



CITY OF NEW WESTMINSTER

DESIGN CRITERIA

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1. DESIGN CRITERIA – GENERAL REQUIREMENTS

1.1 General

The City of New Westminster Engineering Design Criteria (“Design Criteria”) is to be used as a guide for the provision of minimum standard requirements for both City of New Westminster (referred to in this manual as the “City”) capital works projects and subdivision and development services design. If, however, criteria is not covered in the Design Criteria, then the design criteria shall be in accordance with good engineering practice, as determined in consultation with the Consultant and the Director of Engineering or their representative.

Consultants are encouraged to seek innovative and superior solutions where appropriate. A Consultant who wishes to adopt criteria not specifically included in or variant from those within this design specification shall justify the proposed change in a letter/report prepared, signed and sealed by a professional engineer. Submissions must demonstrate that the proposed change is equivalent to or better than these guidelines. The letter/report shall be submitted to the Director of Engineering for review and approval, prior to acceptance of the proposed change.

In spite of using these standards and specifications, the Developers and their Consulting Engineers remain fully responsible for the design and construction of City infrastructure utilities according to good engineering standards adequate to address the specific needs and site conditions of their project.

The Consultant must be satisfied that the design criteria contained herein are applicable to the project at hand, and must apply more stringent criteria where appropriate. The Consultant is fully responsible for designing to standards which exceed these standards when specific site conditions dictate that more stringent performance measures are required.

This document is to be used in conjunction with the City of New Westminster approved edition of the Master Municipal Construction Documents (MMCD) and the City of New Westminster Supplementary Specifications and Detail Drawings.

The City of New Westminster Supplementary Specifications and Detail Drawings for City services include:

- Item 1 Supplementary Specifications – Additions, amendments and deletions to the Specifications in the MMCD
- Item 2 List of Approved Materials and Products
- Item 3 Supplementary Detail Drawings

1.2 Approval of Services

Approval of the proposed design and construction of services, as applicable, must be given by several authorities in addition to the City. These authorities are:

<u>Governing Authorities</u>	<u>Areas of Jurisdiction</u>
Ministry of Environment	<ul style="list-style-type: none">• pollution, sanitary sewer systems• fisheries and wildlife
Greater Vancouver Sewerage and Drainage District (G.V.S. & D.D.)	<ul style="list-style-type: none">• GVS&DD sanitary sewer systems• Brunette River Drainage Channel
Greater Vancouver Water District (G.V.W.D.)	<ul style="list-style-type: none">• G.V.W.D. watermains
Canadian Transport Commission	<ul style="list-style-type: none">• crossing of existing railway at grade associated with roadway widening• construction of new road crossing existing Railway track at grade• replacing existing Railway trestles
Canadian National Railway, Canadian Pacific Railway, Burlington Northern Santa Fe, Southern Railway	<ul style="list-style-type: none">• as per Canadian Transport Commission• all underground services crossing existing Railway rights-of-way• installation of overhead transmission lines crossing existing Railway rights-of-way
Terasen	<ul style="list-style-type: none">• as per Terasen regulations and the Pipeline Act• all work in the vicinity of intermediate pressure (IP) and transmission pressure (TP) gas mains and rights-of-way
BC Hydro	<ul style="list-style-type: none">• as per BC Hydro regulations• all work in the vicinity of any underground plant as well as any transmission lines and rights-of-way

- | | |
|---|---|
| City of New Westminster Electrical Utility | <ul style="list-style-type: none">• all work in the vicinity of any underground plant as well as any transmission lines and rights-of-way |
| Telus, Rogers AT&T, Bell Canada, and other telecommunications providers | <ul style="list-style-type: none">• all telephone underground and overhead services |
| Ministry of Transportation | <ul style="list-style-type: none">• all construction (underground and/or surface work) on Ministry of Transportation rights-of-way• subdivision, road improvements within radius of 0.5 km of the intersection of a controlled access highway with any other highway (see Controlled Access Highway Act) |
| Fraser River Estuary Management Program (FREMP) | <ul style="list-style-type: none">• works on or about river and foreshore• dredging proposals• stormwater discharge points |
| Inspector of Dykes | <ul style="list-style-type: none">• reconstruction of dykes, fill and excavations adjacent to dykes• any structure on or across dykes |
| Fraser River Port Authority | <ul style="list-style-type: none">• dredging proposals in Fraser River• crossing of dykes – temporary or permanent works |

For City projects the Consultant will make all applications to the Authorities concerned on behalf of the City, unless otherwise advised. In case of subdivisions, applications will be made by the Developer, with any costs incurred from the application being assessed to the Developer. The final agreement for such application will be drawn between the Authority concerned and the City, provided the proposed services, upon satisfactory completion, revert to and form part of the City services system.

No construction may proceed without the approval of the Authority having jurisdiction.

In all cases, the Authority having jurisdiction has specific requirements of its own, such as

- specific application forms
- utility clearance from the proposed services
- protection of services, carrier pipes, depth of cover
- method of construction (Ministry of Transportation and railway companies may not permit open trenching on major highways and freeways.)

These requirements will be obtained directly from the Authority involved.

1.3 Subdivision and Development Servicing Procedures

Unless otherwise specified, the Developer shall design and install complete City services for the land being subdivided or developed, including provision of services to facilitate further development.

The City services shall include but not limited to:

1. Roads, lanes and walkways
2. Concrete sidewalks, extruded curbs, combined curb and gutter or alternative street edge
3. Sanitary Sewer systems
4. Storm Sewers systems
5. Watermains
6. Ornamental Street Lights
7. Trees and Landscaping
8. Underground Hydro power
9. Underground Telephone
10. Underground Cablevision
11. Natural Gas
12. Lot Grading

1.4 Drafting Requirements

Engineering drawings, details sketches and digital files prepared for submission to the City must conform to the City of New Westminster drawing and digital information standards.

1.5 Rights of Way and Easements

Where specifically approved by the Director of Engineering to locate a City service within a utility right-of-way, the minimum widths of rights-of-way shall be:

- a) for single service

R.O.W. width = 3 metres minimum width

- b) for two or more services

R.O.W. width = 6 metres minimum width

- c) When the service is within a City road allowance but the distance from the property line to the centre of the main is less than one half of the width necessary for a single service, the difference shall be provided as right-of-way on the adjacent property.

In all cases the width of rights-of-way shall be sufficient to permit an open excavation with side slopes in accordance with the Workers' Compensation Board (WCB) regulations, without impacting on or endangering adjacent structures.

Where required, sanitary trunk and interceptor sewers shall have rights-of-way wide enough for future widening and/or twinning. The width of the right-of-way shall be the required separation between pipe centrelines plus 2 times the depth to the crown of the deeper sewer.

The Consulting Engineer shall provide cross sections on the design drawings, indicating the minimum safe distances to adjacent building footings based on a safe angle of repose from the limits of the excavation.

The maximum depth of sewers in a right-of-way shall be 3.5 metres from finished ground surface to the pipe crown unless approved by the Director of Engineering.

1.6 Revisions to the Design Criteria

The criteria and design parameters contained in the manual are subject to constant review and re-evaluation and the Director of Engineering reserves the right to initiate revisions or additions to these criteria as and when he deems it is necessary to make such revisions.

The Director of Engineering may consider submissions from Consulting Engineers at large wishing to amend the City's Design Criteria. Such submissions shall be in a report format, signed and sealed by a professional engineer, and shall include clear and succinct expressions of concern, suggestions for alternatives including their economic, engineering and environmental benefits, and recommendations proposed to address improvements to the current Design Criteria.

The Director of Engineering may, at his sole discretion, review, assess and accept or adopt in whole or in part, the submissions and/or the recommendations from a Consulting Engineer for inclusion within the Design Criteria manual at a future date.

1.7 Glossary of Terms

The following terms used in the Design Criteria shall have the meanings indicated below:

“City” shall mean the City of New Westminster as a corporate body, as represented by the Director of Engineering.

“Director of Engineering” shall mean the Director of Engineering or his/her appointed alternate.

“Consultant” or “Consulting Engineer” shall mean the Professional Engineer responsible for the preparation of: proposals, reports, associated documents, design submissions and detailed engineering designs and drawings, and for the execution and the implementation of such designs for infrastructure utilities and services to be incorporate in the City.

“Developer” shall mean the proponent of a land development proposal, or the Owner as defined in a Servicing Agreement. Requirements of the Developer stated in this document, or associated documents, apply to the Consultant or Contractor acting on the Developer's behalf.

“Specifications” (to be confirmed with the city) shall mean the Master Municipal Construction Documents (MMCD, 2000) Volume II – Specifications, and the City of New Westminster ‘Standard Construction Documents – Supplementary Specifications’, latest revision, including all amendments and appendices.

“Standard Drawings” shall mean the Master Municipal Construction Drawings (MMCD, 2000), Volume II – Specifications – Standard Detail Drawings, and the City of New Westminster “Supplementary Standard Drawings”, latest revision, including all amendments.

2. FIELD SURVEY REQUIREMENTS

All field survey information should follow the requirements outlined in the City of New Westminster Drafting and Drawing Submission Standards,

3. STORM DRAINAGE SYSTEM

3.1 General

All drainage works shall be designed with considerations for public safety, regulatory requirements, economic benefits and the natural environment.

Designers shall consult with the City to determine what existing information may be of assistance to them.

The presence of an existing municipal drainage system does not mean, nor imply that the existing system has adequate capacity to receive the proposed design flows either adjacent to the site or further downstream, nor does it indicate that the existing system pattern is acceptable to the City. Existing facilities which are undersized or inadequate to accept additional drainage must be upgraded at the Developer's expense to accommodate the appropriate flows. Alternative drainage proposals may be considered.

Proper erosion and sediment control is required for all developments or works discharging runoff into the City drainage system and/or natural watercourses.

It is essential that the Consultant is aware of the following information:

- a) Drainage catchment boundary
- b) Location of major pumped and gravity facilities
- c) Location of the future gravity conveyance systems

Stormwater management (SWM) is the planning, analysis and control of stormwater runoff in consideration of the opportunities and constraints that both the engineered and natural drainage systems have to offer. The objective is to maximize the practical level of service to development, while minimizing the risk to properties and public safety. The design of the stormwater management system shall incorporate techniques to mitigate the runoff impacts due to changes in land use.

A Stormwater Management Plan and Sediment Control Plan are required for all proposed developments within the City.

3.1.1 Stormwater Management Plan

A Stormwater Management Plan (SWMP) describes the details of how drainage servicing will be provided to the proposed development, indicates how the development will impact existing drainage infrastructure downstream, and shows how the proposed drainage system will meet the City's design criteria set out herein.

A Stormwater Management Plan must be provided by all developments. At the discretion of the City, only those developments which do not alter the existing drainage characteristics are exempt. The submission must include appropriate drawings as well as a written report that contains the supporting background and analytical information related to the SWMP in accordance with the City's submission criteria.

The Stormwater Management Plan must include the following information either on the drawings or in textual format:

- Existing and proposed tributary areas in the catchment along with existing and ultimate land uses;
- The development area within the drainage catchment including all features such as roads, ditches, drainage control structures, storm sewers, culverts, drainage facilities, and grading;
- Pre and post development hydrologic and hydraulic calculations summarized in table form and supporting parameters;
- Be consistent with all existing City Master Drainage Plans (MDP) or equivalent;
- Major and minor system flow routing
- Downstream conveyance capacity limitations;
- Design details and supporting information for all proposed SWM facilities (i.e., detention ponds, onsite retention measures, etc);
- External drainage issues and recommended options to address impacts;
- Potential floodplain issues and recommended options to address impacts; and
- Easements required.

3.1.2 Sediment Control and Sediment Control Plan

The proposed drainage system must be designed in such a way as to provide adequate control of sediments during construction.

During the construction phases of the culvert system, temporary sediment catches must be constructed upstream of each culvert entrance.

Prior to any works being completed on site for all new developments, a Sediment Control Plan must be submitted. The Sediment Control Plan should include the following information:

- Vicinity map showing location of site in relation to the surrounding area.
- Site plan details. This should include existing vegetation, existing and proposed ground contours, existing and proposed drainage patterns, limits of clearing and grading, limits of cut and fill, external drainage to be addressed, and locations of sediment control best management practices.

