SCHEDULE B

REGULATIONS, STANDARDS, AND SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF HIGHWAYS

This is Schedule B of the Corporation of the Village of Valemount Subdivision and Development Servicing Bylaw No. 450, 1998.

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Clerk

SCHEDULE B

REGULATIONS, STANDARDS, AND SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF HIGHWAYS

1.0 GENERAL

Where the provisions of Schedule A of this Bylaw require the construction of roads, the Owner shall construct such roads in accordance with the regulations, standards and specifications set out in this Schedule.

1.01 Approval of Engineering Drawings Required Prior to Construction

Engineering drawings showing detailed design of roads shall be submitted to the Village Engineer for approval prior to commencement of construction. These drawings shall show existing groundline and proposed alignment and grade of the highways, horizontal and vertical curve information and all other details as may be required. Grades shall be given at all changes in vertical and horizontal alignments for centreline and gutter lines. Elevations shall be shown on the drawings at all changes in vertical alignments.

1.02 Classification of Highways

Prior to design of the road system, the Village Engineer shall classify each road proposed within the subdivision and stipulate the required standards in accordance with the provisions of this Bylaw.

1.03 Geotechnical Evaluation

In addition to the Geotechnical overview undertaken during the preliminary phase of the project the Owner shall engage the services of a qualified Geotechnical Engineer to investigate surface and sub-surface conditions within the proposed subdivision. The Geotechnical Engineer shall prepare a report outlining his findings and shall provide clear, definitive recommendations on the geometry and placement of fill sections, compaction requirements over and above those stipulated in this Bylaw, cut slope geometry, pavement structures for roads, and any other geotechnical issues affecting road construction within the proposed subdivision. A copy of the Geotechnical evaluation shall be submitted to the Approving Officer at the time the engineering drawings are submitted to the Approving Officer for approval.

2.0 DESIGN CRITERIA

2.01 General Design Requirements

In the preparation of engineering plans for highways, the Owner shall take into account the following general design considerations:

.1 Continuation of Existing Streets

The design and arrangement of highways within a subdivision shall provide for the continuation or projection of existing streets in the surrounding area. In no case shall the arrangement of highways within a proposed subdivision make impractical the subdivision of adjoining parcels; and

.2 Topography to be Taken into Account

The design and arrangement of highways shall be suited to the topography of the land proposed to be subdivided.

2.02 Consistency with Official Community Plan

The location, classification and standard of all highways proposed within a subdivision shall take into account the proposed use of the land and shall conform to the provisions of the Village of Valemount Official Community Plan.

2.03 Local Highways

Local highways within a proposed subdivision shall be arranged so that their use by through traffic will be discouraged.

2.04 Cul-de-Sacs

Cul-de-sac streets shall not exceed 150 metres in length measured from the intersection to the center of the bulb and shall be provided with an area designed to permit safe and adequate space for the turning of motor vehicles.

2.05 Lanes

Lanes, meeting the standards set out in this Bylaw, shall be provided where the Village Engineer deems them to be necessary.

2.06 Walkways and Fences

.1 Walkways shall be provided where the Village Engineer deems them to be necessary to provide access through a subdivision to schools, parks, playgrounds, commercial areas or other community facilities, or for the safe and efficient circulation of pedestrian traffic.

.2 Walkways shall be chain link fenced for their full length on both sides. The minimum height shall be 1.5 meters but may vary at the discretion of the Approving Officer according to individual situations and the height requirements of the Municipal Zoning Bylaw.

2.07 Driveways

.1 Single Family Residential Driveway:

.1 minimum driveway width shall be 3.0 metres;
.2 driveway widths (surfaced) in excess of 8.0 metres must be approved in writing by the Village Engineer;
.3 maximum driveway grade shall not exceed 12%;
.4 minimum driveway surface shall be compacted all weather gravel surface;
.5 surface water from driveway on private property must be contained on-site, unless otherwise approved in writing by the Village Engineer;
.6 driveway access roads must have a minimum of 9.0m centre line radius on all curves and corners along the road;
.7 turn around facilities are to be provided for any dead-end access driveway fronting an arterial roadway;
.8 the finished elevation of the driveway at the road property line shall not vary more than 150 mm from the elevation of the centreline of the existing road, unless otherwise approved in writing by the Village Engineer; and
.9 unless otherwise approved in writing by the Village Engineer only one driveway will be permitted into each lot.

