

SCHEDULE F

REGULATIONS, STANDARDS AND SPECIFICATIONS FOR THE DESIGN AND INSTALLATION OF DRAINAGE SYSTEMS

Schedule F - Regulations, Standards and Specifications for the Design and Installation of Drainage Systems

This is **Schedule F** of the Corporation of the Village of Valemount Subdivision and Development Servicing Bylaw No. 919, 2026.

Corporate Officer

SCHEDULE F – REGULATIONS, STANDARDS AND SPECIFICATIONS FOR THE DESIGN AND INSTALLATION OF DRAINAGE SYSTEMS

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SCHEDULE F

REGULATIONS, STANDARDS, AND SPECIFICATIONS FOR THE DESIGN AND INSTALLATION OF DRAINAGE SYSTEMS

GENERAL

Where the provisions of Schedule A of this Bylaw require the construction of a storm drainage system, the Owner shall provide a storm drainage system including sewer mains, manholes, service connections, and all related appurtenances.

The Village of Valemount has limited existing drainage infrastructure. Before making a development application, it is recommended that the Design Engineer review the stormwater drainage concept in the development area with the Approving Officer to establish guidelines for the drainage plan for the proposed development. Items that should be reviewed include (but are not limited to):

- Development area (upstream, in-situ and downstream catchments);
- Local connections to existing drainage infrastructure;
- Geotechnical and groundwater conditions
- Lot and development grading;
- Design methodology and design storms

The results of this meeting will set the stage for the design of drainage infrastructure within the proposed development.

All drainage designs and discharges shall be in full compliance with applicable laws, regulations and guidelines and it is the Owner's responsibility to ensure that the appropriate consultation with authorities (municipal, provincial, federal as necessary) and permits have been obtained prior to any construction.

Approval of Engineering Drawings and Report Required Prior to Construction

All drainage systems in the Village of Valemount shall be designed in accordance with the primary purpose to limit the effect of peak flows and volumes of runoff on private and public property, receiving streams, and watercourses.

The Design Engineer shall prepare a Stormwater Drainage Plan at a scale and with sufficient detail that adequately and clearly presents the design. The plan shall explicitly indicate existing and proposed drainage courses (both major and minor routes) and drainage areas (including all catchments affected whether they are upstream or downstream of the subject area), together with estimated runoff flows and proposed drainage works.

The stormwater drainage plan and supporting documentation shall include the items identified in Schedule H along with:

- Consideration of impact on the total watershed and recommendations in the Official Community Plan (OCP) and other applicable plans;
- Tributary areas to the development including existing and ultimate land use in accordance with the OCP;
- Impervious or runoff coefficient values for each catchment area based on future OCP land use;
- Hydrologic calculations for the development;
- 1:100 year storm flow routing internal and external to the development;
- Control of discharges to meet downstream conditions such as to prevent erosion and flooding;
- Hydraulic considerations as applicable – surcharged system impact, water flow on the road surface;
- Recommendations for works required to address the above including interim facilities.
- Anticipated system function;
- Major and minor system function and flow routing;
- Tie in locations to existing infrastructure;
- Potential ponding areas;
- Applicable erosion control methods;
- Pertinent calculations or summarized model results.

The report shall be written to be read in conjunction with the engineering drawings submitted to the Approving Officer for approval prior to the commencement of construction. The drawings shall show (at a minimum):

- Overland drainage systems;
- Alignment and size of pipes;
- Proposed grades;
- Distances between manholes;
- Manhole invert elevations;
- Existing ground elevations;
- Proposed finished ground elevations;
- Service connections to the property line;
- Proposed easements or rights-of-way;
- Pipe bedding requirements; and
- Any other relevant details.

The report and drawings shall be prepared by a Professional Engineer licenced to practice in British Columbia.

Where Storm Drainage Collection System Not Required

Where storm drainage facilities are not required at the time of development, the Corporation of the Village of Valemount may require rights-of-way to be provided by the Owner to allow for the eventual installation of these facilities. Such rights-of-way shall be registered in favour of the Corporation of the Village of Valemount at the Owner's expense. In this instance, the Owner will be required to provide for surface drainage as required by the Approving Officer, with all catch basins and other appurtenances designed to facilitate connection to the future storm sewer system.

Lot Grading Plan

A comprehensive lot grading plan prepared by the Design Engineer is required. This requirement may be waived by the Approving Officer if fewer than three new lots are created and there is no apparent impact on adjacent properties. Regardless of the size of the development, the Approving Officer may require a report or grading plan prepared by the Design Engineer analysing the existing development and impact on adjacent properties. This plan must illustrate a strategy that addresses both the compatibility of the grading on all lots within the development area and the impact of these strategies on the existing adjacent development area. Items to be addressed are identified in Schedule H along with:

- Existing drainage patterns adjacent to the site; and
- Lot numbering as per the final registered plan.