- Identification of erosion and sediment control best management practices should include consideration for:
 - a. Cover Practices – the first line of defence is to prevent erosion. Examples include limiting the impact of development through the use of such measures as buffer vegetation strips.
 - b. Structural Practices – this includes sediment catches in the storm sewer system and where necessary other features such as sediment ponds, rock check dams, and inlet protection measures.
 - c. Construction Management Measures – good construction management is as important as physical practices for erosion and sediment control. Examples include staging construction activities to minimize exposed areas, gravel access pads to construction sites, construction vehicle wash facilities, vegetation strips, silt fences, covering of stockpiles, and cleaning of all storm sewer facilities before connection.

3.1.3 Design Frequencies

The design of storm drainage system components is required to accommodate a number of variable storm runoff rates and volumes generated by storms of certain recurrence intervals. The following storm return frequencies shall be used for the design of the drainage and stormwater management system components:

Table 3.1 Design Frequencies

Drainage System Component	Hydrologic Variables	Hydrologic Design Basis
Minor systems	Peak flow rate, flow depth, duration, runoff volume and base flow rates	1:10 year design storm
Major trunk sewers, outfalls, and Queensborough	Peak flow rate, flow depth, duration, runoff volume and base flow rates	1:25 year design storm
Overland flow systems	Peak flow rate, flow depth, duration, runoff volume and base flow rates.	1:100 year design storm and / or with safe overflow to protect City infrastructure and private property
Flood Protection	Flood construction levels	1:200 year design flood with freeboard

3.2 Design Requirements & Procedures For Collection System

The storm drainage design shall show the proposed storm sewer mains, service connections, all other existing underground services, overland flow details and ditch drainage patterns as appropriate.

The following considerations must be incorporated into the design:

- a) The elevations of underground utilities, which are crossing the proposed storm sewer line shall be shown on the profile. Field confirmation is required at construction stage or at the design stage if required.
- b) Field survey pick-up should be provided with sufficient detail to determine drainage patterns in the area. A topographic survey of the site will be required including elevations of surrounding properties and the crown of the roadway fronting the development. Proposed ground elevations for the development should also be given.
- c) Provision must be made for house drains from each lot, either to storm sewer, open ditches in the roadway or lane, underground storm sewers elsewhere or natural watercourses.
- d) All new streets and those associated with newly created subdivisions shall have an appropriate storm conveyance system designed to take care of house drains and road drainage.
- e) Catch basin type shall be chosen according to Supplementary Specifications and Detail Drawings. Lead size shall be not less than that shown on Detail Drawings. Type of catch basin and lead size shall be marked on construction drawings.
- f) When establishing inverts in a manhole at the junction of two or more pipes, the crowns shall be coincident provided that there is sufficient cover at the ultimate terminal. In built up areas where there is not sufficient cover available at the ultimate terminal, the design may be invert to invert with the hydraulic grade line shown on the profile and as approved by the Director of Engineering.
- g) The "Storm Sewer Design-Rational Method" table which appears at the end of this Section shall be completed and submitted with the drainage drawings for the design of the minor system where a subsurface collection system is implemented. Computer modelling of the proposed drainage system will be accepted and/or required subject to the Director of Engineering or designate.

3.3 Runoff Analysis

Storm drainage systems shall be designed to accommodate predicted flows using the Rational Method or the Runoff Hydrograph Method. All calculations pertinent to the design of the drainage system shall be signed and sealed by the Consultant and submitted to the City.

The extent of the tributary drainage areas of the storm drainage system under design shall be in accordance with the natural contours of the land, existing downstream pipe and pump capacities and area servicing plans established for the catchment in which the subject property is located.

It is the Consultant's responsibility to confirm the extent of the drainage area with the Director of Engineering prior to final design.

In areas serviced solely by combined sewer, pre and post development flows for storm and sanitary contributions shall be determined. Where post-development flows exceed pre-development flows, onsite storage or equivalent best management practices will be required to limit peak discharge rates to pre-development levels. Existing conditions will be considered 'pre-development' for non-greenfield sites unless historical site design documentation is submitted.

Catchment Area

Regardless of the analytical method being used, the tributary area used for the design of the storm drainage system shall be consistent with the actual contours of the land and natural drainage flow patterns. Although minor changes in the catchment boundaries may be necessary for development, the total developed tributary area should not deviate from the total natural drainage area, unless otherwise approved by the Director of Engineering, or as dictated by applicable drainage plans which may exist specific to that catchment. The Consultant is responsible for obtaining true and accurate surface elevations for the analysis.

The analysis must include all lands tributary to the system being analysed, whether considered on-site or off-site to the Developers parcels.

3.3.1 Rational Method

The Rational Method calculates the peak flow using the formula:

$$Q = RAIN$$

Where

- R = Runoff Coefficient
- A = drainage area in ha
- I = Rainfall intensity in mm/hr
- N = 0.00278

$$Q = \text{Flow in m}^3/\text{s}$$

a) Runoff Coefficients

Zone designations selected for design purposes shall be based on the highest and best use for the properties in the design catchment area based on the Zoning Bylaw of the City of New Westminster currently in effect. Future land designations, as defined in the City's Official Community Plan (OCP), shall be used if its land use designations will result in a higher runoff coefficient.

Table 3.2 Runoff Coefficients

Type of Area	Coefficient
Park/Open Space	0.10-0.25
Single Family Residential	0.45-0.55
Low Density Multi-Family Residential	0.60-0.70
Apartment	0.70-0.90
Commercial	0.90
Industrial	0.90
Institutional	0.80
Roofs or Pavement	0.95

b) Time of Concentration

The time of concentration is the time required for water to flow from the most remote part of the catchment area under consideration to the design node. The time of concentration consists of the following formula:

$$T_c = T_i + T_t$$

Where
 T_c = time of concentration (minutes)
 T_i = inlet or overland flow time (minutes)
 T_t = travel time in sewers, ditches, channels or watercourses (minutes)

Inlet or Overland Flow Time (T_i)

i) Inlet times for various development conditions are given to ensure uniformity in runoff computations.

Lot Size m ²	Inlet time (Min)
≤ 2000	10
>2000	15 or as calculated

- ii) The inlet time shall be calculated using the following method:

$$T_i = \frac{3.26(1.1 - C) L^{0.5}}{S^{0.33}}$$

Where T_i = inlet time (minutes), minimum time = 15 minutes
 C = runoff coefficient
 L = travel distance (m), maximum length = 300m
 S = slope of travel path (%)

Travel Time (T_t)

The equation below provides an approximate travel time which shall be corrected with the actual time of flow calculated from the hydraulic properties of the selected pipe/channel. A composite value for T_t shall be calculated in cases where the type of flow along the longest path varies or the slope changes.

The travel time in sewers, ditches, channels or watercourses and overland can be estimated using the following formula:

$$T_t = \frac{C_t L n}{12 s^{0.5}}$$

C_t = Concentration coefficient depending on the type of flow
= 0.5 for natural watercourses or ditches
= 1.4 for overland flow
= 0.5 for storm sewer flow
 L = Length of watercourse, conduit or overland flow in metres, along the drainage path from the furthest point in the basin to the outlet.
 n = Channel friction factor
= 0.050 Natural channels
= 0.030 Excavated ditches
= 0.016 Overland flow on smooth paving
= 0.400 Overland flow on natural areas
= 0.013 Concrete pipe
= 0.011 PVC Pipe
 s = Basin slope in metre/metre

c) Rainfall Intensity

The rainfall intensity for the Rational Method formula shall be determined from a rainfall Intensity-Duration-Frequency (IDF) curve based on the calculated time of concentration. The rainfall IDF curve is based on information collected from the Westburnco Reservoir Meteorological Station in New Westminster and is provided at the end of Section 3.

d) Presentation of Rational Calculations

The Designer will be required to tabulate the rational calculations on the “Storm Sewer Design-Rational Method” table for submission along with the appropriate plans and other relevant information.

3.3.2 Runoff Hydrograph Method

In addition to designing the collection system using the methodology described in Section 3.3.1, hydrologic programs shall be used for the design of all stormwater detention facilities. To address the requirement to maintain post-development release rates at pre-development levels on smaller sites, spreadsheet level hydrologic routing may be utilized. The choice of a stormwater model other than those identified below will require the approval of the Director of Engineering.

a) Selection of Modeling Program

Pre-approved standard runoff simulation modelling programs include OTTHYMO.89, Visual OTTHYMO, and SWMM.

For smaller sites, simple spreadsheet hydrologic routing using modified rational method may be used to assess the volume of storage required to limit post development flows to pre-development levels.

b) Design Storms

Design storm selection is based on the design frequencies contained in Table 3.1. The duration of the events used for each return period is dependent on what results in the most critical hydrologic response. Typically, the smaller the catchment area the shorter the critical timespan. Hyetographs are provided in Appendix A: Meteorological Data for 1, 2, 26, 12 and 24 hour events.

c) Catchment Data

Data preparation for planning areas or proposed development shall be based on the best available information as per the Official Community Plan (OCP), Zoning Bylaw and all other land use plans, subdivision proposals and other pertinent land use information.

In most cases, the Consultant may develop both pre-development and post-development flows using the Soils Conservation Service (SCS) curve number (CN) approach. If sufficient information is known about the infiltration characteristics of the soils, either the Horton's or Green Ampt methods may be applied. Which ever method is selected, the parameters must be reflective of the type of soils, ground cover and typical antecedent moisture condition (AMC) prevalent during the winter season.

Where information is not specifically available through applicable documents, future impervious fractions for common land uses, as shown in Table 3.3, shall be used for analysis. These are intended as a guide only. In areas of existing development or where more detailed information is available, the Consultant shall verify that the values shown are representative of the true conditions.

Table 3.3 Common Impervious Fractions

Common Land Use	Total Impervious Fraction
Park/Open Space	0.10
Single Family Residential (700 m ² lot)	0.45
Low Density Multi-Family Residential	0.65
Apartment	0.80
Commercial	0.90
Industrial	0.90
Institutional	0.80

d) Presentation of Modeling Results

To document the design rationale used to develop the hydrologic model and to standardize the presentation of model results, the design reports shall include appropriate sections which will indicate the following:

- type and version of computer model used;
- all parameters and specific simulation assumptions used;
- design storms used, to be clearly documented and plotted;
- summary of peak flows and inflow outflow hydrographs of storage facilities;
- predicted hydraulic grade lines throughout drainage system under conditions governing the design;

- volumetric runoff coefficient or total runoff obtained; and peak flow vs. area, plotted for each event studied.

The report documentation should include:

- i) A plan showing sub-catchment areas, catchment boundaries and the drainage system.
- ii) A plan identifying the specific land uses modeled for each development condition analysed.
- iii) The function layout and sizing of any flow control/diversion structure and the tabular/graphical plots of inflow and outflow hydrographs.
- iv) Tables summarizing the above described performance related parameters.

3.4 Storm Sewers and Appurtenances

3.4.1 Sizing of Storm Sewers

The required storm sewer capacity shall be calculated using the Manning Formula under free flow (non-surcharged) condition. The Manning formula is:

$$Q = \frac{A R^{0.667} S^{0.5}}{N}$$

Where	Q = flow capacity (m/s)
	A = cross sectional area (m ²)
	R = hydraulic radius (m)
	S = slope of hydraulic grade line (m/m)
	n = roughness coefficient
	0.011 for PVC pipe
	0.013 for concrete pipe
	0.024 for corrugated metal pipe (CMP or CSP)

The minor storm system shall be designed without surcharging.

The hydraulic grade line shall be calculated and shown on the design drawings along with the design flow rate and pipe capacity for each reach.

3.4.2 Minimum and Maximum Velocity

The minimum velocity for pipes flowing full or half full shall be 0.75 m/s where achievable.

The maximum velocity for pipes flowing full or half full shall be 4.5 m/s.

Where drainage discharge enters a channel or sensitive outfall, provisions for energy dissipation shall be provided to prevent scour.

3.4.3 Minimum Grade and Size

Due to the site specific nature of the topography in Queensborough, the minimum grades associated with the minimum velocity identified in Section 3.4.2 may not always be achievable. For these cases, site specific designs will be required that will be reviewed on a case by case basis. Drainage features must be designed with a positive grade and a methodology must be identified to verify the system has been constructed with a positive grade.

It may be necessary to analyse the earth characteristics for ditches to prevent scouring even at minimum grades specified.

A minimum 250 mm diameter storm sewer shall be provided at the beginning of any storm sewer line.

