjacent lanes in same direction at major intersections (opposing lanes at minor intersections).

Pedestrian refuges shall be provided at crosswalks. Where cycling facilities are provided, a "protected intersection" shall be designed to mitigate conflict zones, in accordance with best practices.

Direct access to arterial roads should be limited and efforts should be made to minimize the proliferation of accesses along arterial roads. Where the opportunity exists, access to arterial roads should be from a lane or side street.

For additional information on access, refer to Section 7.4 of the EDCG.

7.3.5 Lanes, Mews and Emergency Access Roads

Lanes provide the following functions in the Town's transportation system:

- providing direct and emergency access between residential, commercial or mixed-use properties and the adjacent roadway network
- providing direct and emergency access to reverse housing properties that front onto lanes in established areas.

Mews are publicly accessible private roads that provide a similar function to lanes in terms of providing direct and emergency access to residential properties. They are intended to provide a comfortable walking environment for people accessing residential properties that front away from the adjacent roadway network. Mews are designed to a higher standard than lanes, and typically include traffic calming features (e.g. chicanes) and lighting levels equivalent to a local road. Higher quality finishes are encouraged.

Emergency access roads provide emergency access routes to residential or other isolated development areas. These lanes or roads are connections between other roads and are used when the primary access is cut off during an emergency. They may also serve as alternative evacuation routes in case of major emergencies or natural disasters. They are usually closed to all except emergency traffic but should allow for walking and cycling connectivity.

Emergency access requirements will be reviewed and determined on a case-by-case basis. The City of Calgary's *Fire Department Access Standard* (2018) shall be used as guidance for emergency access, in addition to other applicable guidelines (including the National Fire Protection Association 1141 guidelines), or as determined by the Canmore Fire Chief to appropriately meet standards of safety and the best interests of the community. Emergency access roads are discouraged in favor of lanes or streets.

Walking and Cycling

No specific infrastructure is required for people walking and cycling in a lane.

In existing neighbourhoods, where an accessory dwelling unit fronts onto a lane, a minimum 1m wide hard-surfaced walking connection with pedestrian level lighting must be provided from the fronting street to the rear development fronting onto the lane (though the development site).

In newly developing areas, residential properties that front away from the street shall face onto private mews rather than a lane. Walking and cycling are accommodated on a shared driving surface, which is traffic calmed with features such as chicanes to encourage low driving speeds. Pedestrian-level lighting should be provided.

Parking

Parking is not allowed within the right-of-way of a lane, mews or emergency access road.

Access and Layout

Lanes provide access to abutting residential, commercial and mixed-use properties.

Private Mews provide access to adjacent residential properties that feature rear-fronting developments (such as accessory dwelling units).

Emergency access roads that provide access to local or collector streets must have removable or knock-down bollards at entry points to allow emergency access and permeability by pedestrians and cyclists. The use of gates is not permitted. Access from properties abutting an emergency access road is not permitted.

Turnaround facilities for fire trucks are encouraged along lanes, mews and emergency access roads, particularly in cases where one end of the lane, mews or emergency access road is not visible from the other end.

Right-of-Way and Carriage Width

Lanes must meet the following design parameters:

- Lanes must have a minimum 6m right-of-way and must be designed to maintain a 6 m clear working space for emergency response where abutting development.
- The entire lane width must have a load bearing capacity of 38,556 kg (85,000 lbs.) or greater.
- All newly constructed lanes shall be paved.
- Lanes in existing areas that provide access to commercial land, parkade entrances or development fronting onto the lane shall be paved.
- For lanes longer than 150 m, lay-bys may be required at the discretion of the Town.

Private Mews must meet the following design parameters:

- Mews should be designed within a 9 m right-of-way or larger, except where it can be demonstrated that shallow utilities cannot be accommodated within a 6 m right-of-way width.
- Mews must be hard-surfaced. Higher quality decorative finishes are encouraged, to create a welcoming pedestrian environment.
- Where mews serve an emergency access purpose, they must have a load bearing capacity of 38,556 kg (85,000 lbs.) or greater.

Emergency access roads must meet the following design parameters:

- 6 m right-of-way minimum and possibly wider, if utilities are present. Refer to Section 4.3.2 Easements, Legal Requirements and Implications. Turns in emergency access roads shall be constructed to provide sufficient width to accommodate the largest piece of fire apparatus available to be operated within the road (a ladder truck). The swept path for this design vehicle must be demonstrated along the proposed alignment prior to development approval.
- The road must have a paved width of 6 m with a load bearing capacity of 38,556 kg (85,000 lbs.) or greater, unless otherwise approved by the Fire Chief.

Restrictions

The layout of lanes should be designed to prevent possible shortcutting, which could result in later requests for closure. Maximum lengths of lanes between exits to streets shall not exceed 150 m.

7.4 Access Management and Design

The following principles shall be applied to the layout and design of access to development sites, which are subject to review and approval by the Town. Separation distances between accesses and intersections shall be based upon the City of Edmonton's *Access Management Guidelines.* Where there is a discrepancy between the City of Edmonton's *Access Management Guidelines* and the principles outlined in the EDCG, the EDCG shall take precedence.

Emphasis shall be placed on preserving or enhancing the character of the street and the pedestrian realm through the design of access. Accesses shall be located and designed to minimize conflicts with pedestrians, cyclists, transit and other automobiles.

Existing accesses shall be consolidated where possible and shared access between sites should be provided to minimize the number of intersections along the fronting road. Beyond requirements for emergency access, multiple access points to a single site shall be minimized or avoided. Along roads with street-fronting mixed-use and commercial development, and where a rear lane exists, access should be provided from the lane rather than the fronting street to minimize interruption to the pedestrian realm. In newly-developing areas that consist primarily of residential land uses, access to rear-fronting developments should be provided via private mews of a reduced right-of-way width compared to local roadways. In newly-developing areas that consist of detached residential housing with no accessory dwelling units or rear-fronting developments, consideration will be given to front driveway accesses to the adjacent local roadway. In general, high-quality built form and an uninterrupted pedestrian realm are encouraged to create inviting public spaces.

For development sites that front onto arterial roads and flank collector (or local) roads, access shall be provided from the side street, rather than the arterial road. For development sites that front onto collector roads and flank local roads, access shall be provided from the local road.

Where access is permitted onto a fronting road, access shall align with opposing intersections or driveways (if possible) and shall provide adequate distance between all-turns and right-in/right-out accesses, as outlined in the City of Edmonton's *Access Management Guidelines.* Where a new access may result in operational issues or conflicts with pedestrians, cyclists or automobiles as a result of existing development patterns, access may be limited to right-in, right-out only, subject to review and approval by the Town.

Where an access crosses a sidewalk or bike path, it shall be designed to include the following elements:

- The sidewalk and bike path surface shall maintain their longitudinal grade (no ramping) as they intersect with the driveway surface.
- The cross-slope of the sidewalk and bike path shall be designed to a maximum of 2% where the driveway crosses them.
- The sidewalk and bike path shall be maintained in the same surface material through the driveway.
- Aprons of a minimum 2 m width shall be provided on the driveway in a contrasting material (e.g. concrete, asphalt, paving stones or other differently-coloured material) on both sides of the sidewalk and bike path to emphasize the crossing location.
- Where road elevation and site grading permit, the driveway surface shall ramp up to cross the sidewalk and path, and ramp down on the far side of the sidewalk and path. Designers should give consideration to ramp slope and length to effectively reduce vehicle speeds without resulting in vehicles bottoming out.
- Where an access crosses a bike route, sightlines shall meet the recommended guidelines within the *Alberta Bicycle Facilities Design Guide*.

Accesses shall not exceed maximum slopes as identified in the “Driveway Grades” detail in the City of Calgary’s Roads Construction Standard Specifications, to ensure that vehicles do not bottom out, with the exception of accesses to underground parkades. Below grade driveways shall not exceed a maximum of 10% grade for a minimum distance of 5 m into the site, to ensure adequate sightlines for exiting vehicles before crossing a sidewalk.

Access to development along Bow Valley Trail shall conform to the recommendations D.A. Watt Functional Planning Study (2005), unless otherwise approved by the Town. Where there is a discrepancy between this functional planning study and the City of Edmonton’s *Access Management Guidelines*, the functional study shall take precedence.

7.5 Low Impact Design

Low Impact Design (or Green Infrastructure) is a common term to broadly describe the watershed-scale approach to development using natural features and systems. Where existing or future topography presents the opportunity to integrate low impact design into a roadway cross-section, these opportunities should be pursued as part of the design process, in collaboration with the Town of Canmore, as per the guidelines and standards outlined in Section 6.

7.6 Pathways

Pathway Network

Pathways should conform to the latest edition of the Town of Canmore's *Open Space and Trails Plan* and are subject to review by the Town. Pathways may sometimes provide the

most direct connections between newly developing areas and the established active transportation network. Opportunities should be identified to create direct linkages to support active transportation trips and recreational opportunities. These opportunities should consider existing and potential future desire lines based on existing and planned origins and destinations, connectivity to transit and the overall transportation network.

Incorporating prominent vistas and highpoints should be considered during the design of pedestrian/cycling routes.

Pathway Design

Pathways shall be designed in accordance with best practices, as identified in the *Alberta Bicycle Facilities Design Guide*. See Figures EDCG STR 7.9 Typical Shared-Use Path Cross-Section - Asphalt Surface, and EDCG STR 7.10 Typical Shared-Use Path Cross-Section - Gravel/Clay Surface.

Pathways should be orientated and cross sloped in a way that takes advantage of the sun's rays to maximize the time the trails are dry with minimal maintenance. Pathways that are shielded from the sun will be prone to developing ice build-up, and drainage and outfall locations should be designed to mitigate this.

A spun polyester root barrier shall be provided on all sides of the pathway. Modular tree root barrier protection panels (2 mm thick polypropylene, or equivalent) may be installed on both sides of pathways as an alternate means of inhibiting root damage.

Bidirectional asphalt shared-use pathways shall be a minimum of 3.5 m wide. Pathways where higher numbers of people walking and cycling are expected may be designed up to 4.0 m wide.

Corner radii for pathways should be designed according to best practices in cycling design, as identified in the *Alberta Bicycle Facilities Design Guide*. Additional design considerations for pathways should include the accommodation of maintenance equipment, which require minimum corner radii of 3 m to enable snow clearing.

Pathways shall be separated from the road by a minimum of 2 m and shall be above or equal to the road elevation, especially at crossings, driveways and accesses, unless otherwise approved by the Town. See Section 7.4 of the EDCG for more information.

Sightlines approaching intersections and crossing points shall meet the recommended guidelines within the *Alberta Bicycle Facilities Design Guide*. Landscaping, signage, fencing or other elements should be reviewed at the time of pathway design.

Where pathways interact with transit, best practices shall be applied as identified in the *Alberta Bicycle Facilities Design Guide*.

Pathway surfacing shall be consistent with the Town's *Open Space and Trails Plan*, subject to review and approval by the Town.

7.7 Street and Path Lighting

Street and path lighting should be in accordance with IES standards for street lighting.

7.8 Off-Street Parking

Off-street motor vehicle and bicycle parking shall be provided as per the requirements of the Town of Canmore's *Land Use Bylaw*. Any parking studies required by the Land Use Bylaw shall be based upon a Terms of Reference approved by the Town of Canmore and shall be informed by the direction set by the Town's Integrated Parking Management Plan. Transportation Impact Assessments shall be based on the City of Calgary's Transportation Impact Assessment Guidelines, with additional context based on local conditions and the strategic direction set by the Integrated Transportation Plan.

All off-street parking areas shall provide high quality and continuous connections for people walking and cycling through the site. Desire lines shall be accommodated between walking and cycling accesses to the site, bicycle parking areas and building entrances. Elements such as raised crossings within the parking lot are encouraged.

The layout and design of all bicycle parking shall, at minimum, meet the recommended standards as identified within the Association of Pedestrian and Bicycle Professionals' *Essentials of Bike Parking* document. Any bicycle parking to be installed by a developer within road right-of-way shall require review and approval by the Town prior to installation. The Association of Pedestrian and Bicycle Professionals' *Bicycle Parking Guidelines* document provides additional detail on the positioning of bike racks within public spaces. Bicycle racks positioned within road right-of-way must ensure that parked bicycles can be accommodated within the furnishing zone, and do not encroach on the active transportation zone, as identified in Figures EDCG STR 7.3 Local Residential (ULU 50) Parking Both Sides Cross-Section, EDCG STR 7.4 Local Rural Residential Parking Both Sides Cross-Section, EDCG STR 7.5 Collector (UCU 50) Parking Both Sides Cross-Section and EDCG STR 7.6 Arterial (UAD 50) No Parking Cross-Section.

Developers shall allow for stormwater needs in all aspects of design and site layout, in accordance with the standards and guidelines contained in Section 6 of the EDCG. Where there are opportunities to integrate low impact design into an off-street parking lot, these opportunities should be pursued as part of the design process, in collaboration with the Town. Preference shall be given to low impact design stormwater management over traditional grey stormwater management techniques (piped/channeled storm systems).

Signage for on-street parking bordering new developments must be submitted with development applications and is subject to review and approval by the Town.

Simple vehicular access shall be provided to and from the development site (maximum 3 point maneuvers to enter and exit).

Automobile Parking Design Standards

Minimum dimensions for the design of parking areas shall be as shown in Table 7-7. The design standards in Table 7-7 are a composite, assuming a general mix of large and small vehicles. Where the mix of vehicles differs from the general mix, alternative dimensions may be required, to the satisfaction of the Town. Barrier-free parking stalls shall be provided in accordance with the Alberta Building Code. Best practices that are based on the Alberta Building Code are also provided within the City of Calgary's Access Design Standards, and the Safety Codes Council's Barrier-Free Design Guide, which should be applied to the layout of barrier-free parking areas during site design.

A loading space shall be designed and located so that all vehicles using that space can be parked and maneuvered entirely within the bounds of the site before moving onto adjacent streets. A loading space shall be:

- A minimum width of 3.1 m.
- A minimum depth of 10.0 m.
- Maintain a minimum overhead clearance of 4.3 m.

Parking stall dimensions shall be clear of all obstructions, other than wheel stops.

- Parking stalls abutting a physical barrier shall be a minimum width of 3.1 m.

Parking facilities for oversize vehicles, propane-powered vehicles and other special parking facilities may be required by the Town.

Driveways, loading spaces and bus parking stalls shall be designed to allow for adequate turning radii and movement within the site and be demonstrated by indicating appropriate vehicle sweep paths.

Table 7-7: Design Standards for Parking Areas

Stall Width	Parking Angle	Aisle Width (A)	Stall Depth Perpendicular to Aisle (D)	Stall Width Parallel to Aisle	Half Parking Module (D+A)	Parking Module (2D+A)
Dwelling Units						
2.50 m	90 degrees	7.20 m	5.40 m	2.50 m	12.60 m	18.00 m
2.50 m	75 degrees	6.12 m	5.64 m	2.59 m	11.76 m	17.40 m
2.50 m	60 degrees	4.82 m	5.49 m	2.89 m	10.31 m	15.80 m
2.50 m	45 degrees	4.00 m	5.00 m	3.54 m	9.00 m	14.00 m
Other Developments						
2.60 m	90 degrees	7.20 m	5.40 m	2.60 m	12.60 m	18.00 m
2.60 m	75 degrees	6.12 m	5.64 m	2.69 m	11.76 m	17.40 m
2.60 m	60 degrees	4.82 m	5.49 m	3.00 m	10.31 m	15.80 m
2.60 m	45 degrees	4.00 m	5.00 m	3.68 m	9.00 m	14.00 m

The maximum grade of a parking stall shall not exceed 8% in any direction. Parking dimensions for parking angles between 75 degrees and 45 degrees shall be calculated using a straight-line interpolation between dimensions shown in Table 7-7.

7.9 Figures

Figure EDCG STR 7.1 Design Elements for Urban Thoroughfares

Figure EDCG STR 7.2 Road Classification

Figure EDCG STR 7.3 Local Residential (ULU 50) Parking Both Sides Cross-Section

Figure EDCG STR 7.4 Local Rural Residential Parking Both Sides Cross-Section

Figure EDCG STR 7.5 Collector (UCU 50) Parking Both Sides Cross-Section

Figure EDCG STR 7.6 Arterial (UAD 50) No Parking Cross-Section

Figure EDCG STR 7.7 Parking Bay

Figure EDCG STR 7.8 Collector Concrete Bus Stop Layout

Figure EDCG STR 7.9 Typical Shared-Use Path Cross-Section - Asphalt Surface

Figure EDCG STR 7.10 Typical Shared-Use Path Cross-Section - Gravel/Clay Surface

Figure EDCG STR 7.11 Typical Street Sign Installation

8. SHALLOW UTILITIES

The design and installation of shallow utilities in the Town of Canmore shall be guided by the current adopted version of the City of Calgary's *Design Guidelines for Subdivision Servicing* and the design guidelines and standards produced by service providers.

Guidelines for the design and installation of street lighting are currently under review. In the interim please contact the Town engineer for requirements.

The following information is supplementary to the above-mentioned documents.

8.1 Application Process

When submitting a development permit application for a large development, the developer is required to provide a detailed shallow utility plan for each phase of development for review by the Town engineer and for use by the shallow utility providers. The shallow utility plan shall show the location of all underground and aboveground facilities relative to existing and proposed surface works and landscaping.

The developer shall coordinate with the shallow utility providers for design approval. The shallow utility providers shall submit utility line assignment (ULA) requests to the Town engineer for review and acceptance. The developer is responsible for the costs associated with the design, approvals process and installation of shallow utilities.

The developer is responsible for providing rights-of-way, easements registered in the name of the Town of Canmore or public utility lots to accommodate the servicing. The tentative legal plan and utility right-of-way plan, together with the utility right-of-way agreements are to be submitted to the Town for acceptance prior to submittal to Land Titles for registration. All instruments shall be registered on the affected lots prior to the sale of any lot in the development area.

The developer and shallow utility providers are responsible for identifying the requirements for federal and provincial permitting. The developer and shallow utility providers shall prepare, submit and pay all costs associated with these applications.

In areas of infill development and redevelopment where aerial facilities exist, developers or homeowners may wish to relocate existing poles, anchors, transformers, etc. In these cases, the applicant shall request a preliminary design from the appropriate service provider which is forwarded to the Town for review. Should the Town agree to the work in principle, the applicant will be required to provide the design details to affected property owners and register their consent. The Town will identify the scope of property consents required and will approve the ULA request only if 100% of owners surveyed consent to the work.

8.2 Design

All new installations shall be underground. For isolated rural applications where the installation of buried services is not practical, aerial infrastructure may be accepted by the Town engineer. Adequate ducts shall be installed under roads prior to construction to accommodate the installation of shallow utilities. The use of municipal reserve lands for shallow utilities is discouraged in order to minimize constraints to future development.

Shallow utilities shall be installed in a four party trench wherever practical. Four party trenches shall be located in continuous dedicated 3.5 m wide easements located adjacent and parallel to roads in the front of lots abutting roads, however the Town of Canmore would support reduced URW widths if agreed to by the shallow utility providers. Shallow utilities shall be separated laterally from water and sewer mains by not less than 3.0 m and shall be located a minimum distance of 3.0 m from any valve or hydrant, however decreased lateral separation may be considered by the Town where water and sewer mains are installed at shallow depths and where the shallow utility providers are in agreement.

8.3 Construction

Trenchless methods shall be used whenever proposed services cross existing roads in order to avoid compromising the integrity of the road surface. The developer, shallow utility provider and contractor shall familiarize themselves with local soil conditions to ensure that an appropriate methodology is selected.

Road use and excavation permits must be obtained from the Town for any work on municipal property. These permits must reference the ULA reviewed and accepted by the Town during the approval process. The utility provider must notify the Town of completion of work on an approved ULA within ten calendar days. The utility provider must submit as-built drawings within sixty calendar days following completion of the work.

8.4 Figures

Figure EDCG SHU 8.1 Standard Placement Service Pedestal and Transformer 3.5 Front Yard URW

9. HAZARDS AND LOCAL CONDITIONS

In addition to hazards that municipalities in western Canada are typically exposed to such as high surface water levels, wildfire and transportation related events, the Town of Canmore is also vulnerable to steep creek hazards, undermining from former coal mining activities and high groundwater levels.

This section of the *Engineering Design and Construction Guidelines* (EDCG) provides a description of the hazards and location conditions associated with undermining, flood risk, steep creeks and high groundwater in the Town of Canmore. It provides information about the constraints when working in these areas and possible mitigation measures that developers and consulting engineers need to consider when presenting development applications and undertaking capital projects in the Town.

9.1 Undermining

Surface and underground coal mines were developed on the southwest side of the Bow River valley, between Pigeon Mountain and what is now the Nordic Centre, from the 1880s to the 1970s. Coal was primarily extracted by underground mining; however, some surface exploration and mining also occurred. Subsidence, surface features of past mining activity and the presence of coal seam outcrops all present potential concerns. When developing land where these hazards may be present, an undermining assessment is required, and remedial action may be necessary. The requirements for undermining assessments and remediation have been issued by the Province of Alberta.

Alberta Regulation AR 34-2020

This regulation designates the applicable lands (See Figures EDCG HLC 9.1 and 9.2 Canmore Undermining Review Regulation Designated Land) and sets out the requirements for an undermining review that a developer must undertake. When the review has been completed satisfactorily, a Compliance Review Certificate will be issued, and acknowledgment of receipt forwarded by the Province of Alberta to the Town of Canmore. This regulation also requires the developer to file with the Register of Land Titles a caveat against any title to land for which an undermining report is prepared and a compliance review certificate is completed.

Developments & Municipal Improvements on Designated Lands

A developer shall submit to the Town, together with any construction drawings required for a development (whether subdivision, development permit or building permit) application, pursuant to these guidelines, a plan showing the phasing (if any) and status of the undermining review for that development. The plan shall be updated regularly as the land use and/or proposed development changes.

As per *AR 34-2020*, a developer may commence construction of roads, infrastructure and site clearing on municipal lands, subject to compliance with other regulatory requirements, prior to completion of the undermining review. However, the Town must be in receipt of written confirmation from Alberta Municipal Affairs that the Compliance Review Certificate has been accepted before the Town will accept a Construction Completion Certificate for any municipal improvement.

Site Developments on Designated Lands

An undermining review may result in different requirements for development approval depending on the type of development or building proposed for a site. Development approval may be conditional on additional undermining mitigation measures being undertaken or incorporated into a specific site development. In such cases, the site developer shall submit to the Town a certificate from the undermining engineer and/or other consultants (such as structural or geotechnical engineers) confirming that all such additional undermining mitigation measures have been incorporated into the design of the proposed development. The certificate shall be submitted along with any construction drawings required for a site development as per Town guidelines. A developer may start construction of a development, subject to compliance with other regulatory requirements, prior to completion of the additional undermining mitigation measures required by the undermining review. However, the Town must be in receipt of written confirmation from Alberta Municipal Affairs that the Compliance Review Certificate for the site has been accepted before the Town will accept an Occupancy Certificate for any building on that site.

The Province also approved *Guidelines to Evaluate Proposed Development Over Undermined Lands in the Town of Canmore*, Alberta April 1, 2020 through Ministerial Order MSD: 004/20.

9.2 Flood Risk Areas

Certain sites within the lower valley area of the Town of Canmore are located in the floodway, flood fringe and overland flood zones, as designated by Alberta Environment. These sites are within the *Flood Risk Area* as described in the Town's *Valley Bottom Flood Hazard Overlay District* section of the *Land Use Bylaw*. These regulations establish permitted and discretionary uses, minimum first-floor elevations, locations of mechanical and electrical equipment and building setback requirements. Refer to Figure EDCG HLC 9.3 Overland Flow Elevations for specific details.

9.3 Steep Creeks

After the flood event in 2013 the Town of Canmore established the Mountain Creek Hazard Mitigation Program with the goals of re-establishing damaged infrastructure, learning about hazards from steep creeks in the community, assessing the consequences and mitigating accordingly. The Town has adopted a risk-based approach for evaluating options for

mitigation. This means that mitigation is not solely based on a return period but on the consequences of a hazard occurring, including but not limited to the overall community impact, the safety risk to individuals and potential economic losses.

Steep creeks have been addressed in the Town of Canmore *Municipal Development Plan* (MDP) and *Land Use Bylaw* (LUB). Development in steep creek hazard zones may be permitted according to these regulations.

For development in moderate hazard zones, flood protection measures shall be designed to mitigate flood, debris flood or debris flow hazards. The level of protection required is determined on a case-by-case basis with the goal of meeting tolerable risk criteria as adopted by the Town in the MDP.

The Steep Creeks section of the EDCG provides direction and guidance to support resilient development in hazard areas where development is permissible It provides guidance for small-scale on-site mitigation up to established thresholds defined within this document. Off-site mitigation, and mitigation work that exceeds these thresholds, shall be designed by a qualified professional. The EDCG are also applicable for existing developments in identified hazard zones to reduce vulnerability.

The Town may use in-house personnel or retain an independent qualified professional to provide advice during the review and approval process for any proposed work in hazard areas.

9.3.1 Policies, Regulations, Emergency Plan and Flood Insurance

Government

The recent adoption by the Town of Canmore of policies and guidelines on steep creek hazard and risk, and changes in land use regulations are all aiming at reducing the risks due to steep creek hazards. The 2014 edition of the *Alberta Building Code* does not have any specific codes related to buildings in flood or steep creek hazard zones.

Flood Insurance

The Alberta Emergency Management Agency (AEMA) states the following regarding flood insurance:

> The Government of Alberta strongly advises all property owners to purchase adequate overland flood insurance for their property, as the Disaster Recovery Program may not provide assistance for damages once insurance is considered reasonably and readily available.

More information regarding flood insurance can be found on AEMA's website: http://www.aema.alberta.ca/overland-flood-insurance-faq

Developer

Evacuation routes, including main and alternate routes, should be designed and analyzed carefully to ensure that building occupants and rescuers can successfully evacuate the property when required. The building itself should have two egress routes that can provide efficient escape.

Property Owner

Owners should plan for and know what to do in the case of an emergency. Moreover, an emergency plan and 72-hour emergency kit should be prepared by the property owner or occupant(s). AEMA provides further information on their website: http://www.aema.alberta.ca/plan-and-prepare

In the case of a commercial property, emergency instructions and map(s) should be posted on egress doors of the building.

9.3.2 Referenced Reading

- American Society of Civil Engineers. *Flood Resistant Design and Construction*. Standards ASCE/SEI 24-14. ASCE. 2014.

9.3.3 Design – General

Flow processes in mountain creeks strongly depend on geological conditions and morphology of the catchment. Processes considered herein are, in order of increasing sediment concentration, clear water flood, debris flood, and debris flow. There is a continuum between these processes: floods transition to debris floods, and eventually to debris flows. Conversely, dilution of a debris flow through partial sediment deposition and tributary injection of water can lead to a transition of debris flows to debris floods, and eventually floods. The damage potential usually increases with increased sediment concentration. These three flow processes are considered in the present guidelines, as they can all occur during a single event.

Steep creek hazard zones are areas identified as potentially dangerous for development. The MDP defines three different hazard zones. They are defined under the Section *Steep Creek Hazard Zone*. The zones are identified in the Steep Creek Hazard Overlay in the LUB.

New development should not encroach on riparian buffers (land and natural vegetation adjacent to water bodies), and minimum setbacks, as defined in the LUB, should be maintained along water bodies to reduce the risk of flooding due to stream movement and bank erosion. See the MDP and LUB regarding development constraints and environmental setbacks from waterbodies.

9.3.3.1 Level of Protection

Due to the risk-based approach for assessing steep creek hazards adopted by the Town, the level of protection required can change on a case-by-case basis and depends on the type and number of elements that are exposed to the hazard.

The Town's requirements for assessment studies, and policy for development in steep creek hazard zones, can be found in the MDP and the LUB.

High/extreme hazard zones shall be kept free of new development.

In moderate hazard zones, a site-specific steep creek risk assessment (SCRA) is required. The risk assessment will determine if the development is allowed and what level of protection is required. SCRAs shall be undertaken by a qualified professional. Site-Specific SCRA guidelines are found in Appendix C of the EDCG, with supplemental information regarding risk analysis, vulnerability and loss estimation in Appendix D Quality Assurance Statement for Site-Specific SCRAs is found in Appendix E

In low hazard zones, the risk can be mitigated by adopting some of the measures outlined in these guidelines. A risk assessment is usually not required for developments in low hazard zones. However, where a development proposal may result in significant economic losses or damage to buildings in the case of an event, a site specific steep creek risk assessment, specifically related to economic risk, may be required to evaluate the development and proposed on-site mitigations.

9.3.4 On-Site Mitigation Measures

In general, any mitigation measures proposed or constructed shall not cause any material adverse impact on other properties without written consent of the affected landowner. Ideally, it should also reduce the overall flood risk.

Flood avoidance ensures that the water will not come into contact with the building. Flood resistance, or dry-proofing, stops water entering a building. Flood resilience, or wet-proofing, accepts that water will enter the building, but through careful design will minimize damage and allow the re-occupancy of the building quickly.

Minimum Floor Elevation

Minimum floor elevations are established to ensure that the habitable space of a development is higher than expected flood levels. This ensures adequate flood protection.

Minimum Building Opening Elevation

The minimum building opening elevation concept is similar to the minimum floor elevation. However, it is used for below-grade basement in low hazard zone, or in moderate hazard zone if deemed acceptable (once a site specific steep creek risk assessment has been

completed). Building openings refer to window wells, garage doors, door entrances, and the top of foundation walls.

Low Hazard Zones

In low hazard zones, the minimum floor elevation and the minimum building opening elevation shall be 300 mm above finished grades. Any alternate elevation shall be approved by the Town.

Moderate Hazard Zones

In moderate hazard zones, the design flood level, plus 100 mm of freeboard, is used to define the minimum floor elevation and the minimum building opening elevation. The design flood level is based on flow data provided by the Town of Canmore for the site specific steep creek risk assessment.

9.3.4.1 Flood Avoidance

Avoidance measures are aimed at preventing water coming into contact with a building. The most basic principle of flood avoidance is to not build in flood risk areas. Whenever this is not possible or desirable for economic reasons, new development should not cause any material adverse impact on other properties without written consent of the affected landowner. New developments add impervious area which may introduce a greater burden on the existing drainage systems, increasing the risk of flooding for existing developments as a result.

Avoidance can be accomplished by raising the development above the expected flood level, or by using the landscaping to divert flood waters away from the development.

Driveways

Driveways shall be built to slope away from homes or garages. Reverse-slope driveways are to be avoided. The Town requires that garage walls extend 500mm above anticipated water level as well as doors to be located 500mm above anticipated water level.

9.3.4.1.1 Elevation: Raising the Development Above the Design Flood Level

The development is not exposed to the hazard when raised above expected flood level. Development can be built on higher ground by raising the property lot, or by raising the development itself on piles that can withstand the impact of the flow. Minimum floor elevation shall be used.

Raising the Lot

Lots should not be raised in areas where doing so will result in increased flood risk elsewhere. The potential impacts of raising a lot could be to reduce flood storage capacity and displace flood water, thus increasing flow speeds and water depths in adjacent areas. If raising of a lot is required, it might have to be compensated by the provision of additional flood storage areas or improved flood routes.

Creating an island effect with surrounding areas inundated by floodwater is not acceptable as there must be safe access for emergency vehicles and evacuation. Essential and emergency access routes should be designed above design flood level.

Raising the elevation of a lot shall be designed by a qualified professional and shall consider the following:

- topsoil stripping, storage and reinstatement
- existing ground conditions and type of material
- compaction and settlement of structural fill material
- possibility of mobilizing contaminants
- possible changes to flow behavior of debris floods.

Slope and embankment fill is required to be stable under conditions of flooding, including rapid rise, rapid drawdown and prolonged inundation. Fill side slopes shall be no steeper than 2(H):1(V). Moreover, a minimum Factor of Safety of 1.3 should be used for the design of those slopes.

Erosion protection of side slopes shall be designed according to Table 9-1, below.

Table 9-1: Design Standard for Side Slope Protection

Hazard Zone	Flow Conditions (depth & velocity)	Design Standard
Low	Less than 1m & 1m/s	Grassed side slopes, as per Design of Deflection Measures section, below.
Moderate	As per site specific flow data	Shall be designed by a qualified professional.

Retaining Walls

Elevation of a building or a lot may be done with stone, concrete, or stone-pitched retaining walls. An example of a stone wall is shown in Figure EDCG HLC 9.4 Stone Retaining Wall on Silvertip Road, Canmore AB. Retaining walls shall be designed in accordance with Section 3.3.1 of the EDCG and minimum requirements described in Table 9-2. Stone-pitched walls and concrete walls shall be design by a qualified professional. An example of stone-pitched wall is shown in Figure EDCG HLC 9.5 Example of Raised Lot Grading with Stone Pitched Retaining Wall.

Table 9-2: Retaining Walls

Hazard Zone / Flow Velocities	Foundation Depth	Wall Type
Low / Less than 1 m/s	Only EDCG Section 3.3.1 applies	Stone retaining wall, concrete wall or stone-pitched wall.
Moderate / 1 m/s to 2 m/s	Minimum 1 m 0.5 m acceptable if wall is directly adjacent to a paved road or has adequate scour protection	Either: a) Stone retaining wall b) Stone-pitched wall c) Concrete walls (covered by rock or abrasion resistant material for walls exposed to debris flood / debris flow impacts).
Moderate / Greater than 2 m/s	Minimum 1.5 m 0.5 m acceptable if wall is directly adjacent to a paved road or has adequate scour protection	Either: a) Stone-pitched wall b) Concrete walls (covered by rock or abrasion resistant material for walls exposed to debris flood / debris flow impacts).

Figure EDCG HLC 9.4: Stone Retaining Wall on Silvertip Road, Canmore AB *Source: Google Maps*

Figure EDCG HLC 9.5: Example of Raised Lot Grading with Stone Pitched Retaining Wall

Reinforced Piles

Elevation may also be accomplished with reinforced piles, providing space for flood waters below the main floor. This solution is also outside the scope of these guidelines and shall be designed by a qualified professional.

Fuel Storage and Other External Installations

Fuel storage containers, private pumping stations and any other external service installations with mechanical or electrical parts should be raised and secured at or above the minimum floor elevation.

9.3.4.2 Flood Resistance

Resistance measures are aimed at preventing floodwater ingress into a building; they are designed to minimize the impact of floodwaters directly affecting buildings and to give occupants more time to relocate ground floor contents. They are only effective for short duration flooding of low flow depth. They include the use of low permeability materials that reduce the rate of water ingress into a property. However, total prevention of water ingress, or dry-proofing of a building, is very difficult to achieve. Structural reinforcement can also be used to reduce the impacts of debris flood or debris flow.

9.3.4.2.1 Temporary Measures

Temporary measures may be adequate only for existing development in low and moderate hazard zones of steep creeks. The application of temporary measures shall be assessed on a case-by-case basis by a qualified professional.

Examples of temporary measures for flood protection include:

- flood shields, panels, doors and gates
- temporary covers for openings in the foundation walls
- sandbags
- deployable flood barriers.

However, the following issues with temporary measures have been identified:

- Homeowners have the responsibility to store, maintain and install the flood protection products.
- Future homeowners must be made aware of the use of temporary products as the chosen flood mitigation measure.
- The durability and sustainability of some products has not been proven.

Temporary measures are therefore not appropriate for new developments and shall not be pursued. Consequently, only permanent flood resistance measures are permissible for new development.

9.3.4.2.2 Permanent Measures

Lot Grading and Drainage

Landscaping of a development site or property boundary to direct or divert floodwater away from buildings can be effective, particularly in low hazard zones, where the predicted duration of flooding is short (i.e., hours rather than days).

Grades adjacent to new buildings should be sufficient to allow for settlement of fill and maintenance of positive drainage away from the building. A minimum slope of 2% should be established on all lots to provide positive drainage away from the buildings. The minimum grade should be exceeded if topography allows. Grades shall be designed by a qualified professional.

Basement and Below Grade Spaces

Because of potential harm to building occupants, flood-proofing of spaces below the top of foundation wall is only permitted for non-residential occupancies (non-habitable structures, crawl spaces, building access, garages and additional storage area for residential buildings), unless a site-specific risk assessment demonstrates that the risk associated with a habitable basement is within acceptable threshold. In such cases, only walk-out basements are permitted, if they are on a non-flow exposed side of the property. Walk-out basement are usually built into a hill or into a lot with strong grades between the front and rear yard. Walk-up basements, containing sunken entrance, or dug-in stairs that go from the ground level down to the basement as a and entry/exit, are not permitted in a steep creek hazard zone due to the potential of deep water accumulation in the enclosed space.