.2 Reciprocal Access Driveway for a Maximum of Three (3) Single Family Residences:

.1 minimum driveway width shall be 6.0 metres;
.2 driveway widths (surfaced) in excess of 8.0 metres must be approved in writing by the Village Engineer;
.3 maximum driveway grade shall not exceed 12%;
.4 minimum driveway surface shall be hot mix asphaltic concrete with curb and gutter; and
.5 surface water from driveways on private property must be contained on-site, unless otherwise approved in writing by the Village Engineer.

.6 driveway access roads must have a minimum of 10.25m centreline radius on all curves and corners along the road;
.7 turn around facilities are to be provided for any dead-end access driveway;
.8 the finished elevation of the driveway at the road property line shall not vary more than 150 mm from the elevation of the centreline of the existing road, unless otherwise approved in writing by the Village Engineer; and
.9 unless otherwise approved in writing by the Village Engineer only one reciprocal access driveway will be permitted into clusters of single family residence.

.3 Multi-Family Driveways and All Other Driveways Not Noted in Clause 2.07.1 and 2.07.2 of Schedule B:

.1 driveways shall be in accordance with the requirements of clause 2.07.2 of Schedule B.

2.08 Highway Right-of-Way Requirements

.1 Highway rights-of-way widths shall be in accordance with Table A.1 of Schedule A.

.2 The tops of road cuts and the toes of road fills that are outside the highway right-of-way shall be identified and legally protected.

2.09 Intersections

Intersections shall be designed as follows:

.1 intersecting highways shall meet substantially at right angles (between 70 degrees and 110 degrees);
.2 jogs in highway alignment at intersections shall be avoided except where the distance between centrelines is sufficient to ensure traffic safety. The minimum spacing between the intersections along a street shall be 40 m;
.3 intersections having more than four intersecting legs shall not be permitted;
.4 intersections shall provide adequate crossing sight distances and stopping sight distances, whichever is greater; and
.5 a property line cutoff of 3.0 metres for local roads and 4.0 metres for collector and arterial roads shall be at all intersections.

2.10 Reverse Curves

If reverse curves are required in a highway alignment, the Village Engineer may require that they be separated by means of tangents of sufficient length to allow superelevation rotation.

2.11 Mail Boxes

Where required by Canada Post, the Owner shall construct a base for super mail boxes in the location specified by Canada Post and approved by the Village Engineer. The owner is referenced to Canada Post for location and design guidelines.

2.12 Street Names and Traffic Signs

Street name signs and traffic signs required as a result of constructing or improving streets shall be provided by the Village of Valemount at the expense of the Owner. Street names shall be assigned by the Village of Valemount.

2.13 Appurtenances

The Design Engineer shall detail on the design drawings the location of all proposed traffic islands, retaining walls, guardrails, and permanent barricades. These structures shall be designed in keeping with good engineering practices.

The design should show the location of all traffic signs, street signs, and other traffic control devices required to be placed in the road allowance.

Drawings must show all utility poles. The Design Engineer shall indicate those poles which require relocating prior to road construction, and shall confirm with the utility the feasibility of their relocation prior to design completion. For underground systems, design drawings shall show the location of underground wiring, and appurtenances including the connections to properties.

2.14 Vertical Alignment

The vertical alignment of a road shall be set so the grades of the driveway to adjacent properties shall be in accordance with clause 2.07 of Schedule B. The maximum grade of the driveway as it crosses the road boulevard will be 3 percent.

The minimum longitudinal gradient at the gutter line shall be 0.50% for all classifications of streets.