3.4.4 Storm Sewer Location

The location of the storm sewer main shall be in accordance with the City's standard utility location as shown on the "Typical Cross Section" drawings for roadways. It may be necessary to vary from the standard cross-section because of the existing ditch or underground utilities. Any variation from the standard utility location must have the prior approval of the Director of Engineering.

Where feasible, all new storm lines must interconnect at the high points to provide alternate routing of storm water in case of blockage and for added subsurface storage capacity.

3.4.5 Minimum Depth of Cover

Storm sewers shall be installed at a depth, to be able to service properties on both sides of the roadway. Elevation of storm sewers at upstream tributary points must be of sufficient depth to service all of the tributary lands. The Consultant shall verify that the pipe material and bedding are suitable for the live and dead loads imposed on the pipe, but in no case shall cover be less than 0.9 m without the approval of the Director of Engineering.

3.4.6 Pipe Joints

All joints shall be gasketed.

3.4.7 Curvilinear Sewers

Pipes are not to be laid on a curve unless approved by the Director of Engineering. PVC pipe will not be permitted for curvilinear sewers.

Where approved, horizontal curves will require a constant offset and/or shall be uniform throughout the curve. The minimum radius should not be less two times the minimum recommended by the pipe manufacturer. The maximum joint deflection shall not exceed one half of the pipe manufacturers' recommendations and all joints shall be deflected equally.

If straight tangent lengths with metered bends are approved instead of curvilinear sewers each bend shall be located by survey.

3.4.8 Manholes – Standard Requirements

Manholes are required at:

- change of grade, size or alignment
- every intersecting sewer
- all changes in pipe size
- every 100 m for pipes within a road allowance
- end of each line

Generally frames and covers should be located outside the wheel path on the roadway.

Where ditches discharge into a storm sewer system, the initial manhole shall be of a sump type. All other manholes shall be channelled and benched. A detail drawing shall be provided for manholes of special design.

3.4.9 Manhole Diameters

The inside diameter of manholes shall conform with the City approved edition of the MMCD and the City Supplementary Specifications and Detail Drawings.

3.4.10 Catch Basins

In new developments the maximum spacing shall be established to permit each catch basin to drain a maximum area of 700 m². Adequate inlet capacity must be provided to address the runoff between catch basins.

Generally 600 mm diameter reinforced concrete catch basins shall be used for roadway drainage. Special prefabricated pan catch basins shall only be used where approved by the Director of Engineering.

Grates shall have a “fish” symbol.

Catch basins shall be provided at regular intervals along roadways, at upstream end of radius at intersections and at low points (sags). Low points are to be avoided within curb returns at intersections. The Consultant must ensure that sufficient inlet capacity is provided to collect the runoff for which the underground pipe system has been sized.

Double curb inlet catch basins shall be provided at all low points and on steep road grades.

Leads shall be 150 mm in diameter (minimum) for single basins and 200 mm (minimum) in diameter for double basins. Double catch basins shall not be connected directly together but rather one basin will be wye'd into the lead of the other. Maximum lead length shall be 30 meters. The minimum grade for the lead is 2%.

3.5 Service Connection

Every lot (existing or newly created) capable of being serviced, whether it is vacant or not, must be provided with at least one connection. The service connection shall be installed in accordance with the standard drawings.

The minimum diameter of all service connections shall be 100 mm and have a slope not less than 1.0% from the property line to the main. Refer to the Supplementary Specifications and Detail Drawings for the location of storm sewer connections.

3.6 Surcharged Sewer

Every effort should be made to avoid surcharge of existing or proposed sewer pipes. If surcharged is unavoidable because of conflicts with existing utilities, structures or other implications, the discharge volumes under the surcharged conditions must be calculated and the water surface profiles must be plotted on the sewer profile. At least 150 metres of water surface profile should be plotted upstream and downstream of the surcharged sewer.

The principle of siphons shall be used for calculating the discharge volume. A self-cleaning velocity of 0.6 metres per second must be maintained at all times. The inlet to the surcharged sewer must be carefully designed to prevent silting the surcharged sewer.

A surcharged sewer should not be considered for pipes smaller than 600 mm diameter. Surcharged pipe length should be minimized.

At no time will surcharging be permitted where the HGL under the design storm conditions is within 0.3m of the surface.

3.7 Inlet and Outlet Structure

The Supplementary Specifications and Detail Drawings shall be used as a guide for designing inlet and outlet structures for storm sewers and culverts. The structural requirements for the inlet and outlet structures, given on the standard drawings, are the minimum requirements only. Structures that vary from the standard drawings should receive individual structural design with details to be provided on the drawings.

Outlets for culverts and storm sewers, having discharge velocities greater than 1.0 m/s require rip-rap or an approved energy dissipating structure to control erosion.

A trash screen/safety grillage is required at the entrance to every permanent storm sewer.

3.8 Culverts

Culverts located in ditches or culverts crossing all roads shall be designed to convey the 1:25 year flow. The Consultant shall determine whether the culvert will operate under inlet or outlet control at design conditions.

Driveway culverts shall be installed or approved for installation by the City.

3.9 Overland Flow Routings

Unless the storm sewer system is oversized to accommodate the major flow (i.e. 1:100 year return frequency storm), provision for surface flow is required. Overland flow routing is generally accommodated along roadways, swales and watercourses. These designated flow paths shall be protected by restrictive covenants or rights-of-way and clearly identified in the stormwater management plan.

The quantity of flow to be conveyed by the surface flow path is the total overland flow less the capacity of the piped system. The design of the major flow routing shall ensure to the satisfaction of the Director of Engineering that no endangering of public safety nor substantial property damages will occur under the major flow conditions.

3.10 Roadway Surface Drainages

Urban roadways with curbs and gutters can be designed as wide shallow channels to convey major surface flow. The water elevation at minimum ponding/flow shall be at least 0.35 m

below the lowest minimum building elevation of the adjacent buildings. The maximum depths of flow shall not exceed 140 mm above the gutter line.

The design of intersections shall ensure that the surface flow can continue along the designated path crossing over lateral streets. Similar considerations are required if a change of surface flow direction is required at an intersection.

3.11 Minimum Building Elevation (MBE)

Refer to the City of New Westminster Building Bylaw for minimum elevations.

3.12 Roof Drainage

Roof drainage for all new dwellings shall be discharged to the ground and dispersed via splash pads at the downspouts.

If discharge of roof leaders to splash pads is not feasible, roof drainage may be discharged into the City drainage system, at the discretion of the Director of Engineering, where the size of the proposed or existing storm sewer has been designed for, or can be shown to accommodate the anticipated flows. Roof leaders shall be connected directly to the storm drain connection at the property line. Roof leaders shall not be connected to foundation drains.

Subsurface discharge in accordance with the Best Management Practices Guide (GVRD, Oct. 1999) may be permitted subject to approval of the Director of Engineering.

3.13 Stormwater Management Facilities

When a Stormwater Management Facility (SWMF) is being proposed to address development impacts, pre-consultation with City Staff will be required to obtain relevant acceptable criteria. If a development is located within an area wherein an overall SWM planning study is available, the design criteria and recommendations as specified in the study must also be satisfied.

3.14 Lot Grading

- a) Lawns and swales shall have a minimum slope of 2% and a maximum slope of 6%.
- b) Where grade changes in excess of the above are required, the maximum slope should be 3:1. Where these occur between dwellings the slope is to be located on the lower lot.
- c) Grade changes in excess of 1m are to be accomplished by the use of a retaining wall.
- d) The maximum depth of rear yard swales shall be 0.3m.

- e) The maximum depth of side yard swales shall be 0.2m. The grade adjacent to the house shall follow the grade of the swale to maintain constant depth.
- f) At least one side yard of all dwelling units shall have a minimum (2% slope) level area of 0.6m.
- g) The crossfall at the back of all units shall not exceed 2%.
- h) For all lots with detached and semi-detached dwellings having conventional rear yard setbacks and reverse frontage on arterial roads, the rear area shall be graded at 2% for at least 7.5m of the total rear yard depth.
- i) The maximum flow allowed in a swale between two houses is that from 4 rear yards.
- j) The maximum flow allowed in a rear yard swale shall be that from 6 rear yards and in no case will the swale lengths be greater than 3 lot widths for single and semi-detach houses. For townhouse units, eight (8) rear yards and a maximum swale length of 4 lot widths will be permitted.
- k) The ponding depth over rear yard catchbasins shall not exceed 0.3m.
- l) Grade differences between housing units shall be minimized, especially where new developments abut existing developments. The vertical distance between the ground level at the rear wall of houses which back on to each other shall not be greater than that achieved by striking a 3% grade between the units.

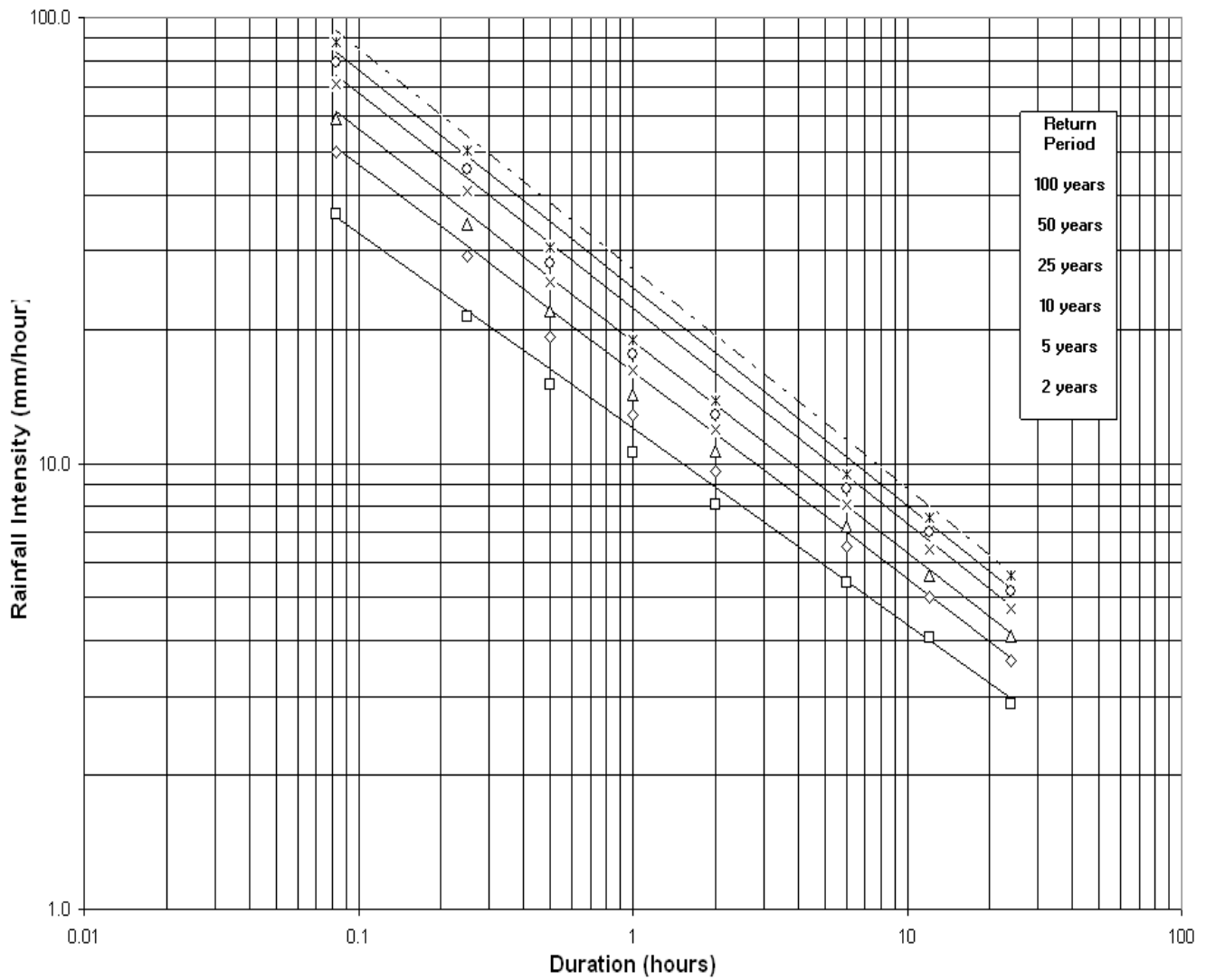
3.15 Oil and Grit Separators

Oil and grit separators will be required for all developments where there is a risk of a spill. Final discretion will be exercised by the Director of Engineering or designate with respect to the proposed land uses that will require O&G separators. Currently the only O&G separators approved for use within the City consist of Vortechincs (www.vortechincs.com) or Stormceptor (www.stormceptor.com). Design services for each are available from the respective manufacturers.