Foundation Design

The building foundations shall be designed by a qualified professional and must resist all anticipated flood loads (lateral hydrostatic forces and the vertical buoyant) and potential debris impact loads (impact forces based on velocities) in combination with other regular anticipated loads. The design flood elevation should also be considered to determine bearing capacity requirements of footings. The assumptions and calculations used to decide on the specifications (concrete mix, thickness and reinforcement schedule, waterproofing) of the foundation walls are required in an engineering report. Table 9-3, below, describes the minimum design consideration for foundation walls.

Table 9-3: Foundation Design Considerations

Hazard Zone	Design Requirements	Scouring Consideration
Low hazard	Waterproofing measures apply	None
Moderate hazard	Steel-reinforced concrete walls required on flow-exposed side(s), designed to withstand expected debris impact forces.	Building shall have either: a) deep foundations able to resist anticipated scouring. b) scour protection to protect the foundations

Openings in Foundation Walls

Openings (doors, windows, dryer outlet, etc.) in foundation walls may be allowed in accordance with Table 9-4, below.

Table 9-4: Allowable Openings in Foundation Walls

Hazard Zone	Openings on Flow Exposed Foundation Walls	Openings on Non-flow Exposed Foundation Walls
Low hazard	Windows allowed: Only non-opening and sealed windows - bottom of window, or top of window well, shall be above the Minimum Building Opening Elevation Other openings: not allowed	Windows allowed: bottom of window, or top of window well, shall be above the Minimum Building Opening Elevation Other openings allowed: shall be above the Minimum Building Opening Elevation
Moderate hazard	No openings allowed	Openings allowed: shall be above design flood level, plus 100 mm freeboard.

Window Wells

All window wells in a steep creek hazard zone shall be designed by a qualified professional and shall follow the requirements set-out below, and as detailed in Figure EDCG GRD 3.4 Window Well Drain.

- Window wells must be properly drained to minimize the likelihood of water accumulation in the well.
- The contact between the window well and the foundation wall shall be sealed (with a heavy-duty and long-lasting sealant).
- The bottom of the well shall be at a minimum of 150 mm below the underside of the window.
- The top of the window well shall extend at least to the Minimum Building Opening Elevation.
- Minimum thickness of 300 mm of drainage material, such as gravel, shall be placed in the well.
- Grades around the window well must slope away at 2% minimum.

Waterproofing Measures

Waterproofing of foundation walls significantly increase the flooding resistance of a building.

The Foundation Walls section of the National Institute of Building Science's *Whole Building Design Guide* provides specific descriptions of waterproofing membranes, drainage materials, and systems common in foundation walls and below-grade building enclosure systems that can be adopted for building in steep creek hazard zones. The information is

found at: https://www.wbdg.org/guides-specifications/building-envelope-design-guide/below-grade-systems/foundation-walls.

9.3.4.3 Flood Resilient

Flood-resilient buildings, or wet-proofing of buildings, are designed and constructed to reduce the impact of flood water entering the building so that minimal permanent damage is caused, structural integrity is maintained, and drying and cleaning is easier.

Internal Space Layout

Careful layout of internal space is an effective measure to minimize the impact of floods. Living accommodation, mechanical room and electrical panel, storage space for key provisions and equipment, shall be located at or above the design flood level. Further consideration should be given to locate the mechanical room and the more-frequented rooms in the sheltered area of the building, opposite to the flow-exposed side(s) of the building.

An access to the building shall be located on a side that is not exposed to flood. This will help guarantee safer egress in case of an event.

For development with underground parking below the design flood level, flood-proofing may not be necessary to prevent damage from floodwater as vehicles can be moved to higher ground. However, services shall not be located below the design flood level. An unobstructed means of pedestrian ingress and egress shall be provided above the design flood level.

Strategies to Minimize Flood Impacts

The recommended strategies to minimize flood impact to buildings and their occupants, flood resiliency measures, are described in Table 9-5, below.

Table 9-5: Strategies to Minimize Flood Impact to Buildings

Building Components	Strategies to Minimize Flood Impact
Walls and Insulation	Solid walls with external insulation are preferred to cavity construction as this avoids problems of contamination entering the cavity. If cavity insulation is required, it is recommended to use rigid closed-cell materials. Closed-cell materials are preferred as they retain integrity when moist or wet, and they resist moisture take-up. Other common insulation types, such as mineral wool batts, are not generally recommended as they can remain wet for several months after exposure to flood water, which slows down the wall drying process and compromises the insulation properties of the wall.
Design of Services	Where possible, all service entries should be sealed (e.g., with expanding foam or similar closed cell material).
Pipework	Expanding foam should be used for pipes that enters the building below the design flood level.
Water, Electricity and Gas Meters	These services shall be located a minimum of 1 m above finished grades.
Electrical Services	Electrical panel should be located a minimum of 1.5 m above slab elevation and outlets shall be installed 1 m above slab elevation to minimize damage to electrical services and allow speedy re-occupation.
HVAC Systems and Hot Water Tanks	Air conditioning compressors, heat pumps, furnaces, hot water tanks, tankless water heaters, ductwork and ancillary devices shall be installed 1 m above slab elevation and preferably on the first floor of two-story properties. Units hung from the ceiling are also permitted. Underfloor heating should be avoided on ground floors and controls such as thermostats shall be placed 1.5 m above the slab elevation. Baseboard heaters shall not be installed in below grade basements.

9.3.5 Deflection Measures

This section covers the design of simple deflection measures, including basic principles of bioengineering. Deflection measures minimize the building exposure to the hazard by deflecting flow away from the development. Deflection measures will typically be off-site.

The retention of water and/or sediment to reduce peak discharges and sediment volumes, extensive soil bioengineering, as well as forest management measures, are out of scope for these guidelines. Any such measures shall be designed by a qualified professional.

9.3.5.1 Deflection Measure Requirements

Flood protection measures shall have the same lifespan as the proposed development and provide adequate protection for the lifetime of the building (expected to be a minimum of 50 years). Protection measures shall be able to withstand the design flow impacts without posing risk to the development and the people inside.

Protection measures shall be designed by a qualified professional and shall comply with the Deflection measures shall have the same lifespan as the proposed development and provide adequate protection for the lifetime of the building (expected to be a minimum of 50 years). Protection measures shall be able to withstand the design flow impacts without posing risk to the development and the building's inhabitants.

The deflection measures shall be designed by a qualified professional and shall comply with the following requirements:

- Deflection measures shall be designed and constructed in a way that people inside the building are safe and protected in case of a flood event. There might be residual risk for events of extreme magnitude.
- Deflection measures may not adversely affect health, safety, property or asset values of adjacent properties and other third parties.
- Measures shall be designed according to the impact intensities determined in the hazard assessment studies or site specific steep creek risk assessments.
- Consideration shall be given to access and egress from a property in case of an event.
- Deflection measures can also have the function of a retaining wall to elevate a building.

9.3.5.2 Design of Deflection Measures

Deflection of flow can be achieved with berms, walls or wedges. These deflection measures may be applied for floods, debris floods and debris flow of different flow depths and velocities. However, these guidelines apply only for the design of an earth berm in a low hazard zone, with maximum flow velocities of 1 m/s and maximum flow depth of 1 m.

Deflection measures in a moderate hazard zone shall be designed by a qualified professional. Impact pressure and geotechnical conditions are critical design consideration for such designs. The design of deflection walls shall include structural analysis of the proposed structure according to the impacts as provided by the hazard analysis. Minimum berm height shall be the design flood level plus 300 mm of freeboard. Higher freeboard might be required for higher flow velocities.

Design of Seeded Earth Berm

In low hazard zones, a grassed earth berm without additional erosion protection may be sufficient. The berm shall be constructed according to the specifications below. Alternate protection measures shall be designed by a qualified professional.

Berm specifications:

- Maximum slope steepness of 2(H):1(V).
- Berm height shall be 1.3 m, which includes the required 150 mm of topsoil and 300 mm of freeboard.

- The foundation of the berm shall be stripped of all vegetation, organic and otherwise objectionable materials, to a minimum depth of 300 mm. After stripping, the earth foundation should be moistened if dry and should be compacted before placement of the first layer of fill material. Fill shall not be placed on frozen soils, ponding or standing water, or on deleterious materials
- Fill material should be locally sourced, if readily available. Table 9-6, below, shows suitable materials for berm construction, as per the Unified Soil Classification System (USCS), ASTM D-2487. Inclusion of vegetation, organic material or frozen soil in the berm is not permitted.
- The fill shall be layered along the full length of the berm in depths appropriate to the equipment used. Maximum lift thickness of 100 mm is appropriate for small equipment use, such as vibratory plate compactor. Maximum lift thickness of 200 mm is permitted for heavy equipment use, such as sheepsfoot rollers, vibratory and smooth-wheeled rollers.
- Compaction shall meet 95% Standard Proctor Max Dry Density

Table 9-6: Materials Suitable for Berms, in Preferential Order

Material	Description
GC	Clayey gravel
SC	Clayey sand
GM	Silty gravel
CL	Lean clay (low plasticity)
CI	Intermediate clay (moderate plasticity)

Topsoil, Seeding and Plant Material

Topsoil and plant material used for flood protection, as well as the maintenance requirements, shall adhere to the landscaping guidelines in Section 10 of the EDCG. Additional specifications are provided below.

On an earth berm, on side slope of a raised lot, or within the banks and channel of a creek, only grass and small shrubs shall be planted. The following shrub species, with a maximum trunk diameter of 40 mm, are appropriate:

- Green Alder (*Alnus crispa*),
- Pussy Willow (*Salix discolor*)
- Smooth Willow / Gray-leaved Willow (*Salix glauca*)
- Meadowsweet / Birch Leaved Spiraea / White Spiraea (*Spiraea betulifolia*).

Only the Willow species can grow from the stump and can be used for brush layers or willow staking. Plan material must be harvested within the Bow Valley, from a location with similar

growing conditions. Approvals for harvesting shall be obtained on private and provincial lands.

Strong rooted grass species, of the seed mix shown in Table 9-7, below, shall be used. A seeding rate of 25 kg/ha shall be used. Erosion protection, such as coconut mat, geofabric and hydromulch, should be considered, especially when grass has not been established prior to autumn and winter months.

Table 9-7: Seed Mix for Flood Protection

Scientific Name	Common Name	Target Cover	% of Seed Mix (PLS)	Kg Required (PLS)
Deschampsia ceaspitosa	Tufted Hairgrass	20%	6.6%	1.65
Koeleria macrantha	Junegrass	20%	5.2%	1.30
Bromus carinatus	Mountain Brome	10%	28.4%	7.10
Agropyron smithii	Western Wheatgrass	10%	23.3%	5.83
Poa alpina	Alpine Bluegrass	20%	10.2%	2.55
Agropyron dasystachyum	Northern Wheatgrass	10%	16.6%	4.15
Elymus canadensis	Canada Wildrye	5%	9.3%	2.33
Agrostis scabra	Rough Hairgrass	5%	0.4%	0.1

Maintenance of Grass and Plant Material

The following maintenance is required on berms and raised lot side slopes:

- The grass shall be cut once, only after a year of growth, to promote early root growth.
- Re-seeding shall be undertaken every spring until the grass is well established.
- Weeds shall be removed as per Section 10 of the EDCG.
- Trees, plants or shrubs shall be cut when trunk diameter of 40 mm is reached.

Design of Other Deflection Measures

The design of other deflection measures, such as timber plank wall and earth berms with stone-pitching, is out of scope for these guidelines. Other deflection measures shall be designed by a qualified professional.

9.3.6 Out of scope: Mitigation of Large Developments

Mitigation of flood hazards for medium to large-scale developments (i.e., on subdivision level, area structure plan) must be designed by a QRP. The development must be adapted to provide the most efficient land use in accordance with the hazard situation. Thereby, high hazard areas can be utilized for low-risk uses, such as parking spots or green space, whereas moderate and low-hazard zones would provide space for buildings and infrastructure in accordance with the MDP and LUB. Appropriate space use can therefore be adopted to reduce the risk while still allowing development. Several different strategies to protect development may still be required in the low and moderate-hazard zones.

9.4 Groundwater

The central portion of the Town of Canmore (situated in the valley bottom) is underlain by coarse and pervious river gravels to a considerable depth. These gravels together with the nearby presence of the Bow River result in high groundwater levels that impact trench and foundation excavations as well as completed building foundations and underground utilities. A number of piezometers and staff gauges are located throughout the central area of Canmore. In the past, ground and surface water levels were recorded regularly and analyzed for historic trends. This information is available to the Town and developers to improve the design, construction, operation and maintenance of municipal infrastructure, stormwater management systems and buildings with respect to the impact of high groundwater levels.

Monitoring locations are shown on Figure EDCG HLC 9.6 Piezometer and Staff Gage Location and sample level fluctuations on Figure EDCG HLC 9.7 Typical Water Level Fluctuation.

Building Floor Elevations

Town's *Land Use Bylaw*, *High Groundwater Area Regulations*, prohibits the building of habitable floor space below the maximum 1:100-year design groundwater elevation. These elevations, which include a 0.6 m freeboard allowance, have been calculated from data provided by Alberta Environment for the central area of the Town and are shown on Figure HLC 9.8, 1:100 Year Design Groundwater Elevations. In the case of data discrepancies that may exist between information on Figure EDCG HLC 9.6, Figure EDCG HLC 9.8 and more recent piezometer data, the engineer shall determine whether the highest anticipated groundwater elevation shall be determined using the highest of elevations from Alberta Environment's 1:100-year design groundwater levels, data from Town historical records or by recent data from test wells or piezometers on site.

All sanitary sewer and water service piping located in a subsurface mechanical room shall be sealed against infiltration of any groundwater and water meters shall be situated above the 1:100-year ground water level unless the mechanical room is designed and constructed to withstand the infiltration of groundwater. All sanitary sewer and manholes located below

the 1:100-year groundwater elevation shall be tested for infiltration/exfiltration as outlined in the Section 5 of the EDCG. The developer is responsible for all costs associated with the testing.

Underground Parking and Lowest Parking Slab Elevation

Parkade floor levels may be lower than the 1:100-year groundwater level but not lower than the 1:20-year groundwater level to avoid frequent nuisance flooding. However, the Town has the authority to make the final decision on the appropriate elevation to be used on a site. The impact of periodic flooding shall be determined and evaluated by the developer. In all cases, the structure shall be designed to withstand all hydrostatic and hydrodynamic forces due to high groundwater conditions at the site.

Mechanical and Electrical Installation Elevation

The Province of Alberta and Town of Canmore require that all mechanical and electrical installations be installed above the maximum 1:100-year design and groundwater elevations noted above.

Utility Installations and Foundation Excavations

The installation of deep utilities and excavation for buildings in the central area of Canmore shall, whenever possible, be scheduled for times when groundwater levels are at their lowest. This occurs between the late fall and early spring. When excavation into the water table cannot be avoided, disposal of groundwater from an excavation may be necessary. The consulting engineer shall prepare and submit plans for such disposals to the Town engineer as part of the construction management plan. Provided there is no detrimental impact to the aquifer, vegetation, adjacent properties or structures, groundwater may be discharged as follows:

- Water may be discharged to a temporary, on-site infiltration basin specifically designed for that purpose based on the maximum discharge pumping rate and the soil infiltration rate. If the discharged water contains a high sediment load, a separate sedimentation basin or an additional allowance for the infiltration basin shall be provided.

- Water may be discharged to a naturally vegetated area of adequate size and with suitable soils. If the discharged water contains a high sediment load, a geotextile filter shall be installed at the discharge point to collect and contain the sediment; this shall be removed upon completion and any disturbed areas restored to an acceptable condition.

- Water may be discharged to a natural watercourse or surface water body provided the discharge has first been treated and the quality of the discharged water is equal to or better than that of the receiving body, especially with respect to sediment and turbidity. The consultant (and in smaller cases the builder) is responsible to obtain additional

approvals that may also be required from Public Land Services or Fish & Wildlife Services of the Province of Alberta.

In all cases, the point of discharge shall be protected against erosion. If sediment-laden or turbid discharge water finds its way into any surface water course, discharge shall cease immediately, sediment shall be removed, and the area shall be restored to its pre-existing condition. All groundwater disposal methods proposed on municipal lands or within the Town's wellhead capture zone must be accepted by the Town engineer prior to construction. The consulting engineer (and in smaller cases the builder) is responsible to obtain additional approvals that are required from Public Land Services or Fish & Wildlife Services of the Province of Alberta.

Trench or excavation groundwater may not be discharged to the sanitary sewer system.

Discharge to a contained stormwater sewer system (system with a detention pond that does not discharge directly to a surface water body) or to a stormwater drywell may be considered where the water is of acceptable quality and such discharge has been authorized in writing by the Town engineer.

9.5 Protection of Aquifer for Municipal Water Supply

The Town obtains a significant portion of its' total municipal water supply from groundwater in the Bow River valley aquifer beneath the Town. Existing production wells are located adjacent to Policeman's Creek near the intersection of Railway Avenue and Old Canmore Road. The Town has adopted a wellhead protection strategy made up of three control mechanisms to protect this water supply source. Development in the area upstream of and near to the production wells is controlled by the Town and restricted to uses or activities that will not adversely affect the quality of the groundwater. Refer to the *Land Use Bylaw, Groundwater Protection*, and to the *Well Head Protection Zone Bylaw* No. 36-96 for additional details.

Control Mechanism #1 - Construction Activity Control

Construction of municipal improvements on municipal lands or other activities not regulated by the *Land Use Bylaw* and located within the wellhead capture protection zone (see Figure EDCG HLC 9.9 Wellhead Capture Protection Zone) as defined by hydro-geological parameters, shall comply with these guidelines and any other specific requirements deemed necessary by the engineer for the protection of the Town's water supply source.

Control Mechanism #2 - Land Use Control

The Town's *Land Use Bylaw* establishes the wellhead protection area, which is used to regulate land use for all development sites wholly or partly within the boundary of the area. The limits of the wellhead protection area (land use) are shown in the Figure EDCG HLC 9.10 Wellhead Protection Area – Land Use. Certain types of land uses are prohibited

from the wellhead protection area. Permitted or discretionary uses must conform to the performance criteria listed in the *Land Use Bylaw* and the Town may require a risk assessment report as part of a site development permit application. Refer to the *Land Use Bylaw* for additional details.

Control Mechanism #3 – Stormwater Disposal Control

Stormwater treatment and disposal for areas within 500 m of a water course (see Figure EDCG STM 6.1 500 m OGS Infiltration Zone) shall be in accordance with the Town of Canmore's EDCG or Alberta Environment standards, whichever is the more stringent. Refer to Section 6 of the EDCG for additional details.

9.6 Technical Requirements and Performance Regulations for Wellhead Protection Areas

A wellhead protection area is considered to be the extent of the areas covered by the three control mechanism described in the previous section (construction activity control, land use control, and stormwater disposal control). The technical requirements for development in wellhead protection areas is describe in Table 9-8, below.

Table 9-8: Technical Requirements for Development in Wellhead Protection Areas

Development Description	Technical Requirements
All Proposed Developments	A stormwater drainage plan shall be prepared for all proposed developments to the satisfaction of the development authority. The plan shall show how surface water can be effectively managed, including the identification, containment and appropriate disposal of contaminants found in surface water should they occur.
All New Developments Where On-Site Collection and Treatment are Proposed	Stormwater systems shall be constructed in conformance with the guidelines provided in the Town of Canmore's EDCG.
Development in Residential Areas of the Wellhead Protection Area	It shall be demonstrated, to the satisfaction of the development authority, that excavations shall not expose the aquifer to any harmful degradation including the removal of overburden for extended periods of time and the creation of permanent pathways without stormwater disposal control between the ground surface and the aquifer.
Development that Uses Pilings	It shall be demonstrated, to the satisfaction of the development authority, that the pilings shall not degrade the aquifer including the development of pathways without stormwater disposal control between the ground surface and the aquifer.
Development in Commercial and Industrial Areas of the Wellhead Protection Area	• All new petroleum storage tanks and all petroleum storage tank replacements shall be placed above ground. Tanks shall have secondary containment with dikes, impervious liners or equivalent, a leak detection and/or monthly statistical inventory reconciliation analysis system and shall have an overfill or spill prevention system. • All containers of material that could contaminate the aquifer shall have secondary containment and continuous monitoring.

Development Description	Technical Requirements
	• It shall be demonstrated, to the satisfaction of the development authority, that excavations shall not expose the aquifer to any harmful degradation including the removal of overburden for extended periods of time and the creation of permanent pathways without stormwater disposal control between the ground surface and the aquifer. • All holes created by the removal of piles, foundations, drilling or any other similar activity shall be properly sealed in a manner to minimize seepage into the underlying aquifer. • If required, monitoring programs that detect contamination of the aquifer shall be prepared and implemented to the satisfaction of Alberta Environment. • A materials handling management plan shall be prepared for hazardous and dangerous materials that are brought on site. The plan shall be in compliance with the Canadian Transportation of Dangerous Goods Act, WHMIS and Alberta Environmental Protection and Enhancement Act.
Development that Involves Compressed Gas Pipelines	• All pipeline plans shall meet the conservation and reclamation requirements of the Alberta Environmental Protection and Enhancement Act. • It shall be demonstrated, to the satisfaction of the development authority, that excavations shall not expose the aquifer to any harmful degradation including the removal of overburden for extended periods of time and the creation of permanent pathways without stormwater disposal control between the ground surface and the aquifer.
Development that Involves Liquid Petroleum and Oil Pipelines	The same requirements as those listed for compressed gas pipelines shall apply.
Development that Involves Pasture, Dry Land Farming and Passive and Active Recreational Activities	• A pesticide and/or fertilizer management plan that complies with the Alberta *Environmental Protection and Enhancement Act* AR 24/97, Section 5 and the *Public Health Act, Nuisance and General Sanitation Regulation* AR 242/85 shall be prepared and implemented. • Pesticides shall only be stored in facilities that comply with Alberta's *Safety Codes Act* and environmental *Enhancement and Protection Act Regulations* 24/97. • The application of pesticides shall be done only by individuals holding a valid and applicable pesticide applicators certificate or by uncertified individuals working under the direct supervision of a provincially certified applicator. • All new petroleum storage tanks and all petroleum storage tank replacements shall be placed above ground. All tanks shall incorporate secondary containment with dikes, impervious liners or equivalent, leak detection and/or monthly statistical inventory reconciliation inventory system and each tank shall have an overfill or spill prevention system.

Development Description	Technical Requirements
All Current Uses Which Involve the Handling of Biomedical Wastes	All such business or operations shall register their existing management plans with the Town of Canmore and shall ensure that the Town is notified of any plan modifications.
All Commercial Kennels and Veterinary Clinics	All such businesses shall develop animal waste management plans and register these plans with the Town of Canmore and shall ensure the Town is notified of any plan modifications.

9.7 Figures

Figure EDCG HLC 9.1 Canmore Undermining Review Regulation Designated Land

Figure EDCG HLC 9.2 Canmore Undermining Review Regulation Designated Land

Figure EDCG HLC 9.3 Overland Flow Elevations

Figure EDCG HLC 9.4 Stone Retaining Wall on Silvertip Road, Canmore AB *(Figure embedded in EDCG text, Section 9.3.4.1.1)*

Figure EDCG HLC 9.5 Example of Raised Lot Grading with Stone-Pitched Retaining Wall *(Figure embedded in EDCG text, Section 9.3.4.1.1)*

Figure EDCG HLC 9.6 Piezometer and Staff Gage Location

Figure EDCG HLC 9.7 Typical Water Level Fluctuation

Figure EDCG HLC 9.8 1:100 Year Design Groundwater Elevations

Figure EDCG HLC 9.9 Wellhead Capture Protection Zone

Figure EDCG HLC 9.10 Wellhead Protection Area – Land Use

10. LANDSCAPE DESIGN GUIDELINES

The following sections of the *Engineering Design and Construction Guidelines* (EDCG) are intended as design guidelines for Town owned land and land operated by the Town. They are not specifications to be used for construction. The developer is responsible for the development of specifications for construction specific to each project. The guidelines are not intended to stifle innovative design, the Town encourages new ideas and methods.

The preparation of landscape drawings by the developer should be done in consultation with the Town Planning and Development and Engineering Departments.

10.1 Required Reading

All plans and specifications shall conform to the following documents:

- *Guidelines for Subdivision and Development in Mountainous Terrain*, Adopted June 13, 2006 by Council, Resolution 282-2006
- Town of Canmore. *Open Space Development Guidelines*. 2005.

10.2 Landscaping Application Requirements

The developer shall engage a registered landscape architect to undertake conceptual design, detailed design and construction drawings, construction inspection and record drawings for all Town owned land or land operated by the Town, in accordance with these guidelines. Landscaping applications requirements can be found in Section 2.5.5

10.3 Landscaping Inspections

Landscaping inspections, CCC and FAC, follow the process for municipal improvements inspections describe in Section 2.4.

10.4 Site Preparation, Grading, Topsoil, Seeding and Sodding

10.4.1 General

In areas where cut and fill is necessary, earthworks shall be done in a manner compatible with the natural landform. Unnatural, continuous slopes of the same gradient shall be avoided. Contours shall modulate and blend with the existing natural slopes wherever appropriate.

The developer shall contact all required utility companies prior to commencing work to determine the location of buried utilities. In the case of pipelines, a crossing agreement is

required from the utility company. Restoration of any disturbed land is the developer's responsibility.

The developer shall ensure that care is taken to protect the following against damage:

- existing plant material
- existing natural undisturbed soil conditions
- lawns
- buildings
- sidewalks
- curbs
- fences
- paved areas
- other natural and built features.

The developer shall maintain adequate barriers and construction signs to ensure public safety at all stages of work. The developer shall provide and maintain temporary roadways and walkways for vehicular and pedestrian traffic as directed by the Town of Canmore's Engineering Department.

Prior to any type of planned traffic disruption within the Town's road right-of-way (ROW), which includes roadways, back lanes, utility right-of-ways (URWs) and sidewalks, the developer shall contact the Engineering Department to arrange permitting and formal authorization.

Prior to any type of planned closures within the Town's existing municipal reserves (MR), environmental reserves (ER) or parcels including trails and public green space, a cross reserve permit is required. Contact the Parks Department to arrange for permitting and formal authorization.

10.4.2 Clean-Up

Upon completion of work, all work material, stones, roots, oilcans, equipment and excess excavated material shall be removed from the site.

Any plant material deemed invasive or noxious (that falls under the Alberta Weed Control Act) shall be removed and disposed of in an appropriate manner. Invasive or noxious plant material shall not be mixed with the removed grubbing material to be disposed of in a landfill site without discussing disposal methods with the Parks Department. The invasive or noxious plant material may be required to be handled and disposed of separately to avoid cross-contamination at the landfill site.

Any soil and debris spilled onto pavement, concrete, natural areas and waterways shall be cleaned immediately.

Refuse or foreign material of any kind shall not be buried on site. All soil contaminated by oil, gasoline and diesel fuels or any other substance harmful to the natural environment shall be immediately excavated and remove from the site all and dispose of at an appropriate landfill site.

All litter and debris resulting from construction that may be on adjacent properties and natural areas shall be removed.

In general, the site shall be left in in a neat and clean condition that is equal to or better than the site conditions before work started.

10.4.3 Grading

10.4.3.1 Sub-Grade Preparation

Sub-grade elevation shall be the final grade minus surfacing material depth as shown in the following list:

- seeded areas: 150 mm below final design grade
- sodded areas: 100 mm below final design grade
- shrub beds: 450 mm below final design grade
- playground sites: 300 mm below final design grade
- graveled areas: 225 mm below final design grade
- paved areas: 225 mm below final design grade
- concrete sidewalks: 150 mm below final design grade.

Slopes along property lines or perimeters of construction areas where design contours must match existing elevations shall not exceed 3:1. Slopes in areas to be mowed shall not exceed 3:1. Changes in grade shall be made to appear natural and to blend slopes into adjacent areas.

The Engineering Department representative may check specified compactions. The developer's representative shall arrange for an independent testing company to perform tests. Compaction shall be measured in accordance with ASTM (American Society for Testing Materials) Standards. All materials, including fill, topsoil and topsoil amendments shall be approved prior to installation. Upon request by the Engineering Department, a representative sample of all materials will be subject to laboratory analysis.

10.4.3.2 Final Grade Preparation

The Engineering Department shall approve the sub-grade before placing any base or surface material, including topsoil. The grade shall ensure positive drainage of sports fields, with an optimum 2% grade in all directions for the playing surface. Wherever possible, new work shall enhance the overall drainage of the area.

Existing drainage courses shall be maintained and incorporated into the development wherever possible. Grading shall insure positive drainage away from buildings and sidewalks. Design drainage so that the retention and infiltration of water is not on public walkways and trails. Drainage patterns that direct surface runoff onto roads and ditches shall be approved by the Engineering Department. Grading may allow water to pond within eight hours of a rainfall in areas where natural infiltration exists, to allow a natural area to retain more ground moisture. The Engineering Department prior to work commencing shall approve this work.

When necessary manhole frames and covers, valve boxes, hydrants or any other appurtenance shall be adjusted to design grade.

The Engineering Department shall approve the final grade preparation prior to fertilizing, seeding, and/or sodding.

10.4.4 Topsoil and Finishing Grade Quality

10.4.4.1 Source Quality Control

The Town of Canmore requires inspection and testing of imported topsoil prior to placement on site. A testing laboratory designated by the Town of Canmore's Engineering Department shall carry out inspection and testing of topsoil. The developer shall pay all costs of testing, as specified. Topsoil will be tested for texture (clay, sand and silt content), nutrient content, soluble salt content, pH value, organic matter, weed seed content, growth inhibitors and soil sterility.

Samples submitted to the testing laboratory shall be 0.5 kg in size and shall include the following information:

- present use of topsoil, location of stockpile or source
- intended use of topsoil
- type of sub-soil
- quality of site drainage.

Samples shall be prepared and shipped in accordance with provincial regulations and testing laboratory requirements.

Submit two copies of the soil analysis and the recommendations for corrections to the Engineering Department for acceptance.

10.4.4.2 Topsoil Placement

Schedule the placement of topsoil and finish grading to permit sodding, hydro/spray seeding or seeding operations under optimum conditions. If native plant communities are to be established, replacement of topsoil with enough time to allow for proper weed control to

occur before seeding and planting. This involves allowing seed in the seed-bank of the soil to germinate over several weeks, then tilling or spraying as necessary to control the weeds.

10.4.4.3 Topsoil Materials

Topsoil supplied by the developer/supplier shall be a fine, friable, medium loam, neither of heavy clay nor of a very light sandy nature and shall be capable of sustaining good agricultural growth. The target use and long-term maintenance goals should be reflected in the selection and application of all soil materials used within the Canmore area. For passive open spaces or active open spaces, follow the guidelines below, unless otherwise specified by the Engineering Department.

Passive Open Spaces: Berms, Ditches and Boulevards

Topsoil is required in all passive open spaces. In specific situations where native plant materials are being used, xeriscaping with minimal topsoil or no topsoil at all is possible. To ensure this is done properly, all xeriscaping shall require specific approval from the Engineering Department. Table 10-1 provides a summary of topsoil characteristics required for use in various passive open spaces.

Table 10-1: Topsoil in Passive Open Spaces

Type of Passive Open Space	Soil Mix Characteristics
Mowed and Un-Mowed Turf Areas	• acidity range pH of 5.5 to 7.0 • free from subsoil, roots, vegetation, weed seeds, stones larger than 40 mm in the greatest dimension, or any other extraneous materials • topsoil containing prohibited invasive or noxious weeds is not acceptable
Planting of Trees, Shrubs and Ground Covers	• mix 3 parts topsoil to 1 part peat moss and 1 part sharp sand • incorporate bone meal into planting soil at a rate of 0.6 kg/m3 of soil mixture • peat moss: derived from partially decomposed fibrous or cellular stems and leaves of species of sphagnum mosses • elastic and homogeneous, brown in colour • free of wood and deleterious material, which could prohibit growth • shredded particle minimum size: 5 mm
Xeriscape Area Without Grass Cover (Rock gardens or shrubs planted in rocks)	• containing minimum 4% organic matter for clay loams • acidity range pH of 5.5 to 7.0 • free from subsoil, roots, vegetation or weed seeds • topsoil containing prohibited invasive or noxious weeds is not acceptable • large rocks may be acceptable depending on the construction design (contact the Engineering Department for design-specific approval)

Active Open Spaces: Sports Fields, Baseball Diamond Outfields & Parks

Topsoil is required for development of all Active Open Spaces as described in Table 10-2, below.

Table 10-2: Topsoil in Active Open Spaces

Soil and Amendments for Active Open Spaces	Soil and Additive Characteristics
Soil Mix for Mowed Active Open Space Turf Areas	• containing minimum 4% organic matter for clay loams • acidity range pH of 5.5 to 7.0 • free from subsoil, roots, vegetation, weed seeds, stones larger than 20 mm or any other extraneous materials • topsoil containing prohibited invasive or noxious weeds is not acceptable
Fertilizer	Furnish and incorporate amending materials as determined by laboratory analysis to eliminate deficiencies. Submit application schedule and rates for approval by the Engineering Department.
Sand	• clean sharp sand passing a 2 mm sieve • free of chemical or organic impurities

10.4.4.4 Subgrade Preparation

Soil contaminated with toxic materials shall be removed and disposed of at an appropriate landfill site. Surface debris, roots, vegetation branches and stones in excess of 50 mm diameter shall be removed.

The entire area to receive topsoil shall be cultivated to a depth of 100 mm. Cultivation shall be repeated in those areas where equipment used for hauling and spreading has compacted the soil.

10.4.4.5 Spreading of Topsoil

Topsoil shall be spread with adequate moisture in uniform layers over approved, dry and unfrozen sub-grade during dry weather. Table 10-3, below, provides topsoil spreading details.

Table 10-3: Spreading of Topsoil

Type of Space	Topsoil Spreading Details
Passive Open Spaces: Boulevards, Berms and Ditches	Spread topsoil evenly over the entire area to obtain a minimum depth of 150mm after settlement.
Active Open Space: Sports Fields, Baseball Diamond Outfields, Parks	Evenly spread mixed topsoil (1:2 peat moss and medium loam) over the entire area to obtain a minimum topsoil mixture depth of 150 mm after settlement.
Shrub Bed Areas	Spread planting soil mix to a depth of 450 mm for shrub planting.
Rock Gardens and Xeriscape Areas	If groundcover species are to creep throughout the rocks, topsoil shall be spread 50 mm thick over the area. Cover rocks should be placed on the soil as desired, with groundcover species planted among the rocks. Where grass and flowers are to be planted, the shrub soil mix shall be placed 300 mm deep. Where shrubs and trees are to be planted, topsoil shall be placed 450 mm deep. If no groundcover species are to spread among the rocks, no topsoil should be spread. Landscaping fabric or geotextile fabric allowing water to pass through shall be placed to prevent weed establishment but allow water to infiltrate. Where grass and flowers are to be planted, the shrub soil mix shall be placed 300 mm deep. Where shrubs and trees are to be planted, topsoil shall be placed 450 mm deep. In gravel soils and areas of fast-draining soils of 150 mm depth, a silt/clay mix over sub-grade is required to improve moisture retention. Manually spread topsoil around trees, shrubs and obstacles.

10.4.4.6 Soil Amendments

Soil amendments shall be added at a rate determined by the laboratory analysis of the soil sample. A soil amendment application schedule and rates of application shall be submitted for approval by the Engineering Department. Soil amendments shall be mixed to the full depth of topsoil prior to application of sod, seed or fertilizer.

10.4.4.7 Finish Grading

Finish grade shall be completed to the following specifications:

- Do not mix topsoil and subsoil during loading, hauling, and spreading.
- Topsoil shall be finely graded and loosened. Eliminate rough spots and low areas to ensure positive drainage. A loose, friable bed shall be prepared by means of cultivation and subsequent raking.
- Finely grade surface to ensure positive drainage away from buildings and sidewalks.
- Smooth fall cut to catch basin rims and finished flush.
- Do not cover catch basins, valve covers and inspection vaults.

- Roll topsoil to consolidate it in areas to be sodded, leaving the surface smooth, uniform and firm against deep foot printing. Achieve a fine, loose texture, which meets the approval of the Engineering Department.
- Leave the finished surface smooth, uniform and sufficiently firm to prevent sink pockets when irrigated.
- For active open spaces, accurate grade surveys may be required for both sub-grade and finish-grade.
- For sports fields, accurate grade surveys are required for both sub-grade and finish-grade.
- Remove materials not required for construction from the site.

10.4.5 Seeding

The establishment of new plant communities can easily fail due to the presence of invasive species. For this reason, proper weed control shall occur prior to any attempts to establish the new plant community. Pre-seeding chemical weed control is recommended wherever possible. The use of weed-free soil is essential to ensure the success of any project.