2.15 Design Speeds

The design speeds used for design of Highways shall be as in Table B.1.

TABLE B.1
DESIGN SPEED

Collector (C)	60 km/h
Local (L)	50 km/h

2.16 Road Crossfall

Minimum road crossfall shall be 2%.

2.17 Road Grades

Minimum and maximum road centreline grades shall conform to Table B.2 based on the classification of the road.

TABLE B.2
ROAD GRADES

Road Classification	Minimum Grade	Maximum Grade
Collector	0.5%	10%
Local	0.5%	10%
Cul-de-Sac (entry downhill)	0.5%	8%
Cul-de-Sac (entry uphill)	0.5%	10%
Cul-de-Sac (bulbs)	0.5%	6%
Lane	0.5%	8%
Walkway	0.5%	15%

Maximum grades are to be reduced by 1% for each (or part of each) 30 metres that the centreline radius is less than 150 m.

2.18 Vertical Curves

Vertical curves shall be designed to provide safe stopping sight distances. Minimum stopping sight distance is the least distance required to bring the vehicle to a stop under prevailing vehicle and climatic conditions. Vertical curves shall be provided at all grade changes greater than 1.0%. Vertical curve length is calculated by the equation L = KA where:

.1 L is the length of the vertical curve in metres;
.2 K is a constant related to lines and geometry of a parabolic curve; and
.3 A is the algebraic difference in grades in percent.

L shall not be less than the design speed in kilometres per hour.

Minimum K values (in metres) for vertical curve design shall be as described in Table B.3.

TABLE B.3
MINIMUM K VALUES FOR VERTICAL CURVE DESIGN

Road Classification	Crest Curve	Sag Curve	
	Minimum	Lighting	No Lighting
Collector	15	10	20
Local	7	6	11

2.19 Horizontal Alignment

Centre Line Radii

The minimum required centreline radius for various superelevation rates for each classification of roadways are described in Table B.4.

TABLE B.4
MINIMUM CENTRELINE RADIUS

Road Classification	Horizontal Curve Radii (m)			
	Superelevation (m/m)			
	None	0.02	0.04	0.06
Collector (60 kph design speed)	160	140	130	N/A
Local* (50 kph design speed)	95	N/A	N/A	N/A

** Radius may be reduced at the discretion of the Village Engineer*

2.20 Curb Return Radii

Curb return radii shall conform to the following and be based on the lesser classified Highway:

.1 Collector 11 m;

.2	Local	8.0 m;
.3	Cul-de-Sac	11.5 m; and
.4	Industrial	11 m.

2.21 Intersection Design

Unless indicated elsewhere herein, all intersection design standards shall conform to those outlined in the latest edition of "Geometric Design Standards for Canadian Roads and Streets" as published by the Transportation Association of Canada (TAC).

2.22 Intersection Grades

Approach grades for a crest curve of minor streets at intersections to major streets shall not exceed 75% of the maximum grade allowed for that street classification. The minor street shall be designed to intersect the major street with a vertical curve of minimum length required for that street classification. The vertical curve shall terminate at the projected curb line of the major street using K values as described in Table B.5.

TABLE B.5
INTERSECTION CURVES

Intersecting Street	Minimum K Value (in metres)	
	Crest Curve	Sag Curve
Collector	7	(1)
Local	4	(1)

(1) *Approach grades for a sag curve of minor streets at intersections to major streets shall be designed to provide a maximum gradient of 3% at a point 15 metres from the projected curb line of the major street.*

2.23 Pavement Structure

The pavement structure shall be designed in accordance with Manual Series MS-1 of the Asphalt Institute (1981 or most recent edition). The pavement structure shall be designed for a fifteen (15) year design life. Staged construction may be considered in the structural design by the Village Engineer when a road is to be constructed and to be widened at a later date.

Roads shall be classified as follows for purposes of structural design of the total pavement structure; design traffic values and minimum depths of hot mix asphalt shall be as described in Table B.6.