Confirmation of final elevations will be required prior to acceptance of works. The final grading plan submitted to provide guidance for the development of buildings on the lots may omit pre-development contours and cut/fill notations. Covenants may be registered on lots to ensure compliance with the approved plan.

Minor and Major Drainage Systems

The drainage system shall consist of two components, the minor and the major systems. The minor system will consist of underground conduits, open channels and watercourses designed to convey a 10-year return period flow for residential, industrial, commercial, institutional, and high-density residential areas. The major system will consist of surface flood paths, roadways and watercourses designed to convey the 100-year return period flow.

Because the Village of Valemount does not have significant drainage infrastructure, it may not be possible to convey runoff from a development site to a receiving body of water. In these circumstances, the Design Engineer shall demonstrate how the runoff generated from the development is managed on the development site.

In special conditions where surface flood paths cannot be established and if applicable, pipes and culverts of the minor system may be enlarged to accommodate the major

system flow. Note the size and number of inlets into the enlarged pipe system needs to be considered to ensure adequate inlet capacity.

Adequate Drainage

All subdivisions shall be adequately drained throughout the year. Where the whole or part of any proposed subdivision is wet or subject to intermittent or periodic flooding, approval of the subdivision will be withheld until the Approving Officer is satisfied that appropriate steps have been taken to drain the land or otherwise remedy such wet or flooding conditions.

Existing and Natural Watercourses

Where a subdivision is traversed by a watercourse, drainage way or stream, a right-of-way shall be provided along such watercourse or its planned re-alignment of a width deemed necessary by the Approving Officer for construction, maintenance, conservation, and beautification purposes.

No natural drainage course shall be altered or diverted unless such alteration or diversion has been approved by the Corporation of the Village of Valemount and any other relevant Provincial and Federal Approving Authorities.

Stormwater shall be discharged from a subdivision to only a drain, ditch, watercourse, stream or other waterway as may, in the opinion of the Approving Officer, be adequate to receive the discharge therefrom, or which has been declared a part of the Village drainage system. It may be the responsibility of the Owner to improve up or downstream infrastructure to meet overall development needs.

Drainage Systems Through Private Property

Where it is necessary to construct a drainage system through privately-owned land, the Owner shall obtain or grant a right-of-way in favour of the Corporation of the Village of Valemount to guarantee the right of access, to the drain area facility in perpetuity.

DESIGN CRITERIA

Sizing of Systems

The system shall be of sufficient capacity to accommodate all tributary areas as defined by the Village. For drainage areas 10 hectares and smaller, the Rational formula may be used,

$$Q = K * C * I * A, \quad \text{where:}$$

- Q = Flow in m³/s;
 K = Constant to establish units of compatibility (0.00278);
 C = Dimensionless runoff coefficient;
 I = Rainfall intensity in mm/hr; and
 A = Runoff area in hectares.

Rainfall intensities shall be calculated according to the following equation,

$$I = A * (t + t_0)^B$$

t = the time of concentration in hours; and

A, B and t₀ are coefficients as specified in **Table F.1**.

TABLE F.1 – RAINFALL INTERPOLATING EQUATION COEFFICIENTS

Rainfall Frequency	A	B	t ₀
<u>Historical IDF</u>			
10-Year Storm	10.8	-0.586	0.252
100-Year Storm	36.0	-0.865	2.836
<u>RCP 8.5 Climate Change</u>			
10-Year Storm	12.3	-0.580	0.213
100-Year Storm	36.9	-0.820	2.417

For the minor system, the 10-year frequency curve shall be used. For the major system, and for special structures such as in the design of storm retention basins, underpass drainage or arterial roads, the 100-year rainfall curve shall be used.

The time of concentration, or inlet time, will vary with topography and the nature of the drainage areas, but will generally be fifteen minutes or greater for residential areas. Inlet times shall be determined by the Design Engineer.

Runoff coefficients for storm sewer design shall be assumed to be not less than the values specified in **Table F.2**.

TABLE F.2 – RUNOFF COEFFICIENTS

Description of Area	Runoff Coefficient
Commercial	
• Downtown	0.82
• Neighbourhood	0.60
Industrial	
• Light area	0.65
• Heavy area	0.75
Residential	
• Suburban	0.30
• Single - family	0.40
• Multi-units - detached	0.55
• Multi-units - attached	0.65
• Apartment dwelling area	0.60
Parks, cemeteries	0.15
Playgrounds	0.25
Unimproved areas	0.15

Runoff coefficients other than those specified in this section shall be used only with the express written consent of the Approving Officer.