10.4.5.1 Description and Quality Assurance

Seeding shall be packaged in original containers. The label shall indicate net mass, analysis of seed mixture, percentage of pure seed, year of production, date tagged and location. Seed packaging label and 500 g samples shall be approved by the Engineering Department prior to seeding operation. All seed mixtures must not contain any weed, such as prohibited noxious or noxious weeds identified under Alberta's Weed Control Act.

Additionally, weed certificates need approval for each species to ensure no other problem species are present in the seed.

The Engineering Department may test grass seed to verify seed conformance to specified requirements.

10.4.5.2 Seed Mixes and Calculations

Seed mixes shall be made using pure live seed (PLS) to calculate the percentages of each species in the mix. For native species, the Tz results (live seed) may be used in place of germination within the PLS calculations for some species due to the long dormancy of many native species. Calculate PLS using the following formula:

SR (PLS)	=	This seed is required by the project (kg).
SR	=	Seed required (kg) - final kg's of seed required after PLS is accounted for in the mix.
SP1 (PLS)	=	% (PLS) of species "1" required in the mix.
SP (PLS)	=	% (PLS) of a species required in the mix.
SP1	=	% (PLS) of species "1" required in the mix.

Gr1 = % germination of species "1" (Tz or germination may be used).
Gr = % germination of each species.

$$SR = (\Sigma SP\ (PLS)\ (1/Gr)*SR\ (PLS) \qquad SP1\ (kg) = SP1*SR$$

$$SP1 = \frac{SP1(PLS)\ (1/Gr1))}{\Sigma SP(PLS)\ (1/Gr)}$$

See Table 10-4 and Table 10-5, below, for examples of these calculations.

Table 10-4: Seed Required

(25 kg/ha PLS Recommended for Native Mixes)

(PLS) Seed Required (kg)	Seed Required (kg)
25	34.47

Table 10-5: Calculation of PLS Required

% PLS in mix	Species	% Germination	% of actual mix	Kg needed
35%	Idaho Fescue/*Festuca idahoensis*	100%	25%	8.75
15%	Blue Grama Grass / *Bouteloua gracilis*	50%	22%	7.5
10%	Western Wheatgrass / *Pascopyron (Agropyron) smithii*	85%	9%	2.94
10%	June Grass / *Koelaria macrantha*	90%	8%	2.78
20%	Alpine Bluegrass / *Poa alpina*	50%	29%	10.00
10%	Perennial Ryegrass / *Lolium perenne*	100%	7%	2.5

The following approved seed mixes shall be used when possible; the Town prior to purchase and placement shall approve substitutions:

Non-Native Seed Mixes

Only use certified Canada # I seed varieties, in accordance with the Canadian Seeds Act for lawn grass mixtures. Mixes shall have minimum purity of 97% and germination of 75% mixed by weight to the following specifications:

Mix 1) grass seed mixture for sports fields and maintained turf areas:

- 25% Able I Kentucky Bluegrass / *Poa pratensis*
- 25% Shadow Chewing Fescue / *Festuca rubra ssp fallax*
- 15% Award Kentucky Bluegrass / *Poa pratensis*

- 15% Nu-destiny Kentucky Bluegrass / *Poa pratensis*
- 10% Creeping Red Fescue / *Festuca rubra*
- 10% Player Pier Perennial Ryegrass / *Labium perenne*

Mix 2) grass seed mixture, non-native mix for slopes, natural areas and non-maintained areas:

- 25% Canada Blue Grass/ *Poa compressa*
- 25% Hard Fescue / *Festuca ovina var duriuscula*
- 20% Sheep's Fescue / *Festuca ovina*
- 20% Alpine Blue Grass/ *Poa alpina*
- 10% Manhattan III Perennial Ryegrass (nurse crop) / *Lolium perenne*

Native Seed Mixes

The use of any native seed shall only be conducted using seed that is free of all prohibited noxious and noxious weeds. A seed purity and weed certificate shall be included for all species in the mix for inspection. Reject any seed lot with too many weeds of concern All weed analysis and germination certificates shall be included. Both germination and Tz analysis shall be submitted if the Tz formula is to be used in the PLS calculations. Native seed mixes, mix by weight to the following specifications:

Mix 3) mowing-tolerant native grass seed mixture for slopes, natural areas and non-maintained areas:

- 35% Idaho Fescue / *Festuca idahoensis*
- 15% Blue Grama Grass / *Bouteloua gracilis*
- 10% Western Wheatgrass / *Pascopyron (Agropyron) smithii* and/or Northern Wheatgrass / *Elymus lanceolatus (Agropyron dasystachyum*)
- 10% June Grass / *Koelaria macrantha*
- 20% Alpine Blue Grass / *Poa alpine*
- 10% Manhattan III Perennial Ryegrass (nurse crop) / *Loium perenne*

Mix 4) non-mowed native grass seed mixture for slopes, natural areas and non-maintained areas:

- 25% Idaho Fescue / *Festuca idahoensis*
- 15% Festuca campestris / *Festuca campestris*
- 10% Western Wheatgrass / *Pascopyron (Agropyron) smithii* and/or Northern Wheatgrass / *Elymus lanceolatus (Agropyron dasystachyum*)
- 15% June Grass / *Koelaria macrantha*
- 15% Alpine Blue Grass / *Poa alpine*
- 10% Manhattan III Perennial Ryegrass (nurse crop) / *Lolium perenne*

- 10% Optional species use one or a number of the following species depending on site characteristics: Alkali Bluegrass / *Poa ampla*, Parry's Oat Grass / *Danthonia parryii,* Western Porcupine Grass / *Stipa curtiseta*. Mountain Brome / *Bromus carinatus*, Alpine Timothy / *Pheleum alpinum*, Tufted Hair Grass / *Deschampsia caespitosa*

Mix 5) wildflower mix for slopes, natural areas and non-maintained areas:

- 25% Yarrow / *Achillea millefolium*
- 25% Blue flax / *Linum perenne*
- 25% Brown Eyed Susan / *Gaillardia aristata*
- 25% Canada Milk Vetch / *Astragalus canadensis*

Substitutions

The Engineering Department shall approve any substitutions made to the above seed mixes. Do not use the following species as substitutions into native seed mixes because they are either non-native or there is a high risk of them being non-native even if a registered variety:

- Rocky Mountain Fescue / *Festuca saximontana* (DNA-proven native varieties not available)
- Sheep's Fescue / *Festuca ovina* (Not native)
- Creeping Fescue / *Festuca rubra* (Not native)
- Hard Fescue / *Festuca ovina*

10.4.5.3 General

Upon request, prior to any application of seeding, the developer shall provide to the Engineering Department all identification labels, including grass seed, fertilizer and other materials used. Labels shall be clearly marked with the content breakdown, weight, analysis results, name of supplier and manufacturer. Quantities of each seed species within seed mixtures must be clearly marked on the labels.

The Engineering Department reserves, the right to reject any proposed turf seed mix or materials that does not conform to the manufacturer' specifications. The developer/contractor will remove all rejected seed/materials from the site immediately.

Due to the wide range of microclimate conditions in the valley, Developers can provide a native turf seed mix developed for a specific site. Submit the proposed native seed mixture details and breakdown (certificate of analysis) to the Town for approval by the Engineering Department prior to the purchase and application of the mixture.

In naturalized areas, the addition of native wildflowers may be applicable if the Engineering Department approves the proposed species. The proposed species may only be native wildflowers of the Canadian Rockies, specifically the Canmore/Bow Valley area. The proposed wildflower seed mixture shall not contain any weeds, such as prohibited noxious

or noxious weeds, as identified under the Alberta Weed Control Act. Submit a certificate of analysis with a complete detailed breakdown of the quantity of ingredients to the Engineering Department for approval prior to purchasing.

10.4.5.4 Preparation and Installation

Surface preparation prior to seeding, seeding and watering shall be as follows:

- Loosen seeded areas to a cultivated surface 150 mm deep. On un-compacted topsoil, scarify the surface to a depth of 20 mm.
- On compacted topsoil, surface shall be aerated and top-dressed with no less than 50 mm of soil.
- The surface shall be finely graded to be free of humps, hollows, and deleterious and refuse material.
- Seed the surface using a Brillion or similar mechanical seeder, or hydro-seed, as required. Seed half the amount of the prescribed seed mixture in one direction, with the other half of the seed mixture seeded in a perpendicular direction.
- Seeding rates shall be applied at no less than the seed mix labeled recommendation per/lb. per/1000 sq. ft. for over-seeding and/or newly seeded areas.
- Do not seed Native seed at a rate lower than 25 kg/ha.
- Drill seeding is not suitable for native seed because it buries the seed too deep for the small native seeds to establish successfully. Recommend Brillion seed drills, broadcast and harrow, and hydro-seed techniques, depending on the project needs.
- In small areas or areas around existing vegetation, hand seeding may be required. In such cases, seed shall be hand raked into the topsoil.
- Native seed mixes shall be seeded before June 1 or after September 15. Other seed mixes shall be seeded during early spring before June 15, or after August 15 or as recommended by the Engineering Department. Seed when the wind is less than 8 km/hr. Work shall not be performed under adverse conditions such as frozen ground, heavy rain or snow.
- Float and roll seeded areas to firm the seedbed.
- Water the entire area with a fine spray immediately after each area been sown. Apply enough water to ensure penetration of at least 50 mm. Care shall be taken to avoid washing out seeds.
- A watering schedule shall be submitted to the Engineering Department for approval. Watering shall be done when necessary and with sufficient amount to ensure germination and to prevent grass and underlying soil from drying out. Care shall be taken to prevent overwatering as this will cause a shallow root system and prevent seed from knitting tightly.
- Immediately after seeding, barricades and warning signs shall be erected to protect the seeded areas from traffic until the grass is established.

Application of Fertilizer

Preparation for fertilizer application and fertilizer application shall be as follows:

- The final grade shall be approved by the Engineering Department prior to fertilizing, seeding or sodding.
- A fertilizer application schedule and rates shall be submitted to the Engineering Department for approval.
- Starter fertilizer (with high Phosphorus content for root initiation) shall be applied immediately after seeding.
- Fertilizer shall be spread uniformly (two directions at half rate) over the entire area of topsoil at a rate determined on the basis of the laboratory analysis of the soil sample.
- A watering schedule shall be submitted to the Engineering Department for approval. Watering shall be done when necessary and with sufficient amount to ensure germination and to prevent grass and underlying soil from drying out. Care shall be taken to prevent overwatering as this will cause a shallow root system and prevent seed from knitting.

Hydroseeding

All seeding shall be done when weather conditions, soil temperature and moisture conditions are suitable.

Upon request and prior to any application of seeding, the developer shall provide to the Engineering Department all identification labels, which include descriptions of grass seed, fertilizer, mulch and other materials used. Labels shall be clearly marked with the content breakdown, weight, analysis results, name of supplier and manufacturer. Quantities of each seed species within the mixtures shall be clearly marked on the labels.

The Engineering Department reserves the right to reject any proposed seed or materials if either does not conform to the manufacturer' specifications. The developer may also be ordered to remove all rejected seed/materials from the site immediately.

Seeding with hydro-seeding emulsion slurry shall be done at the following quantities per hectare:

- 1600 kg of wood fiber mulch
- 300 kg of the approved seed
- 450 kg of fertilizer
- 50 kg of tackifier

Water shall be used in the quantity required to form slurry in accordance with the manufacturer's recommendations.

All seeded areas shall be mulched on the same day, immediately following the seeding. An approved mulch blower shall be used. Only those areas that can be mulched in the same

day shall be seeded. Mulch shall be applied at a rate sufficient to form an even, uniform net over the entire area, to a depth of not less than 20 mm and not exceeding 50 mm.

Seed and mulch mixtures shall not be sprayed onto trees, shrubs, trail surfaces, roads, parking lots, sidewalks, bridges, houses, fences, park amenities (benches, picnic tables, playground equipment, garbage receptacles, etc.) or other surfaces not meant for seeding. All traces of over-spraying shall be removed.

Seed Protection on Slopes

On slopes 2:1 or greater, a Curlex erosion-control blanket or approved equal shall be installed over the seeded area. For grades exceeding 2:1, the seeded slope shall be covered with jute, straw, coconut or other approved matting.

Matting shall be rolled down over slopes without stretching or pulling and should lay smoothly on the soil surface. The top end of each section of matting shall be buried in a narrow 150 mm deep trench, leaving a 300 mm overlap from the top roll over the bottom roll and a 100 mm overlap over adjacent section. The outside edges of the matting shall be stapled and overlapped at 1.0 m intervals.

When seeding in ditches with side slopes that exceed 2:1, matting shall be unrolled in the direction of flow and strip ends overlapped 150 mm with the upstream section on top. Methods shall be at the discretion of the Engineering Department and upon approval.

Slopes shall be top-dressed with a light layer of topsoil to ensure close contact between matting and the soil before seeding.

10.4.6 Sodding

10.4.6.1 Description and Quality Assurance

Nursery Sod

Freshly cut and healthy with a strong, fibrous root system, cultivated in nursery field as turf grass crop containing a maximum of 2% of other grass species and maximum of two broad leaf weeds and ten other weeds per 40 m^2 area. Thickness of sod soil portion shall be a maximum of 40 mm and minimum of 25 mm. Sod shall be cut in accordance with recommendations of Nursery Sod Growers Association of Alberta.

Bluegrass/Fescue Grass Sod

Sod grown from minimum 65% Kentucky Bluegrass and a 35% Creeping Red Fescue blend or sod specifically developed for the Bow-Canmore valley, if available.

Sod Quality

Sod shall be healthy and vigorous with a strong, fibrous root system, free of stones, burned or bare spots, disease, insect infestation, netting, and shall contain no more than 1% weeds and other grasses.

10.4.6.2 Product Delivery, Storage and Handling

Nursery sod shall be delivered rolled or flat to prevent tearing or breaking. Broken or irregular pieces are unacceptable. Sod shall be delivered to site within 24 hours of being lifted. Sod shall be stored pallets and shall be protected from drying out.

A certificate of weed content found in the sod may be requested by the Engineering Department. The developer shall ensure that this certificate is available when requested.

Sod and all other material shall be protected before, during and after installation. This includes providing adequate protection to materials that may deteriorate if exposed to weather.

Sod shall be laid within 24 hours of its arrival on site. Installation shall be during the growing season, not during times of freezing temperatures or over frozen soil. During wet weather, sod should be allowed time to dry sufficiently to prevent tearing during lifting and handling. During dry weather, sod shall be protected from drying by watering as necessary. Dry sod will be rejected. Care shall be taken to prevent dropping of soil in handling.

Loosen areas to be sodded to a cultivated surface 100 mm deep. Fine-grade the surface so it is free of humps, hollows, and deleterious or refuse material.

10.4.6.3 Preparation and Installation

The following steps shall be followed in preparation for and installation of sod:

- The surface shall be floated to achieve design elevations with a tolerance of 25 mm in 3 m when measured in any direction.
- Starter fertilizer (with high Phosphorous content for root initiation) shall be applied as per the manufacturer’s recommended spread rate ratio prior to laying the sod.
- Sod shall be laid in rows, smooth, even and flush with adjoining surfaces and with joints staggered. Care shall be taken to butt sections closely, without overlapping or leaving gaps.
- Immediately after sod installation, the areas shall be watered in sufficient quantities to obtain moisture penetration through the sod and into the upper 100 mm of topsoil.
- To prevent damage, when sod and soil are sufficiently dry, sod shall be rolled to ensure good contact with the topsoil and to remove minor depressions and irregularities.

- All sodded areas that show open joints and/or cuts and that are not butted flush with the adjoining surfaces shall be re-sodded or top–dressed, as directed by the Engineering Department representative.
- Deficient areas shall be top-dressed by spreading and raking topsoil into the open joints between sod pieces and adjoining surfaces.
- Grass seed shall be hand-broadcast on all top-dressed areas with Mix 1 (grass seed mixture for sports fields and maintained turf areas) as per the manufacturer's recommended seed rates. Seeding rates shall be applied at no less that the seed mix label's recommendation per/lb. per/1000 sq. ft. for over-seeding or newly-seeded areas.

The contractor shall provide the Engineering Department with a sod watering schedule to ensure proper root establishment and to maintain the turf areas in a healthy, vigorous growing condition during the warranty/maintenance period.

Application of Fertilizer

Fertilizer shall be spread uniformly in two directions over the entire area of topsoil at half-rate, determined on the basis of laboratory analysis of a site soil sample.

A fertilizer application schedule and rates shall be submitted to the Engineering Department for approval.

Laying of Sod on Slopes

When laying sod on slopes with grades exceeding 2:1, the following steps shall be taken:

1. biodegradable mesh shall be placed on topsoil prior to placing sod
2. mesh shall be secured with wood pegs at 1 m on-center
3. mesh shall be lightly covered with topsoil
4. sod sections shall be laid at right angles to the slope
5. sod shall be secured with five pegs per square metre to prevent shifting
6. pegs shall be driven flush with the sod surface.

10.4.6.4 Turf Maintenance and Acceptance

All turf areas shall be maintained in a healthy, vigorous, growing condition until accepted by the Town on the date of the FAC or DCC.

Grass shall be mowed regularly to maintain a constant height between 50 mm and 65 mm. The first cutting for seeded areas shall occur when the grass is 75 mm high over 75% of the area. No more than 33% of the grass blade shall be cut at any one mowing. Excess clippings shall be removed after mowing. Mowing direction shall be changed each time an area is mowed (i.e., end zone to end zone, sideline to sideline and corner to corner) to avoid compaction and wear.

A watering schedule shall be submitted to the Engineering Department for approval. New turf areas shall be watered when necessary and with sufficient amount to ensure germination and to prevent grass and underlying soil from drying out. Care shall be taken to prevent overwatering as this will cause a shallow root system and prevent seed from knitting

A fertilizer application schedule and rates shall be submitted to the Engineering Department for approval. Areas shall be fertilized regularly to establish healthy grass. Frequency shall be determined on the basis of the laboratory analysis of the soil sample and/or as per the manufacturer's recommendation.

Invasive plant/weed, insect and fungus control shall be completed when required. Chemicals shall be used in strict accordance with manufacturer's recommendations, jurisdictional laws and shall be applied by a licensed applicator. Care shall be taken to ensure safe application during wind and weather conditions. Pesticides and herbicides shall be applied at times when application will not cause damage to new grass or other plants. Precautions shall be taken to avoid spraying existing natural ground covering vegetation, bushes and trees.

Upon completion of a pesticide or herbicide application, signs shall be erected within the area sprayed, which identify that the area has been sprayed, the date of application, contact name and phone number of the licensed applicator, and the type of pesticide/herbicide applied. Signs shall remain in place for 48 hours and shall be removed by the applicator within 72 hours of the application time.

All areas showing deterioration, bare-spots, burns, or areas that are thin or washed out shall be top-dressed and re-seeded or re-sodded. Turf edges shall be trimmed neatly, and all clippings shall be removed from planting beds, tree saucers and pavement. Sod shall be rolled to remove depressions and irregularities when necessary. Areas where subsidence has occurred shall be repaired. Maintenance shall be monitored by the Engineering Department representative throughout the warranty period.

Work under this section shall be accepted when:

- growth of seeded or sodded areas has been properly established
- turf is free of bare and dead spots
- turf is invasive plant-free (free from prohibited noxious, noxious, invasive grasses and annual weeds).

Areas seeded in the fall shall be accepted the following spring, one month after the start of the growing season, provided conditions specified above are fulfilled.

10.5 Plant Material

Developers shall be responsible for site planning and design that respects the following key considerations when choosing plant material for developments in the Bow Valley area:

- Existing vegetation and site features shall be preserved. In natural areas where existing vegetation has been disturbed or destroyed, replanting shall be done with native tree, shrub and grass species. Rehabilitation shall be undertaken in a manner that promotes natural succession.
- Nursery stock that has been propagated from plant stock collected and grown in Chinook regions of Alberta, south of Red Deer, and grown within Hardiness Zones 1-3 shall be selected.
- Plant materials that reduce/eliminate wildlife and fire hazards shall be chosen.
- With the exception of straight-line boulevards, tree planting or formal planting areas in park areas, planting methods that are sensitive to the ecological patterns in the Bow Valley and that blend in with the existing vegetation shall be used.

Methods of establishment, maintenance and irrigation of the proposed landscape design shall be outlined in the development proposal. The quality and extent of the proposed landscape established on the site, and the areas of natural vegetation preserved shall be the minimum standard to be maintained on the site for the life of the development.

Tree planting plans for road rights-of-way shall be approved by the Engineering Department to ensure proper sight clearances from roads and intersections and clearance from utilities.

Developers shall not plant over utility lines or proposed utility line locations. The Engineering Department can be contacted to verify locations. Where overhead utility lines exist, planting guidelines available from Trans-Alta Utilities shall be used.

Proposed tree and planting bed locations shall be staked by the developer's representative and approved by the Engineering Department prior to installation.

10.5.1 Quality Control and Assurance

All plant material shall meet horticultural standards of the Canadian Nursery Landscape Association (CNLA) regarding grading, quality and nomenclature.

All transplant plant material shall be made available for inspection by a representative of the Engineering Department prior to removal at the source. Nursery-grown plants shall be true to type, structurally sound, well-balanced, healthy, vigorous, of normal growth habits, densely foliated when in leaf, and with healthy well-developed root systems. Supplied plants shall be free of disease, insect infestation, insect eggs, rodent damage, sun scald, frost cracks, girdling (deep band/impression made around the trunk of a tree in the bark and cambium layers, generally from the guying collars of tree staking supports, which disrupt the flow of nutrients), and other abrasions or scars to the bark.

Approval of nursery-grown plant material at the source of supply does not preclude the right of the Town to inspect plants upon arrival to the site or during planting, and to reject damaged plants or those not conforming to the specification. Removal of transplant material

shall be done with a tree spade. The extent of root ball removed shall be sized in accordance to the age, type, size and height of the tree.

10.5.2 Allowable Plant Materials

At minimum, all plant material other than native material shall be nursery-grown and shall meet the specifications for size, height, spread, grading, quality and method of cultivation set out in the latest *Guide Specifications for Nursery Stock* prepared by the Canadian Nursery Landscape Association (CNLA) and the International Society of Arboriculture (ISA).

Any plant material not conforming to Section 10.5.7, Plant Species List, shall be designated as non-acceptable and will be rejected. Wild-crafted native plant material may only be used when approved in writing by the Engineering Department. All native plant material shall be, at minimum, second-generation propagule, unless express permission is given by the Engineering Department. Exceptions may be permitted to salvage native material from an area that is to have all vegetation removed or destroyed.

All plant material shall conform to the sizes shown on the approved/accepted plant lists in Section 10.5.6.3, Tree Size and Species Mix and Section 10.5.6.4, Shrub Size and Species Mix. Larger plant material may be used when approved by the Engineering Department. Use of larger plants shall not decrease the number of trees or plant material that the developer is required to install as per the accepted plant schedule detailed on the approved landscape plan.

10.5.3 Delivery, Handling and Storage

All plants shall be handled with care to prevent injuries to the trunk, branches and roots. Plants shall be protected during shipment with a tarpaulin or another suitable covering to prevent excessive drying from the sun and wind, or breakage from wind or equipment.

When plants cannot be installed immediately upon delivery to site, they shall be protected adequately and watered to prevent deterioration. Trees with soil balls shall only be moved when the soil ball is wrapped tightly in burlap. Plants shall not be used if burlap staves and ropes required in connection with their transplanting have been removed. Plants with cracked or broken soil balls shall not be used. Care shall be taken to protect the root zone of bare root plants with wet straw (ensure straw is seed-free), peat moss, mulch or other suitable material.

10.5.4 Tree Planting Quantities

10.5.4.1 Boulevards Less Than 6.0 m Wide

On boulevards less than 6.0 m wide, a minimum of one tree is to be planted on each side of the road for each 10 m length of road. The following guidelines shall be followed for trees planted on boulevards less than 6.0 m wide:

- Only deciduous trees shall be used.
- Trees of one species shall be used on individual boulevards to give continuity, unless approved otherwise by the Engineering Department.
- The street tree size shall be a minimum of 75 mm caliper.

Islands in cul-de-sacs or medians shall be landscaped with low or no maintenance materials approved by the Engineering Department.

10.5.4.2 Parkland and Boulevards Greater Than 6.0 m Wide

In park areas less than 0.5 ha or on boulevards greater than 6.0 m wide, one tree (coniferous or deciduous) per 100 m^2 shall be provided. In park areas larger than 0.5 ha, one tree per 150 m^2 shall be provided.

The majority of plant material shall be planted in clusters or natural groupings. Spacing of individual trees within clusters shall vary depending on the mature spread; a maximum overlap of 30% of the mature spread is desirable. Spacing of clusters shall vary from a minimum 9.0m to a maximum of 30m.

A variety of plant material, both coniferous and deciduous as appropriate to the site, shall be used. Plant groupings shall be designed to appear as natural as possible.

Coniferous trees shall be planted a minimum of 8.0 m from a collector or arterial road, due to potential damage from salt spray. Deciduous trees may be planted up to 2.0 m from the edge of any roadway.

10.5.4.3 Residential Lots

One tree shall be planted in the front yard of each residential lot or one tree per unit for higher density housing developments (where possible) in areas where no mature trees occur naturally.

Where residential lot trees cannot be planted because of utilities, narrow frontages or other restrictions, the equivalent tree quantity shall be added to other open space areas upon approval by the Engineering Department.

Only deciduous trees, minimum of 75 mm caliper size, shall be used. Deciduous trees exceeding 75 mm caliper and conifers trees taller than 3.0 m high will require an extended warranty and maintenance period of five years.

If enhanced planting is desired, developers may seek approval under the super-standard amenities policy. See the Town of Canmore's *Open Space Development Guidelines,* Section 5.4, Policy on Super–Standard Amenities, for further information.

10.5.5 Treatment of Existing Plant Material

Preservation of existing mature trees may fulfill all or a portion of the tree planting requirements, depending on the quality and quantity of the existing trees when reviewed on site by the Engineering Department. Existing plant material to be retained shall be identified on design plans by species, size and exact location. Transplanting of existing vegetation is subject to the same conditions as that of planting nursery stock.

Plans and specifications shall detail the intended methods of protecting and maintaining existing plant material during construction. Existing plant material that is damaged or destroyed during construction shall be replaced to the satisfaction of the Engineering Department.

10.5.6 Plant Species Selection

The Canmore area is characterized by a short growing season, severe temperature fluctuations and freeze/thaw. These factors limit the species of plants that will survive in the region. Proper plant maintenance and seasonal protection are critical to ensure survival, even of plants that are hardy to this region. Zone 0-3 plants shall be selected, depending on the location, from nursery stock that has been propagated from plant stock grown and collected in Chinook regions of Alberta.

Native plants are part of the natural local ecosystem and support the integrity of the natural areas within the Bow Valley. They are already adapted to the soils and climate of the Bow Valley region and require little care (xeriscape maintenance) once established. Native plant material is more tolerant to wildlife browsing and may be beneficial in attracting or deterring different wildlife species. Once established, native plants may also prevent the invasion of non-native plants to disturbed sites.

10.5.6.1 Canmore Region Native Plants Selection Principles

Landscaping in public areas in the Bow Valley region should be dominated by native plants to demonstrate a landscaping aesthetic that celebrates and promotes, rather than replaces, the native diversity of this part of Canada. Long-term landscaping goals should always consider using preferred and recommended native plant species.

Low-maintenance landscaping is considered environmentally responsible and should be promoted over landscaping that requires regular watering, mowing, trimming or chemical inputs. Domestic turf areas should be minimized as these areas require a high level of maintenance, which results in ongoing environmental impacts and pressures to use chemical herbicides to maintain a monoculture of non-native grasses.

Town of Canmore projects and reclamation associated with any landscape-disturbing activities of public areas within the Town's corporate limits are required to use only the plants on the list of native plant species provided in Appendix G.

A weed is a plant growing where it should not. For this reason, some native plants may be weeds. Additionally, some native plants may have weedy growth habits that are not appropriate for all planting purposes. Plants with the appropriate growth type shall be selected based on landscaping needs.

Establishment of native species requires careful planning. While native plants are adapted to our climate, they have not been altered through selection to make them easy to handle. Proper weed control before establishing native plants is usually required, especially when seeding.

Herbicides may be approved by the Town of Canmore during the development process, subject to all applicable guidelines and regulations, only when their primary purpose is to protect the environment by eliminating invasive, non-native plants and when other effective alternatives are not available.

It is not recommended within the Bow Valley to collect native plants in the wild. As an alternative on developable private property, native plants can be salvaged in areas of scheduled construction disturbances, with the landowner's permission. Native plants can also be sourced from the approved native plant growers list.

10.5.6.2 Controlling Non-Native Plants

Non-native plants pose a significant ecological threat to native plant and wildlife communities. Natural insect predators and diseases are absent from areas that non-native plants invade. Non-native plants displace native plant species that stabilize soils and provide forage and cover for wildlife. Lacking natural controls, non-native species can spread rapidly, degrading wildlife habitat.

Other project proponents requiring Town approvals who wish to use non-preferred plant species must prove that the preferred native plant species are unsuitable for the intended purpose.

Since native plants may not always thrive in specific urban-type environments, in exceptional cases, the limited use of non-native plants may be acceptable where suitable native plants for specific purposes or settings do not exist. Approved non-native plants are

included in the tables found in Appendix G but may only be used if permission is obtained for a specific project.

Wherever possible, native plants should be derived from local stocks to reduce the risk of introducing non-native varieties. All the native species listed in Appendix G are now or soon to be available from Alberta native plant sources as seed or plants. The plants included on this list are considered non-invasive and are not normally prone to diseases.

10.5.6.3 Tree Size and Species Mix

Section 10.5.7 provides a list of trees that are native to the Province of Alberta. These species are acceptable for the microclimate areas of landscape planting in the Town of Canmore. Tree selection from this list shall be 50% coniferous and 50% deciduous unless the consultant or developer can demonstrate that the species mix should be different to successfully integrate the project with adjacent natural vegetation patterns.

Coniferous trees must be a minimum of 7 m from any structure and must be separated from other planted or natural coniferous trees by a minimum of 9m between stems.

Coniferous tree sizes at time of planting shall be as follows:

- 25% - 2.0 m height
- 50% - 2.5 m height
- 25% - 3.0 m height

Deciduous tree sizes at time of planting shall be as follows:

- 50% - 50 mm caliper
- 50% - 75 mm caliper

Deciduous trees adjacent to walkways or in boulevards shall have a minimum lower branch height of 1.8 m. Smaller deciduous trees may be used as part of a successional forestry plan.

10.5.6.4 Shrub Size and Species Mix

Section 10.5.7 provides a list of shrubs that are native to the Province of Alberta. These species are acceptable for the microclimate areas of landscape planting in the Town of Canmore. Shrub selection from this list shall be 50% coniferous and 50% deciduous unless the consultant or developer can demonstrate that the species mix should be different to successfully integrate the project with adjacent natural vegetation patterns.

Coniferous shrubs must be a minimum of 3 m from any structure and must be separated from other planted or natural coniferous shrubs by a minimum of 5 m between stems.

Coniferous shrub sizes at time of planting shall be as follows:

- 50% - 2 gallon potted
- 50% - 5 gallon potted or larger

Note that *Arctostaphylos uva-ursi* (Kinnickinnick) and some other ground cover plants are only available in 10 cm containers. In these cases, four individual containers are considered equal to one 2-gallon pot.

Deciduous shrub sizes at time of planting shall be as follows:

- 50% - 2 gallon potted
- 50% - 5 gallon potted or larger.

10.5.6.5 Xeriscape

Xeriscape is the term used for a landscaping method that employs drought-resistant plants in an effort to conserve resources, especially water. Plants identified under this category are recommended for low-maintenance, green design landscaping applications.

Native grasses are, in general, not suited for high-maintenance, regularly-mowed turf areas. Some native grasses can handle mowing and are used as lawn replacements (e.g., blue gamma grass and Idaho fescue). These species are mowed taller than a regular lawn but will handle regular mowing.

Native grasses can be difficult to manage once they have established. It is therefore important to select the appropriate species for a project's needs. Some native grasses grow in bunches and will stay where planted, while others will creep. Some species set seed regularly while others do not. Like non-native species, proper maintenance is required to manage native grass species. It is generally recommended to use long-lived bunch grasses as these are the least likely to grow out of control. Most ornamental non-native grasses are of this variety.

In appropriate moisture regimes, sedges and semi-aquatic species can be beautiful ground cover and ornamental species. These species are less likely to dry out than grasses but require more water throughout the season.

Other groundcovers that are appropriate for xeriscaping include woody species, such as Dryas, Kinnickinnick, Pussytoes and Juniper, which live in dry areas. These species anchor soil in place, but do not dry out so much as to become a fire hazard.

10.5.6.6 Bow Valley WildSmart Program, Prohibited Plant Species, and Plant Species to Avoid

The Bow Valley WildSmart program is a proactive conservation strategy that encourages efforts by communities to reduce negative human – wildlife interactions.

The goal of the WildSmart program is to develop a coordinated approach to education and outreach programs and to help support direct management activities that will aid in

increasing public safety and enjoyment, as well contribute towards sustainable wildlife populations.

Bears are attracted to ripened berries, whether naturally occurring or planted, because of their sweet taste and high caloric value. These attractants can be reduced by not planting fruit bearing shrubs or trees in the first place, by picking berries as they ripen, or by removing berry bushes or trees.

The following species are not permitted as they are attractants for bears and other wildlife.

Table 10-6: Prohibited Plant List

Common Name	Scientific Name	Flammability	Palatability (Wildlife)	Comments
Apple	*Malus spp.*	Low	High	Wildlife Attractant – Bears
Crabapple	*Malus spp.*	Low	High	Wildlife Attractant – Bears
Western Chokecherry	*Prunus virginiana melancarpa*	Low	High	Wildlife Attractant – Bears
Plum	*Prunus spp.*	Low	High	Wildlife Attractant – Bears
Western Mountain Ash	*Sorbus scopulinia*	Low	High	Wildlife Attractant – Bears & Birds
Canadian Buffalo Berry aka: Soap Berry & Russet Buffalo Berry	*Shepherdia canadenis*	Low	High	Primary Food Source for Bears Wildlife Attractant: Bears
Pincherry	*Prunus pensylvanica*	Low	High	Wildlife Attractant – Bears
Saskatoon	*Amelanchier alnifolia*	Low	High	Wildlife Attractant - Bears

WildSmart Plant Selection Recommendations

WildSmart recommends that certain berry and fruit plants not be planted in developed areas. Table 10-7, below, lists plant material (bushes, shrubs and flowers), mostly Bow Valley native, that produce berries or fruit that may attract bears and are, therefore, not recommended by WildSmart. Even though these native plants are abundant throughout the Bow Valley, they should only be used in locations outside developed areas. It is recommended that these plant species not be used in proximity to wildlife corridors or in recognized bears frequented areas.

Table 10-7: Berry and Fruit Plants to Avoid

Common Name	Scientific Name	Flammability	Palatability (Wildlife)	Comments
Red Osier Dogwood	*Cornus stolonifera*	Low	High	**Wildlife Attractant – Bears & Ungulates
Wolf Willow	*Elaeagnus commutata*	Low	Medium	**Wildlife Attractant – Bears
Silver Buffalo Berry	*Sheperdia argentea*	Low	Medium	Primary Food Source for Bears **Wildlife Attractant – Bears
Common Wild Rose aka: Western Wild Rose	*Rosa woodsii*	Low	Medium	**Wildlife Attractant – Bears

10.5.7 Plant Species List

A comprehensive plant species list is included in Appendix G of this document.

10.5.8 Mulch

Mulch shall be composed of the following materials:

- Wood chips obtained from hardwood trees that is free of bark, small branches, and leaves, varying in size from 35 to 75 mm, and with a thickness of 5 to 20 mm.
- Bark chips from coniferous trees, varying in size from 25 to 50 mm diameter.
- Cedar chips with bark varying in size from 35 to 75 mm, and with a thickness of 5 to 35 mm.
- Peat moss that is composed of decomposed plant material; is fairly elastic and homogeneous; is free of decomposed colloidal residue, wood, sulphur and iron. It shall have a minimum of 60% organic matter by mass, and a pH value of 5.5 - 7.0.

Wood chips, bark chips, and cedar chips must be a minimum of 3 m from any structure.

10.5.9 Substitutions

Plants shall only be substituted with prior approval of the Engineering Department. Substitution shall be of the nearest similar approved species and size specified.

If sufficient quantities of nursery stock of the specified size(s) are not available, substitutions shall be with the largest specimen available. An additional 10% shall be added to the total amount of trees to be planted to offset the lack of available specified size(s). Revised sizes shall be indicated on the submitted plans of approval. The developer shall provide proof of the lack of available sizes prior to the Engineering Department approval of the change.

Substitution of plants larger than specified may be permitted if accepted by the Engineering Department. If the use of larger plants is approved, the root balls are to be increased in proportion to the size of plants in accordance with CNLA guidelines. Bare root plants in sizes greater than specified shall be balled in burlap.