TABLE B.6
PAVEMENT STRUCTURE

Road Classification	Design Traffic (EAL'S)	Min. Depth of Hot Mix Asphalt (mm)
URBAN		
Collector	2.8×10^5	75
Industrial	5.6×10^5	75
Residential	2.8×10^4	50
RURAL		
Lanes	Not Applicable	50
Walkways	Not Applicable	50

(1) *To be specifically designed, based on projected equivalent axle loads (EAL's), in accordance with MS-1 of the Asphaltic Institute.*

Soils used to construct the roadway subgrade shall be evaluated in accordance with MS-1 (see Chapter V) to determine the load bearing capacity of the subgrade. For this purpose, the California Bearing Ratio (CBR) test value shall be obtained using soil moulded to the minimum specified compaction level. The design CBR values shall be determined in the soaked condition in accordance with ASTM Des D1883. This value shall be used for structural design purposes. The minimum compacted depth of crushed granular base course, in the total pavement structure, shall be 100 mm.

If the soaked CBR value of the subgrade soil is less than 3, subgrade enhancement shall be provided to create a soaked CBR of 3, and the pavement structure shall be designed using a soaked CBR of 3. Subgrade enhancement shall be provided by placement of an initial layer of granular sub-base of a thickness which has been calculated to provide the necessary structural improvement to the subgrade.

A minimum pavement structure for roads shall be provided, not withstanding the structural character of the subgrade. Minimum pavement structures shall be as described in Table B.7, and will be considered structurally adequate when the subgrade soil exhibits a minimum soaked CBR of 6.

TABLE B.7
MINIMUM PAVEMENT STRUCTURES

Road Classification	Sub-base (Pitrun) mm	Crushed Granular Base (mm)	Hot Mix Asphalt (mm)
URBAN			
Downtown/Frontage/ Commercial	450	80	80
Collector	400	100	75
Industrial	400	150	75
Local & Cul-de-Sac	300	75	50
Lanes	300	75	50
Walkways	200	75	50

The design of structural overlays of existing pavements shall be based on the analysis of the results of Benkelman beam tests and test hole information acquired from the existing road which is to be upgraded.

The Transportation Association of Canada procedure for designing structural design of overlays of existing pavements, as published in "The Pavement Management Guide", shall be used. The maximum permissible Benkelman beam deflections to be used for overlay design shall be as described in Table B.8.

TABLE B.8
MAXIMUM ROAD DEFLECTIONS

Road Classification	Maximum Permissible Deflection After Overlay
Downtown/Frontage/ Commercial	1.00 mm
Collector	1.25 mm
Industrial	(1)
Residential	1.50 mm

(1) *As specified by the Village Engineer.*

The structural design of pavements for roads shall be performed by a qualified pavement engineer. Structural designs of pavements shall be submitted to the Village Engineer in an acceptable report format.

Other payment evaluation systems may be considered upon consultation with the Village Engineer.

2.24 Highway Cross-Sections

The standard street cross-section for various classifications of roadways shall be as described in Table B.9 and the Standard Drawings.

TABLE B.9
HIGHWAY CROSS-SECTIONS

Road Classification	Typical Cross-Section (Dwg. Number)
URBAN	
Downtown Commercial	B-1
Frontage	B-2
Local Rural Road	B-3
Cul-De-Sac	B-4

3.0 MATERIALS

3.01 Roadway Embankment

Roadway embankment material shall be free of rock detrimental to proper compaction and free of organic or other deleterious matter.
Imported roadway embankment material shall conform to the gradation limits as described in Table B.10.

TABLE B.10
IMPORTED EMBANKMENT GRADATION LIMITS

USBC Sieve Size	Percent by Weight Passing
150 mm	100%
75 mm	74 - 100%
38 mm	56 - 100%
25 mm	46 - 94%
4.75 mm	20 - 70%
1.18 mm	10 - 52%
0.300 mm	2 - 26%
0.075mm	0 - 8%

3.02 Rock Fill

Rock, by definition, shall mean any material excepting hardpan or glacial till over 0.75 cu.m. in volume requiring continuous drilling and blasting. It shall mean masonry or concrete as well as natural boulders fitting this definition.

