SCHEDULE F

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

This is Schedule F of the City of
Vernon Subdivision and Development
Servicing Bylaw No. 3843, 1992

"Margaret Bailey"
City Clerk

SCHEDULE F – BYLAW NO. 3843

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

1.00 GENERAL DESIGN

1.01 Standards of Specifications of This Schedule Apply To All Drainage Works

The City of Vernon's approach to stormwater management is to proactively manage all storm events that occur in any given year in a more natural manner. The objective is to limit reliance on piped systems, control runoff at the source and have the developing lands mimic a natural, pervious watershed as much as possible.

All development is to provide drainage system design based on the Best Management Practices (BMPs). This includes all aspects of site design including: site coverage; grading; material usage as well as drainage system methods. All reasonable effort must be made to dispose of minor storm event flows onsite, minimize the reliance on offsite systems and not degrade water quality to receiving waters, consistent with the City's Liquid Waste Management Plan, Appendix D.

Presence of an existing drainage system downstream of proposed works does not mean or imply that adequate capacity exists to receive the development's design flows. Use of, discharge to, or addition to an existing system is contingent upon confirmation of capacity of the downstream works in that system to receive the additional flows.

Lot grading shall be in accordance with Section 4.03 of this Bylaw to ensure proper functioning of the drainage system. Where removal or deposit of soil is required to comply with the accepted lot grading plan, the Owner shall comply with provisions of the Soil Removal and Deposition Bylaw No. 5259, as amended.

Design flows adding to existing drainage facilities and for proposed new drainage facilities in Development District 3 and the parts of Development District 2 where no or limited drainage facilities exist, shall be computed by the design engineer. Anticipated flows shall be on the basis of post-development upstream flows based on the highest land use as per the OCP in the catchment area(s) and submitted to the City Engineer for review and acceptance. Pre development condition flow shall mean the cumulative effect of the flows from undeveloped areas, based on an assumed grassland condition and the flow from existing developed areas. For the purpose of these calculations, existing developed areas with properly operating drainage systems shall be considered as undeveloped areas.

Roof and surface drainage is to be dealt with utilizing Performance Targets identified in Section 1.04. The City Engineer will only permit connection to an existing storm system for drainage other than perimeter drainage where excess capacity in the existing system is known to exist.

No natural drainage course shall be altered or diverted unless such alteration or diversion has been approved by the City Engineer and all other governing authorities. Where a property is traversed by a watercourse, drainage path or stream, a statutory-right-of-way registered on title in favor of the City shall be provided along such, or its planned re-alignment.

All drainage designs must conform to the applicable federal, provincial and municipal statutes, bylaws, regulations and guidelines. Where drainage works are affected or required the Applicant shall design and construct such works consistent with the drawings, regulations, standards and specifications set out in this bylaw and the Master Municipal Construction Documents (MMCD).

The regulations, drawings, standards and specifications and MMCD shall govern and take precedence in the following order:

1) Bylaw regulations, standards and specifications
2) Bylaw Standard Drawings
3) MMCD
4) Applicable Basin Studies endorsed by the City Engineer
5) Stormwater Management Policies and Design Manual (1999)
6) Master Drainage Plan (as updated from time to time)

The decisions of the City Engineer shall be final and binding on all parties. The decisions of the City Engineer do not release any parties from their legal obligations regarding any acts, laws or regulations.

1.01 Stormwater Management Objectives

1. To manage development to maintain stormwater characteristics that emulate the pre-development natural watershed.

2. To envisage potential cumulative stormwater impacts of development and plan for works based on integrating this information with other economic, land use and sustainability objectives and policies when considering land use change.

1.02 Mean Annual Rainfall

A key parameter for describing the rainfall spectrum is defining the size of the Mean Annual Rainfall (MAR), the rainfall event that occurs once per year on average. Based on data collected from local rainfall stations in Vernon, the MAR is set at 20mm of rainfall in 24 hours.