10.5.10 Plant Replacements

During the warranty period, plants found dead or not in a healthy, satisfactory growing condition or which do not meet specified requirements in a timely manner shall be replaced. Replacement plant material shall be supplied and planted in accordance with drawings and specifications, and in accordance with Section 10.5.7, Plant Species List.

10.5.11 Plant Characteristics

All plants shall be true to form with growth habit typical to their species. Trees shall be straight, according to their natural habit of growth. Double leaders are not acceptable. Clump or multi-stem trees shall have three or more main stems originating from a common base at the ground line. Shrubs shall have a natural form with a minimum of four canes, typical of genus, species and variety. Groundcovers shall have healthy tops and their size shall be proportionate to root requirements typical of the species and variety. Plants that have been injected with growth hormones are not acceptable.

10.5.12 Plant Measurement

Plants shall be measured in units of caliber, height, or spread called for on the drawings.

Caliber is measured on deciduous trees only and shall mean trunk diameter measured 350 mm above the grade at which the tree originally stood at its' source.

Height shall be measured from the grade at which the plant originally stood at its' source to the top of the main body of the plant (not to the top of the long leader).

Spread is the lateral diameter of the main body of the plant at its' widest natural dimension, not from branch tip to branch tip.

10.5.13 Container-Grown Plants

Plants shall be grown in containers for a minimum of three months and shall have established root system, which will "hold" soil when removed from the container. All plants shall be hardened off, dormant and have sound buds set intact prior to planting. Container size shall be in proportion to plant size. Root-bound plants are not acceptable.

10.5.14 Balled and Burlap-Wrapped

Balled and burlap-wrapped plants shall be supplied from nursery-grown plants with minimum size root balls as follows:

Deciduous:	Caliper (mm)	Ball diameter (cm)
	50	70
	75	80

Coniferous:	Height (mm)	Ball diameter (cm)
	2000	80
	2500	90
	3000	122

Root ball size shall be adjusted according to the plant's growth habits. The ball size shall be sufficiently large to contain at least 75% of the fibrous root system, with a ball depth not less than 50% of ball diameter. Soil balls shall be secured with burlap, heavy twine and rope, or burlap, wire baskets and rope. Single burlap shall be supplied on root balls less than 50 cm diameter; double burlap shall be supplied on root balls 50 to 60 cm diameter; double burlap and drum-lace with 6 mm rope at 200 mm spacing shall be supplied on root balls with a diameter of 60 cm and larger. Plant material shall not be used if the root ball has been cracked or broken prior to or during the planting process.

10.5.15 Excavation

The location of trees and plant beds shall be staked out, and approval from the developer's representative and/or the Engineering Department shall be obtained prior to excavation and planting.

An Alberta One-Call and private utility locates shall be completed to confirm that no shallow utilities are located within the excavation site. A copy of the completed and signed-off One-Call inspection report for each utility inspected shall be supplied for the Engineering Department development file. Any necessary adjustments to excavation location shall be approved by the developer's representative and/or the Engineering Department.

Shrub beds shall be excavated to a minimum depth of 450 mm. Topsoil or soil mix shall not be placed until the sub-grade has been approved. No foreign material shall be buried beneath any planting area.

Plant pits shall be excavated to be the same size as the tree root ball. Where soil is required to fill the plant pit, not more than 50% imported material shall be used and use of at least 50% of on-site material is required. Plant pits for trees and specimen shrubs shall be centred at the location of the stake. Pits shall be excavated in a cylindrical shape with

vertical sides with a forked, saucer-shaped bottom to a depth of 50 mm. Tree holes shall be backfilled with 150 mm of suitable topsoil or soil mix and tamped firmly.

Prior to planting, all non-porous and non-biodegradable containers shall be removed from plant root balls. The minimum depth of the plant pit from the downward side of the slope shall be measured when planting on an incline. Excess excavated soil and turf stripped from plant beds and plant pits shall be removed and disposed off-site, or as directed by the developer's representative and/or the Engineering Department.

10.5.16 Plant Installation

Plants shall only be installed when the ground is frost-free. Tree holes and shrub beds shall be dug out by tree spade, excavator or hand shovel and excess soil shall be removed off-site. Imported topsoil and soil mixes shall be approved by the Engineering Department before planting in shrub beds and plant pits.

The following drawings provide information about specific plant installations:

- deciduous tree planting (machine-dug): see Figure EDCG LSC 10.1 for details
- shrub planting (coniferous/deciduous): see Figure EDCG LSC 10.2 for details
- coniferous tree planting (hand-dug): see Figure EDCG LSC 10.3 for details
- deciduous multi stem tree planting (hand-dug): see Figure EDCG LSC 10.4 for details
- deciduous/coniferous tree planting in sod: see Figure EDCG LSC 10.5 for details
- coniferous tree planting (machine dug): see Figure EDCG LSC 10.6 for details.

The width of all planting excavations shall be 300 mm greater on all sides than the width of the root ball. Sub-grade material shall be scarified to a depth of 75 mm under all tree pits and shrub beds.

Plants shall be placed plumb in the center of the planting pit and at the same depth as they were previously grown at the source, with a firm base under the root ball. The plant shall be placed in the bottom of the plant pit on a minimum bed of 150 mm firmly- tamped topsoil or soil mix. Soil shall be formed in a concave manner in the center of the excavation for balled or burlap-wrapped plants and container-grown plants, and in a convex manner in the center of the excavation for bare root plants. The roots of bare-root plants shall be spread to their approximated natural position and broken or damaged roots pruned. The plant shall be rotated to give the best appearance or relationship to adjacent structures.

Container-grown plants shall be removed from containers prior to planting, ensuring the soil ball remains intact. Biodegradable containers may be planted only if approved by the Engineering Department.

Plant pits shall be back-filled with topsoil or soil mix and hand tamped firmly in layers, not to exceed 150 mm, to ensure no settling. Firm tamping ensures the plant retains its' orientation. No air pockets shall remain around the roots. Before placing the final layer of

soil, the twine shall be cut and burlap folded back. The pit shall be filled with water, allowing the soil to settle around the roots or soil ball. After the water has been absorbed, soil shall be filled to grade, formed in a concave manner, and water shall be added again until absorbed.

An earth saucer shall be constructed around the base of each tree, as large in diameter as the excavated area. The saucer shall be dug to a minimum depth of 100 mm, which will accommodate 75 mm of mulch wood chip cover and a 25 mm lip around the complete saucer for water retention. Trees shall be thoroughly watered within 24 hours of planting. Water probing is not acceptable.

Shrub beds shall have a minimum depth of 450 mm of soil mix below final design grade. Trees shall remain at 75 mm to 100 mm below the surrounding grade after planting and watering, unless otherwise approved by the Engineering Department. The grade in planting beds shall be sloped to ensure positive drainage from building foundations before planting.

Play Structure Plant Installation

Shrub beds shall be set back from areas designed for play structures. Beds shall be 3.5 m from the outside edge of the play area or the width of a local pathway where the pathway abuts a play area. The type and spacing of plantings shall ensure clear sight-lines into the play structure area.

10.5.16.1 Tree Supports

All trees shall be braced in a vertical position immediately after planting by guying or staking as described in the following drawings:

- deciduous tree (machine-dug) - support: specifications, details, and procedures; refer to Figure EDCG LSC 10.1
- coniferous tree (hand-dug) - support: specifications, details, and procedures; refer to Figure EDCG LSC 10.3
- multi-stem tree planting - support: specifications, details, procedures; refer to Figure EDCG LSC 10.4
- tree planting in sod (coniferous/deciduous) - support: specifications, details and procedures; refer to Figure EDCG LSC 10.5
- coniferous tree (machine-dug) - support: specifications, details and procedures; refer to Figure EDCG LSC 10.6

Stakes and posts shall be spaced equally around the tree, just outside root ball. Posts shall be driven 450 to 500 mm into the ground.

Guy-wires shall be encased in a hose (guying collar) to prevent contact with the trunk, with a 65-degree maximum angle between the guy-wire and the ground. All guy-wires shall be installed at the same angle. Warning flags shall be fastened to all the guy wires halfway up, or as necessary to insure sufficient visibility.

After tree supports have been installed, broken branches shall be removed with clean, sharp tools in accordance with good horticultural practice.

Support accessories shall be maintained in proper condition. Turnbuckles shall be adjusted to keep tree guys taut and ties and stakes shall be replaced when missing or damaged and as directed by the Engineering Department. Plants that lean or sag shall be adjusted. Guy wires shall be adjusted throughout the warranty/maintenance period to prevent girdling.

The guying and metal-bar posts and or the T-bar stakes shall remain for two growing seasons. The developer is responsible for ensuring that all the tree staking has been removed after two growing seasons and that all damages incurred due to the staking have been repaired prior to the FAC.

10.5.16.2 Tree Support Accessories

Tree support accessories are defined in Table 10-8, below.

Table 10-8: Tree Support Accessory Definitions

Tree Support Accessory	Definition
Guying Collars	• Collars for use with 2,450 mm T-rail post shall be fabricated from 3 to 4 mm galvanized wire and encased in two-ply, reinforced 12 mm diameter rubber garden hose or equivalent. • Collars for use with 600 mm T-rail stakes shall be fabricated from 3 to 4 mm galvanized wire and encased in two-ply, reinforced 6.35 mm diameter rubber garden hose or equivalent.
T-Rail Steel Posts	Posts shall be 2,450 mm long and primed with one brush coat of black zinc-rich paint to CGSB 1-GP-18lb.
Steel Stakes	These shall be T-rail stakes, 600 mm long and primed with one coat of black zinc-rich paint to CGSB-GP-18lb.
Ground Anchors	Anchors shall be a 100 mm diameter steel disc, underground screw-in type, or Duckbill Model 68 DTS tree support kits.
Warning Flagging	Flagging shall be 25 mm wide florescent orange, plastic survey tape, and or orange florescent Galvanized warning tags placed at the1/3 height of tree. Place warning flagging/tags on each guying wire.
Tree Wrapping	Wrapping shall be new, clean, plain burlap strips of minimum 2.5 kg/m^2 mass and 150 mm wide or an approved equivalent.
Guy Wire	Wire shall be 3 to 4 mm malleable galvanized steel.
Polyethylene Rope	Rope shall be 12 mm in diameter.
Turnbuckles	Turnbuckles shall be factory galvanized, have 150 mm eyes and a 10 mm diameter threaded opening for tightening.

10.5.16.3 Mechanical Tree Transplanting

All transplant plant material shall be made available for inspection by the Engineering Department prior to removal at the source. Plants shall be excavated with a mechanical tree spade of sufficient size to excavate the required soil ball size (see Figures EDCG LSC 10.1 Deciduous Planting Machine Dug and EDCG LSC 10.6 Coniferous Planting Machine Dug) for details).

Soil balls shall be secured with burlap, heavy twine and rope or with burlap, wire baskets and rope. Tree pits shall be excavated to a size not less than 300 mm greater on all sides than the width of the root ball (see Figures EDCG LSC 10.1 and 10.6 for details). The bottom and sides (75 mm) of the tree pit shall be scarified to ensure root penetration after planting. Warning markers and barricades shall be provided around excavated pits. Excavated plugs shall be placed in former tree locations when possible. Excess plugs shall be removed from the site.

Trees shall be planted immediately upon delivery on site, plumb in the center of the plant pit and at the same depth as previously grown. Trees shall be faced to give the best appearance. After planting, the pit shall be saturated with water to allow the soil ball to settle in the pit. The pit shall be filled to grade with fertile topsoil or soil mix as specified. A 100 mm high lip shall be constructed around the outer edge of the pit.

Guy wires shall be installed immediately after planting, with three double guy lines spaced equally around the plant (see Figures EDCG LSC 10.1 and 10.6 for details). Guy wires shall be attached at 60% of tree height and at a 65-degree angle. Guy wire around the trunk shall be encased in a guy collar to protect the bark. Guy wires shall be flush at finished grade and turnbuckles shall be provided to keep guy wires taut and trees plumb. Warning flagging shall be attached to guy wires as a safety precaution.

10.5.17 Shrub Planting Beds

Figures EDCG LSC 10.7 Shrub Planting Ground Bed, EDCG LSC 10.8 Mulch Bed Bordered by Rock Scaping, EDCG LSC 10.9 Mulch Bed Within a Concrete Sidewalk – Bed Next to Roadway, EDCG LSC 10.10 Plaza Raised Rock Feature Bed, and EDCG LSC 10.11 Sidewalk Raised Rock Feature Bed shall be followed when installing shrub planting beds.

10.5.18 Tree and Shrub Pruning

10.5.18.1 General Tree/Shrub Pruning and Removal

Trees and shrubs on Town owned land and land under the control of the Town shall only be pruned or entirely removed with permission from the Town of Canmore. The Town will determine the serviceable life of any tree or shrub and will generally remove trees deemed hazardous from public lands due to liability concerns.

When pruning public-owned trees and shrubs, good pruning practices, standards and guidelines shall be followed.

The best time of the year to prune trees and shrubs depends on the plant species, its' condition, and the purpose of pruning. In most cases, corrective pruning of dead or weakened branches can be done at any time of the year, as it will have little effect on the tree's growth. Removal of one or two small branches can be done at any time of the year for the same reason. However, heading, limbing or thinning should be done in the late fall or early winter when leaves have dropped.

Corrective pruning is often done to improve the health and appearance of trees and shrubs damaged by wind, snow, insects and diseases. Branches that are not growing in an upright manner are susceptible to snow or wind damage. Corrective pruning can reduce damage caused by these stresses. Trees and shrubs damaged by wind or snow can be pruned to grow into a more symmetrical shape, thus alleviating future problems.

Pruning for line-of-sight or safety shall be done at any time, at the discretion of the Town.

The following pruning method shall be used when pruning trees or shrubs:

Make three cuts when pruning, especially on large branches:

- The first cut is made a short distance from where the final cut is to be made on the underside of the branch.
- The second cut removes the branch.
- The third cut removes the branch stub just above the branch collar.

All dead branches shall be removed. If there is a double leader, one leader shall be shortened approximately 1.27 cm (0.5 in.) back to a live branch that points away from the tree, at approximately 1/3 the diameter of the leader cut. Broken portions of branches shall be cut back to a live lateral.

The removal of lateral branches, or thinning, shall be done to reduce crown density.

Mature trees that receive extensive pruning of large branches from one side shall have structural pruning to maintain a proper aesthetic tree balance.

In the past, pruning paint and other wound dressings were used to prevent decay at pruning wounds; however, their use is no longer recommended. Pruning paint and other dressings do not quicken the growth of callous tissue (tissue produced by trees and shrubs to cover and seal off wounds), nor do they prevent decay organisms and insects from entering the wounds.

Root pruning is the cutting of roots, and it is used when trees/shrubs are transplanted, or when root density needs to be increased for future transplanting.

10.5.18.2 Branch Pruning

Branch pruning is done for a number of reasons. Most importantly, it is critical to the long-term health and vigour of a tree. Periodic pruning can cut away dead or diseased wood that limits growth. It can also contribute to enhancing views and limiting potentially hazardous conditions.

Branch pruning shall be undertaken during the dormant or less active periods of the year, during winter or summer, depending on the tree species (type). If possible, pruning shall be avoided during spring due to the presence of new growth and fall due to the potential to introduce disease.

Branches shall be cut cleanly with a proper saw or shears, depending on the size of the branch. The cut shall be located adjacent to a node (swelling) in the branch. Along the tree trunk, branches shall be cut just above the branch bark collar at the base of the branch, not flush to the tree trunk, to avoid unnecessary tissue damage.

All coniferous trees greater than 6 m in height are to be pruned to a minimum of 2 m above ground level at the lowest point of the branch.

Pruning shall provide for attractive tree form and not create unnecessary stress on the trunk. Branches shall be adequately spaced along and around the tree trunk. With large trees, one tree trunk shall normally be used as the major support for the tree to avoid potentially hazardous situations. Tree paints on cut branches are no longer considered necessary but the application of tree pruning hormones, in certain instances, can prevent excess growth of new stems.

10.5.18.3 Power Line and Aerial Infrastructure Tree Pruning

Trans Alta, Fortis or Alta Link shall be contacted if pruning is required near power lines.

Tree pruning around power lines and aerial infrastructure is to ensure good clearances and to maintain the health and aesthetic qualities of trees within the Town of Canmore.

Historically, tree pruning within power line clearances within the Town of Canmore has included pollarding and indiscriminate cutting and pruning of trees beside, under and over power lines.

Pollarding (cutting at any point into a tree’s trunk or branches) is used to keep woody plants small and to a manageable size. This process is often used on shrubs and hedges to maintain form and shape within a landscape. Trees do not react well to pollarding. Pollarding can create large amounts of dieback and deadwood. This can become hazardous in the future both to the public and tree workers.

10.6 Irrigation Systems

10.6.1 General

Automated irrigation systems may be required where turf areas are to be used for recreational purposes, sports fields and aesthetic features.

This section of the EDCG specifies the supply and installation of irrigation systems. Installers shall have experience at this type and scale of work and be willing to provide proof of experience.

The developer is responsible for verifying all conditions on the site and shall immediately report all discrepancies and variations from the drawings to the Engineering Department.

10.6.2 Record Drawings

Record drawings showing the irrigation system shall be submitted electronically as stated in Section 2.5.5. Drawings shall be drafted in a professional manner and shall be drawn to scale on a legal base plan. Drawings shall show the location of the irrigation system relative to the property line, the power source/tie-in (AC) for the main controller, the main controller location, the electrical providers' consumption meter location. Drawings shall include the locations of all lines, sprinkler heads, valves (drain and zone control), boxes, the water meter location and type of housing, spool to replace the water meter when it is removed during the winter months, double-check valve, park water service (stop and drain type), curb stops, underground pipe fittings not adjacent to surface fixtures (tee, elbows, etc.), saddles for poly-pigtails and other irrigation materials.

Acceptable record drawings shall include but not be limited to the following details:

- A1 sheet size shall be used, showing the Town of Canmore title block.
- The drawing(s) shall be labeled "Irrigation System Record Drawing".
- The drawing(s) shall include a key plan showing the site location.
- Labeling shall be a minimum of 12 pt. font.
- Drawing(s) shall include a plan of the site showing property lines, bearings, surrounding site uses, north location, on-site structures, utilities, fences, buildings, walkways, etc., all to a suitable metric scale.
- The municipal address and legal description of the property, including a registered plan number shall be included on the drawing(s).
- The largest scale shall be 1:250.
- Detail sheets shall not be included in the record drawings. Instead, refer to the year of the specification and the detail sheet name and number (i.e., 1996, Drain Pit for PVC Pipe, Detail sheet #66).
- The type of irrigation system (gravity drain, a blow out or a main line gravity drain with a lateral line that has to be blown out) shall be indicated on the drawings.

- All irrigation zones shall be numbered.
- The drawings shall include the name, address and 24-hour phone number of the irrigation system installer, as well as the developer and consultant, where applicable.
- The drawing shall include the serial number, installation date and confirmation of up-to-date inspection by the Town of the double check valve.

Where deviation from the design drawing is anticipated, all required shop drawings shall be submitted to the Engineering Department for approval. Where deviation from the design drawing conflicts with standard specifications, conflicts shall be identified and an explanation provided (e.g., “This design overrides specification item 7.4 of the ‘Layout’ for the following reasons:…”).

All work shall conform to the approved shop drawings and/or design drawing.

Upon completion of the work, the contractor shall provide the Engineering Department with a complete set of record drawings, showing the sprinkler system as installed. This is the responsibility of the contractor and shall not be construed to be the responsibility of any other party.

10.6.3 Product Delivery, Handling and Storage

All materials shall be stored off the ground and under protection until they are used. Materials shall be supported as required to prevent excessive strain on the piping.

All material that is damaged or rejected shall be removed from the site. No material that has been damaged shall be installed. The Engineering Department reserves the right to reject any material that does not meet the specifications.

10.6.4 Job Conditions

Irrigation installation shall be done in suitable weather conditions. Any conditions or defects encountered on the site upon which work of this section may depend and which may adversely affect the performance of the work shall be reported to the Engineering Department prior to commencing work. Work shall not be started until such conditions or defects have been investigated and corrected.

The irrigation system shall be protected from contamination during construction by blocking all open pipe ends.

10.6.5 Inspection and Testing

The contractor shall have an approved set of drawings and specifications available prior to requesting the Engineering Department for an inspection.

Installations require an inspection from the Engineering Department and/or the Parks Department prior to backfilling.

10.6.6 Open Trench Inspections and Testing

The Engineering Department and/or the Parks Department shall be given a minimum of two full business day notice when an open trench inspection is required.

The following items shall be in place and complete for the open trench inspection:

- proper trench depth and alignment
- bedding material
- pipe alignment joints and expansion couplers and valves
- drains with gravel sumps
- swing joints and head locations
- thrust blocking and conduit under paving
- pressure test with heads (static water pressure)
- pressure test backflow prevention device, in accordance with the Parks Department's specifications. A copy of the Testing and Inspection Report for the double check valve assemblies shall be submitted to the Parks Department. The municipal address of the site shall be indicated on the Testing and Inspection Report.
- electrical wiring
- meter spacer (spool) and meter supplied by the Town of Canmore through EPCOR Water Services.

The above items shall be inspected in the event that the system is plowed-in.

The contractor shall receive an inspection sheet from the Engineering Department and/or the Parks Department verifying acceptance and approval of the irrigation system as viewed during the open trench inspection, prior to backfilling.

10.6.7 Irrigation System Check

The Engineering Department shall be given a minimum two full business days' notice when a pressure test is required. A pressure test shall not be done unless written proof of the open trench inspection is available, i.e., copy of the Engineering Department inspection sheet.

The following items shall be in place and complete for the pressure test:

- backfilling
- drain valves boxes in place and clear of debris
- water pressure on and flowing freely through the system

- irrigation head adjustment and all heads activated and throwing water to provide adequate coverage, as per the manufacturer's recommendations and the submitted irrigation plan.

At the Engineering Department's discretion, a pressure gauge shall be placed at any point on the system and a reading shall be taken to confirm expected pressure loss in the system. Pressure gauges shall be a minimum 50 mm sized face, 0 – 1000 kPa, Peacock or equal, complete with petcock.

The contractor shall receive written acceptance and approval of the irrigation system from the Engineering Department before proceeding with landscape development.

No claims for payment shall be accepted until written acceptance of the pressure test is issued by the Engineering Department.

10.6.8 Materials and Workmanship

Any materials specified by name and/or model number in the specifications, irrigation drawings or detail drawings shall be used to identifying the materials and to ensure the specific use of that material in the construction of the system. No substitutions shall be permitted without prior written approval from the Engineering Department.

All materials used in the system shall be new and without flaws or defects of any type and shall be the best of their class and kind. All materials shall have a minimum two-year guarantee against material defects or defective workmanship. All irrigation items shall meet current specifications and shall go through a maintenance period of duration and under conditions determined by the type of product, but not less than two years.

If a substitution of materials is desired by the contractor, sufficient descriptive literature and material samples shall be provided to establish the material as an equal substitute at least three weeks before the commencement of the work. In addition, the contractor shall state the reasons for desiring substitute materials. Any substitutions shall meet or exceed specifications and performance standards of the proposed system, without any additional cost to the Town of Canmore.

All materials and equipment shall be installed in a neat and professional manner, following manufacturer's recommendations.

The Engineering Department and/or the Parks Department retain the right to order removal or replacement of any items, which do not present a reasonably neat and professional appearance.

10.6.9 Maintenance of Existing System

The contractor shall maintain the existing irrigation system, or such portions as may be planned for retention, in satisfactory working order during the time of the contract work. If

cut-ins or tap-ins to an existing system are required, shutdown time of the existing system shall be minimized as much as is practical.

If the irrigation system being installed is replacing an existing system, the existing system shall be maintained in a satisfactory working order until the new system is available for use in any given area. The reason for this provision is to prevent possible damage to or loss of existing turf due to the loss of an existing irrigation facility. If such capabilities are lost, the contractor shall be held responsible for maintaining the existing turf or for the cost of replacing the turf. If damage to the existing system does not impair the capabilities of irrigating the turf, such damage may be left not repaired on written approval from the Engineering Department and/or the Parks Department.

10.6.10 Equipment, Tools and Labour

Any piece of equipment deemed by the developer's/contractor's representative to be of insufficient or extraordinary size to complete the project shall be replaced by the representative with a piece of equipment that meets the requirements of the task.

10.6.11 Piping and Fittings

10.6.11.1 Park Water Service

One 50 mm irrigation service is required for sub-neighbourhood tot-lots and community regional park sites, subject to the Town's water services agent's approval. A 100 mm service may be required for larger school/community regional park sites.

A back-flow prevention device (i.e., double-check valve) shall be installed on each irrigation service line to Town's water services agent's specifications.

Water meters are provided by the Town of Canmore through Town's water services agent and are to be sized and installed by Town's water services agent. The developer/contractor shall make all water meter supply and installation arrangements with Town's water services agent.

10.6.11.2 Irrigation Systems

A fully-automatic underground irrigation system shall be the minimum requirement for sub-neighbourhood tot-lot park sites and landscaping beds. Irrigation controllers shall conform to the Parks Department's existing systems (e.g., Eklof Park, Town Entrance Features).

A fully centralized (from a main AC controller) automatic underground irrigation system shall be required for community regional park sites and sport facilities. (e.g., Riverside Park or Lions Park). Centralized irrigation systems shall be approved by the Engineering Department and the Parks Department.

10.6.11.3 System Maintenance

The developer shall be required to warranty and maintain the irrigation system for a two-year period, including fall shutdown and spring start-up procedures. Start-up of the irrigation system shall require arrangements to be made with EPCOR to install the water meter and start the water consumption tracking process. At the same time, arrangements shall be made to have the backflow prevention device inspected, tested and sealed by a certified backflow device inspector. This shall be completed prior to activating the system. All records of the backflow prevention device inspection process shall be submitted at FAC for the Town's files.

Winterization of the irrigation system shall require shutting down and blowing out the system. This shall include the removal of the water meter and proper draining of the backflow prevention device to avoid potential freeze-up damages. Arrangements shall be made with EPCOR to remove and store the water meter, install the spool, and record water consumption amounts for the season. The developer is responsible for water consumption during the development process and the warranty/maintenance period and will be billed by EPCOR for water consumption.

Following inspection by the Engineering or Parks Department representative, the developer shall be responsible for any required repairs at the end of the two-year warranty/maintenance period to make the irrigation system fully operational. If the system has been approved and accepted and all other deficiencies have been resolved, the FAC will be approved.

For Town irrigation projects, the contractor shall be required to warranty and maintain the irrigation system for a one-year period, including fall shut-down and spring start-up procedures.

10.6.12 Water Delivery Components

10.6.12.1 Piping and Fittings

All piping downstream of parks water service shall be certified series PVC (SDR26 160 psi) with schedule 40 fittings and schedule 80 nipples, or 75 psi CSA polyethylene pipe for lower capacity systems.

10.6.12.2 Swing Joints and Risers

Swing joints shall be three elbows, using PVC elbows and nipples and brass saddles.

All risers for shrub beds shall be galvanized or schedule 80 PVC and bushed down after the final elbow. A double-clamped tee bar stake shall be used.

10.6.12.3 Sprinkler/Spray Heads

The type of sprinkler/spray heads to be used for irrigation in active open spaces (community regional parks) shall be as follows:

- Sports Fields: Rain Bird Eagle, Hunter I-40 or Rain Bird Falcon
- Baseball Diamonds: Rain Bird Eagle, Hunter I-40 or Rain Bird Falcon
- Parks: Hunter I-40, I-25 or Rain Bird Falcon
- Playgrounds: Hunter I-40, I-25 or Rain Bird Falcon
- Passive Open Space (Sub-Neighbourhood Tot-Lot Parks & Landscaping Beds): Hunter I-40, I-25 or Rain Bird Falcon (depending on the area).

Sprinklers shall meet the following general requirements:

- The sprinkler shall be described on the drawings and shall conform to the manufacturer's performance standards for durability and operation.
- The sprinkler shall have a heavy-duty stainless riser.
- The sprinkler shall have ratcheting riser features on all bodies for easy adjustment.
- The sprinkler shall have two-year, over-the-counter warranty.
- The sprinkler shall have a minimum 4 in. pop up, 6 in pop up preferred. If used on a sports field or ball diamond, the sprinkler shall have a rubber cover to ensure user safety.
- The sprinkler shall be equipped with a drain check valve to prevent low head drainage and shall be capable of checking up to 8 ft. in elevation changes.
- To assist in water conservation, adjustable heads may be used in place of full circle heads for perimeter applications.

10.6.12.4 Controllers

Sub-neighbourhood tot-lot parks and landscaping beds shall have underground automated irrigation systems that include controllers that are compatible with the Town's centralized irrigation system. To be compatible, a Rain Bird Unik or approved equivalent controller shall be installed.

Community regional parks, park/school sites and sports facilities shall have one centralized above ground AC controller with multiple irrigation stations and schedule options.

Wiring to and from the controller and valves shall conform to the Canadian Electric Code and any other regulatory conditions which govern this type of installation. All wiring shall follow irrigation lines where appropriate. Where wiring leaves pipe alignment, it shall be placed in a conduit. Below-ground, PVC conduit is acceptable; above-ground, galvanized conduit shall be used. Splices shall be made waterproof with the use of an acceptable outdoor waterproof wire connector.

10.6.12.5 Electric Valves

Electrical valves shall meet the following specifications:

- Valves shall be Rain Bird P.E.B. with a latching solenoid or approved equal.
- Valves shall be without screens and filters that require replacement.
- Valves shall have a flow control stem.
- Valves shall have a manual open/close valve.
- Valves shall close slowly without a hammer or chatter.
- Valves shall work under extremely low flow and low pressure.

10.6.12.6 Irrigation Boxes

Irrigation boxes shall be constructed of heavy-duty weight polyethylene and be capable of being extended, withstanding the weight of a heavy tractor, and being locked. The gravel beds in boxes shall consist of clean, washed 19 mm gravel with an area marginally larger than the box opening. Irrigation boxes shall be recessed into the ground so the top cover sits flush with the existing turf's finished grade. Care shall be taken to ensure that there are no protrusions above the finish grade and or any tripping hazards.

10.6.12.7 Backfill Material

Backfill material for pipe trenches within 150 mm of the pipe shall be clean, approved sand fill or gravel less than 10 mm in diameter. Backfill material shall be free of organic material, stones and sharp objects capable of damaging pipe.

10.6.12.8 Substitutions

For substitutions, descriptive literature and material samples shall be provided at least three weeks before commencement of work. Any substitutions shall meet or exceed specifications and performance standards of the proposed system without any additional cost to the Town.

10.7 Amenities

10.7.1 Public Space Furniture

Public open space site furnishings shall be indicated on final landscape construction plans and be provided by the developer, in accordance with the direction and approval of the Engineering Department and the *Open Space Development Guidelines*.

Site furnishings shall complement and enhance the natural mountain valley setting and/or the Town of Canmore's mining history. Details consistent with local materials, colour and style shall be used.

Site furnishings shall be vandal–proof where possible.

Plans and details of site furniture, such as benches, picnic tables, bike racks, etc., shall be approved by the Engineering Department.

Table 10-9, below, provides a list of approved site furnishings and details.

Table 10-9: Public Space Furniture

Site Furnishing	Approved Models and Furnishing Details
Park Benches Figure EDCG LSC 10.12	Series "B" Park Bench by Custom Park & Leisure or approved equivalent Details: • free-standing • #1 grade clear cedar • Steel Finish • in-ground or bolted down (depending on application) • used for Memorial Bench Applications (routered for bronze plaque installation)
Public Benches	Wishbone Ltd.: Mountain Classic Straight – Model# MCSB-5 or approved equivalent Details: • free-standing • ## ft. long with arm rests • bolted down only, with concrete spreader inserts and tamper-proof hardware • recycled plastic slats, seat colour in "Sand" • powder-coated aluminum frame, colour in "Textured Black" • stainless steel hardware
Picnic Tables Figure EDCG LSC 10.13	Custom Park & Leisure Ltd: Model# Series B – PBS2 or approved equivalent Details: • free-standing • knotty cedar style, finished in sikkens stain • frame colour: brown, TGIC polyester outdoor finish • wheelchair accessible • surface-mounted onto in-ground concrete foundations • 4 in. x 4 in. treated wood border and trail mix infill pad
Bike Racks	Custom Park & Leisure Ltd: Model# Series B or approved equivalent Details: • in-ground or bolted down (depending on application) • individual loop fits any area • black powdered-coated metal frame, TGIC polyester outdoor finish • For multiple applications, install additional individual units in succession to meet the targeted number of bikes.

Site Furnishing	Approved Models and Furnishing Details
Trail Head Large Information Kiosk	H.R. Construction (a division of Rief Industries); 4477 Dick, Rd., Quesnel, British Columbia, V2J 6W9 Details: • same style and design as the Alberta Government's kiosk • constructed out of wood with recycled rubber roof shakes • in-ground installation
Parks Amenity Small Information Kiosks	Information Kiosks solely sourced from Inline Landscaping Ltd.; #3, 107 Boulder Crescent, Canmore, Alberta, T1W 1K9 Details: • constructed of wood • in-ground installation
Bollards with Lights	Gardco (Philips): LED School Bollard Lights or approved equivalent Model # BRM836, 42 in. high with beveled top Details: • LED control - DR • LED natural Light - LNW • light coverage optional at 360o to 180o • voltage 120-240 • finished in black TGIC polyester outdoor finish - BLP • complete with high strength galvanized steel tenon
Large Decorative Bollard	Reliance Foundry Co. Ltd.: Decorative Steel Bollard Model# R-7736 Details: • polyester powder-coated finish; use an epoxy prime coat and a polyester topcoat • can be utilized for decorative or security applications • decorative - height: 36 in. / 91.4 cm • decorative - base diameter: 11-¾ in. / 29.8 cm • decorative – finished in textured semi-gloss black • security - height: 31 in. / 78.7cm • security - base diameter 10-¾ in / 27.3 cm • security - optional steel or galvanized steel pipe • security - Anti-Ram protection fill pipe with concrete • security - finished in Safety Yellow • installation mounting options depend on application (decorative or security); hardware sold separately
Removable Bollard	TrafficGuard Direct: round post, removable top lock or approved equivalent Model #: TL-1004R Details: • heavy-duty construction • 36 in./914 mm tall, 4.5 in./114 mm od • flush-mounted when post is removed

Site Furnishing	Approved Models and Furnishing Details
	• galvanized ground sleeve and filler piece • all surfaces are primed with rust & corrosion resistant, zinc-rich primer w/5,000-hour salt spray performance • standard finish, TGIC polyester outdoor finish RAL1028 in Safety Yellow or custom black, depending on application • optional reflector tape, as required
Permanent Small Bollard	Custom Park & Leisure Ltd.: Permanent Bollard Series or approved equivalent Details: • optional surface mount or in–ground, depending on application • available in three sizes, depending on application • must withstand vehicle impact • standard powder-coated finishes, Safety Yellow for security applications and Matte Black for architectural applications • optional reflector tape, as required

10.7.1.1 Signage

Signage for residential developments or parks shall be complementary to the mountain valley context of Canmore and in scale with the pedestrian environment. Signage shall blend into the landscape and site development, rather than dominating it with larger signs and taller poles.

Only the specified park-related signage and/or park regulatory type signage shall be placed on or at any public green space with Town approval. All other types of signage are regulated by the Town of Canmore's *Land Use Bylaw*. Prior to ordering any type of special signage intended for private or public lands, plans shall be reviewed and approved by the Planning Department.

All signage shall be vandal and graffiti–proof and shall have a protective, cleanable, anti-graffiti, clear surface coating that is durable and long-lasting.

Park-related regulatory signage placed within the road-right-of-way (ROW) shall be approved by the Engineering Department and the Streets & Roads Department and shall follow ROW signage specifications and requirements.