GREATER VANCOUVER SEWERAGE AND DRAINAGE DISTRICT

Short Duration Rainfall IDF Data for WESTBURNCO RESERVOIR (CW09)

Based on recorded rain gauge data for the period 1959 - 1976, 1978 -2001 (42 Years)



Disclaimer: 100 year return period is an unreliable estimate.

4. SANITARY SEWAGE COLLECTION SYSTEM

4.1 General

Sanitary sewer facilities complete with mains, manholes, service connections and appurtenant structures shall be provided to collect and dispose of sewage.

The sewage catchment boundary and the locations of pump stations and force mains will be pre-determined by the Director of Engineering.

The Official Community Plan, Regional Liquid Waste Management Plan, and any other related planning documents shall be consulted to ensure the long-term sewer plans and objectives are addressed by each design.

4.2 Sewage Characteristics

For all new developments the discharge of storm water into the sanitary system will not be allowed.

All discharge of industrial waste water to the City sanitary sewer requires a permit issued by the GVS&DD. The conditions of this permit include compliance with all regulations of the City, GVS&DD, Provincial and Federal Governments and all other relevant legislative bodies.

4.3 Sewage Flows

The total design sewage flow shall be based on the greater of a) ultimate population densities and land use designations as outlined in the Official Community Plan for the entire catchment area, or b) for the planned development for the entire catchment area. Sanitary sewers shall be designed to convey the calculated peak sewage flows, including an allowance for inflow and infiltration.

Design populations used in calculating sewer demands shall be computed in accordance with the City's land use density and population predictions, or the planned development in the area to be served, whichever is greater. Population densities for residential areas shall be a minimum of 3.0 persons/unit for single family and 1.80 persons/unit for multi-family unless otherwise approved by the Director of Engineering. Where population equivalents are used for non-residential land uses the residential per capita sewage demand is to be used for calculating sewage flows. All design population assumptions must be reviewed with and approved by the Director of Engineering.

The following sewage flow rate guidelines shall be used as a minimum design basis, unless otherwise approved by the Director of Engineering.

Where development is expected to exceed these guidelines the actual development parameters shall govern. For development within existing areas the design basis shall be based on the greater of a) flows from the present development combined with anticipated flows for extension of the sewer to both developed and undeveloped lands and b) flows from future development of the catchment area to full OCP density and land-use.

Table 4.1 Sewage Flows

Land Use	Average Dry Weather Flow	Inflow and Infiltration (litres/ha/day)
Residential	300 litres/capita/day	14,688
Commercial/ Industrial		
• Motels/Hotels	318 litres/unit	14,688
• Restaurants	97 litres/m ² of dining area	14,688
• Office Buildings	90 litres/worker	14,688
• Factories	90 litres/worker	14,688
• Schools	90 litres/student	14,688
• Shopping Centres	0.7 litres/m ² of enclosed sales area	14,688
• Other	According to Health Act Guidelines	14,688
Institutional		
• Hospitals	1,136 litres / bed	14,688
• Nursing Homes	681 litres/bed	14,688
• Other	According to Health Act Guidelines	14,688

4.4 Hydraulics

4.4.1 Downstream System Capacity

The Consultant shall discuss downstream system capacity requirements with the Director of Engineering. If required, the calculation of sufficient capacity of the existing system, downstream of the proposed catchment area, shall be based on modelling results provided by the City or as otherwise directed by the Director of Engineering.

Where the proposed development will be discharging into the combined sewer system, the difference between the post-development and pre-development sewage flows must be estimated, and the stormwater discharge limits then be reduced by the same amount. Effectively, this takes into account the increased sanitary flows and ultimately results in the same flow rates being introduced to the sewer system as under pre-development conditions.

4.4.2 Formula and Method of Analysis

The steady-state design flow rate shall be calculated as follows:

$$Q_{\text{design}} = \text{Peak Sewage Flow from all Sources} + \text{Infiltration and Inflow}$$

$$\text{Peak Sewage Flow from all Sources} = (Q_{\text{ADWF}}) \times \text{Peaking Factor} + Q_{\text{PUMPED}}$$

Where: Q_{ADWF} = Average daily sewage flows, from all sources, for the collection system upstream that is being fed by gravity.
 Q_{PUMPED} = Peak wet weather pumping rate from all upstream pump stations.

The peaking factor shall be calculated using the Harmon equation. All non-residential demands are to be converted to equivalent populations for peaking purposes.

$$\text{Peaking Factor} = 1 + \frac{14}{4 + \sqrt{\frac{\text{Population}}{1000}}}$$

The hydraulic analysis of gravity sewer pipes shall be conducted using the Manning equation. The steady-state “full” capacity of the pipe is determined using the following form of the equation:

$$\text{Flow Rate } Q = \frac{A \cdot R^{\frac{2}{3}} \cdot S^{\frac{1}{2}}}{n}$$

Where: Q = full pipe flow in cubic meters per second
 A = cross sectional area of pipe in square metres
 R = hydraulic radius in meters, $D/4$ (for circular pipes)
 D = inside diameter of pipe in metres
 S = slope of energy grade line in metres/metre of length
 n = Manning coefficient of roughness, 0.013 for all pipes

New sanitary sewers shall be designed with the design peak wet weather flow rate not to exceed 50% of the full pipe capacity at a minimum velocity of 0.75 m/s.

The beginning section of a sanitary sewer, servicing 6 or less residential service connections shall have a minimum grade of 1.0%.

Where deviation from the foregoing methodology occurs, a description of the procedure used for sewer design shall be submitted to the Director of Engineering for approval.

4.5 Piping

4.5.1 Size

The minimum allowable pipe sizes for local gravity sewers are:

- 200 mm diameter
- For new extensions, no reduction in pipe size shall be made for pipes downstream, irrespective of grade provided on the pipe, unless specifically approved in writing, by the Director of Engineering.

4.5.2 Location

Sewers shall be located as shown on the standard Road Cross-section Drawings, in City road/lane rights-of-way. Where sewers are adjacent to or cross existing or proposed water mains the current requirements of the Provincial Authorities for separation shall govern.

Where front of lot sewers are technically impractical, as determined by the Director of Engineering, sewers in lane ways or rear of lot rights of way may be approved. Sewers in lane ways are preferred to rear of lot sewers. Rear of lot rights of way, if approved, shall include a minimum 3.0m wide dedication on both of the adjoining lots for a total 6.0m width. The sewer pipe is to be centred within the half right of way on each property.

The elevations of all existing underground utilities crossing the proposed sanitary sewer shall be confirmed in the field and shall be shown on the profile and/or plan.

4.5.3 Curvilinear Sewers

Curvilinear sewers are not permitted unless authorized in writing by the Director of Engineering.

4.6 Service Connections

The size of service connection shall be designed to accommodate the peak flow rate on the property being served.

Service connections for single family dwellings shall be a minimum of 100mm. For all other uses the minimum size shall be 150mm unless otherwise approved by the Director of Engineering.

Every lot capable of being served, whether it is vacant or not, must have a connection provided, unless otherwise approved by the Director of Engineering.

4.7 Manholes

Manholes are to be placed at a maximum spacing distance of 100 m, at every change in direction, at every change of pipe size, and at all sewer junctions.

Drop manholes, where required, shall be configured as recommended by the approved version of the MMCD and Supplementary Specifications and Detail Drawings.

Temporary cleanouts are required where an extension of the sewer, in the future, will provide a manhole at an appropriate spacing.

Manholes shall be designed to incorporate a minimum pipe invert elevation difference of at least 30 mm in addition to the normal grade of the lateral sewer. For alignment deflections in excess of 45 degrees a 60 mm drop shall be provided. The crown elevations of sewers entering a manhole shall not be lower than the crown elevation of the sewer leaving the manhole.

4.8 Pumping Stations

Guidelines and specific requirements for pumping stations shall be obtained from the Director of Engineering prior to undertaking design.

The location of such stations shall be determined by the Director of Engineering.

4.9 Force Mains

The following criteria apply to force main design:

1. Force mains shall be designed for a 0.9 m/s minimum velocity with a minimum pipe size of 100mm.
2. An automatic air relief and/or vacuum valve shall be placed at high points in the force main. Odour control devices shall be installed on air vents unless otherwise approved by the Director of Engineering.
3. The Consultant shall ensure the pump cycle is set sufficiently to resuspend settled solids.

4. Isolation valves shall be provided at least every 1,000m. Valves shall be full port type to allow for pigging. A resilient seated gate valve is required on a force main prior to tie-in to a trunk force main.
5. Provisions shall be made to allow for force main cleaning. This shall include pig launching and receiving points and selection of appropriate bends and pipe sizes to allow for pigging of the force main.

Thrust restraint must be provided for all valves, tees, bends, and caps. The Consultant must design thrust blocks or mechanical thrust restraint systems with due regard for pipeline pressure transients and expected test pressures. Thrust block design calculations and soil bearing pressures must be shown on the design drawings. Where mechanical thrust restraint systems are used the required length of restrained pipe must be shown on the design drawings. In areas where settlement is of concern (i.e.. lowland areas) mechanical thrust restraints are preferred.

5. WATER DISTRIBUTION SYSTEM

5.1 General

The Official Community Plan, and any other related planning documents shall be consulted to ensure long-term water plans and objectives are addressed by each design.

The location of pressure zone boundaries, PRV stations, and pumping stations will be pre-determined by the Director of Engineering.

Water systems design shall conform to all applicable provincial and federal requirements.

5.2 Demands

Every water distribution system must be designed to convey adequate supply for consumption and fire protection demands at a desirable pressure.

Consumption demand shall be that of all land uses including Residential, Industrial and Commercial demand during the summer season, including demand for irrigation or sprinkling.

The water distribution system must be capable of providing the greater of:

- a) an adequate water supply for fire fighting concurrent with maximum day demand; or
- b) peak hour demand.

5.2.1 Consumption Demand

Design populations used in calculating water demand shall be computed in accordance with the City's land use density and population predictions, or the planned development in the area to be served, whichever is greater. Population densities for residential areas shall be a minimum of 3.0 persons/unit for single family and 1.80 persons/unit for multi-family unless otherwise approved by the Director of Engineering. All design population assumptions must be reviewed with and approved by the Director of Engineering.

Where development is expected to exceed these guidelines the actual development parameters shall govern. For development within existing areas the design basis shall be based on the greater of a) flows from the present development combined with anticipated flows for extension of the water to both developed and undeveloped lands and b) flows from future development of the catchment area to full OCP density and land-use.

Residential

Peak Hour Demand (H)	=	1,600 Litres per capita per day (Lpcpd)
Maximum Day Demand (D)	=	800 Lpcpd
Average Day Demand (A)	=	400 Lpcpd

Industrial, Institutional & Commercial

Flows are to be based on the greater of existing or proposed development requirements and approved by the Director of Engineering. Minimum values for average day demand shall be equivalent to the sewage flows outlined in Table 4.1.

For major subdivision development, it is suggested that the Engineering Department be consulted regarding take-off location(s). Any proposed flow requirements must be approved by the Director of Engineering.

5.2.2 Fire Flow Demand

Fire flow requirements are to be determined as outlined in the latest edition of “Water Supply for Public Fire Protection – A Guide to Recommended Practice” published by the Fire Underwriters Survey. The fire flows are to be determined based on both existing and future development conditions.

All fire flows are to be available to the furthest distance within the site from the service location and/or at the point of highest elevation.

All proposed fire flows are to be approved by the Director of Engineering. In addition all commercial and multi-family developments are to be reviewed by the City’s Fire Department.

5.3 Hydraulics

5.3.1 Level of Service

The water supply distribution system shall be designed to maintain an operating pressure of the particular pressure zone with a minimum pressure of 280 kPa during all except fire events. With the combination of maximum daily demand and the specified fire flow, the minimum residual water pressure shall be 140 kPa at the required fire hydrants and at all other nodes in the system.

Every effort should be made to provide loops in the distribution system. Dead ends will only be permitted upon approval of the Director of Engineering.

5.3.2 Level of Analysis Required

The Consultant shall complete a hydraulic analysis of the proposed distribution system showing flows and pressures during peak hour and maximum day plus fire flow scenarios.

The pipe and node data, including the domestic flows, and fire flows, shall be provided to the City.