For the design of sewer systems servicing areas greater than 10 hectares, hydrologic computer programs using hydrograph generation methodology shall be applied.

It is the responsibility of the Design Engineer to account for climate change considerations in accordance with the Professional Practice Guidelines provided by the Engineers and Geoscientists of British Columbia (EGBC).

Design Grade

The minimum design grade shall be calculated by use of the Manning Formula such that a minimum velocity of 0.6 m/s shall be maintained during the design flow.

Pipes shall be designed to carry the required quantity when flowing 3/4 full for pipes sized 450 mm and smaller. Pipes sized 525 mm or larger shall be sized to carry the required quantity when flowing full.

Roughness Coefficients

Roughness coefficients for use with the Manning's Formula shall be as specified in **Table F.3**.

TABLE F.3 – ROUGHNESS COEFFICIENTS

Pipe or Channel Material	Roughness Coefficient
Concrete Pipe	0.013
PVC Pipe	0.011
Corrugated Metal Pipe	
• Unpaved	0.024 - 0.033
• 25% paved	0.021 - 0.028
• 100% paved	0.013
Smooth Asphalt	0.012
Asphalt or Concrete Paving	0.014
Packed Clay	0.030
Light Turf	0.200
Dense Turf	0.350
Dense Shrubbery	0.400

Minimum velocity of pipes, flowing full, shall be 1.0 m/s.

There are no maximum allowable velocities except that the designer shall ensure that supercritical flow does not occur. Depending on the material and grade, erosion and scour protection may be needed, and anchor blocks will be required. These criteria may be modified by the Approving Officer to meet local conditions.

Minimum Pipe Size

Minimum pipe size shall be as specified in **Table F.4**.

TABLE F.4 – MINIMUM PIPE SIZES

Pipe Usage	Minimum Pipe Size (mm)
Mains	250
Catch Basin Leads	200
Residential Service Connections	100
Non-Residential Service Connections	150
Mains accepting flow from open ditches	400
• Suitable silt traps shall be provided.	

Culverts

Where an open ditch system is required to cross a road, street or driveway, the ditch shall be enclosed by means of a culvert. All culverts shall be of sufficient size to properly drain all of the area naturally draining into the channel or ditch feeding into the culvert but shall

be a minimum 400 mm diameter. Allowance shall be made for future flows as a result of full development of the upstream tributary area. The Owner shall ensure the culvert inlet and conveyance capacity can handle these flows and it should be documented in the design report. The Design Engineer shall provide calculations to outline the performance of the inlet and conveyance capacity of any proposed culverts.

Location of Storm Mains

Storm sewer mains shall, wherever possible, be located in the road right-of-way. Where the location of the sewer main within the road right-of-way is not practical due to topography or other factors, the storm sewer main shall be located in a utility right-of-way registered in favour of the Corporation of the Village of Valemount and having a width of not less than 6.0 metres. The Approving Officer may require a utility right-of-way wider than 6.0 metres in the case where services in addition to storm sewer will be placed in the same right-of-way or where the depth of the sewer main requires a wider easement. There shall be a minimum clear lateral distance between the outside walls of storm sewers and sanitary sewers of 0.75 m.

Alignment of Storm Mains

Storm sewer mains shall generally be designed to follow a straight alignment between manholes. Curved alignments within rights-of-way shall be subject to the approval of the Approving Officer and provided that the pipe is set at a grade greater than the specified minimum and pipe alignment is at a parallel offset with an established boundary. The minimum radius of curvature shall be at least twice the manufacturer's recommended minimum.

Depth of Cover

The minimum depth of storm sewer mains shall be sufficient to provide all service connection piping with a minimum cover of 1.5 m to the top of the service, anywhere within the finished right-of-way. In no instance shall the cover over the crown of the main be less than 1.5 m.

Manholes

Manholes shall be installed at a maximum spacing of 120 metres and in the following locations:

- All changes in grade;
- All changes in alignment, including non-curvilinear sewers;
- All changes in pipe size;
- All pipe junctions; and
- All intersections.

Where, in the opinion of the Approving Officer, the grades of sewer pipes are sufficient to provide proper cleaning, the maximum spacing of manholes may be increased to 150 metres.

The relative elevations of storm sewers entering and leaving a manhole are to be such as to ensure that the manhole does not substantially reduce the hydraulic capacity of the system. Minimum fall through the manhole shall be 30 mm.

There shall be no change in the grades of pipe between manholes.

Catchbasins

Catchbasins shall be constructed as shown on the Supplementary Detail Drawings SS-11A and SS-11B.