Park-related signage drawings are as follows:

Landscaping - Park Signage:

- Figure EDCG LSC 10.14 Playground Sign Age 2 – 5 Years
- Figure EDCG LSC 10.15 Playground Sign Age 5 – 12 Years
- Figure EDCG LSC 10.16 Type “A” Trail Signage (Trail-Backwoods Informal)
- Figure EDCG LSC 10.17 Type “B” Trail Signage (Trail-Multi Use)
- Figure EDCG LSC 10.18 This Park is Closed to the Public (23:00 to 06:00) (NEW)

Landscaping – Regulatory Signage:

- Figure EDCG LSC 10.19 No Pets (NEW) (replaces “No Dog” sign)
- Figure EDCG LSC 10.20 No Pets Within 20 Meters of Play Apparatus (NEW)
- Figure EDCG LSC 10.21 Pet on Leash (NEW) (replaces “Dog on Leash” sign)
- Figure EDCG LSC 10.22 No Bicycles (NEW)
- Figure EDCG LSC 10.23 Day Use Only Parking Lot Signage
- Figure EDCG LSC 10.24 No Camping/No Bicycling/No Campfires

Custom Signage

Signage for special applications or one-off type applications shall be reviewed and approved by the Town. Some custom signage examples are as follows:

Interpretive Signage Examples:

- Water Shed Loop
- Quarry Lake Community/History/Heritage
- Larch Islands Interpretive Loop Trail
- Amenity protocol signage (small amenity kiosks)
- Kiosk Map Panel (large trail head kiosks)
- Quarry Lake; Pets on leash zone/No pets zone/Pets off leash zone
- Quarry Lake; No Lifeguard on Duty/Deep Water Notification
- Quarry Lake; Keep Off Ice

Park Entry Signage Example:

- “Welcome to Centennial Park”

10.7.1.2 Lighting

Park lighting may be required at select public open spaces or parklands abutting a storm water pond, to provide suitable illumination for night safety.

Lighting standards and fixtures shall be of a pedestrian scale and match street lighting in colour, style and quality.

An excessive amount of illumination detracts from the mountain valley setting. Lighting shall be functional and safe, and at the same time protect the night sky with top and side shielding, where possible. The intensity, direction and type of illumination shall be appropriate to the setting of the Bow Valley/Canmore area. Lighting shall be of commercial quality and vandal-proof.

Walkways and trail bollards with lights shall meet the following standards:

- Gardco (Philips): LED School Bollard Lights or approved equivalent (model # BRM836, 42 in. high with beveled top)

- LED control – DRLED natural light – LNW
- light coverage optional at 360 to 180 degrees
- voltage of 120–240
- finished in black TGIC polyester outdoor finish – BLP
- complete with high strength galvanized steel tenon.

10.7.1.3 Fencing

Perimeter fencing may be required around all sports fields, school sites and park sites. Gate systems shall be installed at controlled access points to the road frontage or trail network. Road frontage fencing is required at all sports fields, school sites and park sites. Fencing proposals shall be reviewed and approved by the Engineering Department prior to construction.

Chain link fencing heights and specifications are as follows:

- Fencing shall be 1.5 m high where private property abuts park space.
- Within 15 m of a ball diamond backstop or adjacent to a soccer goal, fencing shall be 1.8 m high.
- Fencing shall be 1.2 m high where park space is adjacent to a roadway.
- Chain link fencing shall be constructed of galvanized, nine-gauge fence materials, with appropriate service and pedestrian access points.
- All posts shall be anchored in concrete and be installed at 3 m centres.

Where parkland abuts a storm water retention pond or an inlet or outlet structure for the pond, the parkland shall be fenced as described above, consistent with Town policies.

Fencing proposals on arterial and collector roadways shall be reviewed and approved by the Engineering Department prior to construction, and shall adhere to the following specifications:

- Fencing shall be of a close-boarded type and shall extend to within 50 mm of ground level.
- All wood fencing shall be finished with two coats of approved stain. Chain link fencing is permitted when desired by residents to maximize views.
- Chain link fencing shall be required around school areas, walkways and utility lots, in addition to arterial roadways, unless otherwise approved.

All fences shall be constructed on private property, approximately 150 mm from the property line.

A post and cable fence system may be used in passive park areas to control access along roadways. Post and cable fence systems shall consist of 150 mm x 150 mm posts spaced 3 m apart and connected with 15 mm wire rope. Post height shall be a minimum height of 800 mm. Alternatively, a natural arrangement of rock boulders may be used as a means of controlling access to parkland.

Controlled maintenance access points to open spaces shall be considered and coordinated with the Parks Department, with acceptance by the Engineering Department (see Figure EDCG LSC 10.25 Pedestrian and Maintenance Access Gates).

10.7.1.4 Installation

Care shall be taken to ensure that site furnishings are level, plumb, straight and centered, as per details. Components shall be handled carefully to avoid shock, stress and damage to structures and painted finishes. Any cosmetic damage resulting from installation shall be repaired by field painting with two coats. Paint or stain shall be matched to the type originally used by the manufacturer, or as specified.

10.7.2 Playground

10.7.2.1 General

All playground installation shall conform to the latest version of the CAN/CSA - Z614-14; *Children's Play Spaces and Equipment CSA Standards*.

All site plans, playground designs, construction material, playground suppliers and playground development shall be approved by The Parks Department. The Parks Department shall determine the acceptability of materials and the extent of the playground development.

Playgrounds shall be developed to serve a broad range of ages (18 months to 5 years and 5 years to 12 years) and shall be accessible to all levels of ability, as per Accessibility Annex "H".

All playground developments shall include a surface and/or subsurface drainage system with a resilient, washed, 7 mm gyra rock base, and shall be installed to a minimum depth of 300 mm in an approved retainer or border (wood or plastic). A minimum of five pieces of traditional equipment shall be installed within a single retained area.

An alternative rubberized cushion play surface may be used if the material is approved by the Parks Department. Rubberized material shall be installed at the manufacturer's recommended depth and shall confirm to the critical fall height requirements in the latest version of the CAN/CSA - Z614; *Children's Play Spaces and Equipment CSA Standards.*

If two different types of play surfacing materials are being considered for use in one play space site, a proper layout of the play space area shall be required. This will ensure that the gyra rock (pea gravel) play surface is kept at a proper distance from the rubberized play surface, avoiding gravel contamination of the rubberized surface.

Playground equipment selection shall be acceptable to the Parks Department. All equipment shall be purchased from a CSA- approved playground manufacturer. The Town of Canmore

reserves the right to remove, without compensation, any or all playground developments on public lands that do not meet safety standards and that have not been approved by the Parks Department.

Consideration for barrier-free accessibility and barrier-free components in playground design and layout shall be made where possible. Although *Accessibility Annex "H"* is not a mandatory section of the CAN/CSA - Z614; *Children's Play Spaces and Equipment CSA Standards,* it is recommended that all designs submitted incorporate some form of barrier-free accessibility and some barrier-free components. The focus of *Accessibility Annex "H"* is on removing barriers, providing supports and increasing opportunities for people of all abilities to grow and learn together through outdoor play. It is intended to make play spaces accessible and usable by persons with physical or sensory disabilities.

Play elements of each play-space shall provide recreation for children as well as sensory stimulation and learning opportunities for both cognitive and motor development. In addition to structural equipment (e.g., swings and platforms), open turf areas shall be provided. Play spaces shall include sunny and shaded areas and shall provide protection from the elements. Contouring and mounding of larger sites shall be considered to provide for a varied play experience.

A seating area for supervising adults (passive area) shall be provided, such as a Town-specified park bench situated in an area of full view of the play structure. A Town-specified picnic table and pedestrian dual waste/recycle container shall be provided within the open turf area at all playground sites.

Play equipment shall be separated from walkways and turf areas.

Equipment which promotes play by a large number of children at one time shall be located to minimize congestion around other equipment, entranceways or walkways. Swings and other moving equipment shall be located towards the outside of the play lot to reduce conflict with pedestrian movements. Slides and equipment with metal pieces shall face north or be situated in shaded areas.

As part of the playground acceptance process, the following requisites shall accompany the CCC application for the Town's landscaping development file:

- A "Letter of Compliance" from the play equipment supplier, indicating that all inclusive play components have been designed and fabricated to meet the latest version of the CAN/CSA-Z614; *Children's Play Spaces and Equipment CSA Standards*.
- A "Letter of Compliance" from the company/contractor that installed the play equipment and play-surfacing material, indicating that the play equipment and play-surfacing has been installed to meet the latest version of the CAN/CSA-Z614; *Children's Play Spaces and Equipment CSA Standards*.

Safety of the playground equipment users and minimizing liability to the Town shall be a priority in the development of all play space sites. During the two-year

warranty/maintenance period, regular inspection and maintenance of the equipment and site is required, with the inspection/repair process diarized. The Town shall provide the inspection form template that the developer must use and follow. All completed inspection forms shall be returned to the Town as part of the FAC application process.

The following safety-related installation and maintenance actions are required:

- Protrusions (nuts, bolts, etc.) shall be minimized or adequately protected where protrusions are unavoidable.
- Vandal-resistant hardware shall be utilized to prevent equipment tampering.
- Cushioned play surfaces surrounding the play equipment shall be maintained.
- Specified age-approximate signs, including user protocols and the Town of Canmore's Parks Department emergency contact information shall be installed, corresponding to the play apparatus' age designation at each playground site.
- Safety-related inquiries or damage noted by the general public during the warranty/maintenance period will be directed to the Town via the age-approximate signage, which will then be deferred back to the developer for immediate follow-up and repair.

10.7.2.2 Sub-Neighbourhood Tot-Lot Park

Sub-neighbourhood tot-lot parks shall be developed to serve children between the ages of 18 months and 5 years and shall be accessible to all levels of ability.

Sub-neighbourhood tot-lot park playgrounds shall be developed to satisfy the four basics of physical play: jumping, swinging, climbing, and sliding. Play structures shall include the following minimum elements: stairs, climber, bridge, slide, tunnel, steering wheel, roofed area and swing(s).

Sub-neighbourhood tot-lot park playgrounds shall be located in small parks or open space areas that are not in close proximity to schools. They shall be located in highly visible areas for safety, security and public awareness considerations.

10.7.2.3 Community Regional Park

Community regional parks shall be developed to serve a broad range of ages (18 months to 5 years, and 5 years to 12 years) and shall be accessible to all levels of ability.

Community regional parks shall contain one play space which contains the two separate age group play structures. Play structures shall be a combination of traditional and creative equipment that satisfy the four basic physical play activities of jumping, swinging, climbing, and sliding. Play structures shall include, at minimum, the following elements: stairs, straight slide, spiral slide, suspension bridge, climber, fire pole, overhead ladder, platforms, roofed area, gliders/sliders and swing(s).

Climbing walls may also be considered and should be installed as stand-alone components within their own protective surfacing. Climbing walls shall have permanent climbing holes in place of adjustable climbing grips. There shall not be any type of removable or adjustable mechanisms for continuous uniformity and user reliability.

10.7.2.4 Playground Installation

Playground sites shall be located in well-drained, dry, high-visibility areas that do not conflict with sports fields, open play areas and wildlife corridors. Sub-surface drainage is required and shall be approved by the Parks Department.

10.7.3 Ball Diamonds

Ball diamond specifications for fastball, slow pitch and hardball are as follows:

Fastball:

- Minimum dimension for a fastball (softball) diamond is 60 m (200 ft.) from home plate to the outfield fence.
- For standard 18.28 m (60 ft.) sized diamonds, the distance from home plate to second base shall be 25.86 m (84 ft. $10^{1/4}$ in.) with a base line of 18.28 m (60 ft.) from base to base.
- Backstops shall be a minimum of 7.62 m (25 ft.), to a maximum of 9.14 m (30 ft.) from home plate.
- The standard distance from the pitcher's mound to home plate shall be 13.11 m (43 ft.). For high school fastball, the distance between the pitcher's mound and home plate shall be 14.02 m (46 ft.).
- The distance from the pitcher's mound to the outfield radius grass line shall be 18.28 m (60 ft.).
- The standard pitcher's mound plate shall be 60.96 cm (24 in.) x 15.24 cm (6 in.). For Little League, the pitcher's mound plate shall be 45.72 cm (18in.) x 15.24 cm (6 in.).

Slow Pitch:

- Minimum dimension for a slow pitch (softball) diamond is 85 m (275 ft.) from home plate to the outfield fence.
- For 16.76 m (55 ft.) sized diamond, the distance from home plate to second base shall be 23.70 m (77 ft. $9^{1/4}$ in.), with a base line of 16.76 m (55 ft.) from base to base.
- For 18.28 m (60 ft.) sized diamonds, the distance from home plate to second base shall be 25.86 m (84 ft. $10^{1/4}$ in.), with a base line of 18.28 m (60 ft.) from base to base.
- For 19.81 m (65 ft.) sized diamonds the distance from home plate to second base shall be 28.02 m (91 ft. 11 in.), with a baseline of 19.81 m (65 ft.) from base to base.
- Backstops shall be a minimum of 7.62 m (25 ft.) to a maximum of 9.14 m (30 ft.) from home plate.

- The distance from the pitcher's mound to home plate shall be 14.02 m (46 ft.).
- The pitcher's mound plate shall be 60.96 cm (24 in.) x 15.24 cm (6 in.).
- For skinned infields, a 16.76 m (55 ft.) and 18.28 m (60 ft.) radius may be used with the front center of the 116.84 cm (46 in.) pitcher's plate as the center point of the arc to determine the distance for the outfield grass line. The following radii are recommended:
    - 16.76 m (55 ft.) radius is recommended for 16.76 m (55 ft.) baselines.
    - 18.28 m (60 ft.) radius is recommended for 18.28 m (60 ft.) baselines.
    - 19.81 m (65 ft.) radius is recommended for 19.81 m (65 ft.) baselines.

Hardball:

- Minimum dimension for a hardball (baseball) diamond is 105 m (350 ft.) from the backstop to the outfield fence.
- All baselines distances shall be 27.43 m (90 ft.) from base to base.
- The distance from the pitcher's mound to home plate shall be 18.44 m (60 ft. 6 in.).
- The distance from home plate to the backstop shall be 18.28 m (60 ft.).
- The pitcher's mound plate shall be 60.96 cm (24 in.) x 15.24 cm (6 in.).
- The distance from the pitcher's mound plate to the outfield radius grass line shall be 28.96 m (95 ft.).
- Major league baseball field dimensions range in size when it comes to the outfield. However, all major league ball parks share the exact same infield measurements. High school and college baseball fields share the same infield dimensions as the major leagues. Little League and youth baseball fields also have a very different measurements regarding the outfield fence. However, the infield dimensions are standardized.

10.7.4 Sports Fields

10.7.4.1 General

The minimum dimensions for a rugby/soccer field shall be 70 m x 145 m. Multi-sport fields can be constructed as a combination major - minor soccer field for regional park applications. Major fields shall have combination football, rugby and soccer goal frames which meeting the following specifications:

- Frames shall be SCOREMASTER model# P-2400C CDN (one goal set equal two goal ends), which includes four hex-type, in-ground sleeves with safety caps or an approved equivalent.
- The goal frames shall be white powder coat finished with tamper-proof stainless steel assembly screws and standard, recessed, smooth stainless-steel net fasteners.
- The goal frame shall be installed with hex type, in-ground sleeves to allow goal frames to be removed in the off-season.

- Two additional goal frames, hex–type, in-ground sleeves, model# SM-GS-PKG, shall be required at each end of the field to provide for the rotation of the goal frame placement location; this will help mitigate center field wear-out conditions. (The rotation design requirements need to be implemented into the field design; this ensures that center field is also adjustable corresponding to the rotation of the goal frame placement locations).
- The soccer goal nets shall be SCOREMASTER model# SM-HD-P2400PRO, or an approved equivalent.
- The SCOREMASTER soccer goal net will require the optional rear stanchion net stays, model#: SM-PRO-Stanchions (c/w four stanchions and four in-ground sleeves with safety caps) and shall be installed as per the manufacturer's design requirements.
- Two additional net stay stanchions with in–ground sleeves (SCOREMASTER SM-GS-PROSTANCHION c/w safety caps) shall be required at each end of the field to allow for goal frame placement rotation and to mitigate center field wear-out conditions.
- All in-ground sleeves must come complete with a safety cap.

Minor soccer goal frames shall meet the following specifications:

- SCOREMASTER model# DM-2400 (SM - DM1200-2400 Series), moveable 24 ft. soccer goal frames (one set equals two goal ends) or approved equivalent.
- The goal frames shall be white powder coat finished, with tamper-proof stainless steel assembly screws and standard, recessed, smooth stainless steel net fasteners.
- The goal net shall be SCOREMASTER SM-HD-NET-DM24-PKG, white in colour with 2 in. square mesh holes.
- SCOREMASTER standard "Z/Spike" ground anchors shall be provided for the goal sets as all goals must be anchored while in use. Different types of fields and soil conditions may require different anchoring methods. Contact SCOREMASTER for an anchoring solution that best meets the existing site conditions. Different anchoring systems will require the Town's approval.

10.7.4.2 Field Dimensions (Industry Standards)

Field dimension for football, rugby and soccer are as follows:

Regulation Canadian football field dimensions:

- 137.16 m / 450 ft. / 150 yards in length
- 59.44 m / 195 ft. / 65 yards in width
- 18.28 m / 60 ft. / 20 yards end zone

Regulation Rugby Field Dimensions:

- 144 m / 472.44 ft. / 157.48 yards in length (including the 10 & 22 meter lines)

- 70 m / 229.66 ft. / 76.55 yards in width

Regulation Soccer Field Dimensions:

- 109.73 m / 360 ft. / 120 yards in length, (including two 9.14 m / 30 ft. / 10 yard end zones)
- 54.86 m / 180 ft. / 60 yards in width
- Adult soccer goal shall be 7.32 m / 24 ft. / 8 yards wide by 2.44 m / 8 ft. / 2.67 yards high.

Sports Field Structures and Fixtures

Sports field fixtures shall be installed on all designated sports fields. All baseball backstops, goal posts, team benches etc. shall be supplied by an approved manufacturer. The specifications for the equipment or fixture shall be approved by the Engineering Department.

10.7.4.3 Super-Standard Amenities

Amenities provided by the developer that exceeds the standard open space amenity requirements outlined in the EDCG are considered to be super-standard amenities. Super-standard amenities are prohibited, unless endorsed and accepted by Town Council as part of the development approval process.

Further information on how to seek approval for super-standard amenities can be found in the *Open Space Develop Guidelines*, Section 5. Additional Guidelines; Sub-Section 5.4 - Policy on Super-Standard Amenities.

The following examples are super-standard amenities that have been identified through the *Recreation Master Plan* process as priorities for the community.

Tennis Courts:

- Tennis courts shall be full size doubles courts, to the approved submitted details as a minimum.
- Specifications for sub-surface, asphalt pad, tennis court rubberized surface materials, net posts/foundations & nets and chain link fencing shall be reviewed by the Engineering Department and must be accepted prior to construction.
- On-site storm control provisions shall be made, with the final court surfacing properly sloped, with a synthetic rubberized surface applied over an asphalt base.
- Provisions shall be made for tennis court divider curtain(s) between courts.
- Provisions shall be made for a non-intrusive practice area.
- Provisions shall be made for a seating/participant temporary storage area (park bench), one bench per each side of court.
- Courts shall be complete with perimeter chain link fencing, utilizing the 1-in. sq. chain link fabric with pedestrian lockable gates that open to the outside of the court.
- Chain link fencing shall have a lower fabric rail that sits flush to the asphalt surface.

- Courts shall be a complete turn-key application and shall have all the required furnishings, signage and protocol kiosk inclusive.

Outdoor Rinks:

- Outdoor ice rinks shall be constructed to the approved details.
- Specifications for sub-surface treatment and final surface materials, interior hockey type boards with the dasher system, appropriate radius corners, lockable latched pedestrian access gates, maintenance equipment (ice re-surfacer) access gates, exterior board treatment and player box areas shall be reviewed and approved by the Parks Department prior to construction.
- Outdoor ices surfaces should include consideration for summer use with basketball, ball hockey and skate boarding /roller blade applications. These will include furnishings, such as removable basketball posts/nets/back boards that are located and installed on the exterior side of the boards with ground-mounted sleeves, removable, medium-weight hockey goal frames and acceptable, portable skateboarding features.
- Chain link fencing placed at the ends of the ice surface behind the goal shall be a 9 mm gauge galvanized steel HD material.
- Outdoor rinks shall be a complete turn-key application and shall have all the required furnishings, signage and protocol kiosk inclusive.

Additional amenity considerations that could be identified through the *Recreation Master Plan* and/or through public demand and needs assessment surveys that require a suitable landmass are also deemed to be a super-standard amenity.

These types of applications will be dealt with as a stand-alone proposal and will need Town Council's endorsement as part of the off-site requirements under the subdivision agreement. These types of amenities are as follows:

- Disc Golf Course
- Mountain Bike Skills Park
- Off-Leash Dog Park
- Outdoor Adult Exercise Equipment Circuit
- Basketball Courts

10.8 Figures

Figure EDCG LSC 10.1 Deciduous Planting Machine Dug

Figure EDCG LSC 10.2 Shrub Planting

Figure EDCG LSC 10.3 Coniferous Planting Hand Dug

Figure EDCG LSC 10.4 Multi Stem Tree Planting

11. SOLID WASTE

For definitions related to solid waste guidelines and specifications, please see the Glossary of Terms in Appendix A, Table 2.

11.1 Guidelines for New and Redeveloped Residential Development

11.1.1 Animal Proof Waste, Beyond Curbside Recycling and Organics Containers

Container Location

Animal proof waste (APW), beyond curbside recycling (BCR) and organics containers shall be located within a one street block radius from intended users. They may be combined with another container or other utility (e.g., Canada Post mail kiosk) at the Town's discretion. The containers shall be located on public land. For multi-family developments over 10 units, the Town may, at its sole discretion, permit APW and BCR containers to be located on private property.

Container Enclosure

APW, BCR and organics containers shall be screened unless otherwise approved by the Town. Suggested screening shall be artificial screening as illustrated in Figure EDCG SWS 11.1 Animal Proof Waste Container – Artificial Screen Dimensions and detailed in Figure EDCG SWS 11.2 Animal Proof Waste Container – Artificial Screen Detail, or as otherwise approved by the Town.

The Town shall have the authority to place its decals on each APW, BCR and organics containers installed by the developer.

Container Quantity

Developers of new and re-developed developments that increase the number of residential units are required to provide and install APW containers or provide monies in lieu of containers as per the guidelines below:

- 1 to 15 new or additional residential dwelling units: Fees per dwelling units apply, refer to the current Town of Canmore Fee schedule
- 16 to 40 new or additional residential dwelling units will require the developer to purchase, locate and install one APW container, one BCR and one organics container.

11.1.2 Pedestrian Waste Containers and Dog Bag Dispensers

Pedestrian waste containers, pedestrian waste/returnable containers and dog bag dispensers are required as described below at playgrounds, parks and trailheads if such amenities are part of a new or redeveloped residential development.

Each pedestrian waste container, pedestrian waste/returnable container and dog bag dispenser shall have a minimum clearance radius of 1.5 meters.

Final quantities and locations of all APW container, BCR container, organics, pedestrian waste container, pedestrian waste/returnable container and dog bag dispenser are subject to Town approval.

Sub-Neighbourhood Playgrounds

Sub-neighbourhood playgrounds as defined by the *Open Space Development Guidelines* require the developer to provide and install a minimum of one pedestrian waste container.

Neighbourhood and Community Parks

Neighbourhood and community parks as defined by the *Open Space Development Guidelines* require the developer to provide and install a minimum of one pedestrian waste/returnable container.

Trailheads

Trailheads for official trail systems require the developer to provide and install a minimum of one pedestrian waste container and one dog bag dispenser.

11.2 Guidelines for Commercial Development

11.2.1 Waste Containers, Animal Proof Waste, Beyond Curbside Recycling and Organics Containers

Container Location

The location requirements for commercial waste and recycling enclosures, whether inside the principal building or in a separate enclosure or location, are regulated through the Town's Land Use Bylaw.

Where an enclosure for a commercial premise is permitted to be attached to or located within a building or structure and is to contain a standard commercial waste or recycling container, the enclosure shall, as a minimum:

- be animal proof (see specifications in Section 11.3 of the EDCG)
- be of similar material and construction as the building or structure it is attached to
- have a reinforced concrete entrance apron pad (as per Figure EDCG SWS 11.3) at a grade not greater than 2%
- provide for an adequate approach and turning radius for service vehicles.

If the enclosure for a commercial premise is permitted to be a separate, stand-alone building or structure and is to contain a standard commercial waste or recycling container, final design approval will be subject to the nature of the redevelopment and at the discretion of the Town.

Container Enclosure and Access

If the waste container to be used at a commercial premise itself is an APW or BCR container that meets the requirements of the Town's *Waste Control Bylaw*, then the container requires screening on three sides as illustrated in Figure EDCG SWS 11.1 Animal Proof Waste Container – Artificial Screen Dimensions and detailed in Figure EDCG SWS 11.2 Animal Proof Waste Container – Artificial Screen Detail for aesthetic purposes only.

If the waste container itself is an APW or BCR container, a concrete pad shall be constructed as specified in Section 11.6 of the *Engineering Design and Construction Guidelines* (EDCG) and in Figure EDCG SWS 11.3 Animal Proof Waste Container – Pad Construction and Anchor and as illustrated in Figure EDCG SWS 11.4 Animal Proof Waste Container – Double Pad (Large).

Front-loading and side-loading containers shall have sufficient access and an appropriate turning radius for service vehicles to service the containers and enter/exit the property. They shall be screened as illustrated in Figure EDCG SWS 11.1 and detailed in Figure EDCG SWS 11.2.

Final enclosure and screening are subject to approval by the Town's Planning and Development Department.

Container Quantity and Size

Commercial premises shall provide the required quantity and size of APW and BCR containers as identified below or otherwise provide for an equivalent APW handling system approved by the Town.

Table 11-1, below, shows the commercial premises guidelines for BCR containers. The guidelines are for number and size of containers and are based on the total floor area measured in square metres.

Table 11-1: Commercial Premises Guidelines for Beyond Curbside Recycling Containers

Commercial Premise Type	Container Size[a)]			
	N/A	3.0 m^3	4.5 m^3	4.5 m^3 [b)]
Retail	< 400 m^2	> 400 m^2	> 600 m^2	600 m^2
Restaurant	< 300 m^2	> 300 m^2	> 600 m^2	600 m^2
Institution	< 400 m^2	> 400 m^2	> 800 m^2	800 m^2
Grocer	< 400 m^2	> 400 m^2	> 800 m^2	800 m^2
Office	< 500 m^2	> 500 m^2	> 750 m^2	750 m^2
Industrial	< 500 m^2	> 500 m^2	> 1,000 m^2	1,000 m^2
Visitor Accommodation - Commercial	< 500 m^2	> 500 m^2	> 1,000 m^2	1,000 m^2

Notes:

a) Container floor area shall be a minimum of 3.5 m^2 per container.

b) One container required for every square metre factor listed.

Table 11-2, below, shows the commercial premises guidelines for Organics Carts. The guidelines are for number of carts and are based on the total floor area measured in square metres.

Table 11-2: Commercial Premises Guidelines for Organic Waste Carts

Commercial Premise Type	Number of 240 Litre Carts[a)]			
	1-2 carts	3-5 carts	6-8 carts	8 carts [b)]
Retail	N/A	N/A	N/A	N/A
Restaurant	< 300 m^2	> 300 m^2	> 600 m^2	600 m^2
Institution	< 500 m^2	> 500 m^2	> 1,000 m^2	1,000 m^2
Grocer	< 400 m^2	> 400 m^2	> 800 m^2	800 m^2
Office	< 900 m^2	900 m^2		
Visitor Accommodation - Commercial	< 500 m^2	> 500 m^2	> 1,000 m^2	1,000 m^2
Notes: a) Cart floor area shall be a minimum of 0.42 m^2 per cart b) Number of carts required for every square metre factor listed				

Upon request from the Town, commercial premises are required to provide proof that waste materials are transferred to a registered recycling broker and/or end market.

Table 11-3, below, shows the commercial premises guidelines for waste containers and APW containers. The guidelines are for number and size of containers and are based on the total floor area measured in square metres.

Table 11-3: Commercial Premises Guidelines for Waste and Animal Proof Waste Containers

Commercial Premise Type	Container Size		
	3.0 m^3	4.5 m^3	4.5 m^3 [a)]
Retail	< 400 m^2	> 400 m^2	400 m^2
Restaurant	< 200 m^2	> 200 m^2	200 m^2
Office	< 500 m^2	> 500 m^2	500 m^2
Industrial	< 200 m^2	> 200 m^2	200 m^2
Notes: a) One container required for every square metre facto listed.			

11.2.2 Animal Proof Waste Handling Enclosure

Waste handling enclosures/garage systems shall be animal proof structures constructed of metal or concrete with doors constructed of metal. The exterior service area shall have a separate access person door.

The area for the service vehicles in front of the access door(s) shall have a slope no greater than 2%. Road access to waste containers shall have a sufficient approach and turning radius for service vehicles to service container and enter and exit the property.

The Town must approve site plan, construction, screening and final location of animal proof waste handing enclosures.

11.2.3 Pedestrian Waste and Recycling Containers

All pedestrian waste and recycling containers located outside a building shall be animal proof to the satisfaction of the Town.

All new and existing commercial premises located outside the downtown core shall provide and locate one pedestrian waste container and one pedestrian recycling container for every 20 parking stalls. A minimum of one pedestrian waste and one recycling container shall be located at the main pedestrian entrance to the commercial premise. The locations for other required containers shall be to the satisfaction of the Town.

The location of pedestrian waste containers shall be within 3 m of the public entrance point into a commercial premise. Each pedestrian waste container shall have a minimum clearance radius of 1.5 m.

11.3 Animal Proof Waste Containers Specifications

11.3.1 Animal Proof Requirement

All containers to be used for the collection of municipal solid waste shall meet the following animal proof specifications:

- No part of the container shall have any spaces or gaps in width exceeding 3.2 mm.
- User doors and dumping lids shall be recessed so that they are flush with the top of the container.
- User doors shall be self-closing.
- User doors shall incorporate a covered stainless steel gravity latch system, which prohibits entry of an animal claw from reaching the latch trigger mechanism.

11.3.2 Container Construction

All containers to be used for the collection of municipal solid waste shall meet the following container construction specifications:

- All metal shall be no less than 12 gauge galvanized steel unless otherwise specified.
- User doors shall be 14 gauge galvanized steel.
- User door dimensions shall be a minimum of 0.450 m x 0.550 m.
- All fastenings (bolts, nuts and washers) shall conform to ASTM standard A307.
- All hinges and latches shall be stainless steel.
- Container panels shall be riveted together using plated steel rivets.
- Container shall not have any sharp points or corners.

11.3.3 Container Finish

All waste containers shall be painted using the Town's standard colour, Neufeld Green, or approved equivalent. All container components shall be cleaned and powder painted prior to assembly. A salt spray cabinet test shall be completed for the powder paint finish. The exterior surfaces shall be coated with an anti-graffiti finish on top of powder coat finish.

Containers shall include a stainless steel (or approved equivalent) plaque attached with rivets listing the container manufacturing year and identification code for inventory and insurance purposes. Containers shall be free of manufacturer decals.

11.3.4 Pedestrian Waste Containers

In addition to the pedestrian waste container (PWC) specifications provided in Sections 11.1.2 and 11.2.3, PWCs shall meet the following requirements:

- The container shall conform to a Haul-All Equipment Hyd-A-Bag model or approved equivalent.
- The container volume shall be approximately 0.26 m^3.
- The height of the user door shall be between 0.9 m and 1.0 m from the base of the container.
- The entire back panel of the container shall function as a service door.
- The latch system on the service door shall have a locking device.
- The container shall include an internal frame system for bag support, the top of which is larger than and sits just below the user door opening to ensure all waste is deposited in the bag.
- The frame system shall employ a pivot or sliding mechanism to allow for easy bag removal and replacement from the container’s service door.
- The concrete pad shall be reinforced with wire mesh and be Type 30 cement with a minimum strength of 30 MPa.

- The concrete pad shall have a minimum thickness of 0.1 m.

11.3.5 APW and BCR Waste Containers

In addition to specifications provided in Section 11.2 of the EDCG, APW and BCR containers shall meet the following requirements:

- The container shall conform to a Haul-All Equipment Hyd-A-Way model or approved equivalent.
- The container shall be operational with the Town's waste collection vehicles (powered by an external hydraulic system from a side loading service vehicle and dumping into a service vehicle hopper).
- The container shall be able to perform in extremes of weather, from a high of +40°C to a low of -40°C.
- The container shall be moveable with a crane truck.
- The container hopper shall be equipped with a dumping lip that directs waste into the service vehicle hopper.
- The container footprint shall be such that it fits on the concrete pads as specified in Figure EDCG SWS 11.4.
- The container frame shall have two anchor holes in frame tubing at the points identified on drawings Figure EDCG SWS 11.4.
- The container hopper base shall have a platform with 0.01 m (minimum) nylon bumpers to cushion the hopper in the resting position.
- The container hopper bottom shall have a drain plug with an opening not exceeding 0.03 m diameter.
- The dumping lid shall be 16 gauge galvanized steel and have four stiffeners.
- In the dumping position, the dumping lid shall open freely by gravity and the contents shall be protected from the wind by a flexible windscreen.
- The windscreen shall automatically extend when the container is dumped and retract internally when the container is lowered.
- Windscreen materials shall be a minimum of 510 g vinyl coated nylon and shall remain flexible within a temperature range of +40°C to -40°C.
- The dumping angle shall be approximately 45°.
- The user step shall be manufactured using Type 30 cement with a minimum strength of 30 MPa. The user step shall have a minimum thickness of 0.14 m and be a height of 0.2 m from ground level.
- The cylinder access door shall open to the left and have a lock that is compatible with all Town APW containers.
- Rear corners shall be skirted with galvannealed steel panels.
- A professional engineer shall stamp design drawings for containers.

Table 11-4, below, shows waste container volumes and the corresponding minimum weight capacities required.

Table 11-4: Waste Container Volumes and Weight Capacities

Waste Container Size	Volume	Weight Capacity
Large	4.5 Cubic Metres	1,350 Kg

11.3.6 Front Load Waste Containers

In addition to specifications provided in Section 11.2 of the EDCG, front load waste containers (FLWC) shall meet the following requirements:

- Containers shall be one unit comprised of a hopper with side fork mounts.
- User door height shall not exceed 1.3 m.
- The hopper bottom shall have a drain plug with an opening not exceeding 0.03 m diameter.
- Containers shall have one dumping lid and two user doors.
- The dumping lid shall be 16 gauge and have four stiffeners.
- In the dumping position, the dumping lid shall open freely by gravity and the contents shall be protected from the wind by a flexible windscreen.
- The windscreen shall automatically extend when the container is dumped and retract internally when container is lowered.
- Windscreen materials shall be minimum of 510 g vinyl coated nylon and shall remain flexible within a temperature range of +40°C to -40°C.
- Large waste containers shall be a minimum of 1.8 m wide and 1.8 m long.
- Medium waste containers shall be a minimum of 1.8 m wide and 1.3 m long.

11.4 Beyond Curbside Recycling Container Specifications

11.4.1 Construction

Beyond curbside recycling (BCR) containers shall be partitioned into three compartments: mixed paper, glass, and plastic and metal. The mixed paper compartment shall be on the right-hand side of the container and the opening shall have a chute with a stainless steel cover. The glass compartment shall be in the middle of the container and the opening shall be a 0.25 m diameter circle with rubber flaps. The plastic and metal compartment shall be on the left-hand side of the container and the opening shall be a 0.25 m by 0.5 m oval with rubber flaps.

Each compartment shall have a separate dumping lid that has a latch to secure it closed when the container is in the dumping position. The mixed paper dumping lid shall have a hinged brace to support the lid open while in the dumping position.

Each compartment shall have the minimum volume as shown in Table 11-5, below.

Table 11-5: Beyond Curbside Container Compartment Material and Volume Specifications

Compartment Material	Volume (m^3)
Mixed paper	2.25
Glass	0.75
Plastic and Metal	1.5

In addition to the compartment specifications described above, containers shall meet the following requirements:

- All metal shall be no less than 12 gauge galvanized steel unless otherwise specified.
- All fastenings (bolts, nuts and washers) shall conform to ASTM Standard A307.
- All hinges and latches shall be stainless steel.
- Container panels shall be riveted together using plated steel rivets.
- The container shall not have any sharp points or corners.
- The container shall be operational with the Town's waste collection vehicles (powered by an external hydraulic system from a side load service vehicle and dumping into a service vehicle hopper).
- The container shall be able to perform in extremes of weather from a high of +40°C to a low of -40°C.
- The container shall be moveable with a crane truck.
- The container hopper shall be equipped with a dumping lip that directs waste into the service vehicle hopper.
- The footprint of the container shall be such that it fits on the concrete pads as specified in Figure EDCG SWS 11.4.
- The container frame shall have two anchor holes in the frame tubing at the points identified on Figure EDCG SWS 11.4.
- The container hopper base shall have a platform with 0.01 m (minimum) nylon bumpers to cushion the hopper in the resting position.
- The container hopper bottom shall have a drain plug with an opening not exceeding 0.03 m diameter.
- Dumping angle shall be approximately 45°.

- The user step shall be manufactured using Type 30 cement with a minimum strength of 30 MPa. The user step shall have a minimum thickness of 0.14 m and be a height of 0.2 m from ground level.
- The cylinder access door shall open to the left and have a lock that is compatible with all Town APW containers.
- Rear corners shall be skirted with galvannealed steel panels.