The following rainfall tiers are the building blocks of an integrated strategy for managing the complete spectrum of rainfall events identified in the Performance Targets:

- Tier A Events – The small rainfall events that are less than half the size of a MAR. Approximately 80% of all rainfall events are Tier A events. In the City of Vernon, Tier A events are up to 10mm of rain in 24 hours.

- Tier B Events – The intermediate rainfall events that are greater than half the size of a MAR, but smaller than a MAR. Approximately 20% of all rainfall events are Tier B events.

- Tier C Events – The extreme rainfall events exceeding a MAR. An extreme event may or may not occur in any given year.

1.03 Performance Targets

Vernon's stormwater management approach is to manage the complete spectrum of rainfall events identified in Section 1.03. All new development projects in the City of Vernon must incorporate stormwater management systems that address the following Performance Targets:

- [1]**Rainfall Capture (Retain)** – The small rainfall events (Tier A Events) are to be captured and infiltrated or reused at the source. Capture the first 10mm of rainfall per day over the [2]impervious area of the site ($100m^3$ per [2]impervious hectare per day) and restore it to natural hydrologic pathways through infiltration, evapotranspiration, rainwater reuse or some other acceptable means based on site conditions. Where a geotechnical engineer has confirmed that site conditions limit the ability to reach this Performance Target and where all other methods of source control to attain this target are not possible, excess flows may be dealt with using Runoff Control, subject to this not negatively impacting the downstream system and acceptance of this by the City Engineer as a viable alternative.

- [1]**Runoff Control (Detain)** – The intermediate events (Tier B Events) are to be detained and released to watercourses or drainage systems at a controlled rate. Detain the next 10mm of rainfall per day over the [2]impervious area of the site ($100m^3$ per [2]impervious hectare per day) and release to drainage systems at controlled rates mimicking natural flow rate. Release rates are not to exceed the 2 year pre development grassland condition (c=0.2) flow rates using the area of the entire site in the Rational Method calculation.

- **Flood Risk Management (Convey)** – The extreme events are to be safely conveyed to downstream watercourses without causing damage to property. Ensure that the stormwater plan can safely convey storms greater than 20mm of rainfall per day (Tier C Event) up to and including the 100-year rainfall event.

[1]In Development District 1 and infill development in other Districts, where site conditions restricts the ability to incorporate the capture and or control performance targets and all other source control methods have been determined as not feasible, *the minimum acceptable standard is to reduce the 5 year post development flows to be released into the storm system at the 2 year pre development (grassland condition c=0.2) flow rate for the entire site*. The detention facility will be required to have

provision of an overflow and clear overland flow route to a City road or other recognized major drainage route to convey the 100 year event.

[2]All roofs and driveways are to be used in calculating the impervious area of a site. If green roofs or pervious paving is used for parking and driveways, that area may be subtracted from the total impervious area.

2.00 DESIGN CRITERIA

2.01 Sizing of Systems

Systems shall be designed using volumes based off the Mean Annual Rainfall event and Performance Targets as stated in Section 1.04. The Rational Method can be used to generate conservative peak flow estimates for the design of conveyance systems for areas 10 hectares and smaller.

Rational Method Formula
Q = CIA/360 shall be used where:

Q = Flow in m^3/s
C = Runoff coefficient (dimensionless)
I = Rainfall intensity in mm/hr
A = Runoff area in hectares

Rainfall intensities shall be as shown on Standard Drawings No. 500-1 or calculated according to the following equation:

$I = A_c \times (T + T_0)^B$ where:

I = the precipitation intensity rate in mm/hr
T = the time in hours
A_c, B and ~~B~~T_0 are dimensionless coefficients for each return period in years

Table F.1

RAINFALL FREQUENCY	A_C	B	T_0
2 Year Storm	9.4	-0.661	0.000
5 Year Storm	13.1	-0.704	0.009
10 Year Storm	16.5	-0.750	0.026
100 Year Storm	35.1	-0.941	0.120

The time of concentration, or inlet time, will vary with topography and the nature of the drainage areas, but will be ten minutes or greater for residential areas. Inlet times shall be determined by the developer's engineer and must be accepted by the City Engineer.