Catchbasins shall be located at a maximum spacing of 75 m along the drainage path, at all intersections, at all low points, or spaced at intervals such that not more than 10% of the gutter flow reaching each inlet will pass on to the next inlet downstream, provided this carry-over is not objectionable to pedestrian or vehicle traffic and the inlet is not in a sump. Catchbasins shall be located at intervals such that surface drainage does not exceed gutter or flow channel capacities, to eliminate overflow to driveways, boulevard, margins, sidewalks, or private property.

Catchbasin Leads

Catchbasin leads shall discharge into a manhole and not directly into the storm sewer pipe wherever possible.

Catch basin leads shall have a minimum cover of 0.7 m.

Service Connections

Storm sewer service connections shall only be used for foundation perimeter drains and roof drains unless otherwise approved by the Approving Officer.

The diameter of storm sewer service connections shall be determined by the Design Engineer, but shall be 100 mm diameter minimum for a single-family residential service and in no case shall a non-residential service connection be less than 150 mm.

Service connections shall be made with an approved branch wye and be installed in a straight line and at a uniform grade from the terminus at the property line to the 45-degree long radius bend at the main. An approved wye saddle may be used to connect a 100 mm diameter service to an existing main. The minimum pipe grade for sewer service pipes shall be:

- 2% for 100 mm service pipe; and
- 1% for 150 mm service pipe.

For services 150 mm and larger, a manhole shall be installed at the intersection of the main and service.

A cleanout shall be installed 300 mm from the property line on all services.

Pipe Class and Bedding Class

The quality of pipe and bedding shall be so selected such that the installation will adequately support the loads to be placed on it during construction and in operation. Pipe type/class and bedding class must be identified on all engineering drawings. Pipe shall have at least Class B bedding.

Design calculations shall be provided showing that the chosen pipe has the capacity to support the loads placed on it. The calculations are dependent on the pipe type and class and shall follow the current edition of industry standard design documents (for example, PVC pipe shall be designed in accordance with the Handbook of PVC Pipe – Design and Construction).

Major Flow Routing

All overland flows in excess of $0.05 \text{ m}^3/\text{s}$ shall have specifically designed flow routes, that are protected and preserved by restrictive covenants or rights-of-way. The major flow routing shall normally be provided along roads and in natural watercourses. In some cases, the major flow may also be carried alongside the road in grassed swales, across country in rights-of-way and along public walkways.

Where the road is used to accommodate major flow, it shall be formed, graded and sufficiently depressed below the surrounding property lines to provide adequate hydraulic capacity. On arterial roads, the 100-year hydraulic grade shall not be higher than centreline of the pavement with the maximum flow depth not to exceed 300 mm. On collector and local roads, the entire roadway may be used as a major flood path with the maximum flow depth not to exceed 300 mm.

Where roadways used for major flows intersect, care shall be taken to lower the intersection to allow flows to pass over the cross street. Where major flow routes turn at intersections, similar care in the road grading design is required.

In areas where surface major flow routes cannot be provided, a pipe system will be designed to accommodate the required major flow, and sufficient inlet capacity will be provided to accommodate introduction of the major flow into a piped system.

Major flow routing over $0.05 \text{ m}^3/\text{s}$ shall be shown on the engineering drawings and sufficient design shall be carried out to provide assurance to the Approving Officer that no property damage or endangering of public safety will occur under major flow conditions. The Design Engineer shall provide the Approving Officer with the depth of flow along the major flow route and shall show on the Design Drawings the hydraulic grade line above the design curb and gutter or above the finished surface of other drainage courses. The discharge point from the development for the major flow route shall be coordinated with the downstream routing to outfalls as determined by the Village of Valemount. Where major flow outfalls to a receiving watercourse, the velocity shall not exceed 1.5 m/s , or energy dissipaters shall be provided to minimize erosion.

The use of catchbasin inlet control devices to separate major and minor hydraulic grade lines may be allowed, subject to the satisfaction of the Approving Officer regarding the suitability

of such control devices. Where catchbasin inlet control devices are used, building elevations may be controlled by the hydraulic grade line occurring in the minor system.

MATERIALS

Execution - Master Municipal Construction Documents (MMCD)

The Village of Valemount is using the MMCD Specifications for the installation of drainage infrastructure. The specifications shall apply with the amendments outlined in:

- Appendix B – Supplementary Specifications
- Appendix C – Supplementary Detail Drawings
- Appendix D – Approved Products List

RECORD DRAWINGS

Prior to final acceptance, the Owner shall deposit with the Village, in AutoCAD and PDF format, one set of original record drawings showing all the information requested by this schedule and conforming to the criteria set out in Schedule H.