11.4.2 Container Finish

Containers shall be painted using the Town's standard BCR container colour (blue) or approved equivalent. All container components shall be cleaned and powder painted prior to assembly. A salt spray cabinet test shall be completed for the powder paint finish. The exterior surfaces shall be coated with an anti-graffiti finish on top of powder coat finish.

Containers shall include a stainless steel (or approved equivalent) plaque attached with rivets listing the container manufacturing year and identification code for inventory and insurance purposes. Containers shall be free of manufacturer decals.

11.5 Organics Collection Container

11.5.1 Organics Collection Containers

In addition to specifications provided in Section 11.2 of the EDCG, organics containers shall meet the following requirements:

The container shall conform to a Haul-All Equipment Hyd-A-Way model or approved equivalent.

The container shall be operational with the Town's waste collection vehicles (powered by an external hydraulic system from a side loading service vehicle and dumping into a service vehicle hopper).

The container shall be able to perform in extremes of weather, from a high of +40°C to a low of -40°C.

The container shall be moveable with a crane truck.

The container hopper shall be equipped with a dumping lip that directs waste into the service vehicle hopper.

The container footprint shall be such that it fits on the concrete pads as specified in Figure EDCG SWS 11.5 Animal Proof Waste Container – Triple Pad (Large).

The container frame shall have two anchor holes in frame tubing at the points identified on drawings Figure EDCG SWS 11.5.

The container hopper base shall have a platform with 0.01 m (minimum) nylon bumpers to cushion the hopper in the resting position.

The container hopper bottom shall have a drain plug with an opening not exceeding 0.03 m diameter.

The dumping lid shall be 16 gauge galvanized steel and have four stiffeners.

In the dumping position, the dumping lid shall open freely by gravity and the contents shall be protected from the wind by a flexible windscreen.

The windscreen shall automatically extend when the container is dumped and retract internally when the container is lowered.

Windscreen materials shall be a minimum of 510 g vinyl coated nylon and shall remain flexible within a temperature range of +40°C to -40°C.

The dumping angle shall be approximately 45°.

The user step shall be manufactured using Type 30 cement with a minimum strength of 30 MPa. The user step shall have a minimum thickness of 0.14 m and be a height of 0.2 m from ground level.

The cylinder access door shall open to the left and have a lock that is compatible with all Town APW containers.

Rear corners shall be skirted with galvannealed steel panels.

A professional engineer shall stamp design drawings for containers.

Table 11-6, below, shows waste container volumes and the corresponding minimum weight capacities required.

Table 11-6: Organics Collection Container Volumes and Weight Capacities

Waste Container Size	Volume	Weight Capacity
Small	1.5 Cubic Metres	1,350 Kg

11.5.2 Container Finish

Containers shall be painted using the Town's standard organics collection (OC) container colour or approved equivalent. All container components shall be cleaned and powder painted prior to assembly. A salt spray cabinet test shall be completed for the powder paint

finish. The exterior surfaces shall be coated with an anti-graffiti finish on top of powder coat finish.

Containers shall include a stainless steel (or approved equivalent) plaque attached with rivets listing the container manufacturing year and identification code for inventory and insurance purposes. Containers shall be free of manufacturer decals

11.6 Container Concrete Pad Construction

Animal proof waste containers (APW), beyond curbside recycling (BCR) and Organics containers shall be located and secured on a concrete pad to the following specifications:

- Site and base preparation for the concrete pad shall conform to the City of Calgary's *Standard Specifications Roads Construction,* Section 311.02.00 and 3.11.03.00*.*
- The container pad shall have dimensions as described in Figure SWS 11.4
- The container pad shall be 0.2 m thick.
- Finishing and curing of the concrete pad shall be as defined in the City of Calgary's *Standard Specifications Roads Construction,* Section 311.07.00.
- The container pad shall be constructed of concrete with a minimum strength factor of 30 MPa.
- The container pad shall have a 2% grade to road.
- The container shall be secured to the container pad with capped rebar.

11.7 Figures

Figure EDCG SWS 11.1 Animal Proof Waste Container – Artificial Screen Dimensions

Figure EDCG SWS 11.2 Animal Proof Waste Container – Artificial Screen Detail

Figure EDCG SWS 11.3 Animal Proof Waste Container – Pad Construction and Anchor

Figure EDCG SWS 11.4 Animal Proof Waste Container – Double Pad (Large)

Figure EDCG SWS 11.5 Animal Proof Waste Container – Triple Pad (Large)

APPENDIX A: ABBREVIATIONS AND GLOSSARY OF TERMS

Table 1: Abbreviations

Abbreviation	Complete Term
A	
AASHTO	American Association of State Highway and Transportation Officials
AEMA	Alberta Emergency Management Agency
ANSI	American National Standards Institute
APW	animal proof waste (containers)
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing Materials
AWWA	American Water Works Association
B	
BCR	beyond curbside recycling
BMP	best management practices
BP	building permit
C	
CCC	Construction Completion Certificate
CCTV	closed-circuit television
CMP	construction management plan
CNLA	Canadian Nursery Landscape Association
CSA	Canadian Standards Association
CTS	copper tube sizing
D	
DCC	Development Completion Certificate
DP	development permit
E	
ER	environmental reserves
ESC	erosion and sediment control
F	
FAC	Final Acceptance Certificate
FLWC	front load waste containers
FRP	fiberglass reinforced pipe
FTP	file transfer protocol
H	
HDPE	high-density polyethylene
HVAC	heating, ventilation and air conditioning
I	

Abbreviation	Complete Term
ISA	International Society of Arboriculture
ISO	International Organization for Standardization
ITP	*Integrated Transportation Plan* (Canmore)
L	
LPS	low pressure sanitary (system)
LUB	*Land Use Bylaw* (Canmore)
M	
MDP	*Municipal Development Plan* (Canmore)
MR	municipal reserves
O	
OGS	oil-grit separator
O&M	operation and maintenance
P	
PDI	probability of death of an individual
PLC	programmable logic controller
PLS	pure live seed
PRV	pressure reducing valve
PUL	Public utility lot
PVC	polyvinyl chloride
PWC	pedestrian waste container
Q	
QRA	quantitative risk analysis
QRP	qualified registered professional
R	
ROW	right-of-way
S	
SCADA	supervisory control and data acquisition
SCRA	steep creek risk assessment
SDR	standard dimension ration
T	
TCA	tangible capital asset
U	
ULA	utility line assignment
URW	utility right-of-way
USCS	Unified Soil Classification System

Table 2: Glossary of Terms

Term	Definition
A	
Active Mitigation	Mitigation measures that directly affect the hazard process by reducing the event magnitude and hence reducing the damage potential; remediating, reducing or eliminating the potential of an event from occurring; or deflection of an event to areas where no adverse effects are expected.
Alluvial Fan	A conical accumulation of sediment deposited where a steep channel flows onto a much lower gradient so that much of the sediment load of the channel is deposited. Alluvial fans form where a mountain tributary enters a main valley.
Animal Proof Waste Container	A waste container for disposing of residential or commercial waste that meets the animal proof criteria set forth in Appendix 'A' - *Criteria For Animal Proof Waste Container*. The container shall be constructed of metal, be designed to be collected by automated means and have a volume of no less than 4.5 m^3.
Artificial Screening	A partition constructed of wood and/or metal for the purposes of obstructing the view of an animal proof waste container or recycling container.
B	
Beyond Curbside Recycling Container	A receptacle for disposing of residential or commercial recyclables. The container shall have three partitioned compartments: one for mixed paper (including cardboard, newsprint and any other paper product), one for plastic and metal food containers, and one for glass. The container shall be designed to be collected by automated means and have a volume no less than 4.5 m^3.
C	
Commercial Premises	A building, structure or premises used for the conduct of some profession, business, manufacturing process or other undertaking. This includes institutional, industrial, commercial, restaurant and retail premises as well as any attached residential dwelling units, and includes areas designated as a Mobile Home Park in accordance with the *Land Use Bylaw*.
Commercial Waste Container	A metal container for the collection of commercial waste that does not meet the requirements of an animal proof waste container, is located on a commercial premise in an approved storage location and has a minimum volume of 2 m^3.
Consequence	The outcomes for elements at risk, given impact by a hazard. In the EDCG, consequences considered include potential loss of life, damage to buildings and infrastructure, loss of usage of critical facilities, and direct interruption of business activity.
Consultant	Professionals registered to practice under their respective Acts or Professional Associations in the Province of Alberta, as Engineers, Architects, Landscape Architects, Planners or Technologists
Consulting Engineer	Professional Engineer registered to practice under the Act in the Province of Alberta
D	
Debris Flood	Very rapid surging flow of water heavily charged with debris in a steep channel.

Term	Definition
Debris Flow	Very rapid to extremely rapid surging flow of saturated, non-plastic debris in a steep channel.
Design Flood	For river flooding, the current design standard in Alberta is the one percent flood, defined as a flood whose magnitude has a one percent chance of being equaled or exceeded in any year. Although it can be referred to as a 100-year flood, this does not mean that it will only occur once every hundred years. For steep creek hazard, the design flood is not based on a fixed return-period and changes based on the risk reduction required. It results from the basin-scale and site-specific hazard and risk assessments. Most creeks will use a 100-year to 300-year flood event as the design flood.
Design Flood Level	The calculated elevation or the modelled water elevations for the design flood. This elevation is used in the calculation of the flood construction level.
Developer	A person or company responsible for the financing and/or construction of a development within the Town.
Development	a. an excavation or stockpile and the creation of either of them; b. a building or an addition to, or replacement or repair of a building and the construction or placing in, on, over or under land of any of them; c. a change of use of land or a building or an act done in relation to land or a building that results in or is likely to result in a change in the use of the land or building; and/or d. a change in the intensity of use of land or a building or an act done in relation to land or building that results in or is likely to result in a change in the intensity of use of the land or building
Dog Bag Dispenser	A container for the dispensing of plastic handbags to collect domestic pet waste. A list of acceptable distributors is available through the Town.
Downtown Core Businesses	A commercial premise that fronts on and provides pedestrian entrance and service on 8th, 9th and 10th Streets between 3rd, 5th, 6th, 7th and 8th Avenues.
E	
Element at Risk	Anything considered of value in the area potentially affected by hazards.
F	
Flood	An overflow of water that submerges land that is usually dry. The amount of suspended sediment is insufficient (less than 10% concentration) to substantially affect how flowing water behaves. Water may appear very muddy; but most of the suspended sediment is transported near the bed.
Flood Construction Level (Minimum Floor Elevation)	The elevation of the underside of a wooden floor system or top of concrete slab for habitable buildings that is calculated from the DFL elevation plus the allowance for freeboard. In the case of a manufactured home, the ground level or top of concrete or asphalt pad on which it is located shall be equal to or higher than the above described elevation. The flood construction level also establishes the minimum crest level of a standard dike for river engineering. Where the DFL cannot be determined or where there are overriding factors, an assessed height above the natural boundary of a water-body or above the natural ground elevation may be used.

Term	Definition
Flood Proofing	The alteration of land or structures, either physically or in use, to reduce flood damage. This includes the use of building setbacks from water bodies to maintain a floodway and to allow for potential erosion.
Freeboard	A vertical distance added to the DFL. It is used to establish the flood construction level or minimum floor elevation.
H	
Habitable Space	The floor space both above and below grade, which includes stairways, mechanical equipment rooms, closets, hallways, bathroom(s) and enclosed areas used for storage. It excludes elevators, areas dedicated to the parking of motor vehicles (up to 60 m2) and areas devoted exclusively to the mechanical or electrical equipment servicing the development.
Hazard Scenario (Steep Creeks)	Hazard scenarios describe various ways that a steep creek hazard could occur within a specified frequency class. This could, for example, include the blockage of a culvert or an avulsion associated with a log jam.
Hydrogeomorphic Processes	Processes such as debris flows, debris floods and bank erosion that are examples of the geomorphic interaction with the surface water regime. Referred to as steep creek processes in this document.
L	
Lane	public thoroughfare with a right-of-way width of not greater than 9.0 m and not less than 6.0 m
Local Protection (On-Site)	On-site mitigation measures located on the property lot that do not affect creek and river channels, or water bodies. Small-scale local protection refers to detached, duplex or fourplex lots. Medium-scale protection refers to flood protection of condominium buildings or a conglomeration of townhouses. Large-scale protection refers to whole land-use districts or parts of a district where the layout of a development can have great influence on the hazard situation. Large-scale mitigation is out of scope for the Steep Creeks section (9) of the Engineering Design and Construction Guidelines and must be designed by a qualified registered professional
M	
Mortality	The number of potential fatalities divided by the number of persons exposed to a hazard, should the hazard occur.
Multi-residential Dwelling	An apartment building, townhouse or condominium complex which contains five or more self-contained residential dwelling units, each having sleeping, cooking and bathroom facilities.
Municipal Improvement	Works that the Town will own, operate and maintain when all the developer's obligations are met
O	
Off-site Mitigation	Mitigation measures that are located on a different lot/parcel than the one being protected. They can be within the bed and shore, or on the bank of a creek or river. Functions of off-site mitigation can be to prevent flow from entering the community, prevent erosion, or reduce the magnitude of an event. All off-site mitigation measures

Term	Definition
	are out of scope of the Steep Creeks section (9) of the Engineering Design and Construction Guidelines and must be designed by a qualified registered professional.
P	
Passive Mitigation	Mitigation measures that do not affect the hazard process itself but that reduce the risk. No attempt is made to prevent, modify or control the hazard, instead hazardous areas are avoided. Passive mitigation can be permanent or temporary.
Pedestrian Waste Container	A receptacle for the disposal of pedestrian waste that is animal proof, constructed of metal and designed to be serviced by manual means.
Pedestrian Waste/Returnable Container	A receptacle with a partition separating sections for pedestrian waste and refundable containers as defined by the Alberta Bottle Depot Association. The container shall be animal proof, constructed of metal and designed to be serviced by manual means. The container shall be painted two colours: Neufeld Green (or equivalent) on the waste half and Town of Canmore Blue on the refundable half.
Playground	An outdoor area containing a physical structure in a retained protective surfacing area of washed pea gravel (7 mm, free of sharp edges, also known as gyra rock), or various types of recycled tire rubberized surface material for the purpose of unstructured play.
Play Space	An area containing play equipment, a play structure or play structures, protective surfacing etc., that is intended for use by children 18 months to 5 years old, and/or 5 years to 12 years old.
Playground Apparatus - Traditional	Individual units designed for a specific activity and constructed predominantly of steel. Single purpose structures of a simple design such as swings, slides, climbers, teeter-totters, etc. generally made from metals.
Playground Apparatus - Creative	An individual unit designed for a variety of activities and constructed of steel. Multi-purpose structures consisting of a series of interconnected components and decks, made from a variety of materials including metal and plastic
Q	
Qualified Registered Professional (QRP) (Steep Creeks)	A qualified registered professional for steep creek mitigation work is an engineer (geotechnical, structural, civil), or licensee with appropriate education, training and experience in steep creek mitigation, and design of retaining walls, foundations and berms as described in this document. They may be responsible for signing off on documents and/or drawings prepared for an assessment.
R	
Recycling Container	A container for the exclusive use and collection of recyclable material.
Residential Dwelling Unit	A single detached dwelling unit and a self-contained dwelling unit in a duplex, triplex, or four-plex.
Risk	The likelihood of (a) hazard scenario(s) occurring and resulting in some severity of consequences. In the EDCG, risk is defined in terms of safety or damage level. For example, this could include the likelihood of debris-flood impact to a building resulting in destruction of the building.

Term	Definition
Risk Tolerance	Risk tolerance defines a specific level of risk (e.g., loss of life, economic or environmental losses, losses to intangible values) that is considered tolerable by the decision-making jurisdiction and its stakeholders. If a specific level of risk tolerance is met, further risk reduction may still be warranted.
S	
Steep Creek Hazard	A hydrogeomorphic process with the potential to result in some type of undesirable outcome. For example, a hazard could include a debris-flood or debris flow into a runout area intersecting the footprint of a developed area. The term hazard refers to the specific nature of the process (type, frequency, magnitude), but not the consequences. Hazards are described in terms of *scenarios*, which define events of a certain frequency and magnitude.
Steep Creek Hazard Area (Zone)	An area subject to steep creek hazards.
Street Block	A distance of 150 m.
T	
Town	The Municipal Corporation of the Town of Canmore and any employee who has been delegated the appropriate decision-making authority, or the area contained within the boundaries thereof, as the context requires.
Training Works	Any wall, dike or protective structure used to prevent a stream from leaving its channel at a given location. This includes any debris flow training structures including basins, trash racks or other works.
V	
Visitor Accommodations—Commercial	A hotel, motel or other accommodation with more than 40 self-contained units to be rented for a period not exceeding 28 days.
W	
Waste Control Bylaw	The Town of Canmore's Waste Control Bylaw as amended from time to time.
Watercourse	Any natural or man-made depression with well-defined banks and a bed 0.6 m or more below the surrounding land serving to give direction to a current of water at least six months of the year or having a drainage area of 2 km^2 or more upstream of the point of consideration.

APPENDIX B: SAMPLE LETTERS AND TEMPLATES

B1: Sample Notice of Engagement Letter

Sample "Notice of Engagement" letter

(*date*)

Town of Canmore

Engineering Department

902 – 7th Avenue

Canmore, AB T1W 3K1

Attention: Manager of Engineering

Re.: Notice of Engagement - Consulting Engineering Services

(*insert development name and stage*)

Dear (*manager of engineering*),

Please be advised that (*insert developers corporate name*) of (*insert developer's complete mailing address*) has retained the services of (*Consulting Engineer's name*) of (*insert Consulting Engineer's complete mailing address*) for the purposes of providing Services as defined in the Town of Canmore document entitled "***Engineering Design and Construction Guidelines***".

Sincerely,

ABC Developments (*insert developer's corporate name*)

John Doe (*insert signing authority's name*)

Director (*insert signing authority's title*)

cc. Planning Department

B2: Construction Completion Certificate Templates

Infrastructure:

Town of Canmore

CONSTRUCTION COMPLETION CERTIFICATE

-INFRASTRUCTURE-

Project:_____ **Submission Dated:**_____
Owner: Town of Canmore **SB or DP #:**_____
Contractor:_____ **Utility:**_____
Consulting Engineer:_____
Boundary of Area: *(see attached map)*

CONSULTING ENGINEER'S CERTIFICATE:

I, _____, Professional Engineer, of the firm of _____, Consulting Engineers, who are engaged by the Developer to design and inspect the construction and installation of Municipal Improvements, do hereby certify that the Municipal Improvements within the area shown on the attached plan have been constructed, installed and inspected, as far as can be practically ascertained, in conformance with the applicable Agreement, the Town of Canmore's Standards & Guidelines, accepted designs or as otherwise required by the Town of Canmore Engineer, and that all defects and deficiencies in work and materials have been reported to the Town of Canmore and have been remedied by the Developer.

I confirm that I have been empowered by the Developer to comply with and perform all of the Consulting Engineer's obligations and to provide all of the Field Services identified in the most recent edition of the Town of Canmore's "Consultant's Guidelines for Subdivisions and Developments".

Inspector: _____ _____
(Type name) *(Signature)*

Consulting Engineer:
(seal, signature and date)

Permit to Practice:

REJECTION OF CONSULTING ENGINEER'S CERTIFICATE:

Date:_____ _____
TOWN OF CANMORE (Manager of Engineering)

Reason:_____

ACCEPTANCE OF CONSULTING ENGINEER'S CERTIFICATE:

Date:_____ _____

TOWN OF CANMORE (Manager of Engineering)

Earliest Warranty Period Expiry Date:_____

Landscaping:

Town of Canmore

CONSTRUCTION COMPLETION CERTIFICATE

-LANDSCAPING-

Project:_____ **Submission Dated:**_____
Developer:_____ **SB or DP#:**_____
Contractor:_____ **Landscape Development:**_____
_____

Consulting Landscape Architect:_____

Boundary of Area: (see attached map)

(type each of the above)

LANDSCAPE ARCHITECT'S CERTIFICATE:

I, _____, Professional Landscape Architect, of the firm of _____, who are engaged by the Developer to design and inspect the construction and installation of the Municipal Improvements within the area shown on the attached plan, certify that the Municipal Improvements have been constructed, installed and inspected, as far as can be practically ascertained, in conformance with the Town of Canmore's Standards & Guidelines, accepted designs, or as otherwise required by the Town of Canmore Representative, and that all defects and deficiencies in work and materials have been reported to the Developer and the Town of Canmore and have been remedied by the Developer.

I confirm that I have been empowered by the Developer to comply with and perform all of the Landscape Architect's obligations and to provide all of the Field Services as identified in the most recent edition of the Town of Canmore's *"Consultant's Guidelines to Subdivisions and Developments".*

Inspector:_____ **Landscape Architect:**
(signature) (sign, seal and date)

_____
(type name)

REJECTION OF LANDSCAPE ARCHITECT'S CERTIFICATE:

Date:_____ _____

TOWN OF CANMORE

Manager of Parks

Reason:_____

ACCEPTANCE OF LANDSCAPE ARCHITECT'S CERTIFICATE:

Date:_____ _____

TOWN OF CANMORE
Manager of Parks

Earliest Warranty Period Expiry Date:_____

B3: Final Acceptance Certificate Template

Infrastructure:

Town of Canmore

FINAL ACCEPTANCE CERTIFICATE

-INFRASTRUCTURE-

Subdivision:_____ **Submission Dated:**_____
Owner: Town of Canmore **SB or DP#:**_____
Contractor:_____ **Utility:**_____
Consulting Engineer:_____
Boundary of Area: *(see attached map)*

CONSULTING ENGINEER'S CERTIFICATE:

I, _____, Professional Engineer, of the firm of_____, Consulting Engineers, who are engaged by the Developer to design and inspect the construction and installation of Municipal Improvements do hereby certify that the Municipal Improvements within the area shown on the attached plan, have been constructed, installed and inspected, as far as can be practically ascertained, in conformance with the applicable Agreement, the Town of Canmore's Standards & Guidelines, accepted designs or as otherwise required by the Town of Canmore Engineer, and that all defects and deficiencies in work and materials have been reported to the Town of Canmore and have been remedied by the Developer.

I confirm that I have been empowered by the Developer to comply with and perform all of the Consulting Engineer's obligations and to provide all of the Field Services identified in the most recent edition of the Town of Canmore's "Consultant's Guidelines for Subdivisions and Developments".

Inspector: _____ _____
(Type name) *(Signature)*

Consulting Engineer:
(seal, signature and date)

Permit to Practice:

REJECTION OF CONSULTING ENGINEER'S CERTIFICATE:

Date:_____ _____
TOWN OF CANMORE
Manager of Engineering

Reason:_____

FINAL ACCEPTANCE OF CONSULTING ENGINEER'S CERTIFICATE:

Date:_____ _____

TOWN OF CANMORE
Manager of Engineering

Landscaping:

Town of Canmore

FINAL ACCEPTANCE CERTIFICATE

-LANDSCAPING-

Subdivision:_____ **Submission Dated:**_____
Developer:_____ **SB or DP#:**_____
Contractor:_____ **Landscape Development:**_____
_____

Consulting Landscape Architect:_____

Boundary of Area: (see attached map)

(type each of the above)

LANDSCAPE ARCHITECT'S CERTIFICATE:

I, _____, Professional Landscape Architect, of the firm of _____, who are engaged by the Developer to design and inspect the construction and installation of the Municipal Improvements within the area shown on the attached plan, certify that the Municipal Improvements have been constructed, installed and inspected, as far as can be practically ascertained, in conformance with the Town of Canmore's Standards & Guidelines, accepted designs, or as otherwise required by the Town of Canmore Representative, and that all defects and deficiencies in work and materials have been reported to the Developer and the Town of Canmore and have been remedied by the Developer.

I confirm that I have been empowered by the Developer to comply with and perform all of the Landscape Architect's obligations and to provide all of the Field Services identified in the most recent edition of the Town of Canmore's "Consultant's Guidelines for Subdivisions and Developments".

Inspector:_____ **Landscape Architect:**
(signature) (sign, seal and date)

_____
(type name)

REJECTION OF LANDSCAPE ARCHITECT'S CERTIFICATE:

Date:_____ _____

TOWN OF CANMORE
Manager of Parks

Reason:_____

ACCEPTANCE OF LANDSCAPE ARCHITECT'S CERTIFICATE:

Date:_____ _____

TOWN OF CANMORE
Manager of Parks

APPENDIX C: STEEP CREEK RISK ASSESSMENT

Basin-scale steep creek risk assessments have been completed for all existing development on an alluvial fan within the Town of Canmore municipal boundary. Table C2 below lists all existing assessment reports completed to date.

The site-specific risk assessment process is very similar to basin-scale risk assessment; however, the scope of work is greatly reduced and not all elements of previous basin-scale assessments may apply to site-specific assessments. Therefore, these guidelines provide guidance for site-specific steep creek risk assessment, only to be utilized for proposed development in an existing steep creek hazard zone

C-1 Site-Specific Steep Creek Risk Assessments

At the onset of a steep creek risk assessment (SCRA) related to development permitting, all parties shall be informed about these guidelines and how they apply to the proposed development project. The qualified registered professional (QRP) undertaking the SCRA shall consult with the Engineering Department to:

- clarify the roles and responsibilities of parties involved in the SCRA
- obtain relevant background information
- clarify the application of these guidelines
- clarify the role of standard and non-standard mitigation works
- clarify the role and applicability of a risk assessment
- clarify the requirements for a development approval
- define the level of effort required for assessment.

Risk assessments should also be undertaken in accordance with any provincial guidelines that may apply.

The following section describes project elements that shall be defined during the beginning stages of the study, including project organization, scope of work and anticipated level of effort.

See the Steep Creek Development Flow Chart in the Municipal Development Plan for a flow chart showing the basic decision-making process when development is proposed in a steep creek hazard zone.

C-1.1 Terminology

The appropriate application of these guidelines requires some understanding of hazard and risk terminology as well as the hazard processes that are the focus of these guidelines. Select terms are defined in the Glossary of Terms found in Appendix A, Table 2. Additional terms are defined as they appear in the text.

For the purposes of this document, a qualified registered professional (QRP) is an engineer (geotechnical, geological) or geoscientist (geologist, geomorphologist or hydrologist), or licensee with appropriate education, training and experience to conduct SCRAs as described in this document. The QRP is responsible for signing-off on documents and/or drawings prepared for the assessment.

C-1.2 Risk Management Framework

The basin-scale SCRAs previously completed follow the risk management framework shown Table D1. It encompasses initial hazard identification through to risk analysis and optimization of risk reduction and monitoring measures. Site-specific SCRAs do not encompass all parts of this framework.

Table C1: Risk Management Framework

Risk Communication and Consultation On an ongoing basis the governing body should keep stakeholders informed about the risk management process.	1. Project Initiation a. Recognize the potential hazard. b. Define the study area/boundary and level of effort. c. Define the roles of the parties involved in the project. d. Identify 'key' risks to be considered in the assessment. e. Identify preliminary geohazard risk scenarios.	Monitoring and Review There should be ongoing review of risk scenarios and risk management process.
	2. Risk Identification a. Collect and review background information. b. Hazard assessment: identify and characterize hazards, develop frequency- magnitude relationship, estimate likelihood, extent and intensity parameters for risk analysis, develop hazard maps. c. Exposure assessment: identify and characterize elements at risk with parameters that can be used to estimate vulnerability to geohazard impact. d. Develop geohazard risk scenarios to be considered in risk analysis.	
	3. Risk Analysis a. Develop risk analysis methodology (quantitative or qualitative). b. Estimate risk for geohazard risk scenarios. c. Communicate the results in an appropriate format (e.g., numerical or qualitative estimates, matrices, graphs, maps).	
	4. Risk Evaluation a. Compare the estimated risk against local or other tolerance criteria. b. Prioritize risks for risk control and monitoring.	
	5. Risk Control a. Identify options to reduce risks to levels considered tolerable by the client or governing jurisdiction. b. Select option(s) providing the greatest risk reduction at least cost. c. Estimate residual risk for preferred option(s).	
	6. Action a. Implement chosen risk control options. b. Define and document ongoing monitoring and maintenance requirements.	

C-1.3 Roles

This section describes typical responsibilities of the parties involved in development approval applications. A QRP shall enter into a professional services agreement with their client prior to undertaking work on a project. The following points shall be considered when developing a professional services agreement:

- Geohazards projects inherently have high potential liability. The agreement shall establish appropriate limitation of liability.
- The agreement shall confirm the scope and deliverables of the project.
- The agreement shall establish a budget estimate, either for hourly services, lump sum or otherwise.

The agreement shall also include a clause that deals with potential disclosure issues. In certain circumstances the professional may have to convey adverse assessment findings to parties who may not be directly involved, but who have a compelling need to know.

C-1.3.1 The Town of Canmore as the Approving Authority

The Town of Canmore's Planning or Engineering Department is the approving authority for SCRAs.

As a prerequisite for development in a steep creek hazard area, the Town may require the proponent to obtain a site-specific SCRA report by a QRP. The report may be required for the following reasons:

- to meet the requirements of the Town of Canmore *Municipal Development Plan* (MDP) and *Land Use Bylaw* (LUB) for a complete application for a development permit and to confirm appropriate conditions for any approvals;
- to ensure that the risk is acceptable for the proposed development.

The responsibilities of the Town are defined for each of the five steps of the risk management framework outlined below.

Step 1: Project Initiation

The Town has significant understanding of steep creek geohazards within the municipality. The MDP and LUB define when SCRAs are required. The Town has completed a baseline risk identification study, including steep creek hazard inventory mapping (hazard and study areas as defined in the LUB for areas of existing and potential development), and an inventory and characterization of existing development within these areas. Expectations regarding consideration of climate change in the SCRA are not yet defined and should be discussed.

Steps 2 and 3: Risk Identification and Analysis

The Town has already undertaken basin-scale SCRAs for existing development. These assessments will inform the scope of work and likely reduce the cost of site-specific SCRAs

within these areas. The LUB defines steep creek hazard zones with SCRA requirements depending on where the proposed development is located within these areas.

Step 4: Risk Evaluation

The MDP establish risk-tolerance criteria against which the SCRA results can be compared. These policies consider risk-tolerance criteria for existing and proposed development, and how to manage societal risk where existing and proposed development overlap (e.g., densification).

The criteria used to measure risk are related to safety and economic cost.

1) Safety

Two metrics are used to measure safety risk:

a. Individual Risk
Individual Risk is the risk of an individual being killed in an event. Individual Risk can be assessed for persons in any given year. Individual risk takes into account the magnitude and frequency of the hazard, the location of the person exposed to the risk and the structure type for persons within buildings, and the probability of a person being present during an event. The resultant measure is referred to as the annual probability of death of an individual (PDI).

b. Group Risk
Group risk is the potential for multiple deaths in a single event. A greater number of persons exposed to the same hazard results in increased risk. As society has a very low tolerance for group risk, new development needs to be maintained within acceptable thresholds. Group risk has already been determined through the basin-scale studies completed and, therefore, does not need to be re-evaluated.

2) Economic Risk

Economic risk includes damage to building structures and damage to municipal infrastructure including roads and utilities. Other areas of economic risk that may be required to be considered include:

- cost of constructing and maintaining mitigation
- business losses
- franchise utilities
- transportation impacts
- property loss beyond damage to building structures, for example building contents and land improvements.

The Town has not established economic risk tolerance criteria. However, the annualized economic damages to building shall be minimized. Maximum annualized costs of $500/year/dwelling unit are attainable and should be targeted.

Risk analysis, vulnerability and loss estimation are described in Appendix D

Step 5: Risk Control

The Town will help define how responsibilities may be shared between the Town and the proponent in terms of individual and societal risk management. Both the steep creek hazard source and preferred risk control measures may be located upstream and outside the development area, and the risk control measures may reduce risk to a wider area than the proposed development.

Before an SCRA is initiated, the Town of Canmore shall complete the following tasks:

- Inform the proponent why a SCRA is required.
- Inform the proponent of risk-tolerance criteria, as defined in the MDP and these guidelines, that will be used to evaluate the results of the assessment.
- Identify known flood hazard information and reports relevant to the project (such as flood reports and maps) and describe how to access the documents. Provide the proponent the relevant flow data from the basin-scale hazard assessment.
- Provide the proponent with information regarding existing structural mitigation works and input on the need for additional works.
- Advise the proponent of any key policies or procedures that have the potential to affect the outcome of the assessment.
- Provide an indication of any desired interaction with the professional during preparation of the report.

After the assessment is submitted the Town will:

- Review the assessment report.
- If necessary, discuss the report with the proponent and/or professional.
- Outline any applicable next steps in the land development process.

C-1-3.2 The Proponent/Client

The proponent is the applicant for the development permit application (which from a QRP's perspective is typically also the client). The proponent shall provide the QRP with the following information for assessments carried out for development approval applications:

- process, procedures and requirements for the applicable land development application within the area of jurisdiction.
- legal description of the land parcel(s) as registered with the Land Title Office and Survey Authority, and a copy of the current land registration including any relevant restrictive covenants.

- a survey plan of the land parcel(s) and the location of the legal parcel boundary markers on the ground in digital (CAD or GIS) format.
- plans of existing buildings or structures, location of the proposed development and drawings of the proposed development in digital (CAD or GIS) format.
- assessment data about the property as typically collected for appraisal and tax purposes.
- relevant background information (written or otherwise) related to the property and the existing and proposed development, including previous assessment reports conducted for the proponent.
- unrestricted access to the property.

After a SCRA has been completed, the proponent shall complete the following tasks:

- Review the assessment report and understand the limitations and qualifications that apply.
- If necessary, discuss the report with the QRP who prepared the report and seek clarification where needed.
- Direct the QRP to complete an assessment assurance statement and provide the statement and the assessment report to the Town.
- Allow the QRP to confirm that his/her recommendations have been followed.
- Notify the QRP if land use, site development or other conditions change or vary from those described in the report.

C-1.3.3 The Qualified Registered Professional

Prior to carrying out a SCRA, a QRP shall meet the following professional responsibilities:

- Be knowledgeable about any of the applicable approval processes for the proposed land development project.
- Confirm that he/she has appropriate training and experience to carry out the assessment in view of the terrain characteristics, the type of potential flood hazard, and the type of mitigation works potentially needed.
- Understand the roles and limitations of a professional engineer vs. professional geoscientist and understand those tasks that are necessarily overlapping.
- Appropriately educate the client regarding pertinent aspects of SCRAs as clients may not be familiar with such studies.
- Consult with the Town regarding applicable regulations, available information, application of the Guidelines, role of structural mitigation works, applicability of risk assessment and requirements for development approval.
- Consider the need for the involvement of other specialists.
- Establish an appropriate mechanism for internal checking and review.
- Consider the need for independent peer review.
- Obtain a copy of any guidelines or regulations that are pertinent to carrying out an assessment and/or preparing an assessment report.

A QRP shall adhere to the following additional general professional responsibilities when conducting a SCRA:

- If necessary, assist the client in obtaining relevant information.
- Make reasonable attempts to obtain from the client and others all relevant information related to flood hazards on and beyond the property.
- Notify the client as soon as reasonably possible if the project scope and/or budget estimate requires modification.
- Write the report clearly, concisely and completely to conform to applicable guidelines and regulations.
- Ensure that the project work is subject to an appropriate checking and review by qualified personnel.
- Where appropriate, obtain an independent peer review.
- Address any significant comments arising from the reviews.
- Where appropriate, submit a draft report for client review and review by other parties.
- Review the draft report with the Town and the technical advisory staff.
- When a report recommends a significant variance from a guideline (e.g., variance of a bylaw minimum floor elevation that covers a wide area), it is strongly recommended that variance be discussed with the Town prior to final submission.
- When the project work is complete, the QRP must submit a signed, sealed and dated copy of the final report and assurance statement (Appendix D). The final report shall explicitly indicate reviews that were performed.
- Where deliverables include interactive web maps and tools, responsibilities for the format, content, and maintenance of such products will need to be negotiated with the client.

After completing a SCRA, the QRP shall carry out the following steps:

- Clarify questions the client and/or the Town may have with regards to the assessment, report, and/or assessment assurance statement.
- Carry out follow-up work if agreed with the client.

If aspects of a SCRA are delegated, they shall only be carried out under direct supervision of the QRP, who assumes responsibility for all work delegated.

The QRP shall advise the client of the potential implications if recommendations are disregarded. This is especially relevant where the QRP identifies a steep creek hazard that was previously unknown to the Town or provides the first detailed study of a known hazard.

Reviewers

The Town may use in-house experts or retain an independent QRP to provide advisory services during a SCRA, or to review a SCRA report. Such a QRP may provide advice regarding the type of SCRA that is appropriate, may informally review documents submitted

by a QRP retained by a project proponent, and may provide advice on improving the local flood management approach and developing new local guidelines and regulations.