Runoff coefficients for storm sewer design shall be assumed to be not less than the values given in table F.2.

Table F.2

DESCRIPTION OF AREA		RUNOFF COEFFICIENT	
		Minor	Major
Commercial		0.85	0.90
Residential	Single Family	0.40	0.50
	Multi-units, Detached	0.50	0.60
	Multi-units, Attached	0.60	0.70
Apartment		0.75	0.80
Industrial		0.75	0.80
Open areas, parks and natural areas		0.20	0.25
Asphalt streets, driveways, roofs,		0.85	0.95

Runoff coefficients other than those specified in Table F.2 shall be used only with the express written consent of the City Engineer.

In a case of applying the Rational Method to a mixed land use in a drainage area, a weighted average C value should be used and can be calculated from the following formula:

$C_{average} = \sum A_i C_i / A$ where:

A_i = The area correlated to that C_i
C_i = The coefficient correlated to that A_i
A = The total area

For tributary areas greater than 10 hectares, computer modelling shall be used by the developer's engineer to calculate storm flows. The model software being used must be up to date and accepted by the City Engineer.

2.02 Hydraulic Design

The minimum design grade shall be calculated by use of the Manning Formula.

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

The following roughness coefficients should be used, in the absence of a value the City Engineer is to be consulted:

Pipe

Concrete pipe	0.013
Smooth Walled PVC pipe	0.010
Corrugated Metal Pipe	
Unpaved	0.024 - 0.33
25% Paved	0021 - 0.028
100% Paved	0.013

(Note: Use manufacturers values for HDPE and helical pipe)

Overland Flow

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 1.0m per second. The designer shall ensure that supercritical flow does not occur. Where grades exceed 15%, scour protection is to be provided and anchor blocks will be required as determined by the developers engineer and accepted by the City Engineer. This criteria shall be modified to meet local conditions and special requirements where necessary.

Connection to existing storm systems for development is subject to confirmation of the hydraulic grade line of major storm events at the connection location and provision of acceptable methods onsite to address any potential for surcharge from the main.

2.03 Minimum Pipe Grades

As per Schedule E- Section 2.02 with the exception of catch basin leads which are to have a minimum grade of 1.0%.

2.04 Minimum Pipe Size

The minimum pipe diameter shall be 250mm for mains, 150mm for services and 200mm for catch basins leads. The minimum pipe diameter for mains accepting flows from open ditches shall be. The minimum pipe diameter for culverts shall be 400mm in residential areas and 500mm in all other areas.

2.05 Manholes

Minimum manhole diameter is relative to pipe size and is defined in MMCD Standard Drawing S1. All manholes must have safety steps for access as shown in MMCD Standard Drawing S1. Manholes located where the pipe grade in the downstream pipe is less than that of the upstream pipe by 10% or greater must have grated manhole covers and rims secured to the manhole cover. Vehicle access for maintenance must be provided to all manholes. A paved apron of not less than 1.0m outside of the frame and cover is required for all manholes not in a paved or concreted surface.

The developers engineer must consider hydraulic losses in manholes in the design and construction of drainage works to ensure manholes do not cause a loss in hydraulic capacity. The hydraulic drop through a manhole must be representative of the pipe grades and hydraulic conditions and shall be no less than a 30mm drop where the inlet pipe is at 180 degrees to the outlet pipe and a minimum drop of 60mm for all other conditions.

2.06 Ditches

In rural areas, where no enclosed storm sewer system is required, drainage shall be by means of open ditches located along the outer edge of the gravel shoulders. The invert of ditches in all cases shall be lower than the sub-grade level, and shall be constructed as part of the sub- grade preparation. The hydraulic and structural design, details and construction of ditches, channels and culverts, as well as erosion protection measures shall be to the satisfaction of the City Engineer. Erosion protection measures are required for all ditches.