The City will supply the Consultant with the maximum design pressure on which to base calculations where available.

For local distribution systems, sources may be assumed to be the nearest water mains that are 300 mm diameter or larger. Available heads and flows will be confirmed by the Engineering Department through overall water network analysis or verification by hydrant flow test data at the discretion of the Director of Engineering.

5.3.3 Formula

The analysis of the proposed distribution system shall be carried out using the Hazen-Williams formula:

$$Q = (C D^{2.63} S^{0.54}) / 278,780$$

Where: Q = Rate of flow in l/s
C = Roughness coefficient
D = Internal pipe diameter in mm
S = Slope of hydraulic grade line in m/m

Appropriate pipe coefficients for existing and proposed pipe shall be approved by the Director of Engineering.

5.3.4 Velocity and Headloss

In all water distribution system analysis the Consultant shall consider the impacts of surge pressures. For mains 400mm and larger, the Consultant shall keep velocities below 3 m/s.

5.4 Piping

5.4.1 Size

The minimum size of water mains shall be 150 mm diameter in single family residential areas and 200 mm in commercial or industrial areas. Any variations shall be approved by the Director of Engineering.

5.4.2 Deflection

Deflection at pipe joints is permitted as outlined in the City approved edition of the MMCD and City of New Westminster Supplementary Specifications and Detail Drawings unless otherwise approved in writing by the Director of Engineering.

5.4.3 Location

Mains shall be referenced to the street or right-of-way and uniformly located within it. Any variations to the minimum separation stated herein require approval of the Director of Engineering.

Where the main is to cross storm sewers and sanitary sewers the requirements of the Province of BC or other governing agency shall govern. In particular the 3 m separation from sewer mains must be maintained. For crossing of gas mains, pipe lines or similar installations, the water main normally shall be laid above such installations, with a minimum of 300 mm vertical clearance between the water main and the other installation in all cases unless otherwise approved. Consult with BC Gas and other utilities to establish their minimum clearances.

Where the water main is parallel to utilities other than storm and sanitary, the water main shall have a minimum clear separation of 1.0 metre from the other utility.

The above vertical and horizontal clearance requirements are minimum for City requirements. The Consultant must confirm that these requirements meet the specifications of each affected Utility.

Water mains are to be located within the road right-of-way as shown on the Standard Road Cross-sections. If, for any reason, the location shown is impractical, the offset may be changed with the approval of the Director of Engineering, but it shall in any case be located clear of curb and gutter. Wherever possible, water mains shall be kept parallel to the property line, and the distance from the property line is to be shown on the drawing.

The elevations of all existing underground utilities crossing the proposed water mains shall be confirmed in the field and shall be shown on the profile and/or plan.

Where the water main being installed has future extension possibility a running line shall be chosen to accommodate it.

Invert grades of water mains shall be such as to assure proper clearance between top of valves and valve box covers.

5.4.4 Crossings

Wherever the main crosses railway or highway rights-of-way, the pipe shall be installed in an encasement pipe to the approval of the relevant authority.

When a water main crosses a Railway a steel encasement pipe shall be used for that portion of the main, extending for the full width of the right-of-way and gate valves installed at approved locations on either side of the crossing. Field Loc Gaskets or other approved joint restraint device shall be used within the encased section.

5.5 Associated Items

5.5.1 Thrust Restraint

Thrust restraint must be provided for all valves, tees, bends, and caps. The Consultant must design thrust blocks or mechanical joint restraint systems with due regard for pipeline pressure transients and expected test pressures. Thrust block design calculations and soil bearing pressures must be shown on the design drawings. Where mechanical thrust restraint systems are used the required length of restrained pipe must be shown on the design drawings. In areas where settlement is of concern (i.e. lowland areas) mechanical thrust restraints are preferred.

5.5.2 Isolation Valves

All water systems shall include valves so the maximum length of main between valves is 200 meters in residential districts and 150 metres in all other districts. Feeder mains larger than 350mm may have increased valve spacing at the discretion of the Director of Engineering.

In addition, water valves shall be located such that no more than 1 fire hydrant will be affected during isolation of a section of the water main.

Valves shall be installed at all branches or intersections. Where a new main is connected to an existing main, valves on both the new and the existing mains shall be installed where necessary.

In general all valves on mains 300mm and smaller are to be resilient seated gate valves at the same diameter of the pipe, unless otherwise approved by the Director of Engineering. For mains

350mm and larger, valve configurations, types, and sizes to be approved by the Director of Engineering.

5.5.3 Hydrants

Fire hydrants shall be spaced not more than 150 m apart in single family residential areas, and 100 m apart in commercial and industrial areas.

The Consultant must ensure sufficient hydrants and access paths are provided to deliver the required fire flows. Hydrant locations must be approved by the Fire Department.

Hydrants shall be positioned so as to be completely accessible, and in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized. A gate valve shall be provided at the main on all hydrant connections.

Hydrants shall be offset 0.5m from the adjacent property line, unless otherwise approved. They must be designed and installed in accordance with Supplementary Specifications and Detail Drawings.

Hydrants shall be provided with thrust restraint to the approval of the Director of Engineering.

5.5.4 Air Valves

Automatic air relief valves shall be installed at all summits in the main in accordance with good engineering practice.

5.5.5 Flushouts/Blow-offs

Blow-off installation must be incorporated in all dead-end mains as approved by the Director of Engineering.

5.5.6 Service Connections

Location

Service connections shall be installed in accordance with the City approved edition of the MMCD and Supplementary Specifications and Detail Drawings.

Services should be kept clear of sewer connections and driveways, and should be installed at 90 degrees to the property line complete with water meter setter, service box, curb stop and associated items, as per Supplementary Specifications and Detail Drawings.

Where service location will conflict with fire hydrants or other obstructions, the locations may be specifically offset. Service connections shall not be connected to 400 mm or larger mains unless specifically permitted by the Director of Engineering.

Size

The diameters of service connections shall be at least 19mm.

Larger sizes shall generally be used to serve all sites other than single family residential and shall be designed individually for the particular requirements in each case. All connections 100mm and larger shall be joint restrained from tee at main to property line.

Service connections to parks, where required, shall be in accordance with Parks Department requirements.

Cover

Service connections shall have a minimum cover of 0.75 metres.

Connection to Main

Services shall be connected to the main by an approved service saddle, installed in the main as part of the service. The saddle shall be tapped with AWWA threads to accept the corporation stop.

Water Meters

Water flow meters are required for all water connections as set out in the Water Works Bylaw. The location, size and the remote reading device of the flow meter shall be as specified by the Director of Engineering.

Ownership of the meter shall be in accordance with the Water Works Bylaw.

5.5.7 Street Ends

At the end of a street which may be extended in the future, the water main shall, whenever possible, extend at least 1.5 metres beyond the end of the paving.

Water mains shall be terminated with a gate valve, followed by a 6 metre length of pipe, thrust restraint and blow-off assembly.

5.5.8 Cul-de-sacs

Water mains ended at a cul-de-sac shall be terminated by 100 mm capped end complete with blow-off as per Supplementary Specifications and Detail Drawings. Every effort shall be made to loop water mains unless approved by the Director or Engineering.

5.6 PRV Stations

Guidelines and specific requirements for pressure reducing stations shall be obtained from the Director of Engineering prior to undertaking design.

The location of such stations shall be determined by the Director of Engineering.

5.7 Corrosion Protection

A geotechnical soils analysis shall be completed by a Professional Engineer on the alignment of any proposed metallic pipeline and in areas of corrosive soils identified by the Director of Engineering.

For areas identified as corrosive, measures shall be taken in the design and construction to prevent the corrosion of the pipeline and appurtenances. In general, within the lowlands area polyethylene bags and wrapping of cast iron fittings and bolts is required as a minimum. The Director of Engineering must approve corrosion protection measures.

5.8 Connection to Existing Mains

All tie-ins to existing water mains shall be done by the City.

6. LIGHTING AND TRAFFIC SIGNALS

6.1 General

The purpose of these design criteria is to establish the lighting and traffic signal design standards used for all projects undertaken within the City of New Westminster.

In this document, the New Westminster Electrical Utility is referred to as the Supply Authority.

6.2 Visual and Environmental Issues

The Consultant shall be fully knowledgeable with the IESNA RP-33-99 – Lighting for Exterior Environments. The City intends to apply sections of this document to outdoor lighting within the City as determined by the Director of Engineering.

Obtrusive light, light trespass, light pollution and environmental zones are key project design issues that will be considered by the City. Engineering Consultants and Architects will utilize luminaires and design techniques that will mitigate these issues. The City prefers fixtures that have full cut-off optics, but if a full cut-off optical system is not available in the selected fixture, then the Director of Engineering may consider the use of a partial cut-off optical system.

6.3 Codes, Rules and Permits

For all projects, the Consultant shall:

- a) Comply with the rules of the latest edition of the Canadian Electrical Code and any bulletins published by the Electrical Safety Branch, of the Province of BC.
- b) Comply with the laws, rules and recommendations of agencies, including the Canadian Standards Association (CSA), the Supply Authority, Workers Compensation Board and regulatory City and governmental authorities.
- c) Construct the lighting and traffic signal system in accordance with the City approved edition of the Master Municipal Construction Documents (MMCD) and the City's Supplementary Specifications and Detail Drawings for lighting and traffic signals.
- d) Coordinate all works with the Supply Authority to ensure minimum clearances from their overhead and underground systems are achieved and exact service locations are confirmed.
- e) Have all submitted plans sealed by a Professional Engineer registered with the Association of Professional Engineers and Geoscientists of British Columbia.

6.4 Illuminance Levels

Roadways, parking facilities, pedestrian walkways and bikeways shall be illuminated for safety and to produce accurate and comfortable nighttime visibility.

The City has standardized on the illuminance method for its lighting designs. The recommended minimum average maintained horizontal illuminance levels, uniformity ratios and veiling luminance ratios used by the City are listed in the ANSI/IES RP-8-00 – National Standard Practice for Roadway Lighting. Luminance and small target visibility (STV) methods shall be used where a specific circumstance warrants their use. Use of these alternate methods must meet the approval of the Director of Engineering.

Tables in RP-8-00 to be referenced for roadway lighting are:

- Table 2: Illuminance Method - Recommended Values.
- Table 9: Recommended Illuminance for the Intersection of Continuously Lighted Urban Streets.

Tables in RP-8-00 to be referenced for pedestrian walkway and bikeway lighting are:

- Table 5: Recommended Values for High Pedestrian Conflict Areas.
- Table 6: Recommended Values for Medium Pedestrian Conflict Areas.
- Table 7: Recommended Values for Low Pedestrian Conflict Areas.
- Table 8: Recommended Values for the Pedestrian Portion of Pedestrian Vehicular Underpasses and Exclusive Pedestrian Underpasses.

Prior to starting a project the Consultant shall verify the Road Classification (i.e.; arterial, collector, local etc) and the Pedestrian Conflict Area Classification with the City. Definitions of these terms may be found in RP-8-00 - 2.0 Classification Definitions.

The road classifications, illuminance levels, ratios, road and pedestrian conflict areas proposed for each roadway and pedestrian walkway/bikeway shall be listed in a table format on the design drawings.

The Consultant shall calculate all illuminance levels and ratios as noted under Section 6.8 Lighting Calculations. For calculations where the roadway surface is asphalt, R3 road surface classification shall be used and for calculations where the surface is concrete, R1 road surface classification shall be used. Refer to RP-8-00 – Table 1: Road Surface Classifications.

Parking facilities shall be illuminated in accordance with the IESNA RP-20-98 – National Standard Practice for Lighting of Parking Facilities.

Tables in RP-20-98 to be referenced are:

- | | |
|----------|--|
| Table 1: | Recommended Maintained Illuminance Values for Parking Lots. |
| Table 2: | Recommended Maintained Illuminance Values for Parking Garages. |

6.5 Light Pole Spacing

Spacing and location of poles shall be governed by road width, road configuration, intersecting property lines, luminaire photometrics, mounting heights and recommended illumination levels. Maintaining clearances to overhead and underground Utilities in accordance with Utilities Standards, Canadian Electrical Code, Workers Compensation Board and the BC Electrical Safety Act shall also govern pole spacing and height.

Poles shall be generally arranged in a one-side, staggered or opposite spacing based on the road classifications listed in Table 6.1 in this Section. In circumstances where overhead lines are in conflict with streetlight poles, one-sided spacing may be considered if the required illumination levels and ratios can be achieved. Alternative pole spacing to those listed in Table 6.1 shall meet the approval of the Director of Engineering.