Rock fill shall be any material containing more than 15% by volume of rock larger than 150 mm diameter, to a maximum of 300 mm diameter.

It shall only be used in approved areas and by approved methods to provide maximum stability of the fill.

3.03 Granular Sub-base Course

Granular sub-base shall be well graded material within the following gradation limits when tested in accordance with ASTM C136 as described in Table B.11.

TABLE B.11
GRANULAR SUB-BASE GRADATION LIMITS

USBC Sieve Size	Percent by Weight Passing
75 mm	100%
25 mm	50 - 85%
0.150 mm	0 - 16%
0.075 mm	0 - 8%

3.04 Crushed Granular Base Course

Crushed base course shall be composed of inert, durable aggregate, reasonably uniform in quality, and free from soft or disintegrated pieces, wood wastes, roots, organic material or other deleterious materials. The gradation shall be within the following limits when tested to ASTM C-136 and C-117, using the designated sieve sizes, and to have a smooth curve without sharp breaks when plotted on a semi-log grading chart.

TABLE B.12
CRUSHED BASE GRADATION LIMITS

USBC Sieve Size	Percent by Weight Passing
25.00 mm	100%
19.00 mm	80 - 95%
9.50 mm	50 - 80%
4.75 mm	35 - 65%
2.36 mm	25 - 50%
1.18 mm	15 - 35%
0.300 mm	5 - 20%
0.075 mm	3 - 8%

A minimum of 60% of the material retained on a 4.75 mm sieve shall have at least two fractured faces as determined by particle count.

3.05 Crushed Granular Aggregate for Asphaltic Concrete

Crushed granular aggregate for asphaltic concrete shall be composed of hard, durable, crushed gravel free from shale, clay, silt balls, loose coatings and other deleterious materials.

The gradation of aggregates, when blended to meet the job mix formula shall be within the following limits when tested to ASTM C-136 and C-117, using the designated sieve sizes, and to have a smooth curve without sharp breaks when plotted on a semi-log grading chart as described in Table B.13 and Table B.14.

TABLE B.13
ASPHALTIC CONCRETE AGGREGATE GRADATION LIMITS

USBC Sieve Size	Arterial, Industrial and Collector Streets Percent Passing by Weight		Residential, Lanes, Walkways, Percent Passing By Weight
	Lower Course	Surface Course	
25 mm	100		
19 mm	85 - 95	100	
12.5 mm	65 - 85	85 - 95	100
9.5 mm		70 - 85	50 - 90
4.75 mm	40 - 65	50 - 65	45 - 80
2.36 mm		38 - 52	32 - 64
1.18 mm	20 - 38	28 - 42	24 - 51
0.600 mm		20 - 30	17 - 40
0.300 mm	10 - 20	12 - 20	13 - 29
0.150 mm	8 - 15	10 - 16	7 - 18
0.075 mm	3 - 8	3 - 7	3 - 8

A minimum of 60% of the material retained on a 4.75 mm sieve shall have at least two freshly fractured faces as determined by particle count.

TABLE B.14
ASPHALTIC CONCRETE AGGREGATE
GRADATION TOLERANCE LIMITS

Tolerance Limits (% Passing By Weight)[1]		
Max. Size To	4.75	5.0
	2.36	4.0
	1.18	4.0
	0.600	3.0
	0.300	3.0
	0.150	2.0
	0.075	1.5

(1) *The tolerance limits are in relation to the design aggregate gradation submitted with the Marshall mix design.*

Aggregate short of material passing the 0.075 mm sieve shall have approved mineral filler added. Mineral filler shall be material passing the 0.075 mm sieve and shall be non-plastic when tested in accordance with ASTM D424. The moisture content of the aggregate after leaving the drier and before mixing shall be not more than 0.5% by weight.