2.07 Inlets/Headwalls

All major inlet/outlet structures shall include grates over their openings to restrict access and entry as shown in MMCD Standard Drawing S13. Fencing and/or no-post guard rails shall be provided to reduce the hazard of headwalls and wingwalls to the public and motor vehicles as shown in MMCD Standard Drawing S13.

Headwall inlets from ditches into the municipal system are to include a sump a minimum of 200mm deep, as wide as the ditch and twice as long as the width of the ditch. The City Engineer may accept that this requirement be omitted if the developer's engineer verifies that the hydraulics of the design flow will cause flooding which cannot be reasonably mitigated. Sandbag headwalls as a minimum are required in rural roads for culvert crossings.

2.08 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 and include suitable silt traps. Allowance shall be made for increasing runoff due to paving and other land development anticipated. All culverts are to be

constructed with headwalls to the satisfaction of the City Engineer. Culvert installation must ensure no deflection of the road surface.

2.09 Location of Storm Sewers

As per Schedule E, Section 2.08.

2.10 Statutory Right-Of-Ways

As per Schedule E, Section 2.09 for piped systems and not less than 10.0m wide on either side of a watercourse or stream from the high water mark or 3.0m wide for surface drainage routes.

2.11 Alignment of Storm Sewers

As per Schedule E, Section 2.10.

2.12 Depth of Main

As per Schedule E, Section 2.04 with the exception that cover over concrete mains 750mm in diameter or larger may be reduced to 1.0m where depth of minor storm event flows in those mains does not exceed 0.3m and installation methods will not result in deflection of the road surface. The minimum depth of the main 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.

2.13 Manhole Spacing

As per Schedule E, Section 2.05 with the exception that the maximum distance between storm sewer manholes shall be 120 m.

2.14 Catch Basin Spacing

Catch basins shall be located as follows:

Road grades less or equal to 3% - at a maximum spacing of 150 m in the drainage path with a maximum tributary area not to exceed 675 m^2 per catch basin.

Road grades greater than 3% - at a maximum spacing of 100 m in the drainage path with a maximum tributary area not to exceed 450 m^2 per catch basin.

Catch basins shall be located at all low points, or spaced at intervals such that not more than 10% of the gutter flow resulting from Tier B events 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.

Catch basins shall be located at intervals such that surface drainage does not exceed gutter or flow channel capacities and so as to eliminate overflow to driveways, boulevard, margins, sidewalks, or private property.

Catch basins shall be located at all intersections in such a manner to minimize interference with crosswalks and where possible shall be located upstream of the crosswalk at the EC or BC.

Side inlet catch basins shall be provided at sags in road grades and in downhill cul-de-sacs as well as where road grades are in excess of 5%.

2.15 Catch Basin Leads

Catch basin 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 0.9m. Cover may be reduced to 0.6m where non-flexible pipe, accepted by the City Engineer is used.

2.16 Service Connections

The diameter of storm sewer service connections shall be determined by the developers engineer and be accepted by the City Engineer. The minimum pipe size shall be 150 mm for residential and non-residential service connections.

The minimum grades for 150 mm diameter storm sewer service pipes shall be determined by the developers engineer but may not be less than 1%.

All services are to include an inspection chamber at or near the property line complete with a backflow prevention.

Service connection for foundation perimeter drains for buildings are required as per the BC Building Code. Connection of roof leaders to the storm service is only permitted where required by site specific soil conditions as verified by a geotechnical engineer. When roof leaders are connected to storm mains, detention with controlled release rates will be required to achieve the Performance Targets set out in Section 1.04.

2.17 Pipe Class and Bedding Class

Pipe class and bedding class must be identified on all engineering drawings. Pipe shall have at least Class B bedding, as defined by Standard Drawings No. 400-8.

2.18 Major Flow Routing

All major event overland flows shall have specifically designed flow routes that are protected and preserved by restrictive covenants, easements 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, and across country in a right-of-way.

In special circumstances, or where desired to enable lower building elevations, the pipes and culverts, which form a part of the minor system, may be enlarged or supplemented to accommodate the major flow. All habitable areas of buildings shall be above the major flow hydraulic grade line, except where specific flood prevention measures have been taken.