Where possible, poles shall be located close to property lines and shall avoid being placed in front of residential windows. Poles shall be located at a minimum of 1.5m from the start/end of curb returns and at a minimum of 1.5m from the widest part of the driveway, including the flare. Poles shall be located in favour of intersections, property corners and pedestrian walkways; however, the area between adjacent driveways should be avoided where possible.

Special considerations shall be given to the relative positioning of luminaires and trees so that a uniform light distribution is maintained on roadways and walkways. The minimum separation between poles and trees shall be 6.0m. The placement of poles shall have priority over the placement of trees.

Streetlight poles shall be offset as shown on the City's "Typical Road Cross Section Supplementary Standard Drawings". Alternate offsets shall meet the approval of the Director of Engineering. On existing roadways where the standard offsets cannot be maintained due to utility conflicts, the Consultant shall make recommendations for alternate locations to the City and obtain approval prior to proceeding.

Where possible, luminaires shall be installed on all signal poles to maximize intersection illumination. The pole spacing at intersections shall therefore be governed by the signal pole locations. Additional street light poles may be required to meet the required intersection lighting levels.

Table 6.1 Light Pole Arrangement

Road Classification	Light Pole Arrangement
Major (Arterial)	Staggered/Opposite/*Median
Collector	Staggered
Local	One Sided
Pedestrian Walkways/Bikeways	One Sided

* Median arrangement may be approved at the discretion of the Director of Engineering.

6.6 Luminaires, Poles, Wattages And Light Source

Luminaire type, pole type and wattages are as listed in Table 6.2.

When expanding an existing street lighting system, the wattage and mounting height should match those previously installed if the road classification and pedestrian conflict area is identical; unless otherwise advised by the Director of Engineering.

Luminaire wattage, distribution type and voltage shall be noted on the Design Drawings.

The preferred operating voltage for the street lighting system is 120/240V, single phase, 3 wire. Alternate voltages must meet the approval of the Director of Engineering and the Supply Authority.

All luminaires shall be flat glass, IESNA full cut-off type; alternate cut-off classifications shall meet the approval of the Director of Engineering. The Consultant shall select the most effective IESNA luminaire distribution type (i.e.; Type 2, Type 3 etc.) to suit the roadway geometrics. Cobra head luminaires shall be used for all roadway lighting applications with the exception of those defined by the Director of Engineering as Decorative Street Lighting areas (refer to Section 6.7). Cobra head roadway luminaires shall be Ministry of Transportation recognized product.

The light source for luminaires used on roadways and parking facilities shall generally be high pressure sodium (HPS). The light source for luminaires used on pedestrian walkways and bikeways and at pedestrian crossings and pedestrian actuated traffic signals shall generally be Metal Halide (MH). Alternatively, light sources may differ in designated Decorative Street Lighting areas, however any deviation from those noted above must meet the approval of the Director of Engineering.

For development projects requiring pedestrian walkway/bikeway lighting the cost for the supply and installation of the lighting system shall be borne by the Developer. The Consultant shall consult the Director of Engineering for specific fixture type, colour and model number information.

Table 6.2 Luminaire Mounting and Wattage

Road Classification	11.0m High Davit Pole with Cobra Head Luminaire	9.0m High Davit Pole with Cobra Head Luminaire	7.5m High Davit Pole with Cobra Head Luminaire	6.0m High Pedestrian Pole and Luminaire
Major (Arterial)	250W/200W	250W/200W/ 150W	(*)	-
Collector	250W/200W	150W	(*)	-
Local	-	-	100W	-
Pedestrian Walkways/Bikeways	-	-	-	100W

(*) For use to avoid conflicts with overhead lines, in all cases the use of shorter davit poles must meet the approval of the Director of Engineering.

6.7 Decorative Street Lighting

The City has designated areas in which Decorative Street Lighting and other electrical features such as pole and tree receptacles and irrigation systems are utilized to enhance the streetscape. Areas such as Columbia Street and Port Royal have decorative lighting specific to their neighbourhood. The City shall provide the Developer with generic details of the decorative lighting, the requirements for any other electrical features and a list of recognized suppliers.

The Consultant will be required to submit the following pole and luminaire information as part of the decorative lighting design:

1. Shop drawings (in digital format) of the light poles proposed complete with pole design criteria, sealed by a Professional Engineer. Pole shall be designed to AASHTO 2000 with a wind pressure of 420 Pascals.
2. Detailed product sheets, information and specifications of the luminaires and lamps proposed. Note that all luminaire ballasts shall be CWA or CWI.
3. Detailed product sheets and information on pole accessories (banner arms, receptacles, decorative castings etc.).

Where metal halide light source is required “pulse start” technology shall be considered and used if beneficial to the longevity of the lamp service.

6.8 Lighting Calculations

- a) Lighting calculations are based on the illuminance methods described in RP-8-00. Lighting calculations shall be completed using suitable computer lighting design software designed to carry out the required calculations by inputting the luminaire manufacturers IESNA formatted photometrics. The IESNA photometric files for the City approved luminaires are available in electronic format through the specific luminaire Manufacturer(s).
- b) Computer lighting calculations for roadways shall be undertaken as described in Figure A4 of the RP-8-00.
- c) Grid spacing for pedestrian walkways/bikeways lighting calculation shall be maximum 1m.
- d) Lighting calculations shall be based on maintained levels using initial rated lamp lumens and the total light loss factor (TLLF) of 0.72. Refer to Table 6.3 for the factors included in the TLLF. The TLLF shall be considered as the total maintenance factor.
- e) The City reserves the right to obtain a hardcopy of the computer lighting calculations from the Consultant.

Table 6.3 Total Light Loss Factor (for HPS only)

Lamp Lumen Depreciation (LLD) ⁽¹⁾	Lamp Dirt Depreciation (LDD) ⁽¹⁾	Lamp Component Depreciation (LCD) ⁽²⁾	Equipment Factor (EF) ⁽³⁾	Total Light Loss Factor (TLLF)
0.82	0.94	0.98	0.95	0.72
Notes: ⁽¹⁾ Based on a 4-year maintenance cycle ⁽²⁾ Degradation of the reflector and refractor ⁽³⁾ Effect of ambient temperature on the lamp including the ballast and lamp factors TLLF = LLD x LDD x LCD x EF				

6.9 Voltage Drop

The voltage drop in an installation shall not exceed 5 percent from the supply side of the Supply Authority to the point of utilization. Calculations shall be based on the nominal line voltage of the system and the VA load of the luminaire ballast.

6.10 Traffic Signals

- a) Traffic signal designs are highly specialized and shall therefore be prepared by a qualified Consultant recognized by the City.
- b) Prior to starting a traffic signal design the Consultant shall contact the City to confirm specific requirements of the signal, timing and coordination plans, operational requirements and specific issues or concerns.
- c) In instances where the project capital costs are borne by the City, traffic signal controllers and specialty signal equipment shall be supplied by the City. The Consultant shall consult the City to determine exactly what equipment shall be supplied.
- d) In the case of private development projects requiring traffic signals, the cost for the design and the supply and installation of traffic controllers and specialty signal equipment shall be borne by the Developer.
- e) Traffic signals shall be designed in general accordance with Sections 402.6 of the Ministry of Transportation Electrical and Traffic Engineering Manual. Contrary to this manual the City uses NEMA phase designations as opposed to the Ministry movement designations.
- f) Traffic signal designs shall also conform to the British Columbia Motor Vehicle Act and the Manual of Uniform Traffic Control Devices for Canada.
- g) Traffic Engineering and timing/coordination plans shall be provided by the Developer and prepared by a qualified Consultant, recognized by the City.
- h) Guidelines for pedestrian actuators and accessibility are provided in the documents "*Signalized Intersection Accessibility Guidelines*" and "*Curb Cut Installation Guidelines*."
- i) If traffic signal control devices, pre-ducting of future traffic signal control devices or traffic signal communications conduit/cable are required for a proposed development, at the discretion of the Director of Engineering (or his/her delegate) these may be designed by City staff and their construction may be included with other City work related to the project. The City requires the Developer to retain an electrical consulting firm to prepare the design drawings then it is assumed that the Consultant has sound knowledge of traffic signal design. All design and construction costs shall be the responsibility of the Developer.
- j) All new conduit crossing existing roadways shall be installed using trenchless technology and shall be a minimum of 1.00m deep unless otherwise specified.

- k) All drawings submitted to the City for review and approval shall be sealed by a Professional Engineer registered with the Association of Professional Engineers and Geoscientists of British Columbia.
- l) All traffic signal poles standards and luminaries to be used shall be confirmed with the Director of Engineering. Decorative traffic signal poles shall be used in designated areas, as directed by the Director of Engineering.
- m) The City requires that every effort be made to incorporate the traffic signal controller cabinet/base into the architecture and/or the landscaping of the new development without losing sight of the need to have the cabinet located so that clear visibility can be maintained between the signalized intersection and the cabinet.
- n) All designs shall meet or exceed requirements set forth in the British Columbia Motor Vehicle Act and the Manual of Uniform Traffic Control Devices of Canada.

6.11 Conduit

- a) Conduits shall generally be parallel or perpendicular to the roadway, and routed to run in a direct line between adjacent poles or junction boxes. The exception would be where existing or proposed trees conflict with the conduit run.
- b) There shall be a maximum of 2-90° bends in a conduit run. Where this cannot be avoided junction boxes shall be used.
- c) Street lighting conduits shall be minimum 30mm diameter RPVC. Signal conduits shall be minimum 50mm RPVC and minimum 25mm RPVC for loop stub-outs. Service conduits shall be minimum 50mm RPVC.

6.12 Interconnect Conduit

The Consultant shall confirm the requirements for and coordinate the design of a traffic signal interconnect system if required with the Director of Engineering.

6.13 Junction Boxes

- a) Approved plastic junction boxes shall be used as follows:
 - 1) Where the maximum number of 90° bends in a conduit run is exceeded.
 - 2) Where branch conduit runs are required.
 - 3) In conduit runs over 100m.
 - 4) At service panels.

- b) Approved junction boxes shall be used for traffic signal installations only in the quadrant where the traffic controller is to be installed.

6.14 Conductors

- a) For the purpose of standardization and to accommodate future expansion, street lighting feeder conductors shall be No. 6 RW90 red, black, and white. The bonding conductor is to be No. 8 RW90 and green in colour. The use of alternate conductor sizes will require the approval of the Director of Engineering.
- b) For traffic signal installations multi-conductor cable shall be used. The cable shall run continuous from the traffic controller to each pole with no splices.

6.15 Service Equipment

- a) Electrical service shall be determined in consultation with the Supply Authority.
- b) Street lighting systems are controlled with individual photocell located on each luminaire. Under certain circumstances, the lighting system may be controlled with a lighting contactor and photocell, in which case the photocell would be located on the luminaire nearest the service panel. The use of lighting contactors shall meet the approval of the Director of Engineering.
- c) Service panels for street lighting systems shall have a 60A – 2P breaker and shall be mounted in a service base as shown on the MMCD Standard Drawings. Smaller size service panels must meet the approval of the Director of Engineering and must be detailed on the Drawings in the form of a “Wiring Diagram” or “One Line” Diagram.
- d) Where possible traffic signal and street lighting systems shall be fed from the same service panel. The combination street lighting and traffic signal service panel shall have a 100A -2P main breaker, 2 x 60A –1P sub-breaker for street lighting and 1 x 60A –1P sub-breaker for traffic controller power. The service panel shall be mounted in a service base or on the side of a streetlight pole or post located near the traffic controller; no signal equipment shall be mounted on the same pole as the service panel. Refer to MMCD Standard Drawings.
- e) All services shall be 120/240V single phase, 3 wire.

6.16 Concrete Bases

- a) When selecting pole base locations search out proposed or existing utility locations and identify sensitive tree root zones to avoid conflicts. The pole base shall be positioned outside

the drip line of trees proposed for retention. The Consultant shall coordinate the design with the Landscape Architect where applicable.