3.06 Tack Coat

Bituminous tack coat shall be undiluted SS-1H or SS-1 asphalt emulsion, and shall be applied at a rate not greater than 0.5 litres per square metre to a clean pavement surface, and provide for adequate curing time prior to placing asphalt paving mixtures. The temperature of the material shall be maintained between 30°C and 40°C at the time of application.

3.07 Asphalt Cement

TABLE B.15
TYPE OF ASPHALT

Requirements	Minimum	Maximum
Viscosity @ 60°Pa/s	5	5
Penetration @ 25°C	150-200	
% Ret. Pen. after T.F.O.T. @ 25°C - 100 g/5 s	55	
Solubility in Trichloroethylene %	99.0	
Flash Point, C.O.C. minimum °C	35	
Ductility at 25°C, 5 cm/min. - cm	100	
Water %		0.5

The asphalt cement shall be homogenous, free from water, and shall not foam when heated to 175°C.

3.08 Asphaltic Concrete

Asphaltic Concrete shall be as described in Table B.16.

TABLE B.16
ASPHALTIC CONCRETE DESIGN

Property	Arterial & Collector Streets		Residential
	Lower Course	Surface Course	Surface Course
Marshall blows per face	75	75	50
Marshall Stability @ 60°C, kN	10 min.	10 min.	8 min.
Marshall Flow, 0.25 mm units	8 - 14	8 - 14	8 - 15
Voids in Mineral Aggregate %	12.5 - 14.0	13.5 - 15.0	14.0 - 15.5
Air Voids in Mixture, % - at design A.C. - Allowable production range	 4.0 ± 0.2 3 - 5	 4.0 ± 0.2 3 - 5	 3.5 ± 0.3 3 - 5
Index of Retained Stability after water immersion for 24 hours @ 60°C	75% min.	75 % min.	75% min.

The Owner shall supply the Village Engineer with a current 5 point Marshall mix design, performed in accordance with ASTM D-1559, under the signature of a Professional Engineer. The design asphalt content shall be specified to comply with the requirements of this article.

The asphalt content of hot mix asphalt which is produced in accordance with the approved Marshall design shall be maintained within plus or minus 0.3% of the approved design asphalt content.

3.09 Chain Link Fence

All frames to be welded and covered with two coats of zinc rich paint. Each knuckle to be independently tied and set flush with the top rail. Dome tops to be riveted or welded to end posts. All galvanizing shall be minimum of 488 gm/M. All poles to be set in concrete. Material used for chain link fence construction shall conform to the following:

.1 fabric - 9 gauge (3.55 mm) galvanized 50 mm mesh;
.2 top rail - 42 mm O.D., 3.55 mm wall thickness, galvanized steel pipe;
.3 end & corner posts - 73 mm O.D., 5.15 mm wall thickness, galvanized steel pipe
.4 line posts - 48 mm O.D., 3.68 mm wall thickness galvanized steel pipe;
.5 gates - sizes as required. Frames 42 mm O.D., 3.55 mm wall thickness galvanized steel pipe;
.6 barbed arms - Galvanized malleable steel;
.7 tension wire - 6 gauge (4.50 mm) galvanized steel;
.8 tie wire - 9 gauge (3.55 mm) aluminium;
.9 tension bar - 4.76 mm x 19 mm galvanized steel; and
.10 dome tops - size as required. Galvanized malleable steel.

4.0 WORKMANSHIP

4.01 Notification of Village Engineer Prior to Undertaking Roadworks

Adequate notice shall be given to the Village Engineer by the Owner prior to the commencement of roadworks as described in Table B.17 The Owner shall not proceed from one stage as described in Table B.17 to another stage without the approval of the Village Engineer.