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 shall be shown on the engineering drawings and sufficient design shall be carried out to provide assurance to the City Engineer that no serious property damage or endangering of public safety will occur under major flow conditions. The discharge point from the development for the major flow route~~,~~ shall be coordinated with the downstream routing to outfalls as determined by the City of Vernon. 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.

2.19 Soil Infiltration

In order to meet the Performance Targets set out in Section 1.04, onsite retention is likely required. The objective is to retain at least 10mm of rainfall in 24 hours of the impervious area of the site ($100m^3$ per impervious hectare per day). Every infiltration system will require a report from a Geotechnical Engineer confirming site conditions are acceptable for an onsite infiltration system and design of a system based on the conditions which that can achieve the Performance Targets The report is to include:

1. Hydraulic Conductivity of the soil;
2. The surface area required to achieve onsite infiltration identified in Performance Target Section 1.04;
3. Highest annual ground water level (either recorded and/or estimated based on historical data and site investigation);
4. A copy of the maintenance manual that will be given to the property owner;
5. Expected service life of infiltration system.

The system design must include:

1. Minimum overflow elevation from the system to surface to ensure flooding of any buildings or habitable space will not result; that no erosion will result from overflow events; that the flows do not compromise the capacity of existing downstream storm systems; and a major flow route is provided;
2. Detailed construction and operational and maintenance requirements;
3. Proposed pretreatment (required if system is to collect other than roof drainage and there are known domestic supply wells in the area or adjacent watercourses). Pretreatment (must meet water use by aquatic life as defined by British Columbia Approved Water Quality Guidelines (Criteria), as amended;

2.20 Oil and Grit Separators

Required for all Commercial, Industrial and High Density Residential sites. Devices used must be consistent with site conditions. Devices may be swirl concentrator or equivalent, including proprietary systems such as Stormceptors and Vortechs or an engineered solution. Design details to be provided by supplier of proprietary system or designer of equivalent. Located onsite at furthest downstream section unless otherwise approved by the City Engineer. Discharge must meet water use by aquatic life as defined by British Columbia Approved Water Quality Guidelines Criteria, as amended.

2.21 Oil / Water Separators

Required for gas stations, vehicle service areas and storage areas for highway vehicles and construction equipment. Coalescing plate separator or equivalent required. Design details in accordance with current technologies as outlined in Urban Runoff Quality Control Guidelines for British Columbia, and related documents. Located onsite at furthest downstream section unless otherwise approved by the City Engineer. Discharge must meet water use by aquatic life as defined by British Columbia Approved Water Quality Guidelines Criteria, as amended.

2.22 Best Management Practices

Storm water Best Management Practices (BMPs) shall be incorporated where applicable to improve the quality of storm water runoff from the developed properties and to meet the Performance Targets set out in Section 1.04 and in accordance with Provincial and Federal objectives and guidelines.

On-site Storm Water Best Management Practices

Site adaptive planning is to be utilized for all development to reduce impervious surface area. Roof leaders are to be directed to a splash pad and dispersed onsite, or captured in a soil infiltration system to achieve the Performance Targets set out in Section 1.04 of this Schedule. Source controls are to be used to maximize infiltration and evapotranspiration based on site specific soil conditions and exposure. Absorbent landscaping, subsurface infiltration facilities (rain gardens and soak away pits), pervious hard surfaces etc shall be provided to maximize retention and infiltration of rainwater on the

property. Use of a rain barrel and or absorbent landscaping prior to entering a lawn basin is encouraged. The depth of topsoil recommended to maximize onsite retention shall conform to the following criteria:

a. Soil depth for lawns = Minimum 150mm
b. Soil depth for trees and shrubs = Minimum 450 mm radius out from root ball

3.00 MATERIALS

Materials shall meet the MMCD standards and standards specified in Schedule E - Sanitary Sewers, except as modified herein.