- b) The Consultant shall select a concrete base to suit the required pole from those shown in the MMCD Standard Drawings. Where a custom base is required to accommodate unusual soils conditions or to avoid underground utilities and sensitive tree root zones, the custom base design shall be sealed by a Professional Engineer and meet the approval of the Director of Engineering.
- c) Avoid running more than two conduits into a streetlight pole base. Where required a junction box shall be used. An exception to this requirement may be granted where the pole base functions as the service base.
- d) Ground rods shall be incorporated into each concrete base utilizing a 25mm RPVC conduit sleeve.
- e) Spread footing shape bases are commonly used in the Queensborough area, the suitability of these types of bases shall be determined by the Consultant.

6.17 Design Submissions

- a) Drawings shall be neatly organized, clear and easy to follow. The drawings shall contain all information required for the Contractor to accurately price and carry out the installation.
- b) Where the signal or street lighting design is part of a roadworks package it shall be submitted for review to the City along with the roadworks drawings. Where the street lighting or signal is not part of a roadworks package it shall be submitted along with any contract documents to the City for review. No designs shall be constructed without prior City review and written approval.
- c) Drawings submitted to the Supply Authority shall be in AUTOCAD format consisting of only the following information:
 - 1) Property lines
 - 2) Curbs
 - 3) Sidewalks
 - 4) Other utilities
 - 5) Utility poles, service boxes, etc..
 - 6) Street lighting, traffic signal details
- d) As-built drawings to be submitted to the Supply Authority prior to energization of streetlights.

7. TRANSPORTATION

7.1 General

The Official Community Plan, Area Plans, Trail and Greenway Master Plan, Bicycle Plan, Long Range Transportation Plan and any other related planning documents shall be consulted to ensure long-term transportation plans and objectives are addressed by each design.

The City has the following road classifications:

- Major Arterial Road/Major Road Network (MRN) (divided and undivided)
- Local Arterial Road
- Collector Streets
- Local Streets (residential; commercial; industrial)
- Lanes

The classification of all impacted roads shall be confirmed with the Director of Engineering. An up-to-date road classification map is available.

7.2 Transportation Impact Study

Major development proposals may require the Developer to engage the services of a traffic engineering consultant for the preparation of a Transportation Impact Study of the proposed development.

If the Director of Engineering determines that a study is required, the Consultant will submit a proposed terms of reference for approval and may include all or some of the following requirements.

7.2.1 General Requirements

- a) General description of location; local area (surrounding roads) and distribution system (regional transportation system leading to location).
- b) Identification of other development sites using same distribution system.
- c) Focus should be on City concerns but regional facilities must be critically analyzed as well.

7.2.2 Data Requirements

- a) Data requirements should be identified along with availability and sources (City of New Westminster, GVRD, etc.).
- b) Data collection from sources or unavailable data may have to be gathered by the Consultant.

7.2.3 Transportation Analysis

Existing Situation

- a) Weekday and weekend (Saturday) traffic volumes for peak hour a.m., p.m. and Saturday.
- b) Distribution of trips (origin and destination of trips for New Westminster and surrounding areas).
- c) Transportation System performance (intersection, laning configuration, capacity analysis).
- d) Identification of existing problems (delays, both local and regional, e.g., bridges).
- e) Transit service.
- f) Cycling Facilities/Routes.
- g) Pedestrian Facilities.

Development Analysis

- a) Development description (floor space, employees, services, type of establishments, etc.).
- b) Description of other developments and adjacent land use.
- c) Site plan/layout: interaction with surrounding road system.
- d) Parking, internal circulation and loading design.

Traffic Generation

- a) By site.
- b) By other area developments.
- c) Identify distribution of trips (origin and destination within City and external).
- d) Growth rates based on population, land use, labour force and employment projections.

Future Situations

- a) Projected traffic volumes for weekday and weekend peak hour a.m., p.m. and Saturday.
- b) Distribution of projected traffic volumes and origin and destination of trips.
- c) Transportation System performance (intersection, laning configuration, progression and capacity) under projected volume conditions.
- d) Identification of transportation system requirements for future conditions.

- e) Future transit needs/services.
- f) Cycling Facilities.
- g) Pedestrian Facilities.

Conclusions

- a) Impact on transportation system both in New Westminster and externally.
- b) Transportation System requirements for all modes of transportation – automobile, transit, bicycle and pedestrian.
- c) Off-site transportation impacts; and
- d) Mitigation measures (included traffic calming).

Periodic reviews should accompany the progress of the study so that periodic evaluation by the Director of Engineering can contribute to the various study stages.

7.2.4 Concerns to be Addressed

Some of the concerns which should be emphasized in the transportation impact study are:

- a) Focus on City concerns
- b) Identify and quantify total trips generated by proposed developments
- c) Assignment of the likely distribution of origins and destination to City and regional network within New Westminster
- d) Impact on traffic operations on adjacent roads. All intersections and regional facility approach roads should be assessed where the volume of traffic generated by the proposed development will exceed 100 vehicles per hour for peak periods
- e) Impact on adjacent neighbourhoods. Identify the potential for short-cutting traffic and other impacts on adjacent neighbourhoods, and identify appropriate traffic calming measures to mitigate these impacts
- f) Accessibility by transit, cycling and walking. Identify appropriate transit, bicycle and pedestrian facilities to accommodate and encourage access by no-automobile modes, and maximize safety for these modes.
- g) Traffic conditions assumed should be in accordance with land use, population, labour force and employment projections.

7.3 Transit

The Consultant shall confirm the requirements for transit service and other amenities, as outlined by TransLink, for all roads designated as existing or future bus routes. The Consultant shall also identify areas where other design objectives, including traffic calming and bicycle and pedestrian access, that may conflict with the requirements of TransLink. These requirements shall be reviewed and approved by the Director of Engineering.

7.4 Traffic Calming

Appropriate traffic calming measures shall be considered and may be required by the Director of Engineering. Traffic calming design shall conform to the latest edition of the Transportation Association of Canada (TAC) / Canadian Institute of Transportation Engineers (CITE) "Guide to Neighbourhood Traffic Calming."

Alternative street designs may be considered as an option in lieu of traffic calming as approved by the Director of Engineering.

7.5 Bicycles

All bicycle facilities (wide curb lanes, bicycle lanes and pathways) shall be designed in accordance with the Geometric Design Guide for Canadian Roads published by the Transportation Association of Canada (TAC), latest edition, the City's Bicycle Plan and all regional or provincial bicycle facility guidelines (i.e. TransLink Regional Bike Plan and Provincial Cycling Design Guidelines). Requirements for bicycle facilities shall be confirmed with the Director of Engineering.

7.6 Access Limitations

Certain access restrictions apply to new and existing streets in New Westminster as outlined in this section.

7.6.1 Existing Major Intersections

Major intersections are those of two adjoining arterial roads or one arterial and one collector road.

Vehicular accesses to corner sites at Major Intersections shall be strictly controlled pursuant to City Bylaws and TAC Guidelines. Specifically:

- a) Consolidation of lands at Major Intersections is encouraged and subdivision of lands is discouraged.

- b) Where re-development occurs at a Major Intersection, the Developer shall minimize the number of access points to the road network.
- c) Vehicular accesses off arterial roads are to be minimized or avoided.
- d) On arterial or collector streets, all vehicular accesses shall be in accordance with TAC Guidelines.
- e) For sites located at the intersection of two roads of different hierarchical ranks, vehicular access shall be off the lower ranked road.
- f) Where a development is on an arterial road and near a Major Intersection, it shall allow for future road widening at the intersection.

7.6.2 Driveways

Certain roads have access restrictions. New driveway access onto such arterial roads will not be permitted. Alternate access via lanes, frontage road, etc.

7.6.3 Intersections at Major Arterial Roads

The Engineering Department shall be consulted with regard to the need for traffic signals, pedestrian signals, left and right turn lanes and pre-ducts for future signals.

If pre-ducting is necessary for future traffic signal or pedestrian signal installation, the pre-ducting layout should be shown on the street light construction plans.

7.6.4 Cul-de-Sacs

The length of the panhandle of a cul-de-sac shall be not more than 90 metres. Any increase in this will require Fire Department approval and provision of an emergency access.

Where space permits in residential areas, on-site parking may be provided at the central island of the cul-de-sac on a local residential road. The central island shall be complete with selected trees, paving blocks or a combination of both. The proposed treatment shall reflect a low maintenance cost.

7.6.5 Lanes

Lanes are generally required for all residential properties that front an arterial road.

7.6.6 Pedestrians

Adequate consideration should be given to the needs of pedestrians and transit passengers.

The internal pedestrian circulation system should be designed, in consultation with City staff.

7.6.7 Disabled Access

Standard wheel chair ramps shall be provided and located at the curb returns at all road intersections. Two separate sidewalk letdowns are preferred to the single wrap around let down design.

Standard wheel chair ramps shall also be provided wherever walkways or crosswalks intersect roads.

Sidewalks across driveways should be designed so as to avoid a crossfall of more than 2%. Design options include placing the slope of the driveway between the sidewalk and curb or at the back of the sidewalk, rather than across the sidewalk, or dropping the elevation of sidewalk to meet the elevation of the driveway.

7.6.8 Emergency Access

In consultation with the Fire Department, the Director of Engineering may require the construction of emergency access in urban developments. Any emergency access must be able to support a wheel axle bearing load of nine decimal one (9.1) tonnes.

7.7 Road Cross Sections

The road standard drawings provide a guide for road cross section requirements. The Consultant shall also consult the relevant local area plans for area specific requirements and obtain approval for the proposed road cross section with the Director of Engineering.

For roads that are designated as bicycle routes in the Bicycle Plan, the dedicated rights-of-way shown in the Table, shall be widened to accommodate cyclists in accordance with section 7.5.

If the proposed works involve extending an existing road, at the Director of Engineering's discretion the existing road width and characteristics may take precedence over these cross sections for the remainder of the block.

8. ROADWORKS SYSTEM

8.1 General

This section is to be read in conjunction with Section 7 Transportation. This section expands on the contents of Section 7 to provide additional geometric and structural requirements.

The design of roads and highways shall conform to these guidelines and:

- 1) Geometric Design Guide for Canadian Roads published by the Transportation Association of Canada (TAC), latest edition,
- 2) City of New Westminster Bylaws, and
- 3) Provincial legislation including the Motor Vehicle Act.

The Consultant shall submit a geotechnical report with each road design that outlines the existing road conditions and recommended road structure. Due to the unique soil and topographic conditions of Queensborough area of New Westminster, it is essential that roads be designed to provide adequate drainage and added safety in areas having unstable soil stratas. If the underlying material is peat, a special stabilization method should be investigated, i.e., pre-load or peat removal. For this reason, the City stipulates the basic minimum required asphalt-concrete, gravel and road base thicknesses (these thicknesses are shown on typical road cross-sections. The Consultant shall verify road structure design based on the geotechnical report, to the satisfaction of the Director of Engineering. The Director of Engineering reserves the right to change the asphalt-concrete and road base thicknesses, if deemed necessary, as the result of unstable sub-grade.

The surface course of asphalt-concrete is usually placed at a later date (one year) after all the service connections, etc., are completed.

8.2 Geometric Design Requirements

8.2.1 Design Speeds

The following minimum design speeds must be provided for both vertical and horizontal alignment, unless otherwise approved by the Director of Engineering:

<u>Road Classification</u>	<u>Design Speed</u>
Major Arterial Road – Divided	70 kph
Major Arterial Road – Undivided	60 kph
Local Arterial Road	60 kph
Collector Street	50 kph
Local Street	50 kph
Lanes	30 kph

8.2.2 Design Gradients

A smooth grade line with gradual changes, consistent with the class of road and the character of the terrain, is preferable to an alignment with numerous breaks and short lengths of grade. The “roller-coaster” or “hidden dip” type of profile shall be avoided.

At intersections of roads of unequal classification, the grade of the road centreline of higher designation will be maintained and the grade of the other road centreline will be altered to conform to the crown of the more major road.

At intersections of roads of equal classification, the grade of the road centreline of each road will be constructed level for the width of the intersection.

8.2.3 Cross Slopes and Superelevation

Cross slopes for all roadways shall not be less than 2% or more than 4% in the direction indicated on the appropriate Road Cross Sections. The crown shall be in the centre of the pavement. A standard “V-Shaped” cross section should be used for lane design.

Superelevation is to be provided as per appropriate TAC Standards unless otherwise directed by the Director of Engineering.

8.2.4 Drainage

On roadways with curbs, drainage is the essential consideration. Longitudinal gradients must be set to eliminate excessive accumulation of water on the pavements.

Unless otherwise specified the following minimum gutter line gradients shall be used:

Road	0.36%
Cul-de-Sac	0.50%.