TABLE B.17
ROADWORKS

Stage	Minimum Notice Required
Prior to construction of fills and subgrade preparation	24 hours
Prior to placement of sub-base gravel	24 hours
Prior to placement of concrete for curbs and sidewalks	48 hours
Prior to placement of base course	24 hours
Prior to paving	96 hours
Prior to top soiling boulevards	24 hours

4.02 Clearing

The road right-of-way shall be cleared of all trees, stumps, logs, roots, and any other objectionable material likely to cause settlement for the full width of the highway, and for such additional width as may be required to contain cut and fill slopes. In addition, buildings, fences, superfluous culverts, or any other structures within the highway shall also be removed. Trees may be left within the highway only where they do not conflict with utility services and where they are not deemed a hazard at the discretion of the Village Engineer.

4.03 Roadway Excavation and Embankment

Prior to placing of any granular aggregate on the highway, all existing topsoil or other deleterious matter shall be removed from the full width of the road right-of-way and the road surface graded to the desired cross-section.

Embankments shall be constructed by placing, shaping and compacting approved materials as classified in this Bylaw. All material placed in embankments shall be bladed smooth in level layers not exceeding 300 mm uncompacted depth over the entire embankment area and placed in successive uniform layers.

When embankments are to be made on hillsides or where a new fill is to be applied upon an existing embankment, the slopes of the original ground or embankment (except rock embankments) shall be terraced or stepped before filling is commenced.

Each layer shall be compacted with approved equipment to 95% Standard Proctor Density.

Sufficient amounts of watering and compaction equipment required to efficiently and properly compact the material for the rate at which the material is being hauled into the embankment area shall be provided.

The embankment shall be constructed to provide adequate drainage. Should the embankment material become damaged or saturated by rain, flooding, or other effects, repair, scarification, or whatever other measures required to restore the embankment to the moisture and compaction requirements of this Bylaw shall be undertaken

Unsuitable materials encountered in the excavation areas, or at the subgrade elevation, shall be excavated, and wasted.

Over excavations shall be rebuilt to grade with an approved compacted material and compacted to the satisfaction of the Engineer.

At transition sections where the profile grade changes from embankment to cut, the natural slope (excepting solid rock) shall be excavated to a depth of 1 meter and replaced with suitable material for a distance of 15 meters in order to prevent abrupt future differential grade changes.

4.04 Subgrade Preparation

Prior to placement of the granular sub-base, the upper 300 mm of the subgrade shall be compacted to 100% of Standard Proctor density. Subgrade preparation shall extend a minimum of 600 mm out from back of curb or sidewalk on either side of the road.

4.05 Proof Rolling

Upon completion of the subgrade preparation, the subgrade shall be proof rolled in the presence of the Village Engineer with a loaded single axle truck with a rear axle load of 8165 kg.

Any areas found to be soft or wet shall be excavated and backfilled with select granular sub-base, or imported granular roadway embankment, and compacted to 100% Standard Proctor density.

4.06 Spreading and Compaction of Granular Sub-Base and Base Gravels

Granular sub-base and base gravels shall be placed in maximum 150 mm lifts and shall be spread in an approved manner such that the aggregate is neither segregated nor contaminated with foreign material. Segregated materials shall be remixed until uniform. Immediately following spreading, granular aggregate shall be compacted to 100% Standard Proctor density. The finished surfaces shall be within +/- 15 mm of the design grade and cross-section.

4.07 General Paving Requirements

Paving shall not be undertaken during snow, heavy rain, temperatures below 5 degrees C or other unsuitable conditions. Asphaltic concrete shall not be placed on a frozen, muddy or rutted base. Asphaltic concrete shall be constructed in lifts of compacted thickness as described in Table B.18.

TABLE B.18
MAXIMUM ASPHALTIC CONCRETE LIFT THICKNESS

Mix type	Permissible Compacted Lift Thickness (mm)	
	Minimum	Maximum
Lower course	50	100
Surface Course	40	75

4.08 Placing and Compacting Asphaltic Concrete

Surfaces onto which bituminous concrete pavement is placed shall be dry, above 4 degrees C and cleaned of all loose and foreign materials. Mixtures shall not normally be laid when the atmospheric temperature is less than 4 degrees C and falling. An approved self-propelled mechanical paver shall be used to spread the mixture to the specified thickness. Compaction shall commence immediately after the bearing capacity of the course is adequate to support the compaction equipment without undesirable displacement or cracking. Compaction methods shall be carried out as specified in the Asphalt Paving Manual published by the Asphalt Institute.