3.01 Pipe

The following pipe material conforming to the appropriate specifications are acceptable for storm sewers:

- reinforced concrete pipe conforming to ASTM C76. Pipe strength (Class III min.) shall be specified for the trench conditions under which the pipe will be installed and operated;

- polyvinylchloride (PVC) pipe either smooth wall or ribbed profile with smooth internal wall, consideration will be given to the installation of perforated pipe where a geotechnical engineer demonstrates it is feasible on pipe grades less than 1%, water table is at least 1 meter below the pipe, adequate soils are proven and where pre-treatment has been provided to the satisfaction of the City Engineer;

- CSP (culverts only) galvanized corrugated steel pipe designed to carry H-20 loading in accordance with AASHTO.

- HDPE (culverts only) as per MMCD Section 33 42 13

3.02 Manholes

Frame and cover to be Dobney C-18 or approved equal marked City of Vernon. Manhole bases and sections to include gaskets with no internal parging except as required for the frame and cover and as necessary in the benching or where directed by the Developers Engineer and accepted by the City Engineer. All manhole bases are to be pre-cast except where approved by the City Engineer. All pre-cast bases are to include a minimum of one length of pipe stubbed out from the manhole for future mains. All pre-cast bases to include a knockout for future connections where connections are not designed or expected but can be reasonably anticipated with future development or zoning.

3.03 Pipe and Fitting Joints

Where root infiltration is prevented and site soil conditions are verified by a geotechnical professional to be acceptable storm sewer mains may be installed as perforated pipes without grouting to facilitate infiltration of ground water or exfiltration to groundwater subject to acceptance by the City Engineer.

3.04 Catch Basins

Catch basin frame and grate to be Dobney B23 and B24 or approved equal. Rollover curb catch basin frame and grate to be Dobney TK-7 or approved equal.

4.0 Submission Requirements

4.01 Stormwater Control Plan

Subdivision and Development Permit applications of unserviced lands, beyond the existing City drainage system are required to submit a Stormwater Control Plan (SWCP) that describes in detail how the proposed development will impact the existing drainage system and how the proposed retention, detention and conveyance drainage infrastructure meets the City's Stormwater Management Objectives and Performance Targets. The SWCP should include:

a. Tributary areas in the catchment including existing and ultimate land-use;
b. Existing and future OCP ultimate land use anticipated flows;
c. The development area within the drainage catchment including all features such as roads, natural watercourses, watercourse crossing structures, and low or poorly drained areas;
d. Contour plan with 1.0m elevation interval at a scale sufficient to show development area and surrounding area;
e. Areas of major cut or fill (greater than 1.0m);
f. Plan view of existing and proposed drainage systems;
g. Calculated Tier A, Tier B and Tier C volumes;
h. Major and minor conveyance capacity;
i. Hydraulic considerations – surcharged system impact. A profile of the 100 year HGL against MBE's is required;
j. Identified undersized infrastructure downstream;
k. Major system (1:100 year) flow routing internal and external to the development, including the direction of surface flows on roadways, other right-of-ways, and all surface flow routes; areas subject to ponding and depths of ponding; elevations of overflow points from local depressions; and details of channel cross sections. Where significant major system flows are expected to discharge or overflow to a watercourse, ravine, environmental reserve area, etc., the rate and projected frequency of such flows to be noted;
l. Outfall capacity constraints including storm sewers and natural watercourses;

m. Control of discharges to meet downstream conditions such as prevention of erosion and flooding;
n. Location and sizes of retention and detention facilities including summary of design flows, volumes, and control orifice sizing;
o. Show the HGL in the detention facility and account for potential backwater effects in the design of sewers draining into it;
p. Details of specialized drainage structures, if present and maintenance manuals or procedures.