The Town or the client may also initiate an independent peer review of a report submitted by a QRP. The need for an independent peer review on behalf of the Town is determined on a case-by-case basis. If an independent peer review is being conducted, the proponent and the QRP responsible for the initial report of the review will be informed of such review. The reasons for the review will be provided and documented.

C-1.4 Common Forms of Project Organization

SCRAs for development permits are, in most cases, initiated by the Proponent. The project proponent typically retains a QRP to carry out a SCRA and prepare a report. The proponent then forwards that report in support of a development application. The SCRA report may be subject to review by the Town, occasionally with assistance by an independent professional.

In most cases the landowner or development consultant is the client, with whom the QRP establishes an agreement for professional services. The QRP should be aware reports will be reviewed by the Town, and possibly other professionals.

The client should be aware that the findings and recommendations of the QRP could result in the refusal of a development permit application by the Town, or a development proposal requiring modification. Therefore, it is more efficient if the SCRA is commenced early in the development planning process.

The role of the QRP in relation to the client and the Town shall be clearly defined. The QRP shall inform the client about land development approval processes and these guidelines, especially if the client has not previously been involved in land development or SCRAs, nor engaged a professional. In such situations, the QRP should consider reviewing with the client the typical responsibilities listed in this document. This will help to establish an appropriate agreement for professional services and to inform the client of the expectation of appropriate and adequate compensation.

C-1.5 Study Boundary

A site-specific SCRA study boundary shall be defined at the onset of a study. It may be further refined (enlarged or contracted) during the study. The initial boundary shall be delineated by a QRP by reviewing existing basin-scale hazard and risk assessment and a field visit. The boundary may need to be expanded to assess the potential for risk transfer associated with any proposed risk control measures.

C-1.6 Scope and Effort

Site-specific SCRAs are required for proposed development in hazard zones that were previously assessed at a basin-scale level of detail. Development proposals within these lands are regulated in accordance with the *Municipal Development Plan* and the *Land Use*

Bylaw. These regulations require completion of a SCRA at a level of effort to be determined by a QRP in consultation with the Town and with reference to these guidelines.

Where a steep creek assessment has been prepared for a specific development, it may not be applicable to other development proposals and a higher level of assessment may be required. The assessment is specific to the type of hazard, the proposed development and local site conditions.

Site-specific SCRAs shall follow the risk assessment framework described in these guidelines and shall generally require some of the elements of previous basin-scale assessments. However, as deemed appropriate by the QRP, not all elements of previous basin-scale assessments typically apply to the site-specific assessment. As such, the perspective of the site-specific assessment is different, and the level of effort is usually substantially less than was required for baseline assessment.

When completing site-specific SCRAs, the QRP is reliant upon previous work. The QRP, client and the Town should be aware of the limitations of previous work and this should be taken into consideration when establishing the professional services agreement.

When completing a site-specific SCRA, the QRP shall identify factors that may change the level of hazard and risk compared to previous assessments, or evidence that previous assessment data and results should be updated. The following questions provide examples of factors that should be checked, but is not intended to be an exhaustive list:

- Was/were the previous basin scale SCRA(s) undertaken in accordance with these guidelines? A list of existing steep creek hazard and risk assessment reports is found in Table D2, below.
- Do conditions exist that post-date previous assessments and that necessitate updates to the baseline SCRA (e.g., new geohazard events, geomorphic changes in the upper basin such as landslides, forest fires, beetle infestations, mining activities, new development, construction of risk control measures, etc.)?
- Do site-specific hazard mechanisms exist above, at, or below the proposed development site that were not identified at the scale of previous studies? If so, should such hazard mechanisms be assessed in more detail (e.g., avulsion points or localized bank erosion and instability, encroachment of the receiving creek, or site alterations caused by the proposed development)?
- Do site-specific conditions affect hazard intensity (destructive potential) that were not identified at the scale of previous studies and should be assessed in more detail (e.g., local terrain factors or site-specific alterations that change the path, velocity or depth of flows)?
- For redevelopment of existing buildings, do the renovations change the temporal probability of building occupancy compared to what was assumed in previous studies and used as the basis for risk estimates (e.g., a change from full-time to seasonal occupancy)?

- For redevelopment of existing buildings, do the renovations change the estimated level of building vulnerability to geohazard impact compared to what was assumed in previous studies and used as the basis for risk estimates (e.g., by adding a habitable basement with windows or doors at ground level)?
- Does proposed development densification change the number of people exposed to hazard, with a commensurate increase in group safety risk?

Table C2: Available Hazard and Risk Assessment Reports

Cougar Creek reports	*Cougar Creek Debris Flood Hazard Assessment*. Final report prepared for the Town of Canmore, March 2014. BGC Engineering Inc.
	Cougar Creek Debris Flood Risk Assessment. Final (Revised) report prepared for the Town of Canmore, June 2014. BGC Engineering Inc.
Three Sisters Creek reports	*Three Sisters Creek Debris-Flood Hazard Assessment*. Final report prepared for the Town of Canmore. October 2014. BGC Engineering Inc.
	Three Sisters Creek Debris-Flood Risk Assessment. Final report prepared for the Town of Canmore. January 2015. BGC Engineering Inc.
Stone Creek reports	*Stone Creek Debris-Flow Hazard Assessment*. Final report prepared for the Town of Canmore. January 2015. BGC Engineering Inc.
	Stone Creek Debris-Flow Risk Assessment. Final report prepared for the Town of Canmore. October 2015. BGC Engineering Inc.
Stoneworks Creek reports	*Stoneworks Creek Debris-Flood Hazard Assessment*. Final (Rev A) report prepared for the Town of Canmore. November 2015. BGC Engineering Inc.
	Stoneworks Creek Debris-Flood Risk Assessment. Final report prepared for the Town of Canmore. September 2016. BGC Engineering Inc.
Pigeon Creek reports	*Pigeon Creek Hazard Assessment*. Final report prepared for the Town of Canmore. November 2016. TetraTech EBA Inc.
	Pigeon Creek Debris-Flood Risk Assessment. Final report prepared for the Town of Canmore. September 2017. BGC Engineering Inc.
Stones Canyon report	*Stones Canyon Creek Development*. Level 2 Debris-Flow Risk Assessment. Final report prepared for Hillcroft Developments Ltd. October 2015. BGC Engineering Inc.

Stewart Creek report	*Stewart Creek Hazard and Risk Assessment.* Final report prepared for Three-Sisters Mountain Village Properties Ltd. July 2017. BGC Engineering Inc.
Echo Canyon Creek report	*Steep Creek Hazard and Risk Assessment: Echo Canyon Creek*. Final Report prepared for the Town of Canmore. December 2018. BGC Engineering Inc.
X, Y, Z Creeks (above Peaks of Grassi) report	*Steep Creek Hazard and Risk Assessment: X, Y, and Z Creeks*. Final Report prepared for the Town of Canmore. December 2018. BGC Engineering Inc.

C-1.7 Suggested SCRA Table of Contents

Table C3, below, provides a suggested table of contents for site-specific SCRAs required for development permit applications in hazard zones defined by the Town, based on previous basin-scale SCRAs.

This information is provided to assist a QRP in completing steps of the SCRA but should not preclude the QRP from selecting a different report structure or contents as deemed to be appropriate and acceptable to the Town. Not all items listed in the table may be relevant to all studies.

Table C3: Suggested Table of Contents for Site-Specific SCRAs

Section	Subsection	Key Items to Include
1. Introduction	1.1 Terms of Reference	• client • consultant • current property owner
	1.2 Location	• fan and creek name(s) • street address • legal address, parcel and building ID • map/figure
	1.3. Proposed Development	• Describe the proposed development (i.e., the element at risk and the vulnerability). • Describe site-specific features relevant to the risk assessment (list). • Describe proposed landscape alterations if any.
2. Baseline Hazard Assessment	2.1 General	• Describe the hazard related to the site as determined in previous studies. • Assess whether additional baseline hazard assessment is required for the specific development proposal.

Section	Subsection	Key Items to Include
	2.2 Methodology	• If additional assessment required, provide hazard scenario descriptions, justification and parameters (probability, mechanisms, destructive potential or intensity). • Describe and assess any additional site-specific factors not captured by previous assessments that have implications for hazard levels and associated risk.
	2.3 Results	• hazard probability and justification • hazard intensity (destructive potential) • describe limitations and uncertainties.
3. Baseline Risk Assessment	3.1 Methodology	If additional assessment required, provide risk analysis methodology and definition of risk parameters.
	3.2 Risk Parameters	If additional assessment required, provide justifications for values assigned to risk parameters.
	3.3 Results	• individual risk estimate (PDI) • economic risk estimate • comparison to risk tolerance criteria • describe limitations and uncertainties
4. Risk Control	4.1 Proposed Risk Control Measures	If risk control measures are required, provide: • description of proposed mitigation measures; reference EDCG • description of design basis including how the design will achieve the target level of risk reduction and avoid risk transfer • drawings showing details of proposed measures.
5. Residual Risk Assessment for Proposed Development	5.1 Revised Risk Parameters	If required, provide: • hazard probability value and justification • spatial probability value and justification • temporal probability value and justification • vulnerability value and justification • elements at risk value.
	5.2 Risk Evaluation	If required, provide: • individual residual risk estimate (PDI) • economic residual risk estimate • comparison to risk tolerance criteria • describe limitations and uncertainties.

Section	Subsection	Key Items to Include
6. Conclusions		• limitations • quality assurance statement • seal and signature
7. References		• as appropriate

APPENDIX D: RISK ANALYSIS, VULNERABILITY AND LOSS ESTIMATION FOR SITE SPECIFIC STEEP CREEK RISK ASSESSMENTS

D-1 Introduction

Risk analysis involves estimating the likelihood that potentially damaging events will occur, impact elements at risk, and cause certain types and severities of consequences (such as loss of life or economic losses). Each of these components (event likelihood, elements at risk, consequences) is estimated separately and then combined. Although every assignment requires professional judgement, the objective is to provide a systematic, repeatable assessment with an appropriate level of detail for the information available and decisions required.

For safety risk (risk of loss of life), risk to life may be estimated for individuals and groups (societal risk). Individual risk considers the probability that a hazard scenario results in loss of life for a single individual, referred to as probability of death of an individual (PDI). Individual risk levels are independent of the number of persons exposed to risk. In contrast, group (societal) risk considers the probability of a certain number of fatalities within the hazard zone. Unlike individual risk, exposing a greater number of people to the same hazard will increase the risk.

This section defines the quantitative approach to risk analysis that has been used in previous basin-scale steep creek risk assessments (SCRAs). This approach should be used for site-specific SCRAs.

D-2 Quantitative Risk Analysis

Quantitative risk analysis (QRA) uses numerical estimates of risk parameters to calculate a probability of some level of damage or loss. Results of a QRA can be presented as a numerical estimate, in a matrix, or graphically as the cumulative probability of consequences.

Quantitative risk analysis is not inherently more accurate than more qualitative methods, and the science underpinning numerical risk estimates requires as much judgement as qualitative estimates. Numerical approaches are also not practical or appropriate in all cases. Quantitative risk analysis is best suited to situations where it is possible to define a logical event chain leading from a hazard occurrence to direct consequences. Moreover, QRA represents a powerful way to consider multiple risk scenarios, evaluate results against adopted risk tolerance thresholds or other types of risks, and measure the effectiveness of measures to reduce risk. It can also allow more transparent communication of uncertainties for each risk parameter (e.g., by the use of uncertainty bounds or ranges). Quantitative risk analysis may also be the most appropriate risk *analysis* tool even when the most appropriate way to *communicate* results is in qualitative terms. It is the preferred risk analysis method for

estimating risk to life because the results can be evaluated against quantitative risk tolerance thresholds.

D-3 Geohazard Risk Scenarios

A geohazard is a geological hazard that may lead to widespread damage or risk. For the purposes of the EDCG, geohazards include flood, debris flood and debris flow. Geohazard risk scenarios previously developed during the basin-scale assessment will become the basis for risk analysis. The starting point for QRA scenario development is to divide the geohazard frequency-magnitude relationship into one or more intervals that will represent the range of event magnitudes to be assessed.

Table E1, below, lists typical geohazard scenario return period intervals used in basin-scale assessments. Together, these intervals extend across a frequency-magnitude relationship ranging from <10 to >1,000 years. The justification to assess a higher spectrum of return periods than might be typical for clear-water floods is that their typically high intensity, combined with little warning, has the potential to result in greater risk to life.

For example, the 1:30 – 1:100-year range is the incremental probability of events at least as large as a 1:30 year event, but not as large as a 1:100 year event. The bounds of the range are exceedance probabilities. For a scenario with the annual probability range P_{min} to P_{max}, the probability of events within this range would correspond to Equation D-1, below.

$$P(H)_i = P_{min} - P_{max} \quad \text{[D-1]}$$

For example, for a 1:30 – 1:100-year hazard scenario range, this would correspond to:

$$P(H)_i = \frac{1}{30} - \frac{1}{100} = \frac{1}{43}$$

When summed, the total probability of all scenarios, including no geohazard event, should equal 1 (certainty).

For the largest event considered, the scenario probability is the probability the event is at least as large as the largest event considered in the hazard analysis. However, to select an event representing the scenario, it is necessary to define an upper magnitude bound.

Table D1: Geohazard Scenario Return Periods

Geohazard Scenario (Annual Return Period Interval)[1]	Probability of Scenario	Typical Representative Return Period (Years)[2]
<10	1/1-1/10 = 0.9	5([3])
10-30	1/1 – 1/30 = 0.07	15
30-100	1/30-1/100 = 0.02	65
100-300	1/100 – 1/300 = 0.007	200

Geohazard Scenario (Annual Return Period Interval)[1]	Probability of Scenario	Typical Representative Return Period (Years)[2]
300-1000	1/300 – 1/1000 = 0.002	650
1000-3000 (>1000)	1/1000 = 0.001	2000

Notes:

1. These return period intervals are not intended to preclude a Qualified Registered Professional (QRP) or an approving authority from selecting other intervals deemed to be appropriate when their use and application can be supported by a suitable level of analysis and relevant documentation.
2. e.g., return period to be modelled and used to prepare hazard intensity maps.
3. A 5-year event is shown as representative here, but for many debris flow or debris flood SCRAs, no events might be assumed to occur beyond some lower cutoff.

The scenario intervals shown in Table D1 are typical for site specific SCRAs.

Geohazard scenarios and the risk equation can also be shown on an event tree, as shown in Figure D1, below . The partial risk that a geohazard occurs, reaches the element(s) at risk when they are present in the hazard zone, and results in consequences, can be calculated from each branch of a tree. Summing the partial risk for each branch (p_E) yields the total risk (P_E) expressed as a probability.

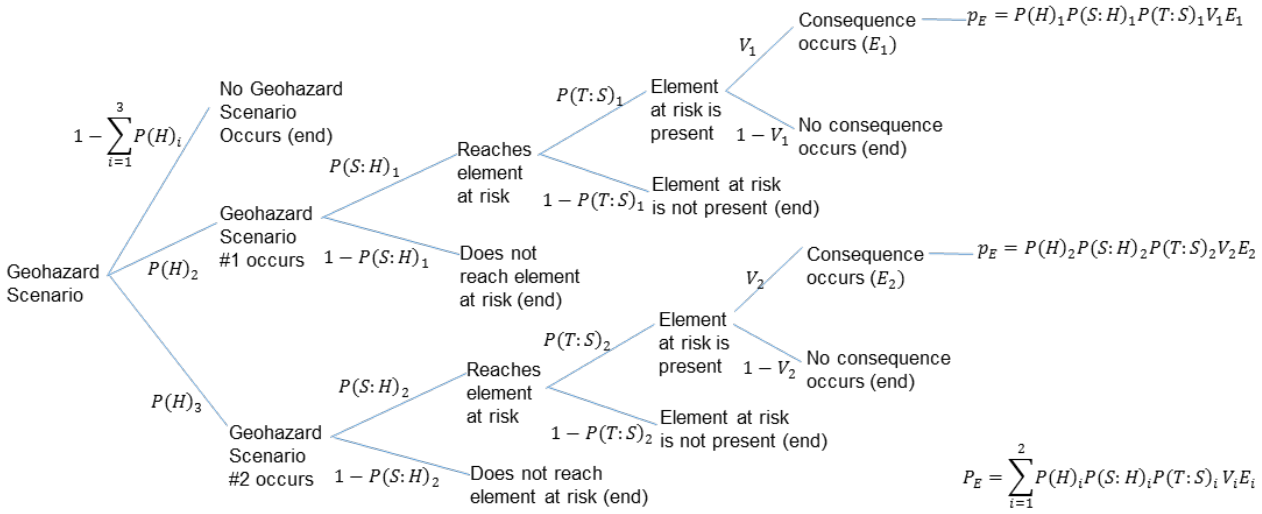

Figure D1: Generic Event Tree Showing Probability of Consequences for Two Geohazard Scenarios

D-4 Risk Equation

Risk can be quantified in terms of the following equation [D-2]:

$$P_E = \sum_{i=1}^{n} P(H)_i P(S{:}H)_i P(T{:}S)_i V_i E_i \qquad \text{[D-2]}$$

The product of the first three parameters define the encounter probability with elements at risk, where:

$P(H)_i$ is the incremental hazard probability of geohazard scenario i of n, where n is the total number of scenarios. It addresses the question, "how likely is the event"? Geohazard scenarios are commonly defined as annual frequency ranges where the bounds of a given range are exceedance probabilities (Table E1). When summed, the total probability of all scenarios, including no geohazard event, should equal 1 (certainty).

$P(S{:}H)_i$ is the spatial probability that, given occurrence, the geohazard would reach the element at risk. Spatial probability may need to be considered in up to 3 dimensions depending on the assessment. In the horizontal plane, it could consider the exceedance probability the hazard reaches at least as far as the element at risk (longitudinal axis) and conditional probability that, given it reaches this far, it impacts the element or passes to either side (lateral axis). In the vertical plane, it could consider the exceedance probability the process reaches at least down to a buried element such as a utility (e.g., by channel scour).

SCRAs that require analysis of spatial probability along more than one dimension can be tricky to set up, particularly for group safety risk estimation and moving elements (e.g., vehicles). Even one dimension can be challenging (e.g., when plotting debris flow runout exceedance probability contours with spatially distributed elements at risk). In relative risk analyses considering only one geohazard risk scenario, spatial probability may also be implicitly assumed in the choice of hazard probability, such as by choosing the most frequent event assumed to result in impact. The use of event trees can help identify and avoid logical errors. This component of risk analysis requires careful review.

$P(T{:}S)_i$ is the temporal probability that the element at risk would be in the impact zone at the time of impact. Note that this variable considers temporal components of the element at risk, not the hazard. It answers the question, "what is the chance of someone or something being in the area affected by the hazard when it occurs"? For example, it could quantify the proportion of time a person occupies a building, the probability that oil will be present within a pipeline, or the probability that moving vehicle(s) will be present in the hazard zone.

For assessment of permanent structures that are certain to be present, this variable equal 1 and may be omitted from the calculation. For non-permanent elements at risk, temporal probability may be considered from two different perspectives: the chance that a *particular* element at risk is present, or the average chance that element(s) (E_i) are present. This has bearing on analysis of individual or societal (group) safety risk, which consider risk for a particular individual or groups of (e.g., 1 or more) individuals, respectively. For example, analysis of individual safety risk for persons within buildings might assign a higher value of

$P(T:S)_i$ to an individual most-at-risk (e.g., elderly or very young) who occupies the building most of the time. For analysis of group risk, an average value for building occupants could be used.

The last two parameters describe the consequences (N), where:

V_i is the vulnerability, which is the probability elements at risk will suffer consequences given hazard impact with a certain severity. For example, vulnerability for persons is defined as the likelihood of fatality given geohazard impact. For buildings, it could be defined as the level of damage, measured as a proportion of the building replacement cost or as an absolute cost.

Vulnerability estimates are typically based on criteria relating hazard intensity to a certain severity of damage or loss. Damage may have spatial or temporal components, or both (e.g., destruction level or duration of loss of function). Vulnerability criteria may be related to direct impact, or indirect outcomes of event occurrence. For example, vulnerability of persons within buildings may be estimated as an indirect outcome of building damage or collapse, using criteria related to building damage level. Vulnerability and loss estimation is further described in a section below.

Estimation of vulnerability can be subject to high levels of uncertainty, and some types of vulnerability cannot be assessed quantitatively. Consequently, the QRP should calibrate vulnerability criteria based on historic events with known damage levels at the site of assessment, if possible, or on comparable sites elsewhere. In this process, the ideal comparison is to damage generated from the same hazard type, although where not possible, known damage from another hazard type may be used as a proxy. The QRP should also document limitations on the use of vulnerability estimates. For example, criteria used to estimate average damage levels for multiple buildings may not be appropriate for site-specific vulnerability assessment of a single building.

E_i is a measure of the elements at risk, quantifying the value of the elements that could potentially suffer damage or loss (e.g., number of persons, value of infrastructure, value of loss of function, or level of environmental loss).

Risk (P_E) is determined by calculating the partial risk for each individual geohazard scenario (i) and summing the results.

The results of Equation [E-2] may be also be presented graphically on an F-N curve. The Y-axis shows the annual cumulative frequency,f_i, of each hazard scenario, and the X-axis shows the estimated consequences, N_i, where:

$$f_i = \sum_{i=1}^{n} P(H)_i P(S:H)_i P(T:S)_i \qquad \text{[D-3]}$$

where the value of $P(T:S)_i$ is estimated for group (not individual) risk

and N_i is the product of two factors as follows:

$$N_i = V_i E_i \quad \text{[D-4]}$$

F-N curves are developed by assembling $f_i - N_i$ pairs sorted in order of increasing N, and then calculating cumulative frequency (F) to arrive at F-N pairs to be plotted.

D-5 Encounter Probability

Encounter probability is the cumulative probability that geohazard(s) occur and reach elements at risk at the time they are present:

$$P_E = \sum_{i=1}^{n} P(H)_i P(S{:}H)_i P(T{:}S)_i \quad \text{[D-5]}$$

Note that temporal probability ($P(T{:}S)_i$) may not be included for assessment of permanent structures, where it is equal to 1.

Estimating encounter probability may be helpful where:

- It can be used to demonstrate that encounter probability (and therefore risk) is negligible. For example, elements at risk could be located outside the reach of the maximum credible hazard ($P(S{:}H)_i \approx 0$). Or, elements at risk could be extremely unlikely to be present at the time of an event ($P(T{:}S)_i \approx 0$), such as for a life safety risk assessment of a very rarely occupied building.
- For relative risk estimation where vulnerability and consequences are assumed to be similar between sites. For example, this could include risk-based prioritization of different steep creek hazard areas along the same road.
- Where event impact can be assumed to cause loss of facility function, and facility function is the over-riding consideration for risk reduction. For example, debris flood impact to a critical facility, such as a care facility, could be assumed to result in closure irrespective of the destructive potential of the geohazard.

If it is demonstrated that geohazards do pose a credible threat to elements at risk, or vulnerability and consequences cannot be assumed to be similar between sites, then formal estimation of risk is preferred over estimates of encounter probability.

D-6 Vulnerability and Loss Estimation

Vulnerability is defined in the EDCG as the degree of loss of a given element at risk that results from geohazards with a certain level of destructive power. For human life loss it addresses the question, “what is the chance of fatality for persons within buildings, should the building be impacted by a geohazard?” For development, it addresses the question, “what level of direct damage will occur if the development is impacted by a debris flood or debris flow?”

Developing vulnerability criteria is a challenging component of SCRA. This section describes vulnerability criteria for buildings and persons within buildings, based on estimated levels of destructive power and resistance to impact. Description of methods to assess the vulnerability of roads and utility systems (e.g., buried infrastructure) is

outside the scope of this document. Methods to assess economic vulnerability for the local or regional economy, or for temporary closure of transportation corridors, are also outside the scope of this document.

Applying vulnerability criteria requires estimates of peak flow velocity and depth during a geohazard scenario. This section refers to debris flood "intensity", I_{DF} as a proxy for destructive power related to flow velocity and depth, calculated as follows:

$$I_{DF} = (d)(v^2) \quad \text{[D-6]}$$

where:

I_{DF} is the intensity index.

d is the modelled flow depth.

v is the modelled flow velocity.

Values of I_{DF} are typically reported without units given that it represents a proxy for intensity. Note that the above approach represents the destructive potential for only direct flow impact. It does not include other possible mechanisms of damage such as bank erosion, which may also need to be considered when estimating vulnerability.

D-7 Buildings and Occupants

The following sections describe vulnerability criteria applicable for lower and higher intensity flows. Both approaches may be required to assess hazard areas subject to variable flow intensities (e.g., debris flows on the upper fan that transform to watery after-flow and backwater flooding on the distal fan).

Low Intensity Flows (I_{DF}<1)

Lower intensity flows are defined in these guidelines as flows on steep creeks where the intensity index (I_{DF}) is less than one. Damages associated with these low intensity flows is typically limited to flood damage. While the possibility of fatalities can never be entirely ruled out, it may be negligible for persons within buildings except where site-specific conditions result in higher vulnerability (e.g., habitable basements, or still-water inundation at depths well exceeding a building first floor elevation). Low intensity flows are typical for low steep creek hazard zones. Therefore, flood damage can be limited by applying the design and engineering principles outlined in Section 9.3 of the EDCG.

Higher Intensity Flows (I_{DF}>1)

Higher intensity flows are defined in these guidelines as modelled flows where I_{DF} is greater than 1. These flows have the potential to result in structural building damage due to dynamic and static impact pressure and are considered to have credible potential to cause loss of life. Vulnerability ratings for these flows consider the likelihood of fatalities as an indirect

consequence of building damage or collapse, given that persons are within the building. Intensity flows (I_{DF}) of 1 to 10 are typical for moderate steep creek hazard zones.

Table E2 shows ranges in building structure vulnerability criteria applied in existing basin-scale SCRAs in Canmore. Table E3 shows ranges of criteria applied to estimate the vulnerability of persons within buildings to fatalities, where vulnerability is primarily an indirect outcome of building damage or collapse. These criteria are approximate averages applied to assessments completed at an alluvial fan level of detail. Unlike depth-damage curves, all building types are represented in a single set of criteria. For re-enforced concrete buildings, the lower vulnerability range is likely more appropriate. For standard wood-frame buildings and mobile homes, the mid to upper vulnerability range is likely more appropriate. The upper end of the range may also be more applicable for debris flow processes, which typically contain a higher proportion of bouldery debris than debris floods.

Group safety risk analyses of multi-unit, multi-story residential buildings should consider the difference in vulnerability for units on the ground floor versus upper floors, depending on the intensity of flow impact. For example, consider a scenario where hazard intensity is too low to result in credible life safety risk to occupants in the second or higher floor units, but there is credible threat to ground floor residents. Individual risk would consider the occupant most at risk on the ground floor. Group risk would consider the number of elements at risk on the ground floor (E_i), not the entire building population.

This simplified approach reflects uncertainties in debris flood or debris flow modelling and factors that are typically poorly known in a study, such as variations in the structure of a given building. For human vulnerability, the location and behavior of persons within the building at the time of impact is also typically not known (except for basic assumptions that may be made for populations within multi-unit buildings). These may strongly influence the actual level of vulnerability, particularly for moderate intensity debris flows (I_{DF} = 1 to 10) that have the highest variability in building damages (Table D2).

Building structure damage and life loss vulnerability criteria due to debris flows or debris floods should be calibrated by the QRP for a given SCRA. Ranges in vulnerability estimates may be carried through the risk analysis to account for uncertainty. Comparison of risk analysis results within basin-scale assessments can help determine whether the vulnerability criteria are reasonable. For building- specific assessments, the QRP should check whether site-specific factors exist that would justify more conservative criteria, such as bedroom windows at ground floor on the upstream side of the building

Table D2: Debris Flow and Debris Flood Vulnerability Criteria for Buildings

Hazard Intensity Index (Range)	Canmore Steep Creek Hazard Zone	Building Damage Description		Building Structure Vulnerability Range[1] (Approx. Average)
		Category	Description	
<1	Low	Slight	Low likelihood of building structure damage due to impact pressure. High likelihood of major sediment and/or water damage. Damage level and cost primarily a function of flood-related damages.	n/a[2]
1-10	Moderate	Moderate	High likelihood of moderate to major building structure damage due to impact pressure. Certain severe sediment and water damage. Building repairs required, possibly including some structural elements.	0.25 – 0.75 (0.5)
10-100	High/Extreme	Severe	High likelihood of major to severe building structure damage due to impact pressure. Certain severe sediment and water damage. Major building repairs required including to structural elements.	0.75 - 0.9 (0.8)
>100	High/Extreme	Complete	Very high likelihood of complete building structure damage or collapse. Complete building replacement required.	0.9 – 1.0 (1.0)

Notes:

1. Values indicate estimated proportion of building replacement value.
2. Stage-damage criteria are typically a more appropriate measure of damage at low flow intensities.

Table D3: Debris Flood and Debris Flow Vulnerability Criteria for Persons Inside Buildings

Hazard Intensity Index (Range)	Canmore Steep Creek Hazard Zone	Human Vulnerability Range[1] (Approx. Average)
<1	Low	~0
1-10	Moderate	~0 – 0.1 (0.05)
10-100	High/Extreme	0.1 – 0.5 (0.3)
100+	High/Extreme	0.5 – 1 (0.8)

[1]Vulnerability ratings indicate the estimated likelihood of fatalities as an indirect consequence of building damage or collapse, given that persons are within the building.

D-8 Business Activity

In many cases, it will be very difficult to determine the vulnerability of businesses to loss of function, and associated economic losses as a result of event impact. For example, a

retail store could suffer loss of inventory and business function, whereas a business generating revenue elsewhere could suffer office-related damages without necessarily losing their source of revenue.

While more sophisticated models of direct and indirect economic losses are commonly developed for large scale flood assessments, such work is rarely undertaken for SCRAs due to the effort involved in relation to the relatively limited areas of impact. In the simplest case, the annual revenue of businesses potentially impacted by a geohazard scenario can be either estimated at time of development proposal or obtained from commercial data providers for existing businesses and used as a relative proxy for the "importance" of economic activity in these areas.

APPENDIX E: QUALITY ASSURANCE STATEMENT FOR SITE-SPECIFIC STEEP CREEK RISK ASSESSMENTS

To: The Town of Canmore
902 7th Ave, Canmore, AB
T1W 3K1

Date: _____

For the Development[1]:

_____

Legal description and civic address of the Development, and creek name

The undersigned hereby gives assurance that he/she is a *Qualified Registered Professional* and is a *Professional Engineer* or *Professional Geoscientist.*

I have signed, sealed and dated, and thereby certified, the attached *SCRA* report on the Development in accordance with the SCRA guidelines. That report must be read in conjunction with this Statement. In preparing that report I have carried out a study which has been approved by the local jurisdiction as being appropriate for the SCRA in this case.

As part of this study, I (our firm) have (check to the left of applicable items)

☐ 1. Collected and reviewed appropriate background information on the hazard and potential consequences as appropriate for this level of study

☐ 2. Reviewed the proposed development plans on the fan or the Development

☐ 3. Conducted field work on and, if required, beyond (fan/watershed) the Development

☐ 4. Reported on the results of the field work on and, if required, beyond the Development

☐ 5. Considered any changed conditions on and, if required, beyond the Development

☐ 6. Included aspects of climate change where appropriate

7. For the SCRA I have:

☐ 7.1 reviewed and characterized, as commensurate with this level of study, any hydrogeomorphic hazard that may affect the Development

☐ 7.2 quantified the hydrogeomorphic hazard as appropriate for this level of study

☐ 7.3 identified existing and anticipated future elements at risk on and, if required, beyond the Development/Fan/Channel

☐ 7.4 estimated the potential consequences to those elements at risk

8. Regarding the level of life loss risk tolerance, I have:

☐ 8.1 compared the level of risk tolerance adopted by the Town with the findings of my investigation

☐ 8.2 found that (mark as indicated)

Individual risk is: acceptable ☐, unacceptable ☐

Group risk is: acceptable ☐, tolerable☐, unacceptable ☐, N/A ☐

☐ 8.3 made recommendations to reduce hydrogeomorphic hazard risks *(where applicable as part of the scope)*

☐ 9. Reported on the requirements for future inspections of the Development/Fan/Watershed and recommended who should conduct those inspections.

I hereby give my assurance that, based on the conditions contained in the attached SCRA report, the hydrogeomorphic hazards and risks potentially subjecting the development have been appropriately and adequately characterized and quantified.

Name (print): _____ Date: _____

Signature: _____

Address: _____

_____ (Affix Professional seal here)

Telephone: _____

If the *Qualified Professional* is a member of a firm, complete the following.

I am a member of the firm _____

and I sign this letter on behalf of the firm. _____

APPENDIX F: PLANT SPECIES LIST

The following tables list trees (Tables F1 and F3), shrubs (Tables F2 and F4) and wildflowers (Table F5) that are native to the Province of Alberta. These plant species are acceptable for the microclimate areas of landscape planting in the Town of Canmore.

Plants in the following tables that are marked with an asterisk (*) are non-native. They are suitable for re-vegetation in natural areas, and in particular high saline areas. They are drought-resistant and ideal for boulevards.

If a plant is a wildlife attractant, the comments section of the table includes information (in brackets and marked with a double asterisk) about the species that is/are attracted to the plant. The fruit, seeds, foliage and the bark of the plant material that is a designated wildlife attractant are palatable to bears, birds and ungulates (deer/elk). These identified wildlife attractant plants should be used on a site-specific basis for remediation, reclamation, habitat enhancement and strategic planning to discourage the likelihood of human and wildlife interactions.

Table F1: Coniferous (Evergreen) Trees

Common Name	Scientific Name	Flammability	Palatability (Ungulates)	Comments
Lodgepole Pine	*Pinus contorta latifolia*	High	Low	Generally found in Sphagnum (peat) covered bogs to montane dry or moist areas. Elk may harm saplings during rutting season & during winter. (**Wildlife Attractant – Ungulates)
Limber Pine	*Pinus Flexilis*	High	Low	Generally found forming open forests in the sub alpine to alpine zones, often in semi-arid areas. Usually found on dry rocky ridges and peaks. Established plants tolerate drought. A fairly wind-resistant species, the plants often colonize exposed mountain slopes in the wild, their deep taproot anchoring them firmly. Long living species, generally not available through Nurseries. Suitable for Xeriscape.
Engleman Spruce/ aka Mountain Spruce	*Picea engelmannii*	High	Low	Generally found in the montane regions to the treeline, especially by swamps. Often found on poor, thin rocky soils, though the best specimens are growing in deep, well-drained clay-loam soils. Young growth is occasionally browsed by ungulates but is not an important food item and is probably eaten as a last resort. (**Wildlife Attractant – Ungulates)

Common Name	Scientific Name	Flammability	Palatability (Ungulates)	Comments
White Spruce	*Picea glauca*	High	Low	Generally found in forested areas with good soils, along streams and lakes, and on rocky hills and slopes, succeeding in a variety of soil conditions. A fairly wind-resistant tree, it can be grown as part of a shelterbelt planting. Trees should be planted into their permanent positions when they are quite small, between 30 and 90 cm. Larger trees will check badly and hardly put on any growth for several years. This also badly affects root development and wind resistance.
Black Spruce	*Picea Mariana*	High	Low	Generally found on cool slopes and bogs. Found on well-drained soils in the north of its range and swamps in the south. Found on a variety of soil types, it grows best in those that are moist and acidic. Moose occasionally browse saplings, but White-Tailed Deer eat it only under starvation conditions. (**Wildlife Attractant – Ungulates)
Douglas Fir	*Pseudotsuga Menziesii var.Glauca*	Medium	Medium	Generally found in moist to very dry areas from sea level to near the treeline. The best specimens are found on well-drained deep loamy soils with plenty of moisture. May be browsed when young and flexible. (**Wildlife Attractant – Ungulates)

Table F2: Coniferous (Evergreen) Shrubs

Common Name	Scientific Name	Flammability	Palatability (Ungulates)	Comments
Common Juniper	*Juniperus communis*	High	Medium	More prickly than Creeping Juniper. Suitable for Xeriscape.
Creeping Juniper	*Juniperus horizontalis*	High	Medium	Many cultivars are available. Suitable for Xeriscape.
Rocky Mountain Juniper	*Juniperus scopulorum*	High	Low	Plants have a vertical growth pattern vs. horizontal. Suitable for Xeriscape.
Kinnickinnick	*Arctostaphylos uva-ursi*	High	Low	Plants are hard to establish. Suitable for groundcover and Xeriscape. (**Wildlife Attractant - Bears)

Table F3: Deciduous Trees

Common Name	Scientific Name	Flammability	Palatability (Ungulates)	Comments
Rocky Mountain Maple	*Acer glabrum*	Low	Medium	A very attractive species. It should be available in the near future from native nurseries.
River Birch	*Betula occidentalis*	Low	Low	Tough, smaller multi-branched small tree or tall shrub.
Paper Birch	*Betula papyrifera*	Low	Low	Tree has delicate bark and needs lots of water. It is currently not available from native plant nurseries
Alpine Larch	*Larix lyallii*	Low	Low	Tree is found at tree line elevations.
Western Larch	*Larix occidentalis*	Low	Medium	This tree is native to Kananaskis. It should be available in the near future from native nurseries.
Balsam Poplar	*Populus balsamifera* (male only)	Low	High	Ungulates eat the bark of this tree. (**Wildlife Attractant – Ungulates)
Trembling Aspen	*Populus tremuloides*	Low	High	This tree is more resistant to ungulate browsing. (**Wildlife Attractant – Ungulates)
Green Ash (*)	*Fraxinus pensylvanica Lanceolata*	Low	High	Deer will browse on this tree and tend to over-browse when other preferred species are unavailable. (**Wildlife Attractant – Ungulates)
Brooks #6 Poplar (*)	*Opulus X* "Brooks #6"	Low	High	If possible, avoid non-native varieties – there is a high potential for genetic contamination of native poplars.