4.09 Density of Completed Asphaltic Concrete Pavement

The minimum allowable density of the completed pavement shall be not less than 97% of the laboratory compacted Marshall density.

Flaws in the pavement surface shall be corrected by removal of the complete area and the full lift involved. Pavement which is unsatisfactory in the opinion of the Village Engineer by reason of faulty materials or methods of placement shall be repaired, removed, replaced or otherwise corrected.

4.10 Tie-Ins to Existing Pavement

Tie-ins to existing pavement shall be made by cutting back the existing pavement to sound material as necessary to produce a neat, vertical face with a straight edge. Prior to placing asphaltic concrete, exposed faces and other abutting structures shall be painted with liquid asphalt and heated to 66 degrees C.

4.11 Restoration of Improvements

Driveways, retaining walls, vegetation and other private or municipal improvements on private or municipal property or highways affected by the road construction shall be restored at minimum to the condition existing prior to construction and to the satisfaction of the Village Engineer.

4.12 Materials Testing

The Owner shall retain an independent materials testing firm to carry out comprehensive testing to frequencies defined below, for each stage of construction of roads and streets. The materials testing firm must employ a full time, qualified professional engineer within the office from which the testing services are provided and he shall review all test data. The owner shall provide a copy of all test data in summary form to the Village Engineer prior to applying for final approval. Testing will be performed at the following minimum frequencies:

1. <u>For Roadwork embankment and subgrade construction:</u>

   .1 Moisture - density relationship (Standard Proctor) - ASTM D698; - one test for each soil type incorporated; and

   .2 Moisture and density tests:

      .1 roadwork embankment - one test per lift per 500 square metres of road; and
      .2 road subgrade preparations - one test per 500 square metres of road.

.2 For Trench Backfill:

.1 One test per lift per 120 lineal metres of trench.

.3 For Sub-Base and Base Course Construction:

.1 Gradation analysis - one test per 1000 m^3 or 2200 tonnes of material delivered to the site with a minimum of 1 test per day of placement;

.2 Moisture - density relationship (Standard Proctor) - ASTM D698; - one test per class of material for each 1000 m^3, or 2200 tonnes delivered to site; and

.3 Compaction testing - one test per 500 square metres of road per lift, to include dry density and moisture content;

.4 For Hot Mix Asphalt Pavement Production and Placement:

.1 Asphalt content and gradation of extracted aggregate - one test per production period, where a production period is defined as that part of the working day either before or after 12:00 Noon local time. In a full working day, the times of test shall be not less than two hours apart;

.2 Marshall analysis of hot mix asphalt - one per work week per mix type; additional tests shall be performed when any of the specified Marshall properties are not met in the initial analysis;

.3 Asphalt cement tests - one complete analysis per project or one every two work weeks, whichever is the lesser in timing; plus one penetration (ASTM D5) test per work week from product obtained from the Contractor's asphalt cement storage tanks;

.4 Density, air voids and pavement thickness tests - 1 core (100 mm dia.) per 500 m^2 of paved area per lift. Air void tests shall be performed in accordance with ASTM D3203; and

.5 Tests on tack coat products - one test per product per project.

The Village shall be provided with copies of all sieve and compaction test results pertaining to subgrade, granular base, granular sub-base and pavement structure.

4.13 As Constructed Drawings

Prior to final acceptance, the Owner shall deposit with the Village one computer diskette (3½" floppy) in AutoCAD (latest release) format and one set of original as constructed mylar drawings showing all the information requested by this schedule and conforming to the criteria set out in Schedule I.