4.02 Erosion and Sediment Control Plan

All development involving earth movement must provide Erosion and Sedimentation Control (ESC) measures. Erosion controls must be in place to prevent or minimize erosion and the creation of sediment. Sediment controls must be in place to prevent or minimize displacement of soil from a project site or any other land disturbance activity. ESC systems are required to include measures, as necessary, that minimize the potential for suspended solids in site runoff, including during storm events. Recommended limits for Total Suspended Solids (TSS) are contained within: *The Land Development Guidelines for the Protection of Aquatic Habitat, Department of Fisheries and Oceans (1993)* *http://www.dfo-mpo.gc.ca/Library/165353.pdf*.This document also details methods of control which may be referenced, where applicable to site specific conditions and controls proposed.

An ESC plan shall be provided for all Subdivision and Development Permit applications as specified in Soil Removal and Deposition Bylaw #5259 as amended. An ESC plan is not required for low density residential home or building construction however measures must be taken to prevent or minimize erosion onsite and deal with any sedimentation that occurs. The ESC plan is to be prepared by a qualified professional and address the following key issues:

a. Existing terrain, site and disturbed soil conditions;
b. Scheduling of works to address seasonal factors and minimize potential for erosion;
c. Retention of existing vegetation;
d. Vegetation or other means to protect stripped areas;
e. Diversion of runoff away from stripped areas;
f. Retention of sediment onsite with control structures suited to the soil types;
g. Inspection and maintenance requirements.

The ESC plan and drawing(s) shall provide the following minimum information:

a. Limits of clearing and grading and mechanisms to enforce, control and phase this;
b. Existing contours of the site at an interval sufficient to determine existing drainage patterns;
c. Final contours if the existing contours are significantly changed;
d. Final drainage patterns/boundaries;
e. Existing vegetation such as trees, shrubs, grass and unique vegetation;

f. Erosion and sediment control measures (temporary and permanent) including locations, size, volume, flow rates and details in accordance with “Land Development Guidelines for the Protection of Aquatic Habitat, Department of Fisheries and Oceans (1993)”. Any other publications being sourced for ESC measures are to be referenced;
g. Storm Drainage systems including drain inlets, outlets pipes and other permanent drainage facilities (swales, waterways, etc.);
h. Cost estimate of works including monitoring, control and removal.

The plan must have a narrative section describing the land, the disturbing activity and details of the methods used for controlling erosion and sedimentation. Include a description of the procedures for construction and maintenance of the control measures. Prior to release of related securities, the site shall be verified by a qualified professional as stabilized and the structural ESC measures (such as silt fences and sediment traps) shall be removed and drainage facilities cleaned as specified.

4.03 Lot Grading Plan

Lot grading is considered an "essential service" and a plan is required prior to the issuance of building permits. Development is required to adhere to lot grading established at the time of subdivision and is not permitted to change established grading or storm water routing without provision of an acceptable alternative plan from a qualified professional, acceptance of this by the City Engineer and re-grading the lot to conform to the new plan. Submission and acceptance of the lot grading as-constructed drawing(s) and individual lot grading plans (as part of service card) is required. Building Permits will not be issued for lots currently going through a subdivision that do not have an accepted lot grading plan for that site.

Lot grading and drainage systems shall be designed to the satisfaction of the City Engineer to provide for proper drainage of the land and the lots created by the proposed development; to prevent the flow of drainage onto adjoining lands, the possible ponding of drainage thereon, and for the prevention of erosion, both within the development and on adjacent lands. Lots shall be graded to drain to a municipal drainage system, independent of adjacent lots. Minimum lot grades shall be 1.0 percent.

Where onsite control systems requires a lawn basin these shall be provided by the applicant to collect and convey drainage originating only from that particular lot.

Runoff on each lot shall be directed to such lawn basins by swales to avoid crossing property lines. Subdivisions establishing lots with proposed or future lots above are required to have an easement registered on title to protect storm routing through to a City road or drainage course. Swales shall be a maximum 150mm deep and shall conform to Stormwater Best Management Practices. Areas around buildings (or proposed building sites) shall be graded away from the (proposed) foundations.