Table F4: Deciduous Shrubs

Common Name	Scientific Name	Flammability	Palatability (Ungulates)	Comments
Green Alder	*Alnus crispa*	Low	Medium	This shrub prefers moister sites.
Labrador Tea	*Ledum groenlandicum*	Low	Medium	This shrub has white flowers and evergreen leaves. It grows in boggy wet areas.
Twining Honeysuckle	*Lonicera dioica*	Low	Medium	This shrub has yellow flowers, and twines around other vegetation. (**Wildlife Attractant – Hummingbirds)
Bracted Honeysuckle	*Lonicera involucrata*	Low	Low	This shrub prefers damp woodlands.
Mountain Rhododendron	*Rhododendron albiflorum*	Low	Low	This shrub is a very attractive specimen, but very toxic to ungulates and humans.
Bebb's Willow / Beaked Willow	*Salix Bebbiana*	Low	High	This plant grows as a large shrub or tall tree.
Pussy Willow	*Salix discolor*	Low	High	This is an attractive larger shrub.
Smooth Willow / Gray-leaved Willow	*Salix glauca*	Low	High	This erect shrub prefers moist areas.
Shrubby Cinquefoil	*Potentilia fruiticosa*	Low	Low	This shrub produces attractive yellow flowers. It is the best choice of all the shrubs to grow in the Bow Valley area. It is not attractive to ungulates or bears and many cultivars are available. The native species has silver leaves as opposed to shiny green leaves for the cultivars.
Prickly Rose	*Rosa acicularis*	Low	High	This is an earlier flowering plant. Most commercial shrub roses are non-native varieties. This shrub is very adaptive to different locales.
Common Wild Rose / Western Wild Rose	*Rose Rosa woodsii*	Low	Medium	This rose is generally found in areas of moist soils of draws, hillsides, along streams and in open valleys. It often forms thickets in open positions and prefers moist woods. It flowers a bit later then Prickly Rose. It succeeds in most well-drained soils, preferring a circum-neutral soil and a sunny position. It also grows well in heavy clay soils, but dislikes water-logged soils. (**Wildlife Attractant – Bears)
Meadowsweet / Birch Leaved Spiraea / White Spiraea	*Spiraea betulifolia*	Low	Low	This shrub is found on stream banks/ lake shores, open to wooded valleys and hillsides often in rockslides from the foothills to subalpine zones. It has showy white flowers.

Common Name	Scientific Name	Flammability	Palatability (Ungulates)	Comments
Common Snowberry	*Symphoricarpos albus*	Low	Medium	This shrub tends to colonize. It is a good tall ground cover. It grows in shady and moist mountain and forest habitat, in woodlands and on floodplains and riverbanks from the foothills to subalpine zones. (**Wildlife Attractant – Bears, Ungulates and Birds)

Table F5: Wildflowers

Common Name	Scientific Name	Comments
False Dandelion	*Agoseris glauca*	This plant has a yellow flower and looks like a Dandelion with long narrow leaves. It blooms mid-summer. It prefers full sun and a sandy or gravelly loam low in nutrients.
Nodding Onion	*Allium cernuum*	This plant cannot grow in the shade. It requires moist soil and can tolerate drought. (Deer-resistant; members of this genus are rarely if ever troubled by browsing deer.)
Wild Chives	*Allium schoenoprasum*	An easily grown plant, it prefers a sunny position in a rich moist but well-drained soil, though it succeeds in most soils. It can grow in semi-shade (light woodland) or no shade. (A good bee plant, members of this genus are rarely if ever troubled by browsing deer.)
Pearly Everlasting	*Anaphalis margaritacea*	This plant prefers a light, well-drained soil and a sunny position. It succeeds in most soils, including poor ones. (Plants seem to be immune to the predations of rabbits.)
Fairy Candelabra / Pygmy Flower	*Androsace septentrionalis*	This plant has white flowers and blooms very early.
Cut-leaved Anemone / Wind Flower	*Anemone multifida*	This plant succeeds in ordinary garden soil but prefers a moist, well-drained woodland peaty soil in some shade. It tolerates drought during its summer dormancy. A greedy plant, it inhibits the growth of nearby plants, especially legumes. (Plants seem to be immune to the predations of rabbits.)
Prairie Crocus / Pasque Flower	*Anemone patens*	This plant requires a well-drained, humus-rich, gritty soil and a sunny position and is lime-tolerant. It is a very ornamental plant. Large plants transplant badly. A greedy plant, it inhibits the growth of nearby plants, especially legumes. It cannot grow in the shade. It requires moist soil.
Lowly Everlasting / Small-Leaved Everlasting / Nuttal's Pussytoes	*Antennaria parvifolia* *Aka : nitida*	This plant has white flowers and grows as an herb mat. It blooms early summer.
Showy Everlasting	*Antennaria pulcherrima*	This plant has white flowers and blooms mid-summer.

Common Name	Scientific Name	Comments
Rosey Everlasting / Rosey Pussytoes	*Antennaria rosea*	This plant has pink flowers and blooms mid-summer.
Blue Columbine	*Aquilegia brevistyla*	This plant succeeds in ordinary garden soil, preferring a moist but not wet soil and a sunny position. A greedy plant, it inhibits the growth of nearby plants, especially legumes. (Plants seem to be immune to the predations of rabbits.)
Yellow Columbine	*Aquilegia flavescens*	This plant succeeds in ordinary garden soil, preferring a moist but not wet soil and a sunny position. It is intolerant of heavy clay. It is a very ornamental plant. A greedy plant, it inhibits the growth of nearby plants especially legumes. (Plants seem to be immune to the predations of rabbits.)
Heartfelt Arnica	*Arnica cordifolia*	This plant is found in woodland garden setting with sunny edges. It prefers a moist, well-drained, humus-rich soil, preferably lime-free, and prefers a mixture of sand, loam and peat. It can grow in semi-shade (light woodland) or no shade. The whole plant is toxic.
Pasture Sagewort / Fringed Wormwood	*Artemisia frigida*	This plant requires a sunny position and a well-drained soil that is not too rich. Established plants are very drought tolerant. Plants are longer lived, hardier and more aromatic when they are grown in a poor dry soil. It is a very ornamental plant. (Members of this genus are rarely if ever troubled by browsing deer.)
Prairie Sage	*Artemisia ludoviciana*	This plant requires sun and dry soil conditions. It shows silvery, silky foliage
Alpine Aster	*Aster alpinus*	This plant has purple flowers and blooms in the late summer.
Smoothing Aster	*Aster laevis*	This plant has purple flowers and blooms in the late summer.
Arctic Aster	*Aster sibiricus*	This plant has purple flowers and blooms in the late summer. Although basically an alpine plant, Arctic Aster can be found on gravely river flats and other rocky areas.
Indian Milk Vetch	*Astragalus aboriginum*	This plant has yellowish white flowers and blooms in the early summer. It requires a dry, well-drained soil in a sunny position. Plants are intolerant of root disturbance and are best planted in their final positions whilst still small. This species has a symbiotic relationship with certain soil bacteria. Many members of this genus can be difficult to grow; this may partly be due to a lack of their specific bacterial associations in the soil. This plant can fix Nitrogen.
Timber Milk Vetch	*Astragalus Miser a.k.a - A. decumbens*	This plant has purplish flowers and blooms mid-summer. It is very common in Lodgepole Pine forests. (It is very toxic to ungulates.)
Ascending Purple Milk Vetch / Standing Milk Vetch	*Astragalus striatus a.k.a. – A. adsurgens*	This plant has purple flowers and blooms early June.
Bluebells / Harebells	*Campanula rotundifolia*	A very easily grown plant, it succeeds in most fertile, well-drained soils though it prefers a moist but well-drained rich sandy loam and a neutral or alkaline soil in sun or partial shade. It succeeds in poor soils. (Members of this genus are rarely if ever troubled by browsing deer or rabbits.)

Common Name	Scientific Name	Comments
Yellow Indian Paintbrush	*Castilleja accendalis*	Paintbrush (Castilleja) is one of the most abundant and variable plants within the Canadian Rockies. The much-branched rootstock is a root-parasite, which makes transplanting the Paintbrush to a home garden almost impossible. There are at least ten species of Paintbrush in the southern Canadian Rockies. Their identification can be frustrating even for botanical experts. The many hues of the Paintbrush dominate well-drained slopes and rocky edges, from low elevations to alpine meadows. This plant species prefers acid, neutral and basic (alkaline) soils. It can grow in semi-shade (light woodland) or no shade. It requires moist soil. The Red Indian Paintbrush is the Town of Canmore's Official Flower.
Red Indian Paintbrush	*Castilleja mineata*	
Pink Indian Paintbrush	*Castilleja c. raupii*	
Alpine Paintbrush	*Castilleja rhexifolia*	
Field Chickweed / Mouse eared Chickweed	*Cerastium Arvense*	This is an abundant species that grows in meadows, sandy or gravely places and on rocky slopes scattered across the boreal forest.
Golden Aster	*Chrysopsis villosa*	This plant prefers dry sandy soil with full exposure to the sun.
Blue Clematis	*Clematis accidentalis*	This plant likes shade to part sun, and moist to well-drained soil. It produces blue flowers with a vine that creeps up trellis or tree or spreads on the ground.
Bunchberry	*Cornus canadensis*	This plant succeeds in any soil of good or moderate fertility. It prefers a damp soil and can grow in semi-shade (light woodland) or no shade. It is a good dense ground cover plant, growing well in light woodland.
Low Larkspur	*Delphinium bicolor*	Growing from prairie meadows to alpine ridges, this strikingly handsome plant blooms from May to July, depending on elevation. Low Larkspur is poisonous to cattle, particularly in early spring.
Tall Larkspur	*Delphinium glaucum*	This plant prefers a rich moist but well-drained soil and dislikes waterlogged soils. It requires an open sunny position. A greedy plant, it inhibits the growth of nearby plants especially legumes. The plant prefers acid, neutral and basic (alkaline) soils. It cannot grow in the shade. It requires moist soil.
Mountain Shooting Star	*Dodecatheon conjugens*	This plant prefers a moist, rich, well-drained soil and some shade. It prefers woodland conditions or a cool moist shady border. Plants prefer a dry period when dormant in the summer. Shooting Star grows easily from seed and it will readily seed itself in future years.
Shooting Star	*Dodecatheon pulchellum*	This plant prefers a moist, rich, well-drained soil and some shade. It prefers woodland conditions or a cool moist shady border. Plants prefer a dry period when dormant in the summer. Shooting Star grows easily from seed and it will readily seed itself in future years.
Yellow Mountain Avens / Yellow Dryad	*Dryas drummondii*	This plant is a common pioneer on gravel flats, rocky slopes, and roadsides in the montane zone. It flourishes in sunny, well-drained situations and makes an interesting and unusual rock garden plant. It is suitable for groundcover and Xeriscape.
White Mountain Avens	*Dryas octopetala a.k.a. hookeriana*	This plant is easily grown in ordinary gardening soil, preferring a sunny position and limestone soils. It prefers a gritty well-drained peaty soil. It is a

Common Name	Scientific Name	Comments
		good plant for a rock garden, and it succeeds on banks and on walls. A very ornamental plant is suitable for groundcover and Xeriscape.
Fireweed	*Epilobium angustifolium*	This easily grown plant prefers a well-drained but moisture retentive soil in a sunny position, though it succeeds in most soils. It spreads vigorously by means of a creeping rhizome, and often forms large patches. It is apt to become a weed especially through its seed, which is very light and capable of travelling long distances in the wind. It is a good bee plant.
Mountain Fireweed / River Beauty	*Epilobium latifolium*	This plant prefers a well-drained but moisture retentive soil in a sunny position but succeeds in most soils. The roots are somewhat spreading and can become invasive.
Tufted Fleabane	*Erigeron caespitosus*	This plant grows in rocky soils from moderate elevations to the alpine zone.
Cut-Leaved Fleabane / Compound–Leaved Fleabane / Daisy Fleabane	*Erigeron compositus*	This plant grows in rocky soils from moderate elevations to the alpine zone.
Smooth Fleabane	*Erigeron glabellus*	This plant is generally found in moist prairies, meadows and open woods. It prefers a moderately fertile well-drained soil in a sunny position and does best in a sandy dry soil but will succeed in fairly heavy soils. It is a good butterfly and moth plant. It succeeds in very exposed positions. There are some named varieties selected for their ornamental value. Very few members of this genus will hybridize with other members of the genus. This plant does well in the border areas or in a rock garden.
Umbrella Plant / Sulphur Buckwheat	*Eriogonum umbellatum*	The plant is widely distributed on exposed sites from low elevations to alpine ridges.
Wild Strawberry	*Fragaria virginiana*	Wild Strawberry is common from the montane to the alpine region, but while it blooms profusely in the subalpine and alpine region, it frequently does not set fruit because of the cold nights and short growing season. It prefers a fertile, well-drained, moisture retentive soil in a sunny position. Plants tolerate semi-shade though fruit production will be reduced when plants grow in such a position. The plants appreciate a mulch of pine or spruce leaves. The fruit is eaten by a number of birds and mammals, so caution should be taken with placement. (**Wildlife Attractant – Bears & Birds)
Gaillardia / Indian Blanket / Blanket Flower / Brown-Eyed Susan	*Gaillardia aristata*	This plant requires a position in full sun and will succeed in any moderately fertile well-drained soil. It performs well in poor soils and copes well with hot dry conditions. It requires winter protection, especially in areas experiencing heavy snows. Covering the plants with brush wood should be enough. (Members of this genus are rarely if ever troubled by browsing deer.)

Common Name	Scientific Name	Comments
Northern Bedstraw	*Gallium boreale*	This plant prefers a loose moist leafy soil in some shade. It tolerates dry soils but the leaves quickly become scorched when growing in full sun. This species does not thrive in a hot climate. The seed can be sown in spring though it may be very slow to germinate. This plant does not really need any help to reproduce itself. Division can be done in spring or throughout the growing season if the plants are kept well-watered. This is a very easy plant, larger clumps can be replanted direct into their permanent positions, though it is best to pot up smaller clumps and grow them on in a cold frame until they are rooting well and then plant them out in the spring.
Felwort / Northern Gentain	*Gentianella amarella*	This plant requires a damp humus-rich soil and should be planted in a situation approaching its native habitat. An aggregate species, individual plants may show unusual features and determinations should be based on small samples of the population. The plant prefers acid, neutral and basic (alkaline) soils. It can grow in semi-shade (light woodland) or no shade. It requires moist soil.
Fringed Gentian	*Gentianella crinata*	This plant is found in moist meadows, shores and calcium-rich ferns, occasional in southern boreal forest and parkland of prairie provinces. It grows best in moist areas, blooms in the late summer with purple flowers and is difficult to propagate.
Wild White Geranium	*Geranium richardsonii*	This is one of the most appealing plants found in aspen glades along the lower slopes of the mountains. It succeeds in any moderately fertile retentive soil in a sunny position. It tolerates a wide range of soil types, succeeding in dry soils. It grows well on woodland edges. The whole plant has an unpleasant aroma; the foxy smell is particularly pronounced after rain. (Members of this genus are rarely if ever troubled by browsing deer or rabbits.)
Sticky Purple Geranium	*Geranium viscosissimum*	This plant is found in open woods and meadows. It is plentiful in medium-dry to moist or even wet soils of open woods, roadsides, creek banks and meadows to an elevation of 2,700 m. It succeeds in any good soil in sun or partial shade. Plants are hardy to about -25°C. (Members of this genus are rarely if ever troubled by browsing deer or rabbits.)
Prairie Smoke / Old Man's Whiskers / Three-flowered Avens	*Geum triflorum*	This plant is easily grown in any moderately good garden soil that is well drained. It prefers a soil rich in organic matter and a rather damp soil. Plants are hardy to about -20°C. This plant hybridizes freely with other members of this genus.
Alpine Hedysarum	*Hedysarum alpinum*	This plant is easily grown in ordinary garden soil in a sunny position, preferring a deep well-drained sandy loam. Plants strongly resent root disturbance and should be placed in their permanent positions as soon as possible. This plant has poisonous seeds.
Northern Hedysarum / Sweet Vetch	Hedysarum boreale	This plant is easily grown in ordinary garden soil in a sunny position, preferring a deep well-drained sandy loam. Plants strongly resent root disturbance and should be placed in their permanent positions as soon as possible. Great care is needed if moved since the plant dislikes root disturbance.

Common Name	Scientific Name	Comments
Yellow Hedysarum / Yellow Sweet-vetch	*Hedysarum sulphurescens*	This unmistakable plant grows in dense clumps along stream banks, in moist woods and occasionally in alpine sites. It is a very important food plant for grizzly bears, which eat the roots in spring and fall. (**Wildlife Attractant – Bears)
Beautiful Sunflower	*Helianthus laetiflorus*	This plant likes sun to light shade and well-drained soil.
Richardson's Alumroot	*Hencheria richardsonii*	This plant prefers sun to light shade and well-drained soil. It produces pink/purple flowers.
Cow Parsnip	*Heracleum lanatum*	This plant is found in areas of rich damp soils of prairies and mountains, especially along streams and in open woods. This species does best in woodland gardens with dappled shade, at a shady edge or in deep shade. It succeeds in any ordinary garden soil, doing best in moist soils or deep woodland.
Yellow Peavine / Cream Coloured Vetchling	*Lathyrus ochroleucus*	This plant prefers areas of dry or moist woods, slopes and rocky banks. An easily grown plant, it succeeds in any moderately good garden soil but prefers a position in full sun. The plant prefers well-drained acidic, neutral and basic (alkaline) soils. It can grow in semi-shade (light woodland) or no shade. It requires moist soil. It may not transplant well so care should be taken when moving it.
Western Wood Lily / Tiger Lily	*Lilium philadephicum*	This lily prefers heavy, often somewhat alkaline, meadows to montane forest. It is usually found in drier woodlands on acid sandy loams and requires a well-drained humus-rich soil and a cool moist root run. It likes a warm position with moisture in summer. Plants are rather difficult to establish. A very ornamental plant, it requires protection from rain in winter. The plant should be protected against rabbits and slugs in early spring. If the shoot tip is eaten out, the bulb will not grow in that year and will lose vigor.
Twinflower	*Linnaea borealis*	This plant prefers acid soils and can grow in very acid soil. It can grow in full shade (deep woodland) or semi-shade (light woodland) and requires moist soil. It prefers a rather shaded position in a rock garden in a moist peaty soil. It grows well in pine woods. Plants can be rather difficult to establish.
Wild Blue Flax / Western Blue Flax	*Linum lewisii*	This plant is found in calcareous grassland and prairies to alpine ridges, usually on dry well-drained soils in western North America. It prefers a light, dry, well-drained, moderately fertile, humus-rich soil in a sunny sheltered position. It prefers an alkaline soil. It is a very ornamental plant that is not generally very long-lived, though it normally self-sows freely. Established plants are drought tolerant and suitable for Xeriscape.
Yellow Puccoon / Woolly Gromwell / Western	*Lithospernum ruderale*	This plant is found in open, fairly dry places from the foothills to moderate elevations. It prefers a sunny position in a moderately fertile, well-drained soil. It does well in cultivated beds. I should be planted out into permanent positions in late spring or early summer, after the last expected frosts.

Common Name	Scientific Name	Comments
Silky Lupine	*Lupinus sericeus*	This plant grows in many types of habitat, including forests, woodlands, sagebrush, and grasslands. It often grows on dry, rocky slopes, and does best in open meadows and forest openings or sites without shade. It can be found at low and high elevations, up to 3,000 m or more. It can often be found in recently burned sites. The inflorescence of this plant is a raceme of many flowers, usually in shades of purple or blue, but sometimes white or yellowish. It often grows in dense clumps or bunches. Like many other lupines, this species is very toxic, but it does not appear to be toxic to wild animals such as white-tailed deer, which often consume it. (**Wildlife attractant – Ungulates, Birds & other small mammals)
Silvery Lupine	*Lupinus argenteus*	This plant is native to much of western North America. It grows in several types of habitat, including sagebrush, grassland, and forests. The plants favour dry soil and prefer sun, part shade or shade conditions and will thrive with minimal water. It contains toxic alkaloids, especially in the seeds, which can be toxic to humans and animals if ingested. The flowers of silver-stem lupine are sometimes pink and rarely white. This species spreads quickly to form colonies. Silvery Lupine is an important food source for butterflies. (**Wildlife attractant – Ungulates Birds&, Hummingbirds)
False Salomon Seal	*Maianthemum stellatum*	This is a woodland herbaceous perennial plant that likes a sunny spot but can do well in partial shade. It prefers moist to dry soil conditions. It is an ever-changing seasonal plant with little white buds in the spring, followed by delicate starry flowers, then stripy berries and deep red berries in the fall. (**Wildlife attractant – Bears, Ungulates& Birds)
Tall Bluebell Lungwort	*Mertensia paniculata*	This plant's flowers are bell shaped, drooping and a purplish blue in color. The plant thrives in moist wooded or meadow areas. It is a shade tolerant species and is present in early and late-seral communities and is known to thrive within the boreal forests. (**Wildlife attractant – Grizzly Bears & Ungulates)
Wild Mint / Field Mint / American Wild Mint	*Mentha arvensis*	Wild Mint is found in moist places at low to moderate elevations. An easily grown plant, it succeeds in most soils and situations so long as the soil is not too dry. This species tolerates much drier conditions than other members of the genus. It prefers a slightly acid soil. Most mints have fairly aggressive spreading roots and, unless you have the space to let them roam, they need to be restrained by some means such as planting them in containers that are buried in the soil. (Members of this genus are rarely if ever troubled by browsing deer and helps to deter insect pests.)
Red Monkey Flower	*Mimulus lewisii*	This is an alpine to subalpine species that needs well-drained sandy soils (both in cultivation and propagation). It is found in alpine and subalpine meadows with vernal run-off. It grows along small streams as well, but the water must be cold and clear (well-oxygenated). This species works best in a woodland

Common Name	Scientific Name	Comments
		garden, at a sunny edge, in dappled shade or around a pond area. (Bees and hummingbirds are frequently attracted to these flowers.)
Yellow Monkey Flower	*Mimulus guttatus*	This plant is found near streams and wet places below 3,000 m elevation. It prefers rather moist places such as damp borders, margins of streams and boggy spots. It thrives in full sun so long as the soil does not dry out, otherwise it is best grown in partial shade. It grows well in shallow water, but it can be invasive. This species works best around a pond or bog garden.
Blunt- Leaved Sandwort	*Moehringia lateriflora*	This plant is found in moist meadows, shorelines, thickets and woods.
Wild Bergamot / Horse Mint / Bee-Balm	*Monarda fistulosa*	This plant is found in dry thickets, clearings and woodland edges. It is easily grown in ordinary garden soil so long as it is not too dry, it also grows well in heavy clay soils. It generally requires a moist soil and a sunny position, though it also succeeds in light shade. This species will thrive when grown in a dry soil. It is a very ornamental plant and a good bee plant.
Alpine Forget-me-not	*Myosotis alpestris*	This plant is generally found growing in damp woodlands and meadows, usually on basic rock formations. It prefers a well-drained, gritty soil. The flowers are deliciously fragrant in the evening and nighttime though there is little or no scent in the daytime. It can be used in a woodland garden along the sunny edge and can tolerate dappled shade or be placed along a shady edge or within a bog garden. (Members of this genus are rarely if ever troubled by browsing deer.)
Reflexed Locoweed	*Oxytropis deflexa*	This plant is found in open woods, moist thickets, banks, shores and gravel bars. Many Locoweeds including Reflexed Locoweed have nodules on their roots that contain bacteria capable of fixing nitrogen even in cold climates. It is a highly circumpolar species that has been divided into many subspecies and varieties by taxonomists.
Early Yellow Locoweed / Silk Locoweed	*Oxytropis sericea*	This plant is found in dry prairies, calcareous gravels and bluffs. It is easily grown in an ordinary garden soil but prefers a sandy loam. It does best in a deep, gritty perfectly drained soil in full sun and can be used in cultivated beds. The plant strongly resents winter wet. It is a very ornamental and variable plant.
Showy Oxytropis / Showy Locoweed	*Oxytropis splendens*	This plant is generally found in open woods, clearings and riverbanks common in prairie and parkland, occasional in boreal forest. An attractive legume, this boldly handsome plant is widely distributed throughout low-elevation grasslands.
Late Yellow Oxytropis / Late Yellow Locoweed	*Oxytropis campestris [O. monticola*	This is a highly variable species and is common on the prairies and in open woodland. Many Locoweeds including Late Yellow Locoweed have nodules on their roots that contain bacteria capable of fixing nitrogen even in cold climates. It is a highly circumpolar species that has been divided into many subspecies and varieties by taxonomists.

Common Name	Scientific Name	Comments
Viscid Locoweed	*Oxytropis viscida*	This is a highly variable species and is common on the prairies and in open woodland. Many Locoweeds including Viscid Locoweed have nodules on their roots that contain bacteria capable of fixing nitrogen even in cold climates. It is a highly circumpolar species that has been divided into many subspecies and varieties by taxonomists.
Silky Scorpionweed / Silky Phacelia / Mountain Phacelia	*Phacelia sericea*	This perennial graces open slopes, screes and rock crevices at high altitudes.
Shrubby Beardtongue	*Penstermon fruiticosus*	This plant likes the sun and is found on dry gravely slopes or rocky sites. It grows as a dense shrub that creeps across the ground. Penstemon species are often used in xeriscape landscaping, as many are native to desert or alpine regions and thus quite hardy.
Yellow Beardtongue / Yellow Penstemon	*Penstemon confertus*	This plant is found in fairly moist, open or wooded places, often in meadows or by streams, in lowland and foothills to moderate elevations in the Rockies. It succeeds in ordinary rich garden soil so long as it is well-drained. It succeeds in dry soils and requires a position in full sun. It is very cold hardy, but some protection from winter wet is beneficial for this plant. Plants are evergreen in mild winters. This plant is recommended to be used in cultivated beds.
Slender Penstemon	*Penstemon procerus*	This plant is native to western North America where it grows in mountain habitat such as meadows, often in alpine climates. It likes sun and prefers dry to well-drained soil. The plant's inflorescence is made up of one or more clusters of tubular flowers with lipped, lobed mouths. Each flower is no more than one centimeter long and is purple to blue in color, often with a white throat.
Jacob's Ladder	*Polemonium pulcherrimum*	A very easily grown plant, it prefers a moist, well-drained, fertile soil in sun or semi-shade. Plants are fairly short-lived in cultivation unless they are divided regularly and moved to fresh soil. (Cats are strongly attracted by the smell of this plant and will frequently roll on it and injure it.)
White Cinquefoil	*Potentilla arguta*	This plant thrives in full sun to partial shade. It is drought tolerant but will tolerate seasonal moisture in a well-drained site. It produces pale yellow flowers throughout the summer that resemble strawberry blossoms. It is preferred by butterflies. The plant has great fall colours. (**Wildlife attractant – Ungulates)
Silverweed	*Potentilla anserina*	Silverweed is found at lakeshores, riverbanks and damp meadows in ditches and moist calcareous soils. It is a common weed of cultivation. It can be utilized in woodland gardens along the sunny edge and can handle dappled shade. I can also be sown into lawns and open meadows and can be used in cultivated beds. These attractive perennials transplant well to rock gardens and borders but are notorious for reaching out to cover new ground.
Graceful Cinquefoil	*Potentilla gracilis*	This plant is found in open woods, grasslands and waste places. It is widespread across southern boreal forest and parkland.

Common Name	Scientific Name	Comments
Yellow Rattle / Rattlebox	*Rhinanthus minor a.k.a R. crista-galli*	This plant can be grown in a meadow and is useful when establishing wildflower meadows. If planting wildflower plugs into existing grass, success is improved by reducing immediate competition while the wildflower establishes itself. This can be achieved by raking Yellow Rattle seed (Rhinanthus minor) into the grass in spring or autumn. This plant is a semi-parasite on grass and once established it will reduce the vigor of the original grass by up to 50%. All ancient meadows have this plant.
Spotted Saxifrage	*Saxifrage bronchialis*	This plant grows in rocky openings on cliffs, scree, crevices, in subalpine and alpine areas. It likes sun to part shade and dry soil conditions. It is a great plant for rock gardens.
Lance Leaved Stonecrop	*Sedum lanceolatum*	This plant is native to western North America and is found throughout western Canada and the United States. It grows in exposed, rocky mountainous habitat at moderate and high elevations, up to 4,048 m in the Rocky Mountains. The plant's inflorescence is made up of one or more erect arrays of several flowers. The flowers have yellow petals sometimes tinged with red, each lance-shaped petal just under a centimeter long. It likes sunny, dry, rocky sites.
Groundsel	*Senecio spp.*	This plant is often found growing in loose sprawling clumps on scree slopes of the alpine or subalpine zones.
Prairie Groundsel / Woolly Groundsel	*Senecio canus*	Although this plant is typical of the prairies, it may be found in dry and exposed sites almost to timberline.
Balsam Groundsel / Canadian Groundsel / Canadian Butterweed	*Senecio pauperculus*	This plant is found in moist open woods, meadows, stream banks, lake shores and roadsides. It is widespread across boreal forest and parkland. It generally grows on shores, in moist to dry meadows or open coniferous forest.
Moss Campion	*Silene acaulis*	This plant is generally found in Arctic regions and is also found further south on mountains in North America, situated on mountain ledges and scree. It is easily grown in a light soil in full sun, doing best on a moraine. It prefers a cool climate and plants can be difficult to bring into flower in the garden. Plants form a rooting carpet and can be grown as a ground cover when planted about 25 cm apart each way. Established plants are drought tolerant and good for Xeriscape.
False Solomon's-Seal / False Spikenard	*Smilacina racemosa*	This lovely plant is found in moist to dry open woodlands, open meadows, riverbanks and lakeshores. Widespread across the Bow Valley region.
Star-Flowered False Solomon's Seal	*Smilacina stellata*	Found in moist to dry open woodlands, open meadows, riverbanks and lakeshores. It is widespread across the Bow Valley region.
Canadian Goldenrod	*Solidago canadensis*	This plant is generally found in dry to damp thickets, on roadsides, slopes and clearings. It avoids acid soils and succeeds in any moderately fertile, moisture retentive soil in sun or semi-shade. It grows well in heavy clay soils. A rather greedy plant, it is apt to impoverish the soil. The flowers attract butterflies and moths. The plant also attracts various beneficial insects such as ladybirds,

Common Name	Scientific Name	Comments
		lacewings and hoverflies to the garden, these insects will help to control insect pests in the garden. It can be used in a woodland garden at the sunny edge with moderate dappled shade.
Missouri Goldenrod / Low Goldenrod /Prairie Golden Rod	*Solidago missouriensis*	This plant is found in the dry prairies, gravels and rocky slopes. It succeeds in any moderately fertile, moisture retentive soil in sun or semi-shade. It grows well in heavy clay soils. A rather greedy plant, it is apt to impoverish the soil. The plant attracts various beneficial insects such as ladybirds, lacewings and hoverflies to the garden, these insects will help to control insect pests in the garden.
Mountain Goldenrod / Spike–like Goldenrod / Coast Goldenrod	*Solidago spathulata a.k.a S. deumbens*	This plant succeeds in any moderately fertile moisture retentive soil in sun or semi-shade. It grows well in heavy clay soils. A rather greedy plant, it is apt to impoverish the soil. The plant attracts various beneficial insects such as ladybirds, lacewings and hoverflies to the garden, these insects will help to control insect pests in the garden.
White Meadowsweet	*Spirea betulifolia*	This plant is found in open, dry to moist forests and rocky slopes. It is easily grown in average, medium, well-drained soils in full sun. It tolerates a wide range of soils. Specimen or group plant for rock gardens. Mass or group plant in shrub borders. It can be grown as a low hedge for paths and walkways. It incorporates well into foundation plantings.
Long-stalked Chickweed / Long-stalked Starwort	*Stellaria longipes*	This plant is generally found in dry to moist open areas and woodlands. It is widespread throughout the Bow Valley region, northwards and upwards (elevation) into tundra and is circumpolar. This plant inhabits exposed rocky ridges and slopes within the alpine zone. Several species of Chickweed are found in the Canadian Rocky Mountains. They are not always easily identified because they tend to be highly variable.
Blue-Eyed Grass	*Sisyrinchium montanum*	This plant is generally found on moist slopes and meadows. It is widespread across the Bow Valley region. It prefers a moist but well-drained, humus-rich, loamy soil and a position in full sun, though it will tolerate part-day shade.
Western Meadow Rue	*Thalictrum occidentale*	Western Meadow Rue is common and widely distributed in moist woods, thickets, meadows and along streams.
Veiny Meadow Rue	*Thalictrum venulosum*	This Rue is generally found in moist prairies, thickets and open woods. It is fairly common across the Bow Valley region.
Golden Bean	*Thermopsis rhombifolia*	This is one of the most striking and colourful early spring flowers. It usually grows in large patches from running rootstock. The plant is common in dry, sandy grasslands.
Wild Vetch	*Vicia americana*	This plant is generally found in damp or gravelly slopes, thickets and meadows. It succeeds in any well-drained soil in a sunny position if the soil is reliably moist throughout the growing season, otherwise it is best grown in semi-shade. It is a climbing plant that attaches itself to supports by means of tendrils. This species has a symbiotic relationship with certain soil bacteria; these bacteria form nodules on the roots and fix atmospheric nitrogen. Some

Common Name	Scientific Name	Comments
		of this nitrogen is used by the growing plant but some can also be used by other plants growing nearby. It can be used in cultivated beds.
Early Blue Violet	*Viola adunca*	This plant is found on damp banks and edges of meadows in most forest communities, at elevations of 1,500 to 2,400 m. It prefers a cool, moist, well-drained, humus-rich soil in partial or dappled shade and protection from scorching winds. It tolerates sandstone and limestone soils but becomes chlorotic if the pH is too high and prefers a pH between 6 and 6.5. It works well in a woodland garden along the sunny edge but will tolerate dappled shade and will also do well at the shady edge of the garden.
Western Canada Violet	*Viola Canadensis a.k.a V. rugulosa*	This plant is found in rich soils in deciduous woods and forests in the mountains. It is easily grown in any fertile soil in full sun or partial shade. It prefers a cool position in a moist, well-drained, humus-rich soil in partial or dappled shade and protection from scorching winds. It tolerates sandstone and limestone soils but becomes chlorotic if the pH is too high and prefers a pH between 6 and 6.5. It works well in a woodland garden along the sunny edge but will tolerate dappled shade and will also do well at the shady edge of the garden.
White Camas / Mountain Death Camas	*Zigadenus [Zygadenus] elegans*	This plant is generally found in open woods and damp open meadows from low elevations to alpine areas and is widespread across the Bow Valley region. Like other members of this genus, White Camas contains an alkaloid and all parts can be poisonous to humans and grazing animals.
Heart-Leaved Alexander / Meadow Parsnip	*Zizia aptera*	This member of the carrot family is most likely found in damp/moist meadows, stream banks, and low ground areas up to timberline across the Bow Valley region. It requires a moist soil and a position in full sun. It is suitable for the wild garden and other informal plantings as well as collections of native wildflowers and can be utilized in a woodland garden placed along the sunny edge.

Wildflower Notes:

- Flammability: Most wildflowers have a low flammability rating.
- Wildlife: Many wildflowers are eaten by ungulates. Fruits may be eaten by birds, rodents or bears. Bears will dig up roots and corns of some members of the pea, lily and Purslane families.
- Deer Resistant Wildflowers: If deer are very hungry, they will eat just about anything. This is especially true during extreme weather conditions such as droughts or severe winters. The identified deer-resistant plants are very low on their list of favourite foods.