To provide drainage for flat roads that require false grading, the maximum gradient should not exceed 0.56% for roads and 1% for cul-de-sacs.

Unless otherwise directed by the Director of Engineering, these gradients shall be used for all normal conditions of rainfall and outlet spacing. In special cases, a hydraulic analysis should be made to determine whether water will flow at an undesirable depth in the gutter.

8.2.5 Vertical Curves

Vertical curves shall be designed in accordance with the latest edition of TAC, governed by the design speed of the road or laneway.

8.2.6 Horizontal Curves

Horizontal curves shall also be designed in accordance with the latest version of TAC, governed by the design speed of the road or laneway.

8.2.7 Driveways

Driveways are to be designed in accordance with City bylaws and the Supplementary Specifications and Detail Drawings. For access requirements refer to Section 7.

All driveways are to include a landing area at the entrance. This landing area is to be 3 metres long, measured from the furthest of the, existing or future, rear sidewalk or curb edge into the site, at a maximum grade of 5%. The maximum grade of the remainder of the driveway may be up to 15%. The Consultant must ensure that grade transitions provide for all reasonable vehicle clearances so that vehicles will not “hang-up” or “bottom out”. Vertical curves may be required.

All driveways are to be asphalt or concrete up to property line. Existing driveways are to be reinstated with asphalt to property line on City rights of way and with material to match existing on the private property side.

The minimum distance between the start of the curb letdown should be as follows: 1.5 m to the nearest street light pole; 1.5 m to the nearest hydrant; and 2.0 m to the nearest tree.

Sidewalks across driveways should be designed so as to avoid a crossfall of more than 5%. Design options include placing the slope of the driveway between the sidewalk and curb or at the back of the sidewalk, rather than across the sidewalk, or dropping the elevation of sidewalk to meet the elevation of the driveway.

8.2.8 Intersections

Geometric design of all intersections shall be in accordance with the last version of TAC. For access requirements refer to Section 7.

Intersection designs shall ensure that pedestrian, bicycle, transit and vehicular concerns are addressed.

The following table lists typically recommended curb return radii. The Consultant shall confirm the required curb return radii based on traffic volumes, turning movements, and vehicle types to be approved by the Director of Engineering. Reduced diameter curb returns may be approved by the Director of Engineering based on traffic calming and pedestrian safety issues.

Table 8.1 Curb Return Radii

	Intersection with		
	Local/Frontage	Collector	Arterial
Local	7 m	7 m	9 m
Industrial Local	9 m	9 m	9 m
Collector		7 m	9 m
Arterial			9 m

8.2.9 Railway Crossings

Whenever roadworks cross an existing railway or railway right-of-way appropriate permits and approvals must be obtained.

If these roadworks involve improvements to arterials, collectors, or roadways with designated bicycle routes, a rubber or pre-cast concrete railway crossing shall be used at the railway crossing.

8.3 Structural Design Requirements

The basic road pavement structural design shall be adequate for an expected road life of 20 years under the expected traffic conditions for the class of road. This shall be determined by the results of soils tests and analysis of the results of deflection testing performed on the surface of the road base gravel by a registered Professional Engineer. The minimum total flexible pavement structure thickness for any road shall be in accordance with standard drawings or greater if determined by the testing.

The Director of Engineering may require the submission of a geotechnical report to confirm the structural adequacy of any existing or proposed street.

8.3.1 Existing Pavement

Overlay of existing pavement shall be based on analysis of the results of Benkleman Beam tests, or other approved method, carried out on the existing road which is to be upgraded.

The Benkleman Beam testing shall be carried out in accordance with current standards, published by the Roads and Transportation Association of Canada (RTAC).

The maximum Benkleman Beam deflection corrected for seasonal variation shall not be greater than:

- Industrial and Arterial streets 1.00 mm
- Collector and Commercial streets 1.25 mm
- All other road classifications 1.50 mm

The overlay thickness shall be determined by both the Benkleman Beam testing and by the shape of the cross-section of the existing pavement, so that an adequate crossfall on the existing pavement is obtained. The structure and/or grade of the existing pavement may indicate complete removal and reconstruction, which shall be carried out at the discretion of the Director of Engineering.

All joints between existing and new asphalt surfaces shall be lap joints. The location and specifications of all joints shall be shown on the Consultant's drawings.

8.3.2 Asphalt-Concrete Pavement

The following minimum pavement, gravel and sand thickness presented in Table 8.2 shall be maintained.

Table 8.2 – Pavement and Gravel Thickness

Road Classification	Granular Subbase (mm)	Granular Base (mm)	Asphalt-Concrete	
			Lower Course	Upper Course
			(mm)	(mm)
Major Arterial (Divided)	500	230	100	40
Major Arterial (Undivided)	500	230	100	40
Industrial	500	230	100	40
Collector	500	230	75	35
Local Residential	300	230	50	35
Cul-de-Sac in Industrial Area	380	230	100	40
Cul-de-Sac in Residential Area	300	230	50	35
Laneway		230	50	25
Emergency	300		2-1.22 m x 200 Concrete Strip or 2-1.4 m paving stone	

8.3.3 Sidewalks and Cross Walks

Sidewalk width shall be a minimum of 1.50 metres, except as shown in the Trail and Greenway Master Plan. For multi-family residential areas or areas with moderate pedestrian or wheelchair traffic, the minimum width should be 1.8m, with 2.0m preferred. In commercial areas or areas with higher pedestrian or wheelchair traffic such as schools and playgrounds, the minimum width should be 2.5m and scaled up according to the anticipated maximum volume of pedestrians. Where local area plans exist, the requirements outlined therein shall govern.

Sidewalks shall be designed to maximize pedestrian safety. No obstructions, including hydrants or utility poles, shall be placed within existing or proposed sidewalks. Where parkade entrances meet sidewalks, a 3m by 3m view corridor shall be provided to ensure adequate stopping sight distance and avoid conflicts between drivers and pedestrians.

Where decorative materials are specified under City design guidelines, surface treatments should minimize vibrations for those using wheelchairs, scooters or strollers. If there is doubt concerning the impact of crossfalls and surface treatments on those with special needs, the Special Services and Access committee should be consulted.

Sidewalks shall be sufficiently wide to accommodate a transit stop pad at all current and potential bus stop locations in order that waiting passengers do not obstruct passing pedestrians and that rain protection can be provided. Where possible, the width should accommodate a standard transit shelter and amenities such as trash cans and benches.

Longitudinal grades on sidewalks shall remain constant and not exceed 10% where possible.

Finished sidewalk elevation at the back of the sidewalk shall be shown on the construction plan at locations corresponding to the gutter high and low point. Intermediate finished grade elevation shall also be shown at 10 m intervals corresponding to roadway cross-sections.

8.3.4 Curb/gutter

All roads shall be complete with wide base barrier concrete curbs and gutters in accordance with the City approved edition of the MMCD and Supplementary Specifications and Detail Drawings.

Traffic circle and lane curb and gutter requirements shall be approved by the Director of Engineering.

8.3.5 Medians

Medians shall be sized in accordance with the Road Cross Sections and landscaped as outlined in Section 9.

8.3.6 Utility Relocations

Many utilities (surface and sub-surface) must be relocated as the result of road widening and reconstruction.

It will be the responsibility of the Consultant to liaise with the City's Electrical Utility at the preliminary design stage, to resolve the new locations and off-sets of the utilities and to meet the requirements of all parties.

The City's Electrical department shall assist with notification of other utility companies on matters such as annual proposed programs and construction schedules so that adequate time is given to them for scheduling and costing.

8.3.7 Road Embankment Grading

Road embankment shall be shaped to a slope of 1 vertical to 3 horizontal with sand fill and shall be finished with a seeded topsoil meeting the existing ground level or suitable alternative in accordance with Section 9.

If the embankment slope is causing inconvenience to property owners and is adversely affecting drainage and driveways, retaining walls complete with top hand rail shall be used. The use of retaining walls should be avoided except in extreme cases.

8.4 Postal Service

The Developer shall set the location of community mail boxes within the development and shall obtain agreement in writing from Canada Post regarding the location(s). The Developer shall provide the required additional street right-of-way at the community box locations to enable Canada Post to install the box.

8.5 Traffic Signs and Street Markings

If traffic signs are required for a proposed development, these will be designed by City staff and their construction will be included with the installation of the City services. If pavement markings are required for proposed developments these will be designed by the Developer and their construction will be included with the installation of the City services.

9. STREET TREES & LANDSCAPING

9.1 General

Trees and landscaping are to be planted on all city road right of ways and within new subdivisions. The location of all civil works shall be shown in relation to the street trees and landscape areas.

9.1.1 Approval

The species of trees to be planted as street trees and plant material shall be reviewed and approved by the City Parks Department.

9.2 Design Criteria

9.2.1 Landscaping Medians and Boulevards

The area between the back of curb or sidewalk and the property line (boulevard area) and the non-travelled central portions of divided arterial roads (medians) normally shall be finished to a lawn or grassed surface using sod unless otherwise approved by the Parks and Engineering Departments. The non-travelled central portions of divided arterial roads (medians) shall be finished to a hard surfaced standard (brushed concrete or brick) or landscaped finish (grassed surface with trees, shrubs or combination of these) or alternative as approved by the Parks and Engineering Departments.

The City Parks Department will plant all trees on City property. The developer/contractor is responsible for all site preparation for the street trees and other landscape areas as noted above.

9.2.2 Minimum Standards

Trees planted along all streets typically shall be:

- Columnar in shape in commercial and high-density areas and of a broader, spreading shape elsewhere;
- Of a size, type and method of planting to be specified by the City Parks Department;
- Spaced at approximately 6.0 m – 10.0 m intervals; and
- Planted in a single row, centered in boulevard along both sides of the street or a second parallel row of trees of equal spacing. Trees may be planted on private property in a right-of-way at the City's discretion.

Unless required or pre-approved by the City, trees will not be planted within:

- a) 6 m from Street Lighting;
- b) 2 m from Catch Basins;
- c) 8 m from Street Intersections (measured from the curb return);
- d) 3 m from Hydrants;
- e) 2 m from Manholes
- f) 2 m from Driveways;
- g) 3 m from Electrical Junction Boxes;
- h) 2 m from Kiosks.

9.2.3 Selection of Trees Species

The City Parks Department shall select and plant all street trees at the Developers cost. The designer will identify tree spacing requirements.

9.2.4 Grating Requirements

For planting in hard surfaced areas such as concrete or paving stone, unless otherwise specified, concrete grates are required.

9.2.5 Tree Root Restraints

A root restraint mechanism approved by the Parks Department shall be provided where tree roots may interfere with service corridors for underground utilities or sidewalks if they are within 1 meter of the tree. The restraint mechanism will be designed such that the major root structure will be restrained from extending into other utility corridors, but still allow for the normal growth of the tree.

9.2.6 Growing Medium

In grassed boulevards the growing medium shall be installed to the satisfaction of the City Parks Department. Where native material is suitable the growing medium will be 25% native material and 75% amended soil or as otherwise specified by the City Parks Department. The amended soil is to be approved by the City Parks Department. Under hard surfaced areas such as under sidewalks, a structural soil mixture shall be installed to the City Parks Department specifications.

9.2.7 Irrigation

Where required by the City Parks Department for the maintenance of trees, grass or other landscaping located in boulevards or medians in the road right-of-way, an underground sprinkler system shall be provided by the Developer. The system must be capable of providing the necessary irrigation as required and shall be automatically activated through a timed control system. Under hard surfaced areas with structural soil mix, irrigation is required from an independent supply. In grassed boulevards (with the exception of single family parcels) irrigation is required and shall be provided from the on-site irrigation system at the Developer's cost.

9.2.8 Drainage

Drainage shall be installed where required and tied into the catchbasins. The drainage system shall be 100mm perforated PVC drainage pipe surrounded by 150mm of drain rock and wrapped with filter cloth. A clean out shall be installed every 15m and at the high end of the system with a Nelson box style lid.

9.2.9 Drawings

The following are required on all drawings:

- a) Typical Cross-section with drainage detail;
- b) Tree Planting and Staking Detail;
- c) Tree Grate Detail;
- d) Proposed Tree and Shrub Species Table
Species to be reviewed by the City;
- e) Plan showing curb gutter and sidewalk, driveway locations including street lights and proposal trees with the chainages;
- f) Irrigation and timer details; and
- g) All civil works within the proximity of trees and shrub root zones.