The lot grading plan shall show:

a. The pre-development contour lines at maximum 1.0 meter intervals. This topography shall extend a minimum 30.0m outside the development site and shall include slab elevations at adjacent properties;
b. Lot dimensions, all existing corner lot elevations (uncircled), all proposed corner lot elevations (circled); maximum spacing between existing elevations shall be 30m;
c. How the development proposal will affect adjacent lands. No surface drainage shall be permitted to flow off-site over adjacent lands unless off-site work(s) are proposed and in compliance with MMCD and Municipal Standards, and easements are obtained. Existing elevations along the development boundary shall meet;
d. The intended drainage pattern for each lot by means of arrows (minimum 1 % slope). Where the lot drainage is split, the height of land shall be indicated. Arrows shall run perpendicular to final grading contours;
e. All drainage facilities complete with lawn basin, pipe invert elevations, and all swales proposed shall be on the submitted plan. Where grading is not feasible to direct surface drainage away from adjacent lot(s), swales shall be incorporated. A private easement is required over any lot accepting drainage from an up-stream lot;
f. Storm sewer connection elevation and lot number of each parcel. Road centreline elevations at maximum 30m intervals;
g. The proposed building envelope with the Minimum Basement Elevation (M.B.E.) noted;
h. A site plan showing the catchment area(s) involved and floodplain contour if applicable;
i. A legend noting all items proposed in the plan and applicable "general notes".
j. Significant areas of cut or fill via shading on the plan.
k. Individual lot(s) will not be permitted to direct storm water discharge or drainage into any natural watercourse, park or green belt area(s) without confirmation of acceptability for this from a Qualified Environmental Professional and the written consent of the City Engineer.

To ensure flooding is avoided, carports or garages attached to residential buildings shall not be constructed with their floor level below the adjacent curb of the city street or crown, unless:

1. The drainage of the driveway serving the carport/garage is connected by gravity to a City storm sewer meeting the connection criteria 2.16, or
2. Is above the 100 year hydraulic grade line, or
3. The runoff water from the driveway may flow past the carport/garage without accumulating and entering. Properties utilizing this method must have an engineer seal the design.

5.00 STANDARD DRAWINGS

5.01 MMCD Standard Detail Drawings
The following MMCD Platinum Edition Standard Detail Drawings shall be used:

Drawing No.	Drawing Description
S1	Standard and Sump Manholes
S2	Standard Manhole Connection Details
S3	Manhole Connection Details Drop and Ramp Type

Addendum to S1, S2 and S3 Precast bases are to be used for new mains.

S5	Precast Riser Manhole
S6	Sewer Cleanout
S8	Storm Sewer Service Connection

Addendum to S8 Inspection chamber with green lid (and Brooks box if in driveway) required.

S11	Top Inlet Catchbasin

Addendum to S11 Dobney B23 and B24 or approved equal frame and cover, Dobney TK-7 or approved equal for roll over curbs. Outlet pipe may be reduced to 100mm diameter.

S12	Lawn Drains
S13	Storm Sewer Inlet with safety Grillage

The following Subdivision and Development Servicing #3843 Schedule O-Standard Drawings are to be used:

400-1	Sanitary and Storm Sewer Manhole Requirements
500-1	Rainfall Intensity Duration Frequency Curves

6.00 SUPPLEMENTS TO THE MASTER MUNICIPAL CONSTRUCTION DOCUMENTS

5.01 The following supplements have not been addressed in the previous sections of this schedule and are to supersede the requirements of the MMCD.

SECTION	SUB-SECTION	SUPPLEMENTARY SPECIFICATIONS
02721 – Storm Sewers	3.6.6.3	This sub-section is to be deleted as no pipe barrel curvature is permitted on any profile pipe.
	3.8.4 - Connections to Existing Mainline Pipes	This specification shall apply to all connections to ribbed pipe, excepting that insertable tees shall not be permitted on ribbed pipe unless installed by City forces.
	3.13.3	City Engineer may require replacement of defective installations at no cost to the City.

	3.13.5	All references to acceptable depth of ponding are to be replaced with a maximum allowable of 10mm.
	3.13.5.4	Ponding will not be accepted on any gravity pipes where design grades are greater than 0